

Price Discovery of Stock Index Futures Between Chinese Cross-straits

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Abstract:

This paper show that, there are bi-directional price lead relationships between Hushen 300 index futures and Hushen 300 index, while index futures lead index spots in the efficiency of information transmission. As for the Taiwan market, unidirectional price lead from index futures to index spots market is found. In the long term, futures markets play dominant role in price discovery, while Taiwan weighted stock index futures is comparatively stronger.

Keywords: Price Discovery; Stock Index Futures; Vector Error Correction Model.

1. Introduction

On April 16, 2010, CSI 300 index started to be traded in Chinese mainland to supply the gap of futures market, finishing the history of securities market's unilateral trading. At first, the regulatory authority developed a strict margin ratio and appropriate investors' regulation to control the risk. However, stock index futures were traded far more than the spots market^① not long after the launch.

^① According to the 2010 Annual Report of stock index futures from Dongxing Futures, more than six months after the launch, average daily turnover of stock index futures achieved more than 23 million, while the average daily turnover of CSI 300 Index was 900 billion yuan.

The transaction positions achieved up to 30 times than the inventory position at one time. Can stock index futures market reflect information in advance of spots market with such frequent trading? And how do stock index futures in Chinese mainland contribute to price discovery process? Same as an emerging financial market, commodity futures market in Taiwan has dropped behind Chinese mainland, while financial futures market in Taiwan has kept ahead than Chinese mainland and its development is better. Is there any difference in price discovery process between Chinese mainland's and Taiwan's stock index futures? What factors can affect the price discovery process?

2. Vector Error Correction Model

2.1 Sample Selection

In May 13, 2010. The introduction of the special hedging account made the transaction subjects of the market more diverse in the mainland market. Haitong Securities (2010) has also pointed out that it would be a significant watershed when the stock index futures has been listed about 1 month and the market would be obviously not mature and the price differences would be very large before the middle of May in 2010. This paper selects the prices every 15 minutes for the CSI 300 Index Futures^②(the contract of this month) and CSI 300 stock index spots as the representative and the time spans

^② The data is from Wenhua financial software.

from May 17, 2010 to January 20, 2011. In order to facilitate the data processing, the data which doesn't match the transaction time in the two market has been excluded and then we obtain a sample of 2672.

Therefore, this paper chooses the stock index futures as the representative to inspect the price discovery function of the Taiwan stock index futures market. The time spans from January 4, 2010 to January 28, 2011. Similarly we choose transaction data every 15 minutes of the day and exclude the data which doesn't match the transaction time in the futures and spots market, then we obtain a sample of 4860.

2.2 Model and Method

First of all, this paper carries on a stationarity test on all the time series, then we study whether there is a co-integration relationship or not between the futures price and spots price by Johansen the Co-integration test. On this basis, if there have a co-integration relationship, we use the error correction model to study the equilibrium price relationship of short term and long term between futures and spots market. The error correction model can be set as the follows:

$$\Delta F_t = \mu_f + \gamma_f Z_{t-1} + \sum_{i=1}^m \alpha_{fi} \Delta F_{t-i} + \sum_{i=1}^m \beta_{fi} \Delta S_{t-i} + \varepsilon_{ft}$$

$$\Delta S_t = \mu_s + \gamma_s Z_{t-1} + \sum_{i=1}^m \alpha_{si} \Delta F_{t-i} + \sum_{i=1}^m \beta_{si} \Delta S_{t-i} + \varepsilon_{st}$$

Where ΔF_t equals one order difference of the spots log price sequence and ΔS_t equals one order difference of the futures log price sequence, which represent continuously compounded rate of return at time t in the futures market and spots market. α_{fi} , α_{si} , β_{fi} and β_{si} equal the short-term adjustment coefficient. Z_{t-1} is the error correction in the Co-integration relationship of the futures and spots prices, which represents the degree of the deviation of the price last period

from the long-term equilibrium. γ_f and γ_s equal the error correction coefficient.

If γ_f is relatively small, which represents the deviation of the price from the long-term equilibrium, the tendency for the futures market to adjust the deviation is small, that is to say most of the adjustment is made by the spots market. Therefore, the futures market plays an important role in price discovery function. In addition, if $Z_{t-1} > 0$, when Z_{t-1} is computed with $F_{t-1} - (\alpha + \beta S_{t-1})$, the futures price should fall and spots price should rise which can make the price relationship return to the long-run equilibrium. So, theoretically γ_f should be negative and γ_s should be positive.

3. Empirical Results and Analysis

3.1 The Co-integration test and Estimation Vector Error Correction Model

Before the co-integration test, we adopt the ADF method to test a total of four groups of stationary price series from mainland and Taiwan in this paper. The results show that both Futures and spots Logarithmic price series are process I (1) which satisfy the requirements of the Co-integration test.

This paper chooses Johansen's Co-integration test. At first, we establish a Binary vector regression model on the price series logarithm of the mainland market or Taiwan market respectively. The SC standard has the gradual consistency in large samples, which is a better standard, so according to the SC standard the mainland market optimal lag order number is 4, while Taiwan market optimal lag order number is 3. Then based on the characteristics of sample series, the Co-integration test of mainland market contains a constant not a time trend, while Taiwan market chooses the

Co-integration test with a constant and a linear trend.

The LNCQH、LNCXH stand for Shanghai and Shenzhen 300 index futures and spots price series logarithm respectively, and LNTQH、LNTXH stand for Taiwan index futures and spots price series logarithm. As is shown in Fig 1, whether trace test or the biggest characteristic root test. In 5% of the significance

level, two sets of data reject the original hypothesis contains 0 Co-integration vector but accept the original hypothesis contains more than one Co-integration vectors. So in the sample period a long-term equilibrium relationship exist between 300 index futures and spots in Shanghai and Shenzhen, the same as Taiwan. And the Co-integration relationship is exclusive.

	Original hypothesis	characteristic root	Trace Statistic	The biggest characteristic root statistics
LNCQH, LNCXH	0 co-integration vector	0.015121	42.19722*	40.36089*
	1 co-integration vector	0.000693	1.836327	1.836327
LNTQH, LNTXH	0 co-integration vector	0.009187	52.21589*	44.82855*
	1 co-integration vector	0.00152	7.38734	7.38734

Fig. 1: Futures Market and Spots Market of Between Co-integration Test[®]

Mainland market	D(LNCQH)	D(LNCXH)	Taiwan market	D(LNTQH)	D(LNTXH)
VECM	-0.0224 (-1.7066)	0.0295* (2.4145)	VECM	-0.0025 (-0.2825)	0.0214* (2.6678)
D(LNCQH(-1))	-0.0341 (-1.0525)	0.3422* (11.3672)	D(LNTQH(-1))	0.0952* (2.8828)	0.3742* (12.3724)
D(LNCQH(-2))	-0.0480 (-1.4074)	0.1085* (3.4296)	D(LNTQH(-2))	0.0449 (1.3529)	0.1579* (5.1902)
D(LNCQH(-3))	-0.0777* (-2.4178)	0.0679* (2.2741)			
D(LNCXH(-1))	0.1101* (3.1713)	-0.2634* (-8.1677)	D(LNTXH(-1))	-0.0784* (-2.187)	-0.3697* (-11.2609)
D(LNCXH(-2))	0.1041* (2.8918)	-0.0763* (-2.2818)	D(LNTXH(-2))	-0.0433 (-1.2247)	-0.1521* (-4.6965)
D(LNCXH(-3))	0.0615 (1.8541)	-0.0729* (-2.3686)	C	2.21E-05 (0.6074)	2.16E-05 (0.6477)

Fig.2: The Estimation Results of the Vector Error Correction Model (5%)

Further, Unit root test results show that two Co-integration equation's error modifications are smooth. On that basis we establish error modifications model, which the set of model equal to Johansen Co-integration test. Fig.2 separately gives the empirical results of Error correction model from Shanghai and Shenzhen 300 index futures and spots, Taiwan index futures and spots.

Above all, observed from the coefficient of the lag, in the formula of Shanghai and Shenzhen 300 futures, the Shang-

hai and Shenzhen 300 spots lag behind 1 to 2 issue of the coefficient is significant, which imply Shanghai and Shenzhen future's Short-term price fluctuations under the influence of Spots lag fluctuations, while in the formula of Shanghai and Shenzhen 300 spots, the future lag behind 1 to 3 issue of the coefficient is significant. So there exist Two-way guide relationship between Shanghai and Shenzhen 300 index futures and spots, but Index futures have stronger leading relationship, From the absolute value of the coefficient

[®] Note: “*” is to reject the Original hypothesis the 5% level of significance.

can see that the guide efforts by future is stronger than spots. As for the Taiwan market, comparing to Taiwan spots index, Taiwan future index has a low negative change on the a period of the change of spots lag but Taiwan spots index has a Strong positive reaction to the two recent period of future lag. All the above show that comparing to Taiwan future, the spots has the specific price guidance, which is not clear.

Secondly, the long-run equilibrium between futures and spots from the coefficient of their error correction terms is shown. For index futures and index spots, the signs of their error correction terms are the same with our expectations whatever in the mainland market or the Taiwan market. However, as only the coefficient of that of the index spots is significant, it indicates that futures and spots markets mainly depend on the adjustment of the spots index to return to the rela-

tionship of long-run equilibrium while the equilibrium is affected by the interfere of the economic factors. Therefore, compared with spots market, the function of price discovery is stronger for the stock index futures in both the mainland market and the Taiwan market.

3.2 Granger Causality Test

As is shown in Fig. 3, during our studied period, the null hypothesis of both “the CSI 300 index spots is not the Granger cause of its futures” and “the CSI 300 index futures is not the Granger cause of its spots” are rejected at 5% significance level. This suggests that there is a mutual guidance relationship between them, which is consistent with the results of The Vector Error Correction Model. The Taiwan stock index spots is not the Granger cause of its futures at 5% significance has further verified the only causality from the futures market to spots market in Taiwan.

The null hypothesis	value of chi square statistic	P value
CSI 300 index spots is not the Granger cause of its futures	14.24991	0.0026
CSI 300 index futures is not the Granger cause of its spots	130.3358	0.0000
Taiwan stock index spots is not the Granger cause of its futures	5.167232	0.0755
Taiwan stock index futures is not the Granger cause of its spots	157.0153	0.0000

Fig. 3: The Results of Granger Causality Test Based on VEC Model

3.3 Variance Decomposition

The results of estimations of the VEC model and the Granger causality test indicate that both the CSI 300 index futures and Taiwan stock index futures have stronger function of price discovery when compared with spots markets. Based on The Vector Error Correction Model, we take further analysis using the method of variance decomposition to compare the function of price discovery of the stock index futures between the mainland and Taiwan in quantity.

This paper decompose the variance which has long-run effect on the change of the futures and spots price by sorting order of the return of index futures and

index spots respectively. Specific results are as follows.

We can know that to the return volatility of stock index futures, the proportion of impact accounted by itself was much higher than that by the spots market. When it comes to the tenth period, the impact proportions of both tend to be stable. To the return volatility of spots market, though it presents a declining trend, the total variance accounted by the futures market exceeds 60% when it is stable. In average, as for the mainland market, the variance from the futures market and spots market is 81.26%^④ and 10.43%

^④ Formula: $(98.72586\% + 63.7884\%) / 2 = 81.26\%$.

respectively. As for the Taiwan market, the variance from future market and spots market is 89.57% and 10.43% respectively. Regardless of the mainland market or the Taiwan market, the average variance from futures market is obviously larger than that from the spots market. Therefore, in the long run, futures market takes a primary position in the price discovering function, but relatively speaking, the dominance of stock index futures is stronger in Taiwan market comparing with mainland market.

3.4 Influencing Factors on Stock Index Futures' Price Discovery

Now we make a comparison between mainland and Taiwan stock index futures in many aspects such as structure of investors, contract design, cap-and-trade system, etc, to discover the primary influencing factors in Stock Index Futures' price discovery between mainland and Taiwan.

First, it can be shown from the investors' structure, the mainstay of Taiwan futures market is the human investor at its early stage, such as when FITX just go public, the trade of individual investor is as high as 94%. With the development of market, the occupations of institutions' invest start raising, by January 2011, the trade of legal and institutional investors in Taiwan futures market is 55.01%. Now, the structure of investors of CSI 300 is similar to the early stage of FITX, the mainstay is human, By February 2011, the account of Institutions investment is 1.67%, varieties of institutional investors' open interest is 30%, and this is not matched to the LTSZ of the institutional investors at spots market whose proportion is as high as 70%. It is commonly believed that institutional investors' comprehension and excavation of information are more adequately, and it could lead changes of market price by their trade, at mainland stock index futures market, institutional investors' participation is still

lower and this limits the use of stock index futures' price discovery function.

Secondly, according to the transaction cost hypothesis, once the transaction cost of market is lower, the reaction to new information is faster (Chung, 1991; Abhyankar, 1995). On the one hand, seen from commission charge, CSI 300 is 0.005%, and the one side commission charge of FITX is NTD14.4 per board lot, but still need to pay 0.004% trading levies. Take the average of CSI300 and FITX during sample period for example to calculate, the transaction cost^⑤ of trading one board lot of CSI 300 is 1.5 times of the minimum fluctuation(RMB60), but he transaction cost^⑥ of trading one board lot of FITX is 0.78 times of the minimum fluctuation(NTD200). On the other hand, seen from margin system, the security deposit of mainland is charged by fixed percentage, but Taiwan is charged flexible by rise and fall of market quotation. The lowest security deposit of CSI 300 futures are 12 percent, but the statistics shown that the security deposit of FITX is between 9.375 percent and 10 percent. The lower security deposit of FITX reduce investors' transaction cost and increase investors' trading enthusiasm, make the price of stock index futures more sensitive to the information, and charged security deposit flexible can reduce traders' transaction cost, increase the capital efficiency and attract more investors when the market quotations have little fluctuation.

4. Conclusions and Suggestions

Basing on the vector error correction model and variance decomposition techniques, the paper compares the main-

^⑤ The average of CSI 300 index is 3000 point during the sample period, trading fees of one board lot of CSI 300 futures = $3000 \times 300 \times 0.005\% \times 2 = 90$.

^⑥ The average of FITX is 8000 point during the sample period, trading fees of one board of one board lot of FITX futures = $(8000 \times 200 \times 0.004\% + 14.4) \times 2 = 156.8$.

land's stock index futures price discovery function with the Taiwan's. It shows:

The long-term equilibrium both exist between the future price and the spot price at the mainland and Taiwan, the above inclusion is similar with the present studies.

The futures market is dominant in price discovery function both the mainland and Taiwan in the long term. But comparatively speaking, the dominant function of Taiwan's stock index futures is more forceful than Shanghai's and Shenzhen's 300 stock index futures. Shanghai's and Shenzhen's 300 stock index futures price discovery function has been initially apparent which has the high pricing efficiency, but still fairly discrepancy to Taiwan's stock index futures. Learn from the development experience of Taiwan market, the mainland's stock index futures market can focus on the following aspects to improve the price discovery function of stock index futures.

Government supervision department should actively encourage corporate investors, especially the special corporate institutions enter the stock index futures market, Promote the implementation of "the trading guide of the qualified foreign institutional investors in the stock index futures" and "the trading business guide of trust company taking part in the stock index futures", meanwhile, encourage and guide insurance companies participate in the stock index futures trading orderly. At the premise of controlling risk, gradually relax the type of transaction. In addition, seeing from the development experience of Taiwan's stock index futures, futures dealers of the transaction proportion occupy an absolute position. Whether should expand the operating range of the mainland futures dealers or not, supervision department should talk about it.

All in all, reduce the service fee and margin level of Shanghai's and Shen-

zhen's 300 stock index futures appropriately. Lower transaction costs can help the stock index futures play the role in the leverage transaction and two-way operation better. That can make the futures market's arbitrage mechanism more efficiently, and improve the pricing efficiency of futures market.

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