Empirical Analysis on the Correlation between Chinese Stock Markets and Developed Oversea Markets

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Abstract

Through the Johansen Co-integration test and the Granger-causality test, we found that the volatility in Chinese stock markets has been affected by the the volatility in United States stock market, however, we have not found that Chinese stock markets would co-move along with the United States market in the long run; Chinese stock markets and Hong Kong stock market have not only been influenced each other by fluctuations in two markets, but also shown a trend of co-movement since 2005; the relationship between Chinese stock markets and Japanese market shows the trend of co-movement between stock markets of two countries only out of regional economy since 2005, however, the volatility in one of which will not lead to fluctuations in another.

Keywords: Relevance, Co-integration, Granger-causality, Chinese Stock Markets, Oversea Markets

1. Introduction

Since 2004, the Chinese government has promulgated a series of policies and approaches for Chinese stock market remaining weak status to inject new vitality. In January 2004, the state council has launched *the State Council on promoting the capital market reform and stable development of a number of observations*, which marked an milestone in the development of Chinese stock market; in April 2005, also issued *Circular on Issues relating to the Pilot Reform of Listed Companies Split Share* which announced the launch of split share reform; and in August, 2006, CSRC, PBOC, and the State Administration of Foreign Exchange have jointly promulgated *the qualified domestic institutional investors in overseas securities investment management pilot scheme*. Such measures have fostered rapid progress of Chinese economy and stock market that China has become the emerging economy with the greatest development potential and prospect in the world. With the influx of foreign capital into China to further deepen the economic globalization, Chinese stock market has grown up a close relationship with world stock market, especially with the developed markets.

2. Literature Review

In recent years, many scholars have studied the relationship between the Chinese stock market and oversea stock markets, and have drawn their own conclusions [1-7]. In 2001, Yu Shidian et al. arrived at the conclusion that there was a weak linkage between Shanghai stock market and some oversea markets (e.g. the U.S., the U.K., and Hong Kong, Japan markets)[8]. In 2003, Chen Shoudong et al. came to the conclusion that China was separated from international stock market by discovering that there was no co-integration relationship between domestic stock market and international stock market, namely no long- term trend existed[9]. In 2004, through researches Zhang Fu et al. concluded that the relationship between the Chinese stock market and the United States stock market varied in different periods of time [10]. In 2007, the articles of Zhou Jun pointed out that before 2003, there had been no Co-integration relationship between Chinese mainland's market and Taiwan, Japan markets, but after 2003, there was a definite co-integration relation between Shanghai stock market and Hong Kong stock market, and Hong Kong stock market had one-way-Granger causality to Shanghai stock market[11]. However, the conclusion was not exactly the same as that concluded by Luo Qingzhong et al [12].

So far, despite a great number of articles on this topic has been made, however, mainly due to such massive changes which had not taken place in Chinese stock market during writing, the conclusion drawn from the articles needs amendment. For such purpose, the paper has chosen the historical period data of stock market in China mainland from initial to recent time as a study sample so as to grasp the overall relationship between Chinese stock market and some international developed stock markets.

3. Research Methods

In this paper, the Granger causality test and the co-integration test are employed to study the relationship between Chinese stock market and some developed oversea stock markets.

3.1. Co-integration

The co-integration test is used to determine whether a group of non-stationary series is co-integrated or not[13]. The assumption is that a pair of non-stationary variables may actually be co-integrated and possess a long-term relationship despite the variables' tendency to drift extensively over time. The presence of a co-integrating relation forms the basis of the Vector Error Correction (VEC) model specification[14]. The test for the presence of co-integration is performed when all the variables are non-stationary and integrated to the same order.

In this paper, the method proposed by Johansen (1991) is used. This method can be illustrated by considering the following general autoregressive representation for the vector Y.

$$Y_t = A_0 + \sum_{j=1}^{p} A_j\, Y_{t-j} + \varepsilon_t \qquad (1)$$

where Y_t is a (n×1) vector of non-stationary I (1) variables, A_0 is a (n×1) vector of constants, p is the number of lags, A_j is a (n×n) matrix of coefficients and ε_t is assumed to be a (n×1) vector of Gaussian error terms. In order to use Johansen's test, the above vector autoregressive process can be rewritten and turned into a vector error correction model of the form:

$$\Delta\, Y_t = A_0 + \sum_{j=1}^{p-1} \Gamma_j\, \Delta\, Y_{t-j} + \Pi\, Y_{t-p} + \varepsilon_t \qquad (2)$$

Where

$$\Gamma_j = -\sum_{i=j+1}^{p} A_j \text{ and } \Pi = -I + \sum_{i=j+1}^{p} A_j$$

Δ is the difference operator, and I is an (n × n) identity matrix. The issue of potential co-integration is investigated when we compare both sides of equation (2). As Y_t ~ I (1), Δ Y_t ~ I(0), so are

ΔY_{t-j} . This implies that the left-hand side of equation (2) is stationary. Since ΔY_{t-j} are stationary, the right-hand side of equation (2) will also be stationary if ΠY_{t-p} is stationary. The Johansen test centres on an examination of the Π matrix. The Π can be interpreted as a long-run coefficient matrix, since in equilibrium, all the ΔY_{t-j} will be zero, and setting the error terms, ε_t , to their expected value of zero will leave $\Pi Y_{t-p} = 0$. The test for co-integration between the Y 's is calculated by looking at the rank of the Π matrix via eigenvalues. The rank of a matrix is equal to the number of its characteristic roots (eigenvalues) that are different from zero. Thus, if the rank of Π equals 0, the matrix is null and equation (2) becomes the usual VAR model in first difference. If the rank of Π is r where r < n, then there exist r co-integrating relationships in the above model. In this case, the matrix Π can be rewritten as Π = αβ′ where α and β are (n×r) matrices of rank r. Here, β is the matrix of co-integrating parameters and α is the matrix of weights with which each co-integrating vector enters the above VAR model.

The test for the number of characteristic roots that are insignificantly different from unity can be conducted using the following two statistics, namely, the trace and the maximum eigenvalue test.

$$\lambda_{trace}(r) = -T \sum_{j=r+1}^{p} \ln\left(1-\hat{\lambda}_j\right) \qquad (3)$$

and

$$\lambda_{\max}(r, r+1) = -T \ln\left(1-\hat{\lambda}_{r+1}\right) \qquad (4)$$

Where $\hat{\lambda}_j$ is the estimated values of the characteristic roots obtained from the estimated Π matrix, T is the number of usable observations and r is the number of co-integrating vectors.

The trace test statistics, test the null hypothesis that the number of distinct co-integrating vectors is less than or equal to r against the alternative hypothesis of more than r co-integrating relationships. From the above it is clear that λ_{trace} equals zero when all $\hat{\lambda}_j$ =0. The farther the estimated characteristic roots are from zero, the more negative is $\ln\left(1-\hat{\lambda}_{r+1}\right)$ and larger the λ_{trace} statistics. The maximum eigenvalue statistics test the null hypothesis that the number of co-integrating vectors is less than or equal to r against the alternative of $r+1$ co-integrating vectors. Again, if the estimated value of the characteristic root is close to zero, $\lambda_{\max}$ will be small (Enders 1995; Madala and Kim 1998).

3.2. Granger-causality test

In this study we use the procedure of causality detection as developed by Granger (1969, 1988) using the regression approach[15-19]. The concept of Granger's causality test (1969, 1988) examines the dynamic linkage between the two series[20]. A time series x_t Granger-causes another time series y_t if series y_t can be predicted with better accuracy by using past values of x_t rather than by not doing so, other information is identical[21]. The Granger-causality test is conducted only when the series are stationary.

The empirical analysis of the causality between any two equity markets is conducted using a bivariate vector autoregression (VAR) model of the following kind:

$$x_t = \alpha_0 + \sum_{j=1}^{k} \gamma_j x_{t-j} + \sum_{j=1}^{k} \beta_j y_{t-j} + \mu_{xt} \quad (5)$$

$$y_t = \alpha_0 + \sum_{j=1}^{k} \gamma_j x_{t-j} + \sum_{j=1}^{k} \beta_j y_{t-j} + \mu_{yt} \quad (6)$$

Where k is a suitably chosen positive integer; γ_j and β_j, j = 0,1, ..., k are parameters and α's are constants; and μ_t's are disturbance terms with zero means and finite variances. The null hypothesis that y_t does not Granger-cause x_t is not accepted if the β_j's, j > 0 in equation (5) are jointly significantly different from zero using a standard joint test (e.g., an F test). Similarly, x_t Granger-causes y_t if the γ_j's, j > 0 coefficients in equation (6) are jointly different from zero.

4. Original Hypothesis and Data

4.1. Original Hypothesis

Hypothesis 1: to suppose that index of Chinese stock market may have no co-integration with that of stock markets in the United States, Japan, or Hong Kong.

Hypothesis 2: to suppose that index of Chinese stock markets may have no Granger causality with that of stock market in the United States, Japan, or Hong Kong.

4.2. Data

Shanghai and Shenzhen composite index (closing) daily data can be downloaded from Gu Feng securities corporation website, and oversea stock market index data (closing) downloaded from Yahoo finance channel.

5. Empirical Analysis

The co-integration test is a means for analyzing whether there is a long-term co-movement relationship between two non-stationary data series, and the Granger-causality test is a technique for examining whether there is impact between two stationary data series in a short term. Therefore, we must conduct the unit root test to determine whether the series is stationary. There are two specific methods to take the test, of which one is ADF test (dickey and fuller 1979, 1981; enders 1995), the other is PP test (phillips and perron 1988). The empirical analysis will be divided into three parts, of which the first part conducting test for stationarity, the second part for co-integration analysis of the relationship between series, and the third part for Granger causality analysis of series.

First, series stationarity test. We use ADF and PP tests to perform a stationary test for the data series of stock markets from Shanghai and Shenzhen stock markets and Hong Kong, Japan, the United States (the Dow Jones Industrial Average and the Nasdaq composite index). The ADF and PP tests for stationarity are applied in three forms: without drift and time trend; with drift and no time trend and with drift and time trend. We found that stock market series data which was always volatile has become the stationary series nevertheless through first order difference.

Second, the co-integration test. We apply Johansen co-integration test to examine whether there are long-term co-integration relationship between Chinese stock market and other four mature markets.

1) With the application of Co-integration analysis from 1991 to 2009, we found that throughout the period since the establishment of stock market in Chinese mainland, the Co-integration relationship had not existed between the Chinese stock markets and the U.S., Japan, Hong Kong stock markets. In order to save the paper space, we only listed the Co-integration test data between the Chinese stock market and Hong Kong stock market, see Table 1.

2) Furthermore, with the same method, we studied the relationship between Chinese stock markets and the United States,

Japan, Hong Kong's stock markets during 7 periods: 1991-2003, 2003-2009, 2004-2009, 2005-2009, 2006-2009, 2007-2009 and 2008-2009. In this paper, we only listed the co-integration test data from all markets, see Table 2. We found that there had been no Co-integration relationship between the Chinese stock markets and the U.S. stock markets. However since 2005, there was a Co-integration relationship emerged between the Chinese mainland stock markets and the Japan, Hong Kong stock markets, respectively at the four periods: 2005-2009、2006-2009、2007-2009、2008-2009.

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
Co-integration Rank (Trace) between SHCLOSE and HKCLOSE				
None	0.001624	13.20391	15.49471	0.1075
At most 1	0.000387	2.540012	3.841466	0.111
Trace test indicates no cointegration at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				

Table 1: Co-integration rank (Trace) (1991-2009).

sample		DQCLOSE \NACLOSE	RJCLOSE	HKCLOSE
SZCLOSE \SHCLOSE	1991-2003	No	No	No
	2003-2009	No	No	No
	2004-2009	No	No	No
	2005-2009	No	YES	YES
	2006-2009	No	-	-
	2007-2009	No	-	-
	2008-2009	No	-	-

No: denotes "No co-integration relationship"
YES: denotes "co-integration relationship"

Table 2: Summary of results of co-integration rank (Trace).

Third, the Granger-causality test. Even though the co-integration relationship may not exist between some variables, in which Granger causality may still exist, it is a forecast for short term relationship. On the one hand, the Granger-causality in the absence of co-integration is interpreted as short-run causal relationship. Madala and Kim (1998: 188–89) explain that co-integration is concerned with long-run equilibrium. On the other hand, the Granger-causality is concerned with short-run forecast ability. We use the Granger Causality tests throughout the period of 1991-2009. As a stationary sequence is required in the test, we need to cope with original sequence by first order difference. The processed variables are DDQCLOSE, DNACLOSE, DRJCLOSE, DHKCLOSE, DSHCLOSE, DSZCLOSE, for which we will respectively use lags 2, 3, and 4 to conduct the Granger causality test, and finally through AIC (Akaike Information Criterion) method to select lag 2 as the lag order. Results listed in table 3(we only listed a part for short), from which conclusions may be drawn:

1) The Nasdaq composite index and Dow Jones industrial average have active Granger-causality with Chinese Shanghai and Shenzhen stock markets, namely Granger-cause to Shanghai and Shenzhen stock markets.

Null Hypothesis	order	Probability	Examine	Conclusion
HK ≠> SH	2	0.00223	Rejection	DHKQCLOSE and DSHCLOSE Granger Cause Each other
SH ≠> HK		2.20E-10	Rejection	
HK ≠> SH	3	0.00057	Rejection	
SH ≠> HK		1.10E-10	Rejection	
HK ≠> SH	4	1.04E-03	Rejection	
SH ≠> HK		8.10E-10	Rejection	
RJ ≠> SH	2	0.13784	No rejection	No Granger causal relationship
SH ≠> RJ		0.36839	No rejection	
RJ ≠> SH	3	0.25116	No rejection	
SH ≠>RJ		0.06129	No rejection	
RJ ≠>SH	4	0.35561	No rejection	
SH ≠>RJ		0.1086	No rejection	

Note: "A≠>B" denotes "A does not Granger Cause B"

Table 3: Granger-causality test during 1991-2009.

2) There is mutual Granger causality between Hong Kong's Hang Seng Index and Shanghai and Shenzhen stock index.

3) There does not exist Granger causality between Chinese stock markets and Japanese stock market.

In order to explain more clearly the Granger causality between Chinese mainland stock market and oversea stock markets, see figure 1.

6. Conclusion

After quantitative analysis, we have drawn the following conclusions.

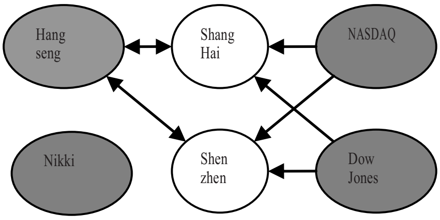

Fig. 1: The Granger Causality between Chinese and Oversea Stock Markets.

1) Analysis of the relationship between Chinese stock markets and the U.S. stock market.

In the long run, the Co-integration relationship between Chinese stock market (index of Shanghai and Shenzhen) and the U. S. stock market (Dow Jones Industrial Average and the Nasdaq Composite Index) has not been established, but in the short term, Stock Market Volatility in the United States has impact on the Chinese stock market. Although it does not show common trend or rule in both markets, the fluctuation in the former market will lead to volatility in the latter.

2) Analysis of the relationship between Chinese mainland stock market and the Japanese stock market

In the long run, the Co-integration relationship and the Granger causality between Chinese stock market and the Japan stock market has not been established. After 2005, both markets have established a co-integration but still have no Granger causality. In other words, even the fluctuations in both stock markets have showed the common trend or rules since 2005, they are still independent from each other.

3) Analysis of the relationship between Chinese mainland stock market and the Hong Kong stock market.

In the long term, there exists no relationship between Chinese mainland stock market and Hong Kong stock market, however since 2005, a co-integration relationship has been established between them. Moreover, since the stock market has been established in Chinese mainland, it has a mutual Granger causality with Hong Kong stock market.

In a simple analysis of the reasons for the above drawn conclusions, the writer thinks that mainly due to Chinese stock market stands at a developing stage that is relatively independent and has not a close relation with such stock markets. However, since 2005, China has regulated and guided her stock markets through the introduction of a variety of policies and rules, with rapid development under the implementation of effective management and incentive mechanism. Concurrently, along with further development of economic globalization and integrated economy between Chinese and developed countries of the world, Chinese stock markets have also gradually established certain co-integration relationship and causality with some oversea developed stock markets. As China lies in Asia with Hong Kong, Japan, all of which enjoy coordinative development of regional economy, a certain Co-integration rule has been shown in presence of the stock market, especially a more closer relation established between Chinese stock market and Hong Kong stock market, which is not only a long term mutual benefit causality, but also a Co-integration relationship after 2005. Although a close-knit relation with the United States in trade and economy, there is still obvious difference in development mode and characteristics from it. For this reason, there does not exist a Co-integration relationship in presence of the stock markets of two countries, although the United States still has a relatively important impact on Chinese stock market, which can be seen in the fluctuations of the stock markets between two countries.

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