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*Shanghai Stock Exchange Composite Index and Bank Stock Prices in China:  
A Causality Analysis*

by

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# Shanghai Stock Exchange Composite Index and Bank Stock Prices in China: A Causality Analysis

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## Abstract

This paper analyzes empirically the relationship between the Shanghai Stock Exchange (SSE) Composite Index and the indexes of 10 Chinese listed banks to test whether the listing of these banks had played a role in leading the Chinese stock market. Using daily prices from 1 June 2006 to 15 November 2007, we applied the Granger causality test and found that a uni-directional causality relationship existed either way between most bank stock prices and the market index while the bi-directional relationship only identified among five of the ten banks. This research finding is in part consistent with previous studies showing that stock markets in great China region are integrated and are strongly influenced by the psychological factors of investors. In the following co-integration test, both AEG and Johansen's methods concluded a long-run stable equilibrium relationship between majority of the banking stock prices and the SSE Composite Index.

**JEL classification:** G21, G14, C53

**Keywords:** Shanghai Stock Exchange, VAR, Johansen co-integration tests, Granger causality tests

## Outline:

1. *Introduction*
2. *Review of the Chinese stock market and listed banks*
3. *Literature review*
4. *Methodology*
5. *Data and results*
6. *Conclusions and discussions*

## Non-Technical Summary

The stock market Bull Run in China during 2006-2007 attracted worldwide attention. Within 15 months, the Shanghai Stock Exchange (SSE) Composite Index rose more than three-fold to 6,170 in mid-November 2007. Many financial analysts and stock brokers sought to investigate the factors driving the market. In particular, they asked whether specific sectors had stimulated the stock market or whether the growth was merely a sentimental euphoria associated with Beijing's 2008 Olympic Games.

The computation of SSE Composite Index is weighted according to the total market value of listed stocks, rather than merely the traded fraction, the financial sector stocks dominates the market, especially after the ICBC listing. On the first day of trading the ICBC gained 15 percent on the Stock Exchange of Hong Kong (SEHK) and 5 percent on the SSE. By the end of 2006, the domestic market value of ICBC reached \$250 billion, more than 20 percent of the SSE Composite Index. Aggregated by other nine listed banks, they accounted for about half of the index. Besides high share of market capitalization, their price performance and trading volume were also strong.

In response to the prominence of bank stocks financial analysts have claimed that the Chinese economy has been transformed irreversibly from a centralized economy to a market one and that the development of the financial market is the primary impetus for the growth of the Chinese stock markets. While ICBC was no longer the largest single stock after the listing of PetroChina in November 2007, many analysts asked whether banks were the preferred stocks, and whether the bank sector had driven the broad market, or indeed, the broad market and the bank stocks were propelling each other amidst the bull market in 2006-2007.

To address this issue, this paper applies a Granger causality test using Johansen's VAR approach to explore the relationship between the daily prices of the listed banks and the SSE Composite Index, and also explore the contribution of the banking stocks to the relationship between the financial sector index and the SSE market index. We concluded that a uni-directional causality relationship existed either way between most bank stock prices and the market index while the bi-directional relationship only identified among five of the ten banks. This research finding is in part consistent with previous studies showing that stock markets in great China region are integrated and are strongly influenced by the psychological factors of investors. In the following co-integration test, both AEG and Johansen's methods concluded a long-run stable relationship between almost all banking stock prices and the SSE Composite Index. In the short run, bank stock prices may deviate from the market index, however, error correction mechanisms would drive them back to the equilibrium in the long term.

## 1. Introduction

The stock market Bull Run in China during 2006-2007 attracted worldwide attention. Within 15 months, the Shanghai Stock Exchange (SSE) Composite Index rose more than three-fold to about 6,000 in mid-October 2007. Many financial analysts and stock brokers sought to investigate the factors driving the market. In particular, they asked whether specific sectors had stimulated the stock market or whether the growth was merely a sentimental euphoria associated with Beijing's 2008 Olympic Games.

The market growth to October 2007 was distinguished by a rapid rise in the price of bank stocks after the 2006 listing on both the Shanghai and Hong Kong markets of the Industrial and Commercial Bank of China (ICBC), one of China's 'Big Four' commercial banks.<sup>1</sup> On the first day of trading the ICBC gained 15 percent on the Stock Exchange of Hong Kong (SEHK) and 5 percent on the SSE. By year-end 2006, the market capitalization of the ICBC had topped \$250 billion and it accounted for 20 percent of the SSE index and the banking sector nearly half the market capitalization of stocks on the SSE.

In response to the prominence of bank stocks financial analysts have claimed the Chinese economy has been transform irrevocably from a centralized economy and that the development of the financial market is the primary impetus for the growth of Chinese stock markets. While the ICBC is no longer the largest single stock since the listing of PetroChina in November 2007, many market analysts have asked whether banks have become a preferred stock, and whether the bank sector drives the broad market.

To address this issue, the paper applies a causality test using Johansen's VAR approach to explore the relationship between the daily prices of the listed banks and

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<sup>1</sup> The "Big Four" refers to the four state-owned commercial banks that comprise, ICBC, China Construction Bank (CCB), Bank of China (BOC) and the Agricultural Bank of China (ABC). The Bank of Communications (BOCOM) has been added to four to form the "Big Five", of which only the ABC is not listed. The names of the banks and their abbreviations are listed in full in Appendix I.

the SSE Composite Index, and also explore the contribution of the banking stocks to the relationship between the financial sector index and the SSE market index. To the best of our knowledge others have not tested the causal relationship between stock index and specific stocks in China. The paper is organized as follows. The next section will review of the development of the Chinese stock market, and in particular the banking sector. Section 3 will discuss the literature on causality tests, Section 4 discusses the methodology and Section 5 describes the data and presents the model results. The final section discusses the conclusions and implications.

## **2. Review of The Chinese Stock Market and Listed Banks**

The establishment of stock exchanges in Shanghai and Shenzhen in the early 1990s marked the re-emergence of the Chinese stock market, which grew rapidly and stimulated reform of the financial system and corporate governance. At first, only A-shares denominated in Chinese yuan (the renminbi, RMB) could be traded by Chinese residents. Later in 1991, B shares, denominated in US or Hong Kong dollars were launched, which allowed limited participation by foreigners.<sup>2</sup>

From 1992 to 2006, the number of listed enterprises increased from 53 to 1,434 and market capitalization rose from 104.81 to 8,940.4 billion yuan. In January 2004, the state council issued “Several Opinions on Promoting the Reform, Opening and Stable Development of the Capital Market”. It is the first time of the state to clarify the function, guideline and role of the capital market, representing an epoch-making period of the Chinese financial sector. Additionally, sustained growth of the national economy, an improved legal environment<sup>3</sup>, the listing of large and new companies, the completion of equity division reforms, and anticipated appreciation of the Chinese currency also stimulated the Chinese stock market development. Since late 2006, the

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<sup>2</sup> B Shares are foreign-invested shares issued domestically by Chinese companies. In addition, H-shares are listed on the Hong Kong Stock Exchange and subject to its stringent listing and disclosure requirements. For a concise history of the recent development of the Chinese stock market and its regulatory regime, see Green (2004).

<sup>3</sup> Both of the Company Law and the Securities Law of People’s Republic of China had been amended in 2005 and became effective since 1 January 2006.

Chinese stock market experienced unprecedented growth, the SSE Composite Index rising more than 3,000 points in a year. Table 1 summarizes the evolution of the Chinese stock market from its inception to the end of 2007.<sup>4</sup>

**Table 1 Development of Chinese stock market, 1992-2006**

<i>Year</i>	<i>A,B-Share Listed firms</i>	<i>Market Capitalization (RMB billion)</i>		<i>Trading Volume (billion shares)</i>
		<i>Total Market</i>	<i>Tradable<sup>1</sup></i>	
1995	323	347	94	40.4
1998	851	1951	575	235.4
1999	949	2647	821	313.2
2000	1088	4809	1609	608.3
2001	1160	4352	1446	383.1
2002	1224	3833	1249	279.9
2003	1287	4246	1318	321.2
2004	1377	3706	1169	582.8
2005	1381	3243	1063	662.4
2006	1434	8940	2500	1614.5
2007 <sup>2</sup>	1530	34824	11419	3630.7

*Source:* BNS (1993-2007), *China Statistical Yearbook*, various years. SSE Monthly Statistics, December 2007. SZSE Monthly Statistic, December 2007.

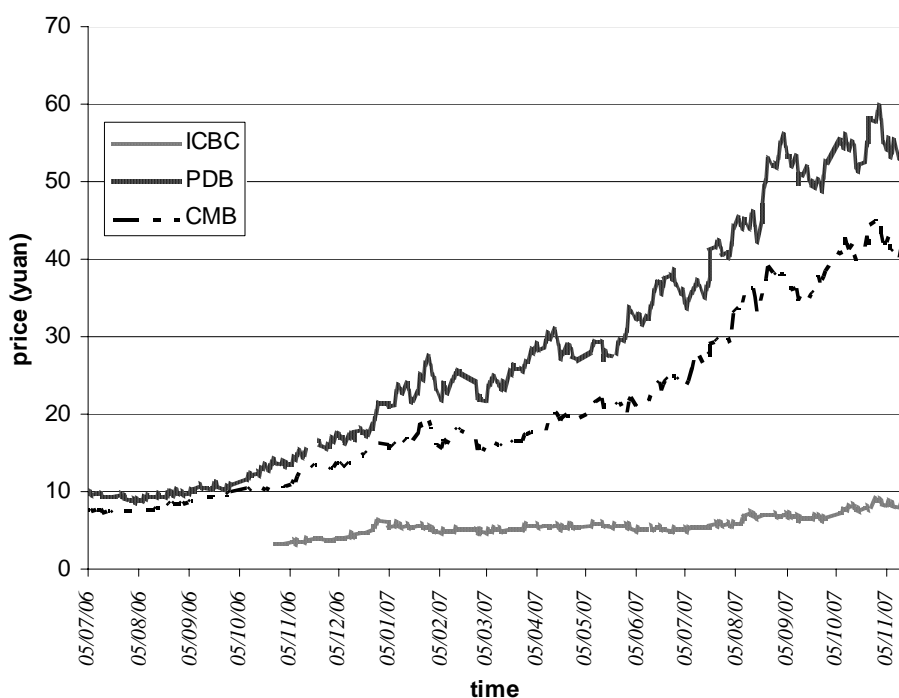
*Notes:* 1. A peculiarity of the Chinese stock market is that the State retains extensive ownership rights through state shares (shares held by the state-owned parent of the listed vehicle) or legal person shares (shares held by other state entities) that can not be traded on the open market.

2. The 2007 data may not be consistent with earlier years as they come from different sources.

Because the computation of SSE Composite Index is weighted according to the total market value of listed stocks, rather than merely the traded fraction, the financial sector stocks dominates the market, especially after the ICBC listing. Its Initial Public Offering (IPO) broke many records and was regarded as the largest IPO in the history of global capital market. By end 2006, the domestic market value of ICBC reached \$250 billion, more than 20 percent of the SSE Composite Index. Aggregated by other nine listed banks, they accounted for about half of the index (Table 2). Besides high

<sup>4</sup> The SSE Composite Index plummeted to less than 3,000 on 11 June 2008 after reaching 6,092 on 15 October 2007. This huge market correction may imply large overvaluation of the stock market in the previous two years. This paper does not cover this period of dramatic downturn in the stock market.

share of market capitalization, their price performance and trading volume were also strong. Figure 1 depicts the share price movements of ICBC, the biggest of the four large state-owned commercial banks and two of the fastest-growing joint-equity banks. For example, the share price of CMB increased from about 15 yuan to more than 40 yuan within a year and the share price of PDB doubled to almost 50 yuan over the same period. Although the share prices of two state-owned banks (BOC and CCB) did not rise as fast as those of the joint-equity banks, they had increased more than two times since their IPO. It is worth noting that on 23 July 2007, ICBC's A share price reached 5.75 yuan, which made it the world's biggest bank by market value of over \$251 billion, overtaking the US's Citigroup. As for trading volumes, banks were among the most traded stocks during 2006-2007 in SSE. For instance, CCB, BOC, CMINB and ICBC with a total traded value of 167 billion yuan are among the top 10 most active shares by transaction value in the A share market, accounting for seven percent of the total market transactions (SSE monthly statistics, 2007).



**Figure 1 Share prices of three representative banks**



**Table2 Importance of 10 listed Banks in the overall stock market (billion shares and billion yuan)**

<i>Banks</i>	<i>ICBC</i>	<i>BOC</i>	<i>CITIC</i>	<i>BoCOM</i>	<i>Market weight</i>	
					<i>Four banks</i>	<i>All banks<sup>1</sup></i>
Shares	2501	178	27	26		
Weight (%)	20.7	14.7	2.2	2.1		
Rank	1	2	4	5	39.7	53.5
Market value	2193	1270	548	436		
Weight (%)	9.8	5.6	2.4	1.9		
Rank	1	5	7	9	19.8	47.3
<b>Banks</b>	<b>CMINB</b>	<b>ICBC</b>	<b>CCB</b>	<b>BOC</b>		
Tradable shares	12	12	6	5		
Weight (%)	3.8	3.8	2	1.7		
Rank	1	2	6	8	12.8 <sup>2</sup>	23.9
<b>Banks</b>	<b>CMB</b>	<b>CMINB</b>	<b>PDB</b>	<b>ICBC</b>		
Tradable value	214	206	192	105		
Weight (%)	3.49	3.35	3.12	1.72		
Rank	3	4	5	8	11.7	27

Source: SSE Monthly Statistic of Oct, 2007, [http://www.sse.com.cn/ps/zhs/yjcb/ybtj/sse\\_stat\\_monthly\\_200710.pdf](http://www.sse.com.cn/ps/zhs/yjcb/ybtj/sse_stat_monthly_200710.pdf).

Note: 1. "All banks" represents the market weight of all top ten banks within each group.

2. CMB, with 4.7 billion tradable shares (1.49%); ranking 10<sup>th</sup> of this group is not listed in the table2.

3. The full names of banks are in Appendix I. Market value was derived from the number of issued shares and the current price per share, while the tradable value is the value of traded-only shared at current prices.

Most of the investors believe that the leading position of banks will continue because of their strengthened balance sheets, enhanced profitability and supportive government policies towards them. For example, with the help of the state, the average NPL/Loans ratio of three state-owned banks had dropped to 2.8 percent till the end of 2007, from over 30 percent in 1999. Table 3 shows the improvements of NPL/Loans ratio of three state-owned banks.

**Table 3 NPL/Loans ratio of three listed state-owned commercial banks (%)**

<i>Year</i>		<i>1999</i>	<i>2000</i>	<i>2001</i>	<i>2002</i>	<i>2003</i>	<i>2004</i>	<i>2005</i>	<i>2006</i>	<i>2007</i>
Name of the Banks (NPL Ratio %)	ICBC	39.5	34.4	29.8	25.7	21.2	19.0	4.5	3.8	2.7
	BOC	37.4	27.2	27.5	22.5	16.3	5.1	9.6	4.0	3.1
	CCB	23.0	15.7	19.4	15.2	9.1	3.9	3.5	3.3	2.6
Average		33.3	25.8	25.6	21.1	15.5	9.3	5.9	3.7	2.8

*Source:* Yao et al. (2008), for 1999-2005; Bankscope: 2006, 2007.

In addition, the new “Tax Unification” policy which starts from 1 January 2008 also gives the Chinese banks more room for profitability improvement. The effective tax rate for domestic banks will be reduced by 13 percent to around 25 percent and the favorable tax rate for the foreign banks is no longer exists.

### **3. Literature Review**

Studies using the Granger causality test (Granger, 1969) have sought to investigate the existence and direction of “causal” relationships among monetary, macroeconomic and financial variables. Using country specific data, one group of studies have focused on the relationship between export promotion and economic growth (Chow, 1987; Hsiao, 1987; Jung and Marshall, 1985; Ahmad and Kwan, 1991, Kwan and Cotomitis, 1990). Some studies have shown a bidirectional feedback relationship, where export promotion and economic growth reinforce each other in the process of economic development (Chow, 1987, Kwan and Cotomitis, 1991). Others have failed, however, to identify any causal links between these two variables (Jung and Marshall, 1985; Hsiao, 1987; Ahmad and Kwan, 1991).

A second group of studies of the relationship between financial development and economic growth has focused the role of the financial sector, specifically the stock market. Stock exchanges are expected to stimulate economic development through

improving liquidity, risk diversification, investment efficiency and the level of savings channeling to enterprises. Again, the empirical analyses are ambiguous. Many time-series studies conclude either unidirectional causality from finance to growth (Bell and Rousseau, 2001; Christopoulos and Tsionas, 2004; Fase and Abma, 2003; Adjasi and Biekpe, 2006) or bivariate causation relationships (Luntel and Khan, 1999; Calderon and Liu, 2003; Demetriades and Hussein, 1996). Some differ. For a sample of African countries, significant positive influence of stock market development on economic growth is only identified for countries classified as upper middle income economies (Adjasi and Biekpe, 2006). The tested causality relationship is therefore highly sensitive to the choice of the sample.

A third group of causality studies have focused on the impact of exchange rate on stock prices. The US data showed a short-run dual causal relationship between the stock prices measured by S&P 500 index and the effective exchange rate of the dollar (Bahmani and Oskooee, 1992) whereas Canada and Ireland studies (Koutoulas and Kryzanowski, 1996; Kearney, 1998) identified a unidirectional causality relationship with stock price significantly influenced by the exchange rate movement. Research results for Asia also lack consensus. Abdalla and Murinde (1997) found exchange rate leads the variation of the stock prices for India, Korea and Pakistan. Granger et al. (2000) concluded this was the case only for South Korea, whereas for the Philippines stock prices triggered exchange rates negatively and for Hong Kong, Malaysia, Singapore, Thailand and Taiwan there was a strong feedback relationship. The predictive power of the test is influenced seemingly by maturity of the stock market.

### ***Causality studies based on China***

Causality tests of the export-led growth (ELG) hypothesis applied to China do not support the common finding of a unidirectional causal link between exports and economic growth. Rather, these studies identify a bi-directional relationship with feedback (Sun, 2001; Lin, 1999). Causality studies of stock market development and

economic growth using Chinese data are also distinctively different. While Wu and Liu (2004) found that development of stock markets triggered economic growth, Liang and Teng (2006) identified an unusual adverse unidirectional causality relationship. Tan (2000) has suggested this reflects the many non-market factors that affect the stock exchange, especially government influence and manipulation that might account for the reported adverse impact.

Recently, dynamic movements of the stock prices and the integration of the Chinese A and B share markets on Shanghai and Shenzhen stock exchanges have also been intensively studied (Laurence et al., 1997, Liu et al., 1997; Su and Fleisher, 1997, Shen et al., 2007). In general, the tested causal direction among the four markets is uncertain but the leading position of B shares is commonly agreed, especially when the Hong Kong stock market is included (Kim and Shin, 2000; Tian and Wan, 2004). It implies that foreign investors could exert significant influence on the markets open only to Chinese residents. Some other studies compare the stock market variations among the US, Japan and the greater China region (Huang et al., 2000, Tian, 2007). The US stock price is found to have stronger impact on the Chinese market than Japan and the equilibrium relationships between A share market and other markets are more stable than that of the B share market.

This study is also interested in identifying factors that trigger the movement of the broader stock markets. However, our perspective is focused on the relationships between the stock prices of a particular industry and the overall stock market index. This is motivated by a belief that a better understanding of the causal relationship between specific stock types can help policy makers and investors better understand the Chinese stock markets and the potential risk of the banking sector in China.

#### **4. Methodology**

The Granger causality test (Granger, 1969) is used to analyse the interdependencies

among the stock market index and banking stock prices based on a vector autoregression (VAR) model. Specifically, if a variable X “Granger-causes” another variable Y, then the past values of X should contain information that helps predict Y above and beyond the information contained in past values of Y alone. A general specification of the Granger causality test in a bivariate context can be expressed as equations (1) and (2).

$$\ln Index_t = \alpha_0 + \sum_{i=1}^p \alpha_i (\ln index)_{t-i} + \sum_{j=1}^q \phi_j (\ln stock)_{t-j} + \mu_{1t} \quad (1)$$

$$\ln stock_t = \beta_0 + \sum_{i=1}^p \beta_i (\ln index)_{t-i} + \sum_{j=1}^q \delta_j (\ln stock)_{t-j} + \mu_{2t} \quad (2)$$

The  $\ln index$  and  $\ln stock$  is the natural logarithm of the SSE Composite Index and bank stock prices. They can be interpreted as the growth rate of the SSE index and stock prices.  $\mu_{1t}$  and  $\mu_{2t}$  are white noises.  $\alpha_0$  and  $\beta_0$  represent the constant growth rates of  $\ln stock$  in equation (1) and  $\ln index$  in equation (2).

Three hypotheses will be made:  $H_{01}$ : stock price growth does not Granger-cause stock index growth;  $H_{02}$ : stock index growth does not Granger-cause stock price growth; and  $H_{03}$ : stock price growth does not Granger-cause stock index growth and vice versa, which means that there is no bilateral/feedback causation.

These hypotheses are tested using the restricted F-test as shown in equation (3) where  $m$  is the number of lagged terms,  $K$  is the number of parameters,  $RSS_R$  is residual sum of squares of restricted models and  $RSS_{UR}$  is residual sum of squares of unrestricted models.

$$F = [(RSS_R - RSS_{UR}) / m] / [RSS_{UR} / (n - k)] \quad (3)$$

As the result is sensitive to the number of lagged terms<sup>5</sup>, the Akaike (AIC), Schwarz

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<sup>5</sup> Including too many lagged terms will consume the degrees of freedom and risk introducing

(SIC) information values and the Sims likelihood-ratio test will be used to decide the appropriate lag length of the model. The lower the values of Akaike and Schwarz statistics the better is the model.

In summary, if the F-value exceeds the critical F-value at the chosen level of significance, the null hypothesis can be rejected, in which case the lagged stock price growth belongs to the regression in equation (1). This would imply that the growth rate of stock price Granger-causes or improves the prediction of the growth rate of stock index. From the F-tests four possible causal relationships between the  $\ln$ index and  $\ln$ stock can be formulated:

(1) The stock price growth “Granger-causes” stock index growth (reject  $H_{01}$  but not  $H_{02}$  and  $H_{03}$ ;  $\phi_j \neq 0$  and  $\beta_i = 0$ ).

(2) The stock index growth “Granger-causes” stock price movements (reject  $H_{02}$  but not  $H_{01}$  and  $H_{03}$ ;  $\phi_j = 0$  and  $\beta_i \neq 0$ ).

(3) A feedback relationship exists between stock price growth and stock index growth (reject  $H_{03}$ ,  $\phi_j \neq 0$  and  $\beta_i \neq 0$ ).

(4) Stock price growth and stock index growth are independent ( $H_{03}$  cannot be rejected,  $\beta_i = 0$  and  $\phi_j = 0$ ).

## 5. Data and Results

Data comprise the daily prices of the eight listed bank stocks and the SSE Composite Index from the Shanghai Stock exchange for the period 1 June 2006 to 15 November

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multicollinearity; including too few lags will lead to specification errors.

2007. The stock price for SDB was obtained from the Shenzhen Stock Exchange. Both CCB's A and H share prices were obtained from the company's website. The "CSI 300 Financial Index"<sup>6</sup> which launched in July 2007, was included in the model to test the integrated influence of the financial sector stocks to the overall index. All the eight listed banking stocks in SSE<sup>7</sup> have been included, with an augmented weight of almost 50 percent of the "CSI 300 Financial index". Therefore, it is quite reasonable to believe that the tested relationships between "CSI 300 Financial Index" and SSE Index could be used to deduct the overall influence of banking stocks with certain level of creditability.

Data after 15 November 2007 are excluded because the stock of PetroChina Company Limited was incorporated into the SSE Composite Index since then. It replaced ICBC as the highest weighted stock in SSE and strongly manipulated the index movement.

### ***Unit root test***

The test of the causality relationship first requires a unit root test to examine whether the series of log-transformed stock prices and indices are stationary. This study applied Augmented Dickey Fuller (ADF) test and reported the results in Table4. The lag order follows the Akaike and Schwarz information criteria. Results of the test statistic show that all these log-transformed time series are nonstationary and integrated of order 1, I(1).

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<sup>6</sup> "CSI 300 Financial Index" is composed of 38 stocks (from 2 July 2007 to 10 July 2007) of the financial sector institutions, such as banks, insurance companies and real estate firms. It is part of the "CSI 300 Index" series. "CSI 300 Index", which represents capitalization-weighted stock market index, is designed to replica the performance of 300 most representative A-share stocks traded in Shanghai and Shenzhen Stock Exchanges.

<sup>7</sup> Stocks of SDB and CCB are not included. CCB was only listed in Hong Kong Stock Exchange by 10 July 2007.

**Table 4 ADF test results—level and first-difference**

<u><i>Banks Name</i></u>	<u><i>ADF statistic (level)</i></u>	<u><i>Lag length</i></u>	<u><i>Critical value (5%)</i></u>	<u><i>ADF statistic (D1)</i></u>	<u><i>Lag length</i></u>	<u><i>Critical value (5%)</i></u>
<u>BOC</u>	-0.3465	0	-2.8701	-18.7908***	0	-1.9418
<u>CCB(A)</u>	-2.2614	0	-2.9571	-4.7789***	0	-1.9521
<u>CCB(H)</u>	-0.8714	0	-2.8940	-4.3698***	4	-1.9453
<u>ICBC</u>	-1.7284	0	-2.8729	-11.7503***	1	-1.9421
<u>BOCOM</u>	-1.0546	3	-2.8867	-5.8567***	2	-1.9436
<u>CITIC</u>	-2.1922	3	-2.8843	-6.6327***	3	-1.9434
<u>CMB</u>	0.9867	2	-2.8668	-18.0087***	1	-1.9414
<u>CMINB</u>	-0.6894	1	-2.8667	-25.6564***	0	-1.9414
<u>HXB</u>	1.6505	11	-2.8688	3.5093***	11	-1.9416
<u>PDB</u>	-0.1140	7	-2.8675	-8.8437***	6	-1.9614
<u>SDB</u>	0.0953	4	-2.8673	-17.6725***	2	-1.9415
<u>INDEX</u>	-0.4041	0	-2.8700	-19.3334***	0	-1.9418
<u>F300</u>	-2.6172	3	-2.8936	-4.4434***	2	-1.9444

Note: \*\*\* means that it is significant at 1%, \*\* at 5% and \* at 10% level.

### *Granger-causality and co-integration analysis*

After the integration order of the series had been tested, we investigate the co-movements among stock index and bank stock prices using Sims' VAR model (Sims, 1980). Generated from the univariate Autoregressive (AR) model, VAR is specialized in capturing the evolution and the interdependencies between multiple time series. With our sample, a VAR (1) with two variables model could be illustrated as the following system of equations (4) and (5) where  $C_1$  and  $C_2$  are constants,  $\beta, \alpha$  are the parameters, and  $\varepsilon$  is the error term.

$$\ln stock = C_1 + \beta_1 \ln stock_{t-1} + \beta_2 \ln index_{t-1} + \varepsilon_{1,t} \quad (4)$$

$$\ln index = C_2 + \alpha_1 \ln index_{t-1} + \alpha_2 \ln stock_{t-1} + \varepsilon_{2,t} \quad (5)$$

Result of the VAR model helps us decide the appropriate lag length adopted in the following Granger causality test. As past studies have shown that 15 lag is sufficient to capture one stock price's response to the variation of the market index (Fun and



Shim, 1989; Janakiramanan and Lamba, 1998), our study starts from estimating a VAR model with 15-day maximum lags and followed by lag-length sensitivity test. The lag term used in the final causality model is determined by the Sims likelihood-ratio. Table 5 reports the Chi-statistics, which can be interpreted the same as the F-values, and the lag length of the Granger causality test.

The variation of SSE Composite Index triggers almost all banking stock price movements, which indicates that the increase of SSE Composite Index potentially implies the market's expectations of higher bank stock prices the next day, even including Hong Kong-listed CCB (H) share prices. Therefore, at least, a uni-directional relationship between SSE Index and particular bank stock prices exists. However, this predictive power of the index has also been argued resulting from the immaturity of the Chinese financial market. Lack of professional investment knowledge makes the Chinese investors buy shares randomly regardless of the performance of the company. As a result, not only the banking sector stocks, virtually all the share prices have been highly manipulated by the market index.

Results from the other direction, bank stock price variations leading to the changes of SSE Index has also been found widely spread. Eight out of eleven banks' share prices could stimulate the movements of the SSE stock index and four of them are significant at 1% level. These banks are either having a large market capitalization, like ICBC, CCB (A) or with outstanding share performance, such as CMB, CMINB and PDB. Shenzhen listed SDB share price is also found to exert strong impact on SSE Index and it has been explained as the signaling effect. As the first foreign controlled Chinese commercial bank, its performance directly influences other banks confidence on such foreign participation strategy and therefore triggers the share price variation of the whole financial sector. Consequently, the SSE Index moves accordingly. In addition, CCB H-share which listed on Hong Kong Stock Exchange has strong forecasting power as well. Information advantage makes the Hong Kong market reflect rapidly to the transformation of the worldwide economy and transmit to

the mainland China afterwards. Finally, the bi-directional relationship, it has been identified for only five bank stocks, including CCB (A), CCB (H), CITIC, CMINB and CMB. F300 index can not predict the movements of SSE overall index even though some components of these two indices are the same. The financial sector stocks are extremely sensitive to the overall stock market sentiment. However, they have not gathered enough power to lead the whole market. Some other sectors, such as energy, real estate might be more important.

**Table 5 Results of Granger-causality analysis**

	<i>H<sub>0</sub>: LnStock does not Granger cause LnIndex</i>			<i>H<sub>0</sub>: LnIndex does not Granger cause LnStock</i>			<i><u>Conclusion</u></i>
	<u>Chi2</u> <u>Statistics</u>	<u>Lag</u> <u>length</u>	<u>Results</u>	<u>Chi2</u> <u>Statistics</u>	<u>Lag</u> <u>length</u>	<u>Results</u>	
<u>BOC</u>	6.7222	10	<u>lnboc - lnindex</u>	18.6040**	10	<u>lnindex ⇒ lnboc</u>	<u>lnindex ⇒ lnBOC</u>
<u>CCB (A)</u>	133.7300***	9	<u>lnccbba ⇒ lnindex</u>	482.3300***	9	<u>lnindex ⇒ lnccbba</u>	<u>lnindex ⇔ lnCCBa</u>
<u>CCB(H)</u>	127.1300***	15	<u>lnccbha ⇒ lnindex</u>	29.1360**	15	<u>lnindex ⇒ lnccbha</u>	<u>lnindex ⇔ lnCCBh</u>
<u>ICBC</u>	21.3060*	14	<u>lnicbc ⇒ lnindex</u>	15.8330	14	<u>lnindex - lnicbc</u>	<u>lnindex ⇐ lnICBC</u>
<u>BOCOM</u>	1.6945	1	<u>lnbocom - lnindex</u>	0.2240	1	<u>lnindex - lnbocom</u>	<u>lnindex - lnBOCOM</u>
<u>CITIC</u>	22.2710**	12	<u>lnctic ⇒ lnindex</u>	30.7310***	12	<u>lnindex ⇒ lnctic</u>	<u>lnindex ⇔ lnCITIC</u>
<u>CMINB</u>	6.7340*	3	<u>lncminb ⇒ lnindex</u>	6.5680*	3	<u>lnindex ⇒ lncminb</u>	<u>lnindex ⇔ lnCMINB</u>
<u>CMB</u>	32.4850***	15	<u>lncmb ⇒ lnindex</u>	31.7840***	15	<u>lnindex ⇒ lncmb</u>	<u>lnindex ⇔ lnCMB</u>
<u>HXB</u>	14.1050	15	<u>lnhxb - lnindex</u>	23.0010*	15	<u>lnindex ⇒ lnhxb</u>	<u>lnindex ⇒ lnHXB</u>
<u>PDB</u>	5.3346*	2	<u>lnpdb ⇒ lnindex</u>	3.5473	2	<u>lnindex - lnpdb</u>	<u>lnindex ⇐ lnPDB</u>
<u>SDB</u>	32.4840*	4	<u>lnsdb ⇒ lnindex</u>	0.6123	4	<u>lnindex - lnsdb</u>	<u>lnindex ⇐ lnSDB</u>
<u>F300</u>	13.4600	14	<u>lnf300 - lnindex</u>	22.2520*	14	<u>lnindex ⇒ f300</u>	<u>lnindex ⇒ F300</u>

**Note:** \*\*\* means that it is significant at 1%, \*\* at 5% and \* at 10% level. In the first and last columns, capital letters represent names of individual banks which are listed in Appendix I, A and H denote respectively A- and H-shares. “-” means there is no causality relationship between the banks and the index.

### ***Long-run equilibrium: co-integration analysis***

After testing that all the time series were I (1), a co-integration test was conducted to identify the long-run relationship between these series. According to Engle and Granger (1987), two or more series are non-stationary and their linear combination is stationary, these series are said to be co-integrated. In this study, both of the Engle-Granger two-step method and the Johansen procedure (1990) will be used to estimate such long-run equilibrium relationship(s).

The Enger-Granger approach is based on the theory that any equilibrium relationship among a set of nonstationary variables implies that their stochastic trends must be linked (Surya and Neupane, 2006). Therefore, if the residual  $\hat{\varepsilon}_t$  of individually I (1) series is stationary, then these time series are co-integrated. The estimated equation is (6) where  $\hat{\varepsilon}_t$  represents the residual.

$$\Delta \hat{\varepsilon}_t = \gamma \hat{\varepsilon}_{t-1} + \sum_{i=1}^p \alpha_i \Delta \hat{\varepsilon}_{t-i} + \mu_t \quad (6)$$

The null hypothesis is  $H_0: \gamma=0$  and if it cannot be rejected, the two time series are non-cointegrating. The AEG test is quite similar to the original ADF tests except it use a different set of critical significance values, -2.5899 (1%), -1.9493 (5%) and -1.6177 (10%).

The second method, Johansen co-integration test is more widely used recently. Based on VAR, this procedure is more suitable for multivariable co-integration estimation and it overcomes the limitation of the first step OLS estimation in the AEG test. The Johansen co-integration test written in a vector error-correction (VECM) form is shown as equation (7) below.

$$\Delta y_t = \Pi y_{t-k} + \Gamma_1 \Delta y_{t-1} + \Gamma_2 \Delta y_{t-2} + \cdots + \Gamma_{k-1} \Delta y_{t-(k-1)} + \varepsilon_t \quad (7)$$

$$\text{where } \Pi = \left( \sum_{i=1}^k \beta_i \right) - I_g \text{ and } \Gamma_i = \left( \sum_{j=1}^i \beta_j \right) - I_g$$

This VAR contains  $g$   $I(1)$  variables ( $g \geq 2$ ) in first differenced form on the left hand side of the equation and  $k-1$  lags of the dependent variables with a  $\Gamma$  coefficient matrix attached on the other side. The Johansen test focuses on examining the  $\Pi$  matrix, which can be interpreted as the long-run coefficient matrix. The test for co-integration calculates the rank of the  $\Pi$  matrix via its eigenvalues to decide whether the restrictions implied by the rank of  $\Pi$  can be rejected.

The Johansen approach estimates two test statistics,  $\lambda_{trace}$  and  $\lambda_{max}$ . The  $\lambda_{trace}$  is a joint test, where the null hypothesis assumes that the number of co-integrating vectors is less than or equal to  $r$ . The rejection of  $H_0$  means that the number is more than  $r$ . The latter  $\lambda_{max}$  tests each eigenvalue against the null that the number of co-integrating vectors is  $r$  against an alternative of  $r+1$  (Johansen, 1990). The outcomes of the AEG, Johansen co-integration and the VECM tests are reported in Table 6 and Table 7.

**Table 6 Co-integration tests results: AEG tests of residuals**

<u>Name of the banks</u>	<u>Test Statistic</u>	<u>Conclusion</u>
<u>BOC</u>	<u>-2.607<sup>***</sup></u>	<u>I (0)</u>
<u>CCB (A)</u>	<u>-2.926<sup>***</sup></u>	<u>I (0)</u>
<u>CCB (H)</u>	<u>-1.620<sup>*</sup></u>	<u>I (0)</u>
<u>ICBC</u>	<u>-2.115<sup>**</sup></u>	<u>I (0)</u>
<u>BOCOM</u>	<u>-1.787<sup>*</sup></u>	<u>I (0)</u>
<u>CITIC</u>	<u>-2.936<sup>***</sup></u>	<u>I (0)</u>
<u>CMB</u>	<u>-3.055<sup>***</sup></u>	<u>I (0)</u>
<u>CMINB</u>	<u>-1.717<sup>*</sup></u>	<u>I (0)</u>
<u>HXB</u>	<u>-0.633</u>	<u>I (1)</u>
<u>PDB</u>	<u>-1.941<sup>*</sup></u>	<u>I (0)</u>
<u>SDB</u>	<u>-3.738<sup>***</sup></u>	<u>I (0)</u>
<u>F300</u>	<u>-2.785<sup>***</sup></u>	<u>I (0)</u>

**Note:** \*\*\* means that it is significant at 1%, \*\* at 5% and \* at 10% level.

**Table 7 Co-integration tests results: Johansen co-integration test and ECM**

<u><i>Banks</i></u>	<u><i>No. of CE(s)</i></u>	<u><math>\lambda_{trace}</math> Statistic</u>			<u><math>\lambda_{max}</math> Statistic</u>			<u>Error Correction</u>	
		<u><i>Eigenvalue</i></u>	<u><i>Statistic</i></u>	<u><i>5% Sig</i></u>	<u><i>Eigenvalue</i></u>	<u><i>Statistic</i></u>	<u><i>5% Sig</i></u>	$\Delta y_t$	<u><i>CointEq1</i></u>
<u>BOC</u>	None **	<u>0.0386</u>	<u>13.197</u>	<u>12.321</u>	<u>0.0386</u>	<u>12.869</u>	<u>11.225</u>	<u>D(lnindex)</u>	<u>0.0012***</u>
	At most 1	<u>0.0010</u>	<u>0.3264</u>	<u>4.1299</u>	<u>0.0010</u>	<u>0.3264</u>	<u>4.1299</u>	<u>D(lnboc)</u>	<u>0.0005***</u>
<u>CCB(A)</u>	None **	<u>0.4846</u>	<u>16.672</u>	<u>12.321</u>	<u>0.4846</u>	<u>16.573</u>	<u>11.225</u>	<u>D(lnindex)</u>	<u>0.02265*</u>
	At most 1	<u>0.0039</u>	<u>0.0989</u>	<u>4.1299</u>	<u>0.0039</u>	<u>0.0989</u>	<u>4.1299</u>	<u>D(lnccb)</u>	<u>0.10157**</u>
<u>CCB(H)</u>	None **	<u>0.1575</u>	<u>14.287</u>	<u>12.321</u>	<u>0.1575</u>	<u>14.223</u>	<u>11.225</u>	<u>D(lnindex)</u>	<u>0.01309***</u>
	At most 1	<u>0.0008</u>	<u>0.0632</u>	<u>4.1299</u>	<u>0.0008</u>	<u>0.0632</u>	<u>4.1299</u>	<u>D(lnccb)</u>	<u>0.00750***</u>
<u>ICBC</u>	None **	<u>0.0477</u>	<u>13.215</u>	<u>12.321</u>	<u>0.0477</u>	<u>11.874</u>	<u>11.225</u>	<u>D(lnindex)</u>	<u>0.00455***</u>
	At most 1	<u>0.0055</u>	<u>1.3414</u>	<u>4.1299</u>	<u>0.0055</u>	<u>1.3414</u>	<u>4.1299</u>	<u>D(lnicbc)</u>	<u>0.00479***</u>
<u>CITIC</u>	None **	<u>0.1302</u>	<u>18.290</u>	<u>12.321</u>	<u>0.1302</u>	<u>17.435</u>	<u>11.225</u>	<u>D(lnindex)</u>	<u>0.00953***</u>
	At most 1	<u>0.0068</u>	<u>0.8555</u>	<u>4.1299</u>	<u>0.0068</u>	<u>0.8555</u>	<u>4.1299</u>	<u>D(lncitic)</u>	<u>0.03321***</u>
<u>CMB</u>	None **	<u>0.0316</u>	<u>17.077</u>	<u>12.321</u>	<u>0.0316</u>	<u>17.077</u>	<u>11.225</u>	<u>D(lnindex)</u>	<u>-0.00014***</u>
	At most 1	<u>0.0000</u>	<u>0.0000</u>	<u>4.1299</u>	<u>0.0000</u>	<u>0.0000</u>	<u>4.1299</u>	<u>D(lncmb)</u>	<u>-0.00017***</u>
<u>CMINB</u>	None **	<u>0.0240</u>	<u>13.039</u>	<u>12.321</u>	<u>0.0240</u>	<u>12.440</u>	<u>11.225</u>	<u>D(lnindex)</u>	<u>0.00046***</u>
	At most 1	<u>0.0012</u>	<u>0.5994</u>	<u>4.1299</u>	<u>0.0012</u>	<u>0.5994</u>	<u>4.1299</u>	<u>D(lncminb)</u>	<u>0.00062***</u>
<u>HXB</u>	None **	<u>0.0332</u>	<u>13.082</u>	<u>12.321</u>	<u>0.0332</u>	<u>12.679</u>	<u>11.225</u>	<u>D(lnindex)</u>	<u>-0.00027***</u>
	At most 1	<u>0.0011</u>	<u>0.4024</u>	<u>4.1299</u>	<u>0.0011</u>	<u>0.4023</u>	<u>4.1299</u>	<u>D(lnhxb)</u>	<u>-0.00057***</u>
<u>PDB</u>	None **	<u>0.0279</u>	<u>15.293</u>	<u>12.321</u>	<u>0.0279</u>	<u>14.678</u>	<u>11.225</u>	<u>D(lnindex)</u>	<u>0.00019***</u>
	At most 1	<u>0.0012</u>	<u>0.6154</u>	<u>4.1299</u>	<u>0.0012</u>	<u>0.6154</u>	<u>4.1299</u>	<u>D(lnpdb)</u>	<u>0.00028***</u>
<u>SDB</u>	None **	<u>0.0311</u>	<u>15.638</u>	<u>12.321</u>	<u>0.0311</u>	<u>15.270</u>	<u>11.225</u>	<u>D(lnindex)</u>	<u>0.00025***</u>
	At most 1	<u>0.0008</u>	<u>0.3683</u>	<u>4.1299</u>	<u>0.0008</u>	<u>0.3683</u>	<u>4.1299</u>	<u>D(lnsdb)</u>	<u>0.00022***</u>

**Note:** \*\*\* means that it is significant at 1%, \*\* at 5% and \* at 10% level. Test statistics of F300 and BOCOM are not displayed as they have no co-integrating vectors.

Results of AEG and Johansen's procedures are roughly the same. A Long term stable relationship had been identified between majority bank stock prices and SSE Index movements. HXB stock had been claimed as having no co-integration relationship by AEG while COBOM and F300 were excluded by the second method. The last two columns list the results of VECM test for the co-integrated time series. CointEq1 represents the coefficient of the error correction mechanism and most of them are significant at 1% level. Therefore, although bank stock prices may deviate from the stock index temporarily, in the long run, there is a stable equilibrium relationship existing between them.

## **6. Conclusions and Discussions**

Our study aims to better understand the Chinese bull market in 2006 and 2007 through a study focused on the relationship between the SSE Composite Index and 10 listed bank stocks. Our central research question was whether the listing of these banks had played a role in leading the Chinese stock market. We applied the Granger causality test and found that a uni-directional causality relationship existed either way between most bank stock prices and the market index while the bi-directional relationship only identified among five of the ten banks.

We also found the SSE index influenced the HK-listed CCB (H-shares), which is consistent with previous studies that stock markets in China are integrated or it might simply reflect psychological factors among Chinese investors. Limited information disclosure of Chinese listed companies, lack of professional financial knowledge accompanied by sentimental euphoria associated with Beijing's 2008 Olympic Games, not only the banking stock prices, virtually, all the share prices were copying the movements of the market index.

Despite the positive effect of the market index on individual share prices, stocks of ICBC, CCB(A), CCB(H), CMB, CMINB, and SDB were found to exert strong impact

on SSE Index as well. The predictive power of the Shenzhen listed SDB might result from the signaling effect. Its performance shows the validity of such foreign participation strategy adopted by many Chinese commercial banks and therefore influences the share price variation of the whole financial sector and consequently, the overall index.

In the following co-integration test, both AEG and Johansen's methods concluded a long-run stable relationship between almost all banking stock prices and the SSE Composite Index. In the short run, bank stock prices may deviate from the market index, however, error correction mechanisms would drive them back to the equilibrium in the long term.

These empirical results provide important insights into the Chinese bull stock market of 2006-2007 despite the limitations arising from available data for some bank stocks and technical constraints in the Grainger method. Stock listing enables the Chinese government to off-load its burden of the formerly trouble-ridden banks to a certain extent as the price of almost all the bank stocks rose with the market. The market crash from November 2007 to the first four months in 2008 implies that the state's success in offloading this burden has to be shouldered by innocent small investors who entered the market at the near peak of the market. More research is desperately needed to follow the dramatic development of the Chinese stock market, especially the future performance of the listed banks.



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**Appendix I Names and abbreviations of listed commercial banks in China**

Abbreviations	Full Name of the Banks
BOC	Bank of China Limited
CCB	China Construction Bank Corporation
ICBC	Industrial & Commercial Bank of China
BOCOM	Bank of Communications Co. Ltd
CITIC	China CITIC Bank
CMB	China Merchant Bank
CMINB	China Minsheng Banking Corporation
HXB	Hua Xia Bank
PDB	Shanghai Pudong Development Bank
SDB	Shenzhen Development Bank Co., Ltd