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# Empirical Analysis on Price-Volume Relation in the Stock Market of China

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**ABSTRACT**

In this paper, the Granger causality test is used to explore the price-volume relation of the Shenzhen Stock Exchange and the Shanghai Stock Exchange and the spillover effect during the consolidation and the bull market. The research results show that price occurs after trading volume regardless of the consolidation period or the period of entering bull market, and spillover effect is not significant during consolidation. After the stock exchanges entered the bull market the spillover effect is rather significant because the causality existed between the Shenzhen Stock Exchange and the Shanghai Stock Exchange due to stock index change.

**Keywords:** Price-Volume Relation, Spillover Effect, Causality
**JEL Classifications:** C23, L25

## 1. INTRODUCTION

The information transfer stock market is always the concerns of financial and economic experts such as spillover effect between the markets and price-volume relationship. The relevant research topics are discussed every year but the conclusions are different. How is the spillover effect between the markets generated? Wei et al. (2011) noted that the effect spillover of the stock exchanges is not necessarily dominated by a stock exchange, and the situation may change with market and time.

In addition, scholars have different opinions on the price-volume relation: Does the price occur before volume? Does the volume occur before the price? Does the price and trading volume occur at the same time? Wei et al. (2014) indicated that the price-volume relation may change with the market and time.

The Chinese stock exchanges started to enter bull market after the second half of 2014, and had been in the consolidation period before the period. Thus, the two periods of 2014 are just the research time. This paper intends to study the price-volume relation between the two stock exchanges and explore information transfer between the two stock exchanges during the periods of consolidation and bull market.

This paper is divided into five parts. The first part presents introduction, which discusses the research motivations, and the second part reviews the past literature, which discusses the price-volume relation and the spillover effect. The third part introduces the research data and methods. The main research method in this paper is to test the research data through Granger causality test. The research data included 2014 market indexes and trading volume of the Shenzhen Stock Exchange and the Shanghai Stock Exchange. The fourth part is empirical analysis, which mainly includes the empirical result report. The final part is conclusion. The conclusions and the suggestions are made based on the research results.

## 2. LITERATURE REVIEW

The research theme is divided into two parts: the first is price-volume relation in the Shenzhen Stock Exchange and the Shanghai Stock Exchange and the rolling stock relationship between the two stock exchanges. The relevant two literatures are introduced as follows.

### 2.1. Price-Volume Relation

The empirical research on the price-volume relation can be traced back to the empirical research by Osborne (1959) and found that the stock price change is directly proportional to square root of the trading frequency. However, the research theme is to discuss relation between the stock price change and trading frequency not directly discuss the relation between the stock price and the trading volume. However, the conclusions caused many discussions on price-volume relation. The previous studies mainly discussed the relation between the price and trading volume in the same period. After the middle 1980s, the attention was paid to the causality between price and volume. These studies related to the price-volume relation of the same period found that positive relation between the price and the trading volume, such as Granger and Morgenstern (1963), Godfrey et al. (1964), Ying (1966), Crouch (1970), Clark (1973), Epps and Epps (1976), Wood et al. (1985), Harris (1987), Karpoff (1987), Jain and Joh (1988), Bessembinder and Seguin (1992), Basci et al. (1996), Bessembinder et al. (1996), Cooper (1999).

However, whether the positive relation between price and volume implies that either price or trading volume can be used to estimate the other initiated another wave of studies on causality between price and volume. These studies mainly analyzed the leading and lag relation of the trading volume with the price (vice versa) to explore whether causality exists between price and trading volume such as Jaffe and Westerfield (1985), Harris (1987), Smirlock and Starks (1985), Eun and Shim (1989), Hamao et al. (1990), Jarrow (1992), Fendenia and Grammatikos (1992), Campbell et al. (1993), Hiemstra and Jones (1994), Theodossiou and Unro (1995), Chiang and Chiang (1996), Brennan et al. (1998), Kumar et al. (1998), Martens and Poon (2001), Wang and Cheng (2004), Baker and Stein (2004), Leigh et al. (2004), Mazouz (2004), How et al. (2005), Cheuk et al. (2006), Gebka et al. (2006). Among the studies, some indicated the price occurs after trading volume, some indicated trading volume occurs after price, some indicated two-way feedback between the price and the trading volume, some suggested some market microstructure, behavioral finance and spillover effect, or some applied the event studies to discuss the price-volume relationship. The empirical research results have difference and the price-volume relationship between the stock markets have been widely supported.

### 2.2. Market Transfer Effect

The scholars always concern the empirical studies on correlation between the stock markets in various countries. Eun and Shim (1989) explored the correlation between the stock markets in the main countries from 1979 to 1985 and found the US stock markets are the main leading indexes. Hamao et al. (1990) studied the correlation between the US, the UK and Japan during January to October 1987. They found that the influence results: the US → Japan → the UK → Japan. The US Congress questioned the impact on UK stock markets. However, Karolyi and Stulz (1996) found that the US, Japan, the UK, Canada, and Germany correlate each other, and not only the US has the leading effect. Cheung and Mak (1992) studied the spillover effect of the main stock markets in Asian and found that Japanese stock markets have leading effect on Hong Kong, Singapore and Thailand stock markets. Roca et al. (1998) explored the stock market in Southeast Asia, found a bi-directional relation between Taiwan and the Philippines, and Singapore has leading indexes in Southeast Asia.

Especially after the financial crisis, the studies found correlation between stock markets in different regions was significant. For example, Lin et al. (1994) discussed impact of the global stock market crash in 1987 period and found that the US stock market has spillover effect on the Japanese stock market. Forbes and Rigobon (2002) studied the relation between the stock markets in various countries after the 1997 Asian Financial Crisis, and found correlation exist between Hong Kong and other countries. King and Wadhwani (1990) and Khalid and Kawai (2003) also obtained the same result.

## 3. RESEARCH DATA AND RESEARCH METHOD

The price-volume relation in the Shenzhen Stock Exchange and Shanghai Stock Exchange was discussed in this paper. The research data and the research method are introduced in two parts. The first part introduces source of the research data and the research period, and the second part is the research method. This paper is focused on the price-volume relation and the second part discusses the research methods. The paper focuses on the relationship between price and volume, and the main research methods include Unit Root Test and Granger causality test.

### 3.1. Research Data

This paper y discusses the price-volume relation and the spillover effect in the Shenzhen Stock Exchange and Shanghai Stock Exchange during the period of 2014/1/1-2014/12/31. The data were sourced from the Taiwan Economic Journal Database (TEJ).

The Figure 1 shows the rise was up to 50% after the Chinese exchange markets enter the bull market in the second half of 2014. Thus, this study intended to analyze the bear market and bull market in China.

Figures 2 and 3 show Shenzhen Stock Exchange and Shanghai Stock Exchange entered a bull market in the second half of 2014, and the rise exceeded 50%.

As shown in Figures 4 and 5, the daily trading volume of Shenzheng Stock Exchange and Shanghai Stock Exchange increased in the second half of the year and the growth was very especially significant in Shanghai Stock Exchange.

Based on the previous research experience, the index and trading volume may have unit root, and thus it is necessary to conduct the

**Figure 1:** Trend chart of HS 300 Price Index in 2014

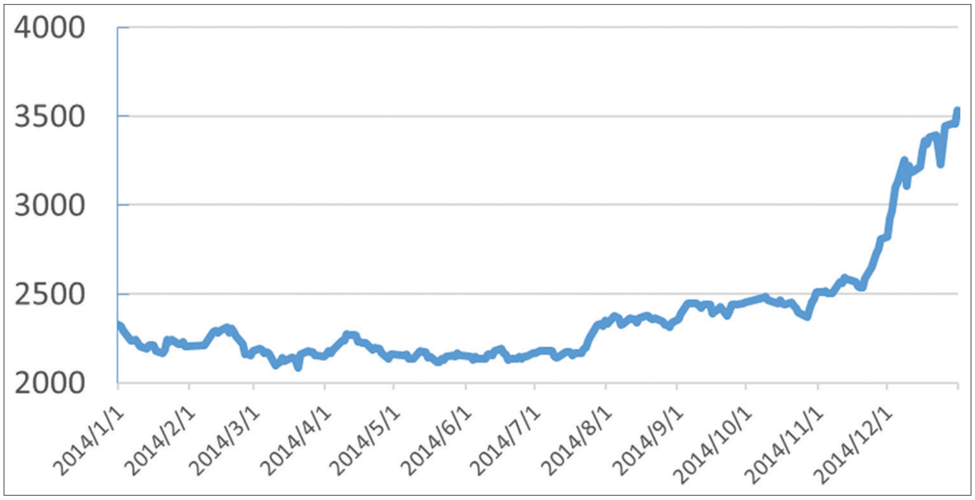



**Figure 2:** Trend chart of Shanghai Composite Index in 2014

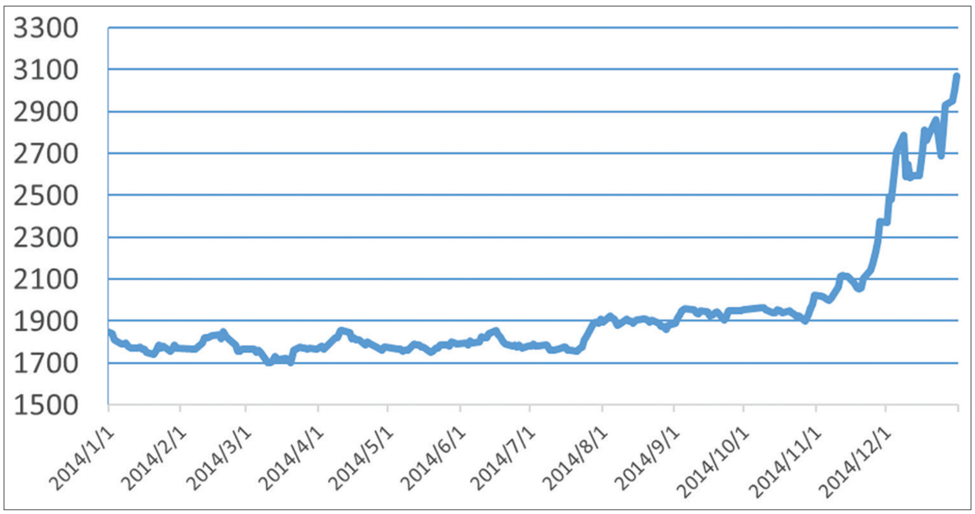
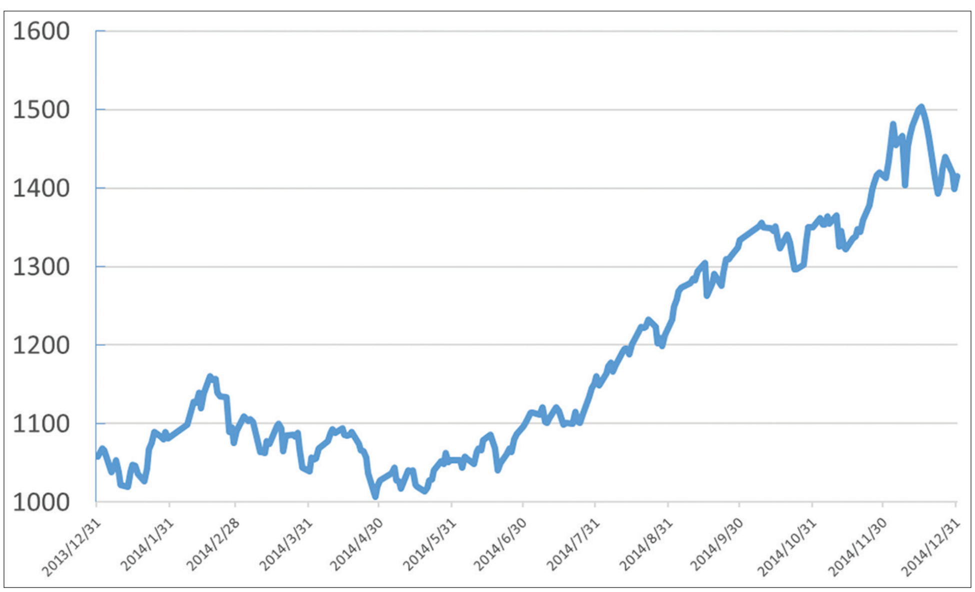



**Figure 3:** Trend chart of Shenzhen Composite Index in 2014




first-order difference for the two data series. This study intended to use return rate for discussion. The calculated return rate is natural logarithm of the closing index of the $t$ day divided by the closing index of the $t-1$ day. The change rate of the trading volume is the

**Figure 4:** Daily trading volume trend of Shanghai Composite Index in 2014

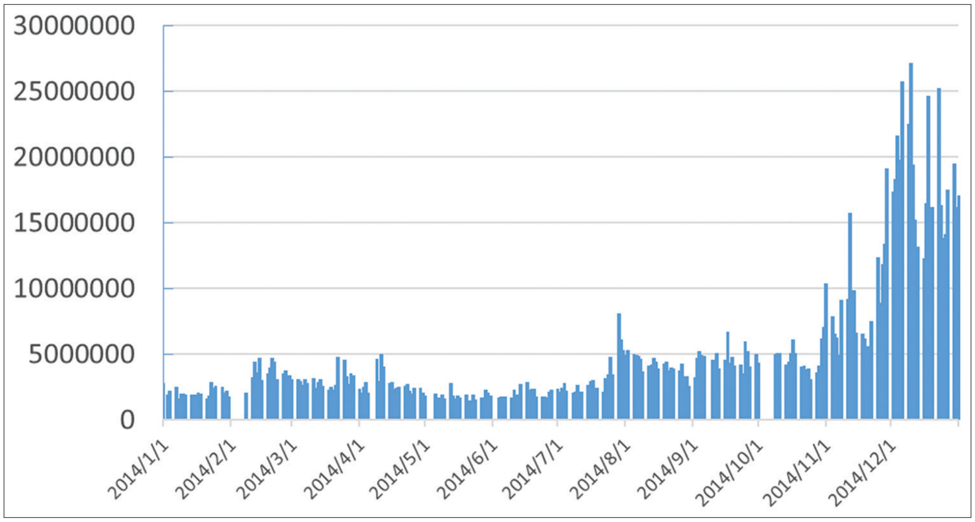
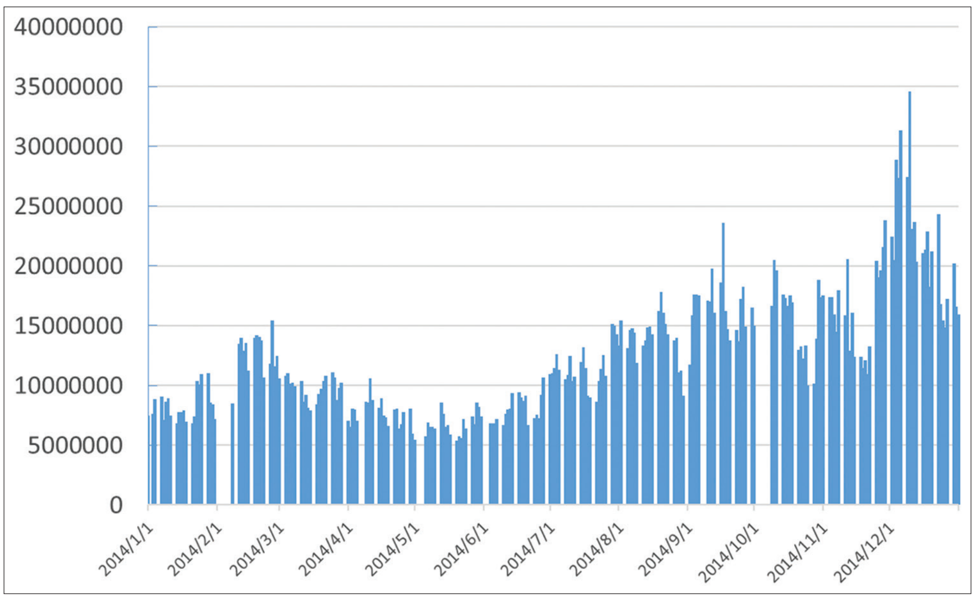



**Figure 5:** Daily trading volume trend of 2014 Shenzhen Composite Index




natural logarithm of the total trading volume of the t day divided by the total trading volume of the $t-1$ day. The return rate and the change rate are calculated as follows:

$$r_t = \left[\ln\left(\frac{I_t}{I_{t-1}}\right)\right]\times 100 \tag{1}$$

$$v_t = \left[\ln\left(\frac{V_t}{V_{t-1}}\right)\right]\times 100 \tag{2}$$

where $r$ and $v$ in Eqs. (1) and (2) denote the return rate on the index and change rate of the trading volume respectively, and I and V denote closing price and total trading volume of the current day and the total volume and $t$ is time.

The basic statistics (number of samples, mean value, average deviation, maximum and minimum) of the data of the research period, the Jarque-Bera statistic and the single root test statistic of ADF are observed first and the data are summarized in Table 1.

The China's stock exchanges totally have 245 business days in 2014. There are 119 days in the first half of the year, and 126 days in the second half of the year. Based on the performance of the stock exchange in 2015, it can be found the stock exchanges enter the bull market, especially in the second half of the year (the median value of the stock price index of the two stock exchanges is greater than 0). The research data only include the trading volume of Shenzhen Composite Index, and the normal distribution is not significant. However, this does not affect the research results.

The ADF results showed the 12 groups of the data series in this study have no unit root.

### 3.2. Research Method

#### *3.2.1. Unit root test*

According to Engle and Granger (1987) and Said (1991), the stationary variable series in the system is required to be verified before co-integration test of the multivariables, and the variable series must be corrected through difference. Therefore, the

**Table 1: Descriptive statistics**

| Market | | Period | Number | Mean | Max. | Min. | σ | JB | ADF |
|---|---|---|---|---|---|---|---|---|---|
| Shanghai Composite Index | Price | Full | 245 | 0.2067 | 5.3506 | −7.3843 | 1.3751 | 293.3770 (0.00)*** | −7.0225 (0.00)*** |
| | | Per- | 119 | −0.0332 | 3.3994 | −2.9068 | 0.9099 | 17.2553 (0.00)*** | −10.8963 (0.00)*** |
| | | Post- | 126 | 0.4333 | 5.3506 | −7.3843 | 1.6742 | 83.3971 (0.00)*** | −10.3818 (0.00)*** |
| | Volume | Full | 245 | 0.7423 | 84.8025 | −63.5145 | 23.1277 | 19.1411 (0.00)*** | −21.3116 (0.00)*** |
| | | Per- | 119 | −0.1440 | 82.6566 | −46.0972 | 22.2423 | 13.2985 (0.00)*** | −15.4834 (0.00)*** |
| | | Post- | 126 | 1.5793 | 84.8025 | −63.5145 | 23.9924 | 6.8606 (0.03)** | −14.6757 (0.00)*** |
| Shenzhen Composite Index | Price | Full | 245 | 0.1189 | 3.4415 | −4.4090 | 1.2099 | 45.1502 (0.00)*** | −15.1496 (0.00)*** |
| | | Per- | 119 | 0.0305 | 2.6385 | −4.0462 | 1.2485 | 9.4826 (0.01)*** | −10.2559 (0.00)*** |
| | | Post- | 126 | 0.2023 | 3.4415 | −4.4090 | 1.1711 | 49.3411 (0.00)*** | −11.1858 (0.00)*** |
| | Volume | Full | 245 | 0.3078 | 46.2000 | −46.3731 | 15.0167 | 2.9622 (0.23) | −18.8775 (0.00)*** |
| | | Per- | 119 | 0.3210 | 46.2000 | −37.2553 | 14.1341 | 1.6533 (0.44) | −12.4877 (0.00)*** |
| | | Post- | 126 | 0.2954 | 43.0221 | −46.3731 | 15.8617 | 1.4355 (0.49) | −13.9323 (0.00)*** |

** and *** represent significance at 5% and 1% significance level respectively. JB is Jarque-Bera test statistics which significantly indicate rejection meets null hypothesis. ADF is a unit root test of Augmented Dickey-Fuller, and the critical value of 1% is −3.44

stationary distribution of the time series must be identified through the single root test. Also, the order of integration of the time series can be identified through unit root test.

According to the time-series literature by Pagan and Wickens (1989), it can be found that the unit root test includes Dickey-Fuller (DF), Augmented Dickey-Fuller (ADF) and Phillips and Perron (PP). ADF is stronger and more stable than DF. ADF and PP can solve white noise problem caused by the moving average term. The Schwart (1987) pointed out that ADF is better than PP. Thus, ADF is used to test stability of the time series in this paper.

In ADF, the regression analysis is conducted for the series lagging one period and the first-order differential lag term after the first-order difference of the non-stationary data series. First, the time tendency is not considered, and the regression equation is applied:

$$\Delta Y_t = \beta + \beta_1 Y_{t-1} + \sum_{k=1}^{n} \gamma_k \Delta T_{t-k} + \varepsilon_t \quad (3)$$

In Eq. (4), $\varepsilon_t$ is white noise process, and the appropriate lag period $n$ is selected to make white noise uncorrelated between error terms. From Eq. (3), $\beta_1 \neq 0$ if $Y_t$ is not stationary, and $\beta_1 \neq 0$ if $Y_t$ is stationary. Thus, the statistical test is assumed to be

$H_0$: $\beta_1 \neq 0$ (when $Y_t$ data series has unit root, it is non-stationary time series)

$H_1$: $\beta_1 \neq 0$ 0(when $Y_t$ data series has no unit root, it is stationary time series)

If the time series $Y_t$ cannot reject null hypothesis $H_0$ after ADF, the data series needs further difference and then is substituted into the ADF model to test whether it is stationary time series. The equation is as follows:

$$\Delta dY_t = \beta + \beta_1 Y_{t-1} + \sum_{k=1}^{n} \gamma_k \Delta dT_{t-k} + \varepsilon_t \quad (4)$$

If the time series $Y_t$ rejects the null hypothesis, the data of the time series are stationary and conform to ARMA. ($Y_t$) is I(1) data series, and most of economic variables often show properties of I (1). I (d) shows the stationary state after d-order difference of the data.

**Table 2: AIC scale**

| Lag period | Full | Per- | Psot- |
|---|---|---|---|
| AR (1) | 3.4774 | 2.7251 | 3.8619 |
| AR (2) | 3.4907 | 2.7533 | 3.8909 |
| AR (3) | 3.5047 | 2.7904 | 3.9280 |
| AR (4) | 3.5056 | 2.8623 | 3.9445 |
| AR (5) | 3.4650 | 2.9182 | 3.8926 |
| AR (6) | 3.4907 | 2.9799 | 3.8109 |

AIC: Akaike Information Criterion. The boldface represents minimum

**Table 3: Co-integration test of price-volume relationship of Shenzheng Stock Exchange and Shanghai Stock Exchange in 2014**

| Eigen value | Likelihood ratio | Critical value | | Ho |
|---|---|---|---|---|
| | | 5% | 1% | |
| $\lambda_1$ | LR1 | C1 | | 0<R |
| $\lambda_2$ | LR2 | C2 | | 1<R |
| $\lambda_3$ | LR3 | C3 | | 2<R |
| 0.3137 | 223.7058*** | 47.21 | 54.46 | |
| 0.2506 | 133.7384*** | 29.68 | 35.65 | |
| 0.1564 | 64.78588*** | 15.41 | 20.04 | |

***represents significance level of 5%. $\lambda_1$ represents eigenvalue of the first vector, LR1 represents probability-likelihood of the first vector, C1 represents tested critical value of the first vector, R represents number of co-integrated vectors existed

**Table 4: Co-integration test of price-volume relation in Shanghai Exchange Stock and Shenzhen in the first half of 2014**

| Eigen value | Likelihood ratio | Critical value | | Ho |
|---|---|---|---|---|
| | | 5% | 1% | |
| $\lambda_1$ | LR1 | C1 | | 0<R |
| $\lambda_2$ | LR2 | C2 | | 1<R |
| $\lambda_3$ | LR3 | C3 | | 2<R |
| 0.6048 | 287.3574*** | 47.21 | 54.46 | |
| 0.5249 | 178.7255*** | 29.68 | 35.65 | |
| 0.3498 | 91.6408*** | 15.41 | 20.04 | |

### *3.2.2. Co-integration test*

The most important issue of the time series research is to select the most suitable lag periods. According to Schwert (1987), the most suitable lag period is required to be determined in unit root test to correct the self-correlation of the residuals, making the residual terms exhibit white noise process. If the lag period is too long, the model may have over-parameterization. The estimated results have no efficiency. In contrast, the selected lag period is too short, deviation may occur due to Parsimonious Parameterization. The above two situations may affect the model analysis and operation and further affect results evaluation. Thus, selection of lag periods should be careful in the economic quantitative analysis. In view of this, the optimum lag period should be generally selected by using Akaike Information Criterion (AIC). Thus, this study selected the optimum lag period based on AIC.

**Table 5: Co-integration test of price-volume relation in Shanghai exchange stock and Shenzhen in the second half of 2014**

| Eigen value | Likelihood ratio | Critical value | | Ho |
|---|---|---|---|---|
| | | 5% | 1% | |
| $\lambda_1$ | LR1 | C1 | | 0<R |
| $\lambda_2$ | LR2 | C2 | | 1<R |
| $\lambda_3$ | LR3 | C3 | | 2<R |
| 0.3372 | 106.9668*** | 47.21 | 54.46 | |
| 0.2447 | 58.0172*** | 29.68 | 35.65 | |
| 0.1312 | 14.6196 | 15.41 | 20.04 | |

The general linear co-integration test method has two types: one is to use stationary characteristics of the residuals with long term equilibrium relationship to determine whether linear co-integration relationship exists between time series. The second method, as proposed by Johansen (1988), is to use maximum likelihood estimate to estimate the co-integration relationship between variables and identify the number of co-integrating vectors. This study uses the Johansen's maximum likelihood estimate to test the co-integration relation between the variables.

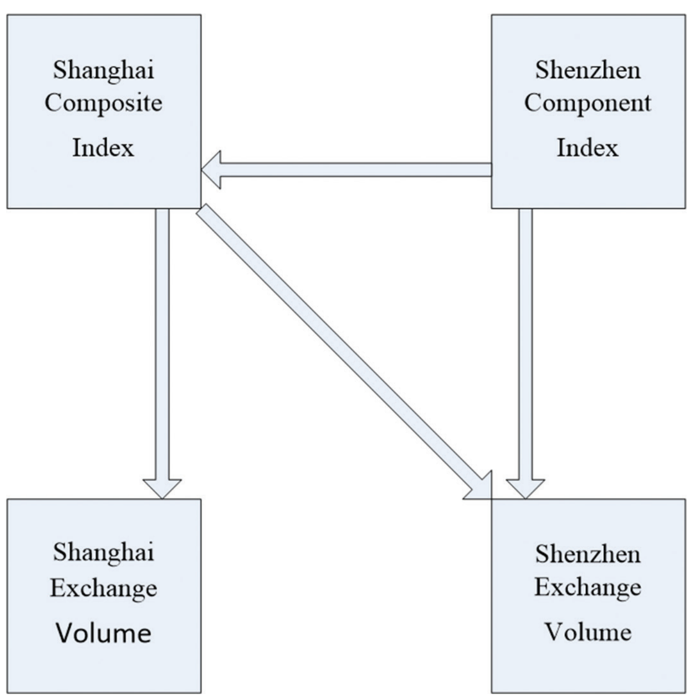
### *3.2.3. Granger causality test*

Granger (1969) defined the causality between the two time series through predictive ability of the variables. According to the definition of Granger causality, another series is added by using different information sets, and the causality test is based on whether it can reduce estimate error. Granger causality refers to a statistical causality, and more accurately is called and leading and lag relation.

**Table 6: Test results of the relation between price and trading volume in the Shenzhen Stock Exchange and Shanghai Stock Exchange throughout 2014**

| Result/Cause | F-Statistic | |
|---|---|---|
| Shanghai Exchange Volume→hanghai Composite Index | 0.7280 | No |
| Shanghai Composite Index→Shanghai Exchange Volume | 7.0521*** | Yes |
| Shenzhen Component Index→Shanghai Composite Index | 1.9317* | Yes |
| Shanghai Composite Index→Shenzhen Component Index | 1.2412 | No |
| Shenzhen Exchange Volume→Shanghai Composite Index | 1.2625 | No |
| Shanghai Composite Index→Shenzhen Exchange Volume | 6.1390*** | Yes |
| Shenzhen Component Index→Shanghai Composite Index | 8.2358 | No |
| Shanghai Exchange Volume→Shenzhen Component Index | 0.6524 | No |
| Shenzhen Exchange Volume→Shanghai Exchange Volume | 1.7630 | No |
| Shanghai Exchange Volume→Shenzhen Exchange Volume | 0.5503 | No |
| Shenzhen Exchange Volume→Shenzhen Component Index | 0.7079 | No |
| Shenzhen Component Index→Shenzhen Exchange Volume | 24.9110*** | Yes |

*** represents the null hypothesis is rejected when the significance level is 1%. ** represents the null hypothesis is rejected when the significance level is 5%. *represents the null hypotheses is rejected when the significance level is 10%



The two sequences $X$ and $Y$ are supposed. Besides $X$ past data, if $Y$ past data are used for estimate using $X$, the estimate will be more accurate. Thus, $Y$ causes $X$; in contrast, if $X$ past data are used for estimate using $Y$, $Y$ estimate error can be reduced, and thus $X$ causes $Y$. If the two situations occur at the same time, $X$ and $Y$ have feedback relationship,

Granger not only defined causality in the literature but also developed one pair of variable regression equations:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \ldots + \alpha_1 y_{t-n} + \beta_1 x_{t-1} + \ldots + \beta_1 x_{t-n} \quad (1)$$

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \ldots + \alpha_1 x_{t-n} + \beta_1 y_{t-1} + \ldots + \beta_1 y_{t-n} \quad (2)$$

However, this regression equation has a small deficiency, which assumes that contemporaneous relation exists between $X$ and $Y$ in the same period. This means addition of $Y$ ($X$) information in the same period is helpful for the $X$ ($Y$) estimate. In this case, the test results only have three types of causality defined by Granger, i.e., independence between $x$ and $y$, causality between $x$ and $y$ and feedback between $x$ and $y$. For all the data pairs $(x,y)$, the tested F value is Wald statistics, and the joint hypothesis is: $\beta_1 = \beta_2 = \ldots = \beta_t = 0$. In Eq. (1), the null hypothesis is $x$ does not Granger-cause $y$. In Eq. (2), the null hypothesis is $y$ does not Granger-cause $x$.

## 4. EMPIRICAL ANALYSIS

### 4.1. Selection of Lag Period

The lag period is tested by AIC in Table 2. Thus, the 5th period has the minimum (3.4650) throughout 2015. Next, this study conducts co-integration analysis and uses AR (5) for the causality test. The earlier and later periods of 2015 adopt AR (1) and AR (6), and the minimum value is 2.7251 and 3.8109.

### 4.2. Co-integration Test

Next, the Johansen co-integration test is conducted to test whether co-integration relationship exists between the four time series price and volume of Shenzheng Stock Exchange and Shanghai Stock Exchange. From Likelihood Ratio in Table 3, LR1 value

**Table 7: Test results of the relation between the price and trading volume in Shanghai Exchange Stock and Shenzhen Exchange Stock in the first half of 2014**

| Result/Cause | F-Statistic | |
|---|---|---|
| Shanghai Exchange Volume→hanghai Composite Index | 0.02148 | No |
| Shanghai Composite Index→Shanghai Exchange Volume | 2.94221* | Yes |
| Shenzhen Component Index→Shanghai Composite Index | 0.50638 | No |
| Shanghai Composite Index→Shenzhen Component Index | 0.55286 | No |
| Shenzhen Exchange Volume→Shanghai Composite Index | 0.02279 | No |
| Shanghai Composite Index→Shenzhen Exchange Volume | 2.16866 | No |
| Shenzhen Component Index→Shanghai Composite Index | 9.72058 | No |
| Shanghai Exchange Volume→Shenzhen Component Index | 0.38209 | No |
| Shenzhen Exchange Volume→Shanghai Exchange Volume | 3.02818 | No |
| Shanghai Exchange Volume→Shenzhen Exchange Volume | 2.52977 | No |
| Shenzhen Exchange Volume→Shenzhen Component Index | 1.03362 | No |
| Shenzhen Component Index→Shenzhen Exchange Volume | 36.6528*** | Yes |

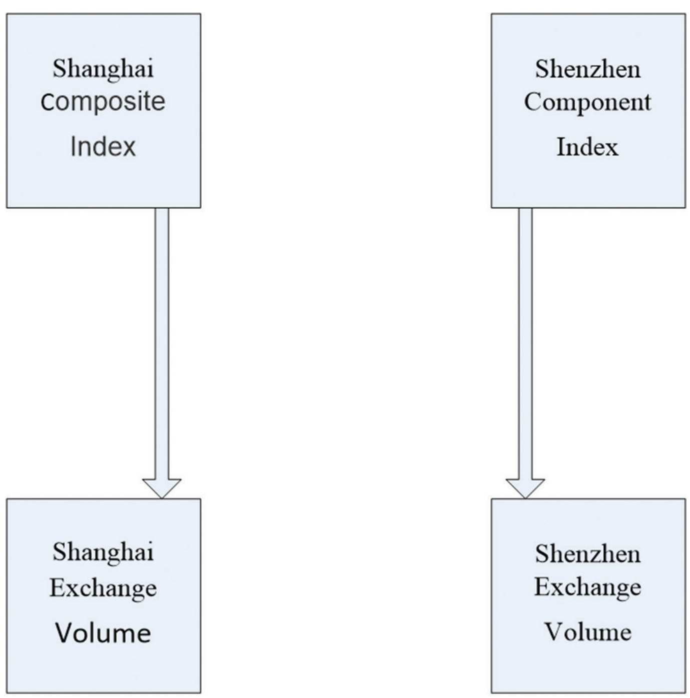
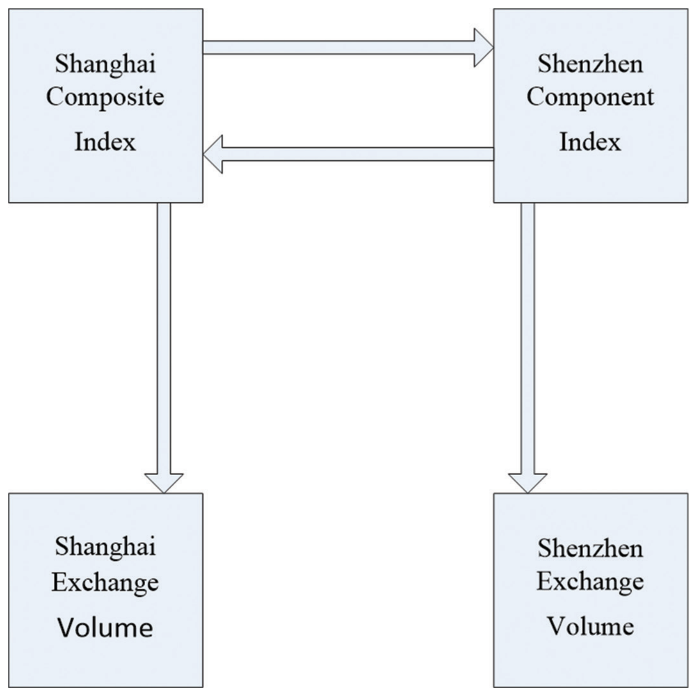


**Table 8: Test results of the relation between the price and trading volume in Shanghai Exchange Stock and Shenzhen Exchange Stock in the second half of 2014**

| Result/Cause | F-Statistic | |
|---|---|---|
| Shanghai Exchange Volume→Shanghai Composite Index | 0.70668 | No |
| Shanghai Composite Index→Shanghai Exchange Volume | 3.27497*** | Yes |
| Shenzhen Component Index→Shanghai Composite Index | 5.41228** | Yes |
| Shanghai Composite Index→Shenzhen Component Index | 2.76560*** | Yes |
| Shenzhen Exchange Volume→Shanghai Composite Index | 1.16043 | No |
| Shanghai Composite Index→Shenzhen Exchange Volume | 3.24152 | No |
| Shenzhen Component Index→Shanghai Composite Index | 5.57763 | No |
| Shanghai Exchange Volume→Shenzhen Component Index | 0.34716 | No |
| Shenzhen Exchange Volume→Shanghai Exchange Volume | 0.47312 | No |
| Shanghai Exchange Volume→Shenzhen Exchange Volume | 0.55603 | No |
| Shenzhen Exchange Volume→Shenzhen Component Index | 0.66099 | No |
| Shenzhen Component Index→Shenzhen Exchange Volume | 15.3784*** | Yes |




is 223.7058 which is greater than the critical value 54.46 of 1%. Thus, the null hypothesis is rejected. This means at least one co-integrated variable exists. It can be deduced that co-integration exists between price and trading volume of the Shenzhen Stock Exchange and Shanghai Stock Exchange in 2015.

From Tables 4 and 5 it can be found that 2015 can be divided into two intervals (the first half of the year and the second half of the year). The co-integration also exists between the four time series price and volume in Shenzhen Stock Exchange and the Shanghai Stock Exchange.

### 4.3. Causality Test

Through the Granger causality test, it has been found that the price occurs before trading volume in Shenzhen Stock Exchange and Shanghai Stock Exchange (Table 6). Furthermore, the Shenzhen Index also has spillover effect on Shanghai Index and trading volume.

It can be found that the consolidation occurred in the first half of 2014, as shown in Figures 1-3. This study found that price occurred after trading volume during the consolidation period, as shown in Table 7.

The Shenzhen Stock Exchange and the Shanghai Stock Exchange entered the bull market in the second half of 2014, and the spillover effect is very obvious. The causality exists between the Shenzhen Exchange Stock and the Shanghai Exchange Stock. As shown in Table 8, the price occurs before trading volume.

## 5. CONCLUSION

In this paper, the Granger causality is used to discuss the price-volume relationship between the Shenzhen Exchange Stock and the Shanghai Exchange Stock and the spillover effect. The findings are consistent with the research by Wei et al. (2011). Wei et al. (2014) indicated the market information changes. All the rules may change with time and place.

For Shenzhen Stock Exchange and Shanghai Stock Exchange, the price occurred before trading volume in any period. The price occurred before trading volume in the whole year, the consolidation period or the bull market.

The spillover effect did not occur during the consolidation. However, the high stock market mobility means the markets enter the bull market. The spillover effect was very significant. The two markets are correlated and affect each other.

It can be found that the trading volume of the stock e may be affected by different markets. The stock price of the Shanghai Stock Exchange may affect the trading volume of Shenzhen Stock Exchange, and the Shenzhen Stock Exchange may have spillover effect on the Shanghai Stock Exchange. Thus, the government implements the Shanghai-Hong Kong Stock Connect. The stock exchanges has leading index.

The consolidation occurred in the first half of 2014, and the stock exchanges entered the bull market in the second half of 2014. However, it is pitiful that this study did not explore the bear market. The future research can fill in the gap.

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