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Empirical Research on Price Discovery Function of Stock Index Futures

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Abstract: ***China's stock index futures market has been running for nearly eight years, and its number of transactions, the number of accounts opened and the amount of transactions have all been improved by leaps and bounds. How the stock index futures guide the development of the financial market, this issue has attracted the attention of many scholars.This article uses the closing price of CSI 300 stock index futures from January 1, 2017 to March 31, 2018 (a total of 287 trading days) as the research object.Applying Co-integration test ,vector correction model and Granger causality test to determine whether the stock index futures price and stock index spot price have the guiding function , that is , whether the stock index futures has the price discovery function .The empirical results represent that from a long-term perspective, when the stock index futures price deviates from the spot market price, it is completed through a greater degree of adjustment in the futures market. In the short term, the stock index futures price has a leading lag with the spot price of the stock index. Finally, the results show that the stock index futures price has a price discovery function.***

Keywords: stock index futures stock index price discovery

1. Introduction

Stock index futures are a kind of financial derivative product based on stock-based innovation. It is a standardized futures contract with the stock price index as the subject matter. Both parties of the transaction agree to buy and sell at a specific price on a specific date and place in the future. During the period, cash settlement will be made at the cash difference. Stock index futures are the products appearing at a highly developed modern capital market with the context of global financial integration, internationalization, and liberalization, which are essentially a combination of the stock market and the futures market and investors or speculators transfer the expected risk of the stock price index by them. Stock index futures are alsothe financial instruments that promote financial market transactions.

In the 1970s, the outbreak of the oil crisis had brought a serious impact on the economies of the United States and other developed countries. As a result, the economic development of Western countries had been unstable, and exchange rates, interest rates, and stock market prices have fluctuated greatly. The economies of the West have experienced serious stagflation. Under this background, the United States government to reduce the fluctuation risk of share prices, interest rates and exchange rate , restored investors' confidence and encouraged people to innovate financially , so, financial tools were come into being to avoid financial risks. In 1972, the exchange futures contract occurred at first time on the Chicago Mercantile Exchange. In 1975, the first interest futures contract (GNMA) was launched on the Chicago Futures Exchange. In 1982, the stock index futures are launched firstly on the United States Kansas Futures Exchange. The emergence of stock index futures contracts has enabled bilateral transactions between the stock market and the futures market, raising the confidence of US investors in solving the problem of economic stagflation and gradually leading the financial market to the right track. The introduction of stock index futures contracts is a sign of the birth of another financial derivative, and the US financial market has gradually entered the era of stock index futures. As the most widely traded financial derivatives at present in the world, stock index futures are called "the most successful and exciting creations" in the 1980s.

In recent decades, stock index futures do not only hit a new high in terms of trading volume, trading varieties have been constantly updated, and they have evolved from simple stock index futures to individual stock futures and options futures. The introduction of option stock index futures has greatly enriched the trading of stock index futures, and the transaction volume has also been greatly expanded. In 2014, the stock index futures trading volume exceeded 4 billion, accounting for nearly two-sevenths of global financial derivatives transactions.

With the rapid development of China's economy, China's financial market has gradually improved. On December 19, 1990 and July 3, 1991, the Shanghai Stock Exchange and the Shenzhen Stock Exchange were established one after another, and our country's securities market gradually became better. With the development of the past 20 years, China's securities market has gradually made mature. On April 16, 2010, the CSI 300 stock index futures were formally launched, which ended the history of China's securities market that had not been short-selling for more than 20 years. The impact on China's traditional stock market is very far-reaching.

Since the 1990s, the Chinese economy has developed rapidly and the financial market has continued to expand. At the beginning of the 21st century, it has already reached a certain scale. In 2001, after China's accession to the World Trade Organization, the rapid development of China's trading economy has continued to improve its position in the international market, and China's trade in the

international market has also become more and more active. Along with the globalization of financial markets, China has gradually become an important financial market in the world. However, China's financial market started relatively late and there are many deficiencies in the development of financial markets. Therefore, if we want to improve the competitiveness of China's financial market, we must improve our financial market risk management and hedging financial instruments.

In 2006, China ushered in a bull market in the stock market, and the size of the stock market had continued to expand under such circumstances, and investors had also continued to increase. At the same time, the risk of the stock market was also increasing dramatically. With the market risks increasing continuously , the unstable factors in the market were also increasing. Under such circumstances, investors were also difficult to master the risk and crisis of the stock market, which was extremely unfavorable for the development of China's financial market. Therefore, there was an urgent need for the emergence of a financial tool that avoided risks to guide the development of China's financial market in a better direction.

Under the circumstance that the market urgently needs to change, on April 16, 2010,CSI 300 stock index futures begun to be traded on the China Futures Exchange, and China's capital market has taken a milestone step. Because China's financial market started relatively late, China's stock index futures market has many shortcomings compared with Western developed countries, and the study of stock index futures is very necessary. The research on the price discovery function of stock index futures will help promote the pricing of stock index futures in the financial market, which is of great significance to the development of China's financial market.

2. Literature Review

The price discovery function is the basic function of the stock index futures. If the stock index futures price reacts more quickly to the market information than the stock index's spot price, the stock index futures price has a guiding effect on the spot price of the stock index. On the contrary, it does not have a guiding role.

Many foreign scholars took the stock index futures market abroad as the research object and drew the conclusion that the stock index futures price is ahead of the spot price of the stock index. Harris (1989) used the trading data of constituent stocks to find that the futures market price preceded the spot market price. Some of these scholars also came to the conclusion that the stock index futures price preceded the spot price. Kawaller and Koeh (1987) studied the S&P 500 index and the minute frequency data of the stock price and found that the futures price was ahead of the stock index price by 20 to 45minutes. Abhyankar and Priestley (1998) research shows that index futures prices are ahead of spot prices by 15 to 20 minutes. Stoll and Whaley (1990) pointed out that S&P 500's MMI futures prices are ahead of stock spot prices by about 5 minutes.

China's stock index futures market has been launched for a relatively short period of time. Previous researchers have mostly used the research conducted on the sample data of mature markets of foreign countries.Yanyan Renand Li Xue (2006) research on the S&P 500 stock index futures and spot prices revealed that the stock index futures market can respond to market information more quickly and effectively, and this information leads the market. Because China's stock market is not mature enough, there are a few scholars such as Tu Zhiyong and Guo Ming (2008) who have simulated the price impact of stock index futures on the spot market through the study of the broader market. The impact of the stock index futures market on spot prices mainly depends on the sheepGroup effect.

In recent years, due to the rapid development of the financial market, some scholars have studied China's CSI 300 stock index futures prices. RenhaiHua, LiheYuan , and FengBao (2015) found that the price discovery contribution during the early trading period of one day was significant by the study of trading prices during trading hours and non-trading hours. Some scholars also study the relationship between the stock index futures price in China and the spot market price. Chen Yan, Li Ping and Liu Tao (2013) show that stock index futures have a low degree of contribution to price discovery, and they have no significant effect on price guidance during dynamic adjustments that deviate from equilibrium. Yang Yang and Wan Diyi (2010) also share the same view that the price of stock index futures has no obvious effect on the stability of the stock market. However, Hua Renhai and Liu Qingfu (2010) pointed out that the futures price has a large guide to the spot stock index, and the stock index futures lead the stock index 7 minutes.

Due to the late start of stock index futures in China, quite a few scholars study that China's stock index futures may not be able to obtain sufficient valid data involving data. I applied the latest data to study the prices of China's CSI 300 stock index futures, and reached consensus with foreign scholars.

3. Price Discovery Function Model and Data Description

3.1 Stationarity test

Before modeling the data of time series, it is necessary to test the stationarity of economic variables, so as to avoid spurious regression in non-stationary time series. Therefore, the data must be tested for stationarity. This article uses the ADF method to test. A stable unit root test is based on the time series AR process, assuming$\{ y_t \}$be subordinated to AR(1)progress.

$$y_t = \beta_1 y_{t-1} + \mu_t \quad t = 1,2,...,T \quad (3.1)$$

β_0 is the intercept term of the regression equation, and β_1

is Coefficient . μ_t of random error term follows the hypothesis of independent distribution. The content of the check is whether the unit root is equal to 1, and if it is equal to 1, it is the unit root sequence, otherwise it is the stationary time series.

Subtract y_{t-1} from the two ends in (3.1), which can be obtained the equation as follows by adding and subtracting terms.

$$\triangle y_t = \eta y_{t-1} + \mu_t \quad \eta = \beta_1 - 1$$

The test hypothesis for unit roots can be set to as below.

Null hypothesis: H_0: $\eta = 0$

Alternative hypothesis: H_1: $\eta < 0$

If the coefficient is significantly no zero, then the original hypothesis containing unit root is rejected, and the alternative assumption is accepted, which shows that the original sequence is stable.

3.2 Co-integration test

In order to test the time series of x and y which have no stationarity, Engle and Granger pointed out that there may be a stationary relationship between the two time series, and put forward the E-G two-step method for testing. If the sequences x_t and y_t are all non-stationary and the d-order differentials are all stationary, then x_t and y_t is a d-ordered single integer sequence.

$$y_t = \alpha + \beta x_t + \mu_t$$

If the estimated residual value μ_t of the model is the stationary time series after OLS estimation, x_t and y_t have a co-integration relationship, and $\hat{\beta}$ is a co-integration estimation relationship. If not, x_t and y_t do not have a co-integration relationship.

3.3 Vector error Correction Model (VEC)

The VEC models established by Engle and Granger are often used in the study of non-stationary but co-integration time series. When the sequences x_t and y_t have a co-integration relationship, the basic form of the error correction model is as follows.

$$\triangle X_t = \alpha_{10} + \sum_{i=1}^{n} \alpha_{1i} \triangle Y_{t-i} + \sum_{j=1}^{T} \beta_{1j} \triangle X_{t-j} + \lambda_1 ecm_{t-1} + \mu_{1t} \quad (3.1.1)$$

$$\triangle Y_t = \alpha_{20} + \sum_{i=1}^{n} \alpha_{2i} \triangle Y_{t-i} + \sum_{j=1}^{T} \beta_{2j} \triangle X_{t-j} + \lambda_2 ecm_{t-1} + \mu_{2t} \quad (3.1.2)$$

μ_{1t} and μ_{2t} is white noise distracter. β_{1j} and β_{2j} of the correction coefficients respectively, which illustrates the price interactions between variables, and F statistics can be used to test their significance. Therefore, the VEC model can analyze how the non-stationary time series with co-integration relationship can be restored to the long-term equilibrium adjustment process through mutual adjustment after short-term deviation from long-term equilibrium.

3.4 Granger Causality Test

In 1969, Granger proposed a method of testing time succor. This method is called the Grainger Causality Test. This method mainly argues for the leading lag relationship of the two variables involved in the economic problem. Causality has a temporal order,and assuming $\{x_t, t = 1,2,3,\ldots,t\}$ and $\{y_t, t = 1,2,3,\ldots,t\}$ is Covariance stationary time series. If knowing $y_{t-1}, y_{t-2}, \ldots, y_{t-k}$, The k-order autoregressive model can be used to predict the value y_t at t.If the added information $\{x_t\}$ contributes to the prediction of $\{y_t\}$, it means that x can significantly improve the prediction accuracy of y, and its expression is as follows:

$$\delta^2(y_t / y_{t-1}, y_{t-2}, \ldots, y_{t-k}) > \delta^2 (y_t / y_{t-1}, y_{t-2}, \ldots, y_{t-k}, x_{t-1}, x_{t-2}, \ldots, x_1)$$

$\delta^2(y/\beta)$ is the predicted mean variance for y as given information. If (3.1) holds, then x is the Granger cause of y, and y is the Granger result of x. This relationship is called Granger Causality. Granger believes that there is a co-integration relationship between non-stationary time series, you need to consider the use of error correction model causality test, otherwise the results will be a problem, so the introduction of the VEC form Granger causality test.

3.5 Data processing

The CSI 300 stock index futures was officially listed on April 16, 2010. In order to analyze the interactive

relationship between stock index futures prices and spot prices after the listing, this article quotes the daily closing prices of the Shanghai and Shenzhen 300 Index and stock index futures from J anuary 1, 2017 to March 31, 2018 (a total of 287 trading days) are from China Financial Futures Exchange and China stock index Ltd., which is expressed in pt and pift respectively. In order to reduce the volatility of the variance and take the natural logarithm, the logarithmic close price sequence of the spot and futures markets is obtained, which is expressed in Lnpt and Lnpift respectively.

4. Empirical Analysis

4.1 An empirical study on the function of Stock Index Futures Price Discovery

4.1.1 Sample data stationary test

To ensure the validity of the estimated results and to avoid spurious regression, it is necessary to test the stability of various sample time series. Therefore, vector auto-regression modeling and Granger causality testing can be performed after the unit root is used to test the stationarity of the sample sequence. Through the observation of the data, we can see that the values of the logarithmic price series of the CSI 300 Index and the stock index futures are all positive. Therefore, the econometric model chosen in this paper has a constant term and is modeled using Eviews 7.2.

Table 4.1: Closed-logarithmic sequence stability ADF test results

variable	t-Statistic	Prob.*	Test critical values			test result
			1%	5%	10%	
lnpt	-1.149786	0.6766	-3.769597	-3.004861	-2.642242	unstable
lnpift	-2.761004	0.1802	-4.739396	-2.903763	-2.842242	unstable

According to the test results of ADF, it can be seen that the t-statistic is larger than the critical value at the significant level of 10%, that is to say, the original hypothesis cannot be rejected and the sequence has a unit root, which is a non-stationary time series.

In order to obtain a stable sequence, it is necessary to further take a first-order difference between the stock price index of the stock index and the price logarithm of the futures, and then obtain a new series, and then perform an ADF test on the new sequence. The result is as follows:

Table 4.2: Stability adf test results for log price log sequence

variable	t-Statistic	Prob.*	Test critical values			test result
			1%	5%	10%	
D(lnpt)	-4.010007	0.0062	-3.788030	-3.012363	-2.646119	stable
D(lnpift)	-5.221032	0.0004	-3.788030	-3.012363	-2.646119	stable

From the test results, the lnpt and lnpit statistics of the ADF test are much smaller than the critical value at the 1% significance level, so the original hypothesis is rejected. That is to say, the first-order difference sequence of the logarithm of the CSI300 stock index futures and the spot price log does not have a unit root,and then, it is a stationary sequence, and both are subject to a first-order single integer.

4.1.2 Co-integration test of sample data

Before processing the ADF test, the co-integration relationship of the sample time series needs to be tested. The E-G two-step method is used for inspection. The precondition of the method inspection must be that the sequence satisfies the same order. The previous section has proved to meet this requirement. Now we need to establish the regression equations for lnpt and lnpit, and perform a unit root test on the residual series.

The first step is to perform a least-squares regression on the variable lnpt. The regression results are as follows:

dependent variable：lnpt sample：1 287		method ： Least Square observational values：287		
Variable	Coefficient	Std. Error	t-Statistic	Prob.
c	2.374497	0.709897	3.344849	0.0031
lnpift	0.706326	0.088347	7.994917	0.0000
R-squared	0.752705	Mean dependent var		8.050028
Adjusted R-squared	0.740929	S.D. dependent var		0.023619
S.E. of regression	0.012022	Akaike info criterion		-5.921229
Sum squared resid	0.003035	Schwarz criterion		-5.822491
Log likelihood	70.09414	Hannan-Quinn criter.		-5.896397
F-statistic	63.91870	Durbin-Watson stat		1.438168
Prob(F-statistic)	0.000000			

The statistic of constant c is larger than t at a significant level of 1%, and the estimation equation is obtained:

$$\ln pt = \underset{t=}{2.3475} + \underset{(3.3448)}{0.7063} \ln pift \quad 7.9949$$

In the second step, the ADF stationarity test is performed on the generated residual sequence. The results are as follows:

Table 4.4: Results of unit root test of residual sequence

variable	t-Statistic	Prob.*	Test critical values			test result
			1%	5%	10%	
u	-4.363736	0.0027	-3.769597	-3.004861	-2.642242	stable

From the above results, it can be seen that the t-statistic is still less than the critical value at the 1% significance level, so the original hypothesis should be rejected. The residual root sequence u does not have a unit root, which means that the residual sequence u is a stationary time series. Therefore, the residual sequence is zero-ordered, and the lnpt and lnpift sequences have a co-integration relationship. That is to say, the impact of one variable leads to a short-term deviation from the long-term equilibrium position. However, in the long-term, the short-term deviation will automatically recover. Therefore, there is a long-term equilibrium relationship between the CSI 300 stock index futures price and the spot price. After the stock index futures price and the spot price are offset by equilibrium.Adjustments can be made in the next period to return to the equilibrium point.

Under the conditions of long-term equilibrium of stock index futures prices and spot prices, the short-term price fluctuations between the two still have an impact. The futures market has a good risk management mechanism and will respond to the stock market before it is affected by the market. The arbitrageurs will use financial instruments to make profits, which will reduce the impact of market information transmission to the spot market. Therefore, the short-term imbalance adjustment needs to be reflected by further establishing a revised model.

4.1.3 Vector Error Correction Model (VEC)

The vector correction model is a model with co-integration constraints. It describes the process of recovering the long-term equilibrium process by adjusting the non-stationary time series with co-integration relationship after deviating from equilibrium in the short-term. The VEC model of CSI 300 stock index futures prices and spot prices was established to describe the short-term adjustment of the price series. Before adjusting, you need to determine the lag order. The basis for the judgment is as follows:

Table 4.5 optimal delay order based on var model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	36.37398	NA	0.000524	-4.716530	-4.669327	-4.717033
1	46.90943	18.26146*	0.000147	-5.877101	-5.735491	-5.988930
2	47.07826	0.270114	0.000135*	-6.987925*	-5.893518*	-5.878609
3	47.26802	0.278320	0.000185	-5.769069	-5.580256	-5.771080
4	47.68961	0.562117	0.000203	-5.691948	-5.455931	-5.694462
5	47.78326	0.112379	0.000234	-5.571101	-5.287881	-5.574118
6	47.78926	0.006402	0.000275	-5.438568	-5.108144	-5.442087
7	50.15729	2.210161	0.000240	-5.620972	-5.243345	-5.624994
8	54.27558	3.294633	0.000169	-6.036744	-5.611914	-6.041269*

According to the AIC and SC criteria under the VAR model, the lag degree of the vector autoregressive model without co-integration constraints is judged to be 2, then the lag order of the VEC model is determined as 1, according to the previous co-integration equation estimation result, the generated error term ecm = u, the specific structural formula is as follows, and the estimated results are shown in table 4.6 and table 4.7.

$$\triangle \ln pt = c_1 + \alpha \triangle \ln \text{pift} + \lambda_1 ecm_{(t-1)} + \varepsilon_{1t} \quad (4.1.3.1)$$

$$\triangle \ln \text{pift} = c_2 + \beta \triangle \ln \text{pt} + \lambda_2 ecm_{(t-1)} + \varepsilon_{2t} \quad (4.1.3.2)$$

Table 4.6: Error Correction Model Equation (4.1.3.1) Estimated Results

dependent variable：△lnpt		method ： Least Square		
sample：1 287		observational values：287		
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C1	-0.000860	0.002665	-0.322906	0.0003
△lnpift	0.646165	0.260961	21.47610	0.0229
ecmt-1	-0.774428	0.340178	-7.276538	0.0046
R-squared	0.249856	Mean dependent var		0.002472

Adjusted R-squared	0.170893	S.D. dependent var	0.011867
S.E. of regression	0.010806	Akaike info criterion	-6.091315
Sum squared resid	0.002219	Schwarz criterion	-5.942537
Log likelihood	70.00447	Hannan-Quinn criter.	-6.056268
F-statistic	3.164232	Durbin-Watson stat	1.836510
Prob(F-statistic)	0.065144		

Table 4.7: Error Correction Model Equation (4.1.3.2) Estimated Results.

dependent variable：△lnpift		method ： Least Square		
sample：1 287		observational values：287		
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C2	0.004203	0.001801	2.334350	0.4307
△lnpt	0.377557	0.152480	2.476102	0.0229
ecm(t-1)	1.096176	0.151056	7.256771	0.0000
R-squared	0.746856	Mean dependent var		0.004911
Adjusted R-squared	0.720210	S.D. dependent var		0.015616
S.E. of regression	0.008260	Akaike info criterion		-6.628649
Sum squared resid	0.001296	Schwarz criterion		-6.479870
Log likelihood	75.91514	Hannan-Quinn criter.		-6.593601
F-statistic	28.02810	Durbin-Watson stat		0.781149
Prob(F-statistic)	0.000002			

From the estimation results, we can see that the constant term is not significant, and the error correction model estimation result is:

$$\triangle \ln pt = \underset{-0.322906}{-0.00086} + \underset{21.47610}{0.646165}\triangle \ln pift - \underset{-7.276538}{0.774428}ecm_{t-1} \quad (4.1.3.1)$$

$$\triangle \ln pift = \underset{2.334350}{0.004203} + \underset{2.476102}{0.377557}\triangle \ln pt + \underset{7.256771}{1.096176}ecm_{t-1} \quad (4.1.3.2)$$

For the △lnpt equation, △lnpift reflects the impact of the change of short-term stock index futures price on the price change, and the t-statistic is relatively large, which means that the price of the stock index futures lagging one period has a significant impact on the spot price fluctuation. The error correction term ecm_{t-1} reflects the adjustment of the deviation of the stock index price to the long-term equilibrium. The significant non-zero coefficient indicates that the market has an equilibrium adjustment, and the spot market is more sensitive to price fluctuations. The estimated value is -0.774428, indicating that adjustment is necessary.

For the △lnpift equation, △lnpt reflects the impact of stock index price changes on the price movement of stock index futures, and the significance of error correction ecm_{t-1} long-term equilibrium relationship. From the coefficient point of view, the CSI 300 stock index futures The coefficient of the correction term of the error term is larger, which indicates that the adjustment rate of the futures market is slightly faster than that of the spot market, that is, there is a leading and lagging relationship between the stock index futures market and the spot market. Therefore, the stock index futures have more advantages in price discovery.

4.1.4 Granger causality test

From the above analysis, we can see that there is a long-term equilibrium relationship between the CSI 300 stock index futures and the spot price, but the price guidance is one-way or two-way, and further inspection is needed. Therefore, it is necessary to further use the error based on co-integration. The modified Granger causality test was used to analyze the leading lag relationship between stock index futures and spot prices. The test results are as follows:

Table 4.8: First order differential Granger causality test of stock index futures and spot prices

Null Hypothesis	Obs	F-Statistic	Prob.
D(lnpift)does not Granger Cause D(lnpt)	287	0.16748	0.0273
D(lnpt)does not Granger CauseD(lnpift)		63.4213	2.E-08

From the above test results, it can be seen that "D(lnpift) does not Granger Cause D(lnpt)" and "D(lnpt) does not Granger Cause D(lnpift)" mean that the null hypothesis ."D(lnpift) is not D lnpt) 's Granger reason and D(lnpt) is not Granger's reasons for D(lnpift), so it shows the stock index futures price and the stock index's spot have the relationship. The price is Granger causality, which is the leading lag between stock index futures price and spot price.

From the above test results, we can see that the probability of 0.0273 indicates that the stock index futures price is not the cause of the stock index price, that is, there is a probability of 0.0273 accepting the original hypothesis, and the probability of almost 0 accepts the original hypothetical stock index price caused the stock index futures price.Therefore, refused to accept the original hypothesis,CSI 300 stock index futures prices and stock index prices affect each other in the Granger sense, that is to say, the CSI 300 stock index futures prices and stock index stock prices are mutually exclusive Granger reasons.

Therefore, China's stock index futures price has a price discovery function.

4.2 Empirical Analysis

The empirical part of this paper through the ADF test and co-integration test, mainly using the VEC model and Granger causality test analysis, demonstrated the price discovery function of CSI 300 stock index futures, and reached the relevant conclusions.

The main conclusions of the VEC model analysis and the Granger causality test are the following three aspects: First, the CSI 300 stock index futures have a balanced relationship with the spot price. When this long-term equilibrium is affected by the market information impact, the market can make a balanced adjustment. Under normal circumstances, the futures market will be more regulated and the reaction will be more sensitive. Secondly, in the short term, the futures market will adjust faster than the spot market. The CSI 300 futures price and spot prices have a leading lag, which means that the CSI 300 stock index futures price has a guiding effect on spot prices. Third, the prices of the stock index spot market and the futures market are Granger's reasons. This may be because the introduction of futures provides investors with opportunities for investment and arbitrage. When the current futures price is lower than the spot price, the investor can buy the stock index futures and sell the stock portfolio for arbitrage. When the spot market price is lower than the theoretical price of the futures, the investor can sell the stock index futures and buy the stock portfolio. Due to the existence of arbitrage, it forms the basis of price interaction between the two markets.

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