An Empirical Study on the Relationship between Stock Index and the National Economy: The Case of China

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Should the national economy lead the stock market or the other way round? Using co-integration test and Granger causality test, this paper analyzes the relationship between the stock index and the national economy in the case of China. The result of the empirical analysis indicates that there is no co-integration relationship between the stock index and the national economy in China. In addition, there is no Granger causal relationship between stock index yield and the national economy growth rate. With the empirical result, the thesis concludes with a discussion of the possible reasons of the seemingly abnormal relationship between the stock index and the national economy in China.

I. Introduction

Since Shanghai Securities Exchange and Shenzhen Securities Exchange established in 1992, China's stock market has made great progresses in terms of total market value, current market value and stock trading volume. By March 2006, the total market value, current market value and stock trading volume of Shanghai Securities Exchange have reached RMB 2482.154 billion, RMB732.100 billion and RMB14.447 billion, respectively[3]. Meanwhile, the corresponding figures of Shenzhen Securities

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[3] Data sources: Shanghai Securities Exchange website: http://www.sse.com.cn/sseportal/ps/zhs/home.shtml, 2/24/2006.

Exchange have reached RMB1029.691 billion, RMB448.256 billion and RMB6.482 billion, respectively[4]. China's stock market has been playing an ever important role for economic growth since its establishment. However, Shanghai Securities Exchange Composite Index (henceforth SHSECI) and Shenzhen Securities Exchange Composite Index (henceforth SZSECI) have been moving in the opposite direction of the national economy since June 2001. SHSECI and SZSECI were 2218 and 658 in June 2001. However, in January 2006, they dropped to 1258 and 307, respectively[5]. Meanwhile, China's macro-economy had been growing rapidly in the same period. From 2001 to 2005, China's GDP growth rate were 8.3%, 9.1%, 10.0%, 10.1% and 9.9%[6] respectively.

The growth of total economic volume induces more capital running into stock market for good fortune. With the support of the capital invested in stock market, it is reasonable for investors to believe that the stock index will rise continually. However, the stock market did not go along the way as expected. The stock index has not followed the movement of the national economy. Especially, the stock index was moving in the opposite direction of the national economy in recent years. What's the real relationship between China's stock market index and the macroeconomic development behind the phenomenon?

Using co-integration test and Granger causality test, this paper analyzes the relationship between the China's stock index and the performance of Chinese national economy. The paper will review some studies that scholars have done in Section II. Section III describes the methodology, variables and data. Section IV presents empirical results. Finally, conclusions and interpretation of the results will be given in Section V.

II.Literature Review

[4] Data sources: Shenzhen Securities Exchange website: http://www.sse.com.cn/sseportal/ps/zhs/home.shtml, 2/24/2006.
[5] Data sources: China Economic Information Network: www.cedb.cei.gov.cn, 2/25/2006.
[6] Data sources: The bulletin of National Bureau of Statistics of China: www.stats.gov.cn, 2/25/2006.

Some scholars have been researching on the relationship between stock market and economic development. However, because of the different approaches employed in their studies, the results they got are usually different from each other significantly.

Based on the data of 24 countries over the period 1976-1993, Levine and Zervos (1996) found that stock market development was strong positively correlated with economic growth. In 1998, Levine and Zervos expanded their sample data to 49 countries over the period 1976-1993. They found that stock market liquidity and future economic growth rate, capital accumulating rate and output growth rate were positively correlated with each other. Beck and Levine (2004) used new panel econometric techniques[7] to analyze the data of 40 countries in the period 1976-1998. The result demonstrated that there existed strong positive relationship between stock market development and economic growth.

Using the data of 70 countries over the period 1985-1997, Randall Filer (2000) found that there was little relationship between stock market activity and future economic growth, especially for the lower income countries and stock market activity did cause currency appreciation. The results of the research suggest that, while a developed equity market may play several important roles in a modern economy, none of these appear to be essential for economic growth.

Using Greenwood-Jovanovic model and Mankiw-Romer-Weil model, Atje and Jovanovic (1993) found that stock market development had both growth effects and level effects. In contrast to Atje and Jovanovic, Richard Harris (1997) brought forward a different opinion. Based on the data of 49 countries over the period 1980-1991, using the method of Two-Stage Least Squares (2SLS), Harris found that stock market was much weaker than they assumed. Harris further divided the sample into developed countries and less developed countries and concluded that for the less developed countries, the stock market effect, as with the full sample, was at best very weak. For developed countries, the level of stock market activity did have some impact, but its

[7] Beck and Levine used Generalize Method of Moments (GMM) econometric technique.

statistical significance was weak.

Other scholars also did some research on the relationship between stock market and economic growth. Using American monthly, quarterly and yearly data over the period 1953-1987 respectively, Fama (1981, 1990, and 1991) found that there was significant positive relationship between stock yield and future output growth rate. According to Poon and Taylor's research in 1991, there was no significant relationship between British stock market price and economic growth. Leigh (1997) found that Singapore stock market could indeed predict the future directions of the economy but it did not run in the reverse direction. Gjerde and Saettem (1999) found that stock market price positively correlated with economic growth. Chung S. Kwon and Tai S. Shin (1999) tested the relationship among Korean stock market index, output index, exchange rate, trade balance and money supply with Error Correction Model (ECM). The results they got indicated that there was co-integration relationship between stock index and macroeconomic variables, but the stock index was not leading variable of economic fluctuation.

At the same time, many scholars in China also did a lot of research on the same subject. Tan Rongru (1999) pointed out that the economic growth effect of China's stock market was quite limited. Zheng Jianghuai, Yuan Guoliang and Hu Zhiqian (2000) believed that the stock market development was significantly positive correlated with savings, which indicated that stock market did stimulate economic growth. Shi Jianmin (2001) introduced general equilibrium in his study on the relationship between real economy and stock market. The results he got showed that stock market did promote economic growth but the effect was very limited. Ran Maosheng and Zhang Weiguo (2002) argued that the expansion of China's stock market had weak effect on economic growth. However, the relationship between stock market liquidity and economic growth was insignificant. The size of stock market was not strongly related to economic growth. Li Guowang, Tong Wei and Zhou Kan (2003) indicated economic growth had significant effect on the movement of stock price index. At the same time, because the movement of stock price index affected the market financing directly and then influenced households' marginal consumption tendency through "wealth effect[8]," stock index also affected economic growth but the significant was not as strong as economic growth.

In describing real economic activities, variables such as stock prices are showing characteristics of time series. If regressions are performed with these variables directly, it is easy to fall in the trap of "pseudo-regression". This paper differs from other papers in this field along several dimensions. Particularly, this article tests the relationship between stock index and economic growth by employing co-integration test to avoid possible misleading regressions.

III.The Methodologies, Variables and Data

1. The Methodologies

(1) Series Stationary Test

To examine whether two time series are co-integrated with each other, we have to test the stationarity of the series. In this regard, unit root test is usually used to confirm the stationarity of a sequence. This paper uses Augmented Dickey-Fuller (ADF) approach to examine whether a sequence is stationary or not. Suppose $\{ y_t \}$ is an $AR(p)$ process, the testing equation is following:

$$\nabla y_t = \gamma y_{t-1} + \xi_1 \nabla y_{t-1} + \xi_2 \nabla y_{t-2} + \cdots + \xi_{p-1} \nabla y_{t-p+1} + \varepsilon_t ,$$

where p is the lag length of the process. The value of p can be determined by Akaike

[8] In the principles of economics, the tendency for rising stock prices to persuade consumers to increase amounts for the purchase of durable and nondurable items. This propensity is caused by greater cash availability from stock market profits and more borrowing, often using the rising stock prices as collateral. The effect can be positive when stock prices are rising, and negative when they are falling.

info criterion (AIC) or Schwarz criterion (SC)[9].

The hypothesis is

$H_0 : \gamma = 0$

$H_1 : \gamma < 0$.

If H_0 is accepted, then the sequence has unit root, which indicates it is nonstationary. On the other hand, if H_0 is rejected, then the sequence doesn't have unit root, which means it is stationary. If the two time sequences are all integrated of order one, $I(1)$, we can perform co-integration test with them.

(2) Co-integration Test

Suppose $\{x_t\}$ and $\{y_t\}$ are integrated with order one. To examine whether $\{x_t\}$ and $\{y_t\}$ are co-integrated or not, Engle and Granger (1987) proposed a method of residual-based test for co-integration (Engle-Granger method). First of all, we can get $y_t = \alpha + \beta x_t + \varepsilon_t$ by regressing y_t with x_t. Secondly, we denote $\hat{\alpha}$ and $\hat{\beta}$ as the estimated regression coefficients vectors. Then, $\hat{\varepsilon} = y_t - \hat{\alpha} - \hat{\beta} x_t$ represents for the estimated residual vector. If $\hat{\varepsilon}$ is integrated with order zero ($\hat{\varepsilon}$ is stationary), then $\{x_t\}$ and $\{y_t\}$ are co-integrated. In this contest, $(1, \ -\hat{\beta})$ is called the co-integrating vector and $y_t = \alpha + \beta x_t + \varepsilon_t$ is called the co-integrating equation, which stands for a long-run equilibrium relationship between $\{x_t\}$ and $\{y_t\}$.

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9 $AIC = -\frac{2L}{n} + \frac{2k}{n}$ and $SC = -\frac{2L}{n} + \frac{k \ln n}{n}$, let L be the value of the log of the likelihood function with the k parameters estimated using T observations. The various information criteria are all based on -2 times the average log likelihood function, adjusted by a penalty function.

Let us suppose that time sequences { y_1 } and { y_2 } are stationary. The Granger (1969) approach to the question of whether y_1 causes y_2 is to check how much of the current y_2 can be explained by past values of y_2 and then to see whether adding lagged values of y_1 can improve the explanation. y_2 is said to be Granger-caused by y_1 if y_1 helps in the prediction of y_2. In other words, if the coefficients on the lagged y_1's are statistically significant, y_2 is said to be Granger-caused by y_1.

Granger causality test runs on the basis of bivariate regressions of the form:

$$y_{1t} = c_1 + \sum_{i=1}^{p} \alpha_i y_{1t-i} + \sum_{j=1}^{q} \beta_j y_{2t-j} + \varepsilon_{1t} \text{..............................Unrestricted Equation } (1)$$

$$y_{1t} = c_1 + \sum_{i=1}^{p} \alpha_i y_{1t-i} + \upsilon_{1t} \text{..Restricted Equation } (2)$$

Equation (1) and (2) can be obtained by Ordinary Least Squares (OLS). The F-statistics are the Wald statistics for the joint hypothesis: $\beta_j = 0 \ (j = 1, 2, 3 \cdots q)$ for each equation. The null hypothesis is that y_2 does not Granger-cause y_1 in the first regression and that y_2 does not Granger-cause y_1 in the second regression. The formula of F statistics is

$$F = \frac{(RSS_0 - RSS_1)/q}{RSS_1/(T - 2q - 1)},$$

where $RSS_0 = \sum_{t=1}^{T} \hat{\varepsilon}_t^2$ is the sum-of-squared residuals of equation (1) and $RSS_1 = \sum_{t=1}^{T} \hat{\upsilon}_t^2$ is the sum-of-squared residuals of equation (2). T is the sample size and q is the lag length. At 5% level, if the value of F statistics $\hat{F}$ is greater than critical value of $F(q, T-2q-1)$, H_0 is rejected, i.e. y_2 Granger-cause y_1, and vice versa.

2. Variables

This paper uses Chinese gross domestic product (GDP) as the variable of macro-economic performance and SHSECI and SZSECI as the representatives of Chinese stock prices.

Table 1 the Symbol of Variables

Symbols	Variables
LGDP	GDP in logarithmic form
LSHSECI	SHSECI in logarithmic form
LSZSECI	SZSECI in logarithmic form
DLGDP	Fist difference of LGDP
DLSHSECI	Fist difference of LSHSECI
DLSZSECI	Fist difference of LSZSECI

Note: Fist difference of stock index corresponds to stock monthly yield. DLGDP corresponds to GDP monthly yield. GDP monthly yield is different with GDP growth rate. However, when GDP growth rate is very small, GDP monthly yield approximately equals to GDP growth rate.

3. Data

Since Shanghai Securities Exchange and Shenzhen Securities Exchange have been established only for more than ten years, the sample size of the stock prices is very limited. We choos monthly data of SHSECI, SZSECI and GDP as sample data. The testing period is from1995 to 2005 and the number of the observations from the sample is 132 in total. The data is coming from China Economic Information Network[10]. Because only quarterly or yearly GDP data are available, this paper uses monthly value-added of industry as the weight and quarterly GDP is adjusted to monthly data.

[10] Website of China Economic Information Network: http://cedb.cei.gov.cn.

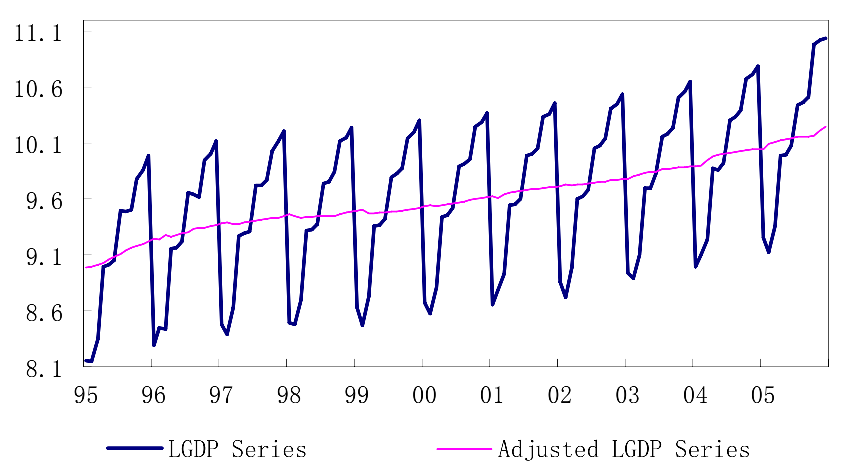
For the software processing the planned regressions, this paper uses Eviews 5.0 to perform the calculations.

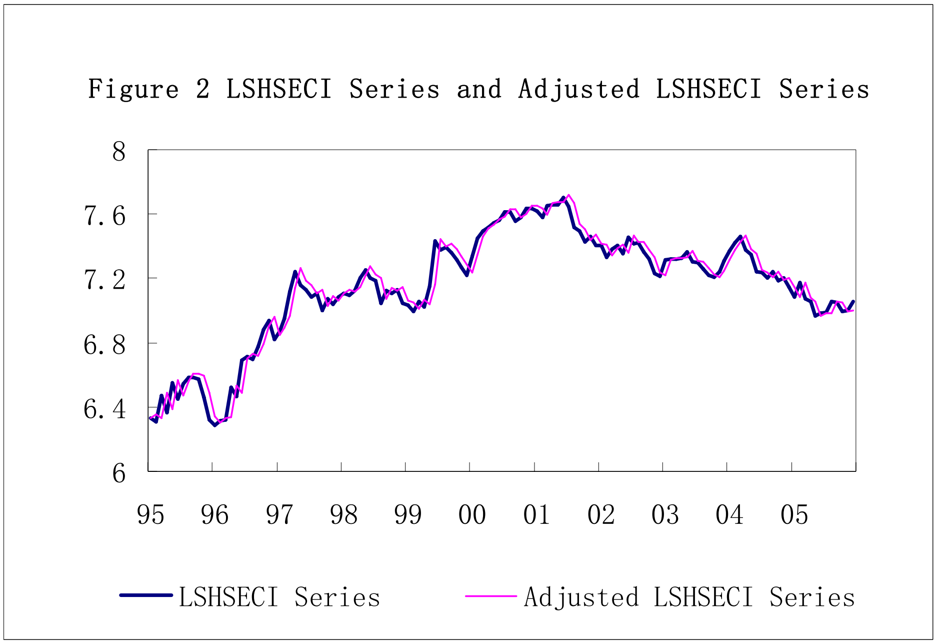
IV. Empirical Analysis

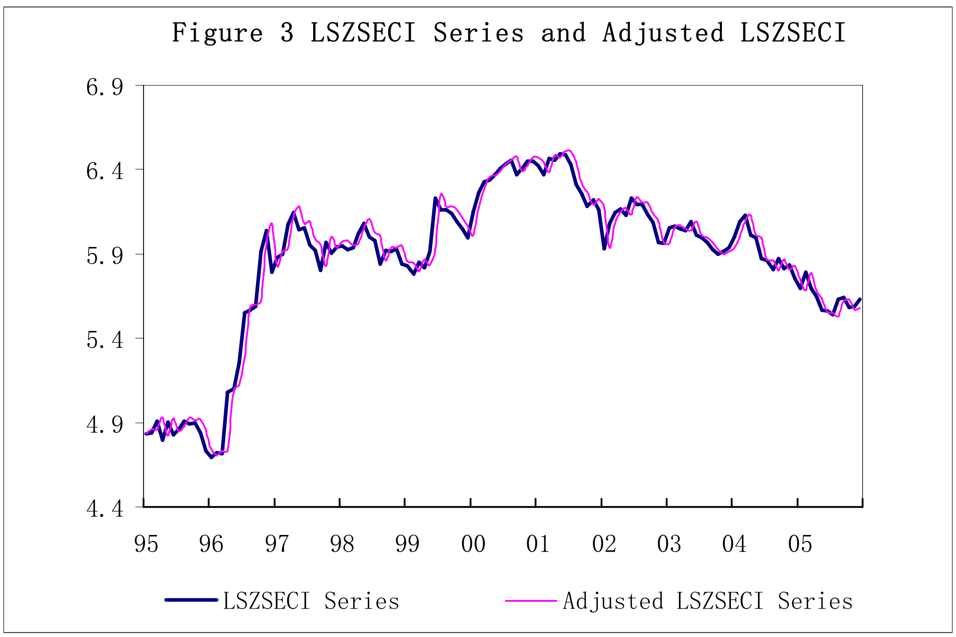
1. Data Adjustment

Because time series observed monthly often exhibit cyclical movements that recur every month, we have to eliminate seasonal effect on the time sequences. We use X11 method to adjust GDP series seasonally and then use Holt-Winter-No-Seasonal method to smooth the series. SHSECI series and SZSECI series are also smoothed by the same method. The following figures show the GDP series, SHSECI series and SZSECI series before and after the adjustment.

Figure 1 LGDP Series and Adjusted LGDP Series







2. Unit Root Test

After seasonal adjustment, exponential smooth and logarithmic transformation of a series, we perform unit root test to examine the stationarity of the series. The following table exhibits the results of unit root test on series LGDP, LSHSECI and LSZSECI.

Table 2: Unit Root Test of Series LGDP, LSHSECI and LSZSECI

Series	ADF	Test Critical Values		
		1% level	5% level	10% level
LGDP	-1.094478	-4.029595	-3.444487	-3.147063
LSHSESI	-2.317086	-3.480818	-2.883579	-2.578601
LSZSESI	-2.177130	-3.480818	-2.883579	-2.578601

As shown in Table 2, the ADF statistic values of series LGDP、LSHSECI and LSZSECI are -1.094478, -2.317086 and -2.177130, respectively. Please note that the ADF statistic values are much greater than test critical values at 1% level, 5% level and 10% level. Therefore, we do not reject the null hypothesis. The result from the test indicates that series LGDP, LSHSECI and LSZSECI are nonstationary.

To examine whether series LGDP、LSHSECI and LSZSECI are integrated of order one, *I(1)*, the paper performs unit root test on series DLGDP, DLSHSECI and DLSZSECI. The test results are shown in Table 3.

Table 3: Unit Root Test of Series DLGDP, DLSHSECI and DLSZSECI

Series	ADF	Test Critical Values		
		1% level	5% level	10% level
DLGDP	-3.390006	-2.583011	-1.943324	-1.615075
DLSHSESI	-11.22806	-2.582872	-1.943304	-1.615087
DLSZSESI	-10.95946	-2.582872	-1.943304	-1.615087

As Table 3 shows, the ADF statistic values of series DLGDP、DLSHSECI and DLSZSECI are -3.390006, -11.22806 and -10.95946, respectively. They are much smaller than test critical values of series DLGDP、DLSHSECI and DLSZSECI at 1% level, 5% level and 10% level. Therefore, the null hypothesis is rejected, which indicates that series DLGDP, DLSHSECI and DLSZSECI are stationary.

From the previous tests, it can be concluded that LGDP, LSHSECI and LSZSECI are integrated of order one, $I(1)$.

3. Co-integration Test

Since the two series are integrated of order one, the paper examines whether they are integrated by applying Engle-Granger Method. The paper estimates co-integrating vector by OLS and then examines whether the residual vectors are stationary or not. Let us define E_1 as the residual series of co-integrating regression of LGDP and LSHSECI and E_2 as the residual series of co-integrating regression of LGDP and LSZSECI. The results of unit root test of series E_1 and E_2 are shown in Table 4.

Table 4: Unit Root Test of E_1 and E_2

Series	ADF	Test Critical Values		
		1% level	5% level	10% level
E_1	-0.191331	-4.029595	-3.444487	-3.147063
E_2	-0.030443	-4.029595	-3.444487	-3.147063

As shown in Table 4, the ADF statistic values of series E_1 and E_2 are -0.191331 and -0.030443, respectively. These ADF statistic values are so much greater than test critical values of series E_1 and E_2. Therefore, we do not reject the null hypothesis, which implies that E_1 and E_2 are nonstationary. As a result, LGDP and LSHSECI are not co-integrated with each other. Furthermore, LGDP and LSZSECI are also not co-integrated with each other. Based on the principle of econometrics, the co-integration test between GDP and SHSECI indicate that there is no long-run equilibrium relationship between GDP and SHSECI. In addition, there is also no long-run equilibrium relationship between GDP and SZSECI.

4. Granger Causality Test

We carry out Granger causality tests on series DLGDP, DLSHSEC and series DLGDP, DLSZSEC with lag length 3. The results are shown in Table 5.

Table 5: Result of Granger Causality Test

Null Hypothesis	F-Statistic	Probability
DLGDP does not Granger causing DLSHSECI	0.47252	0.39543
DLSHSECI does not Granger causing DLGDP	0.80179	0.40430
DLGDP does not Granger causing DLSZSECI	0.99994	0.70199
DLSZSECI does not Granger causing DLGDP	0.98072	0.49521

According to Table 5, to reject the null hypothesis that GDP does not Granger cause SHSECI, the probability of making error type 1 is 39.543%. It indicates that the probability that GDP does not Granger causing SHSECI is too great to reject the null hypothesis. The probability that SHSECI does not Granger causing GDP is also too great to reject the null hypothesis. Therefore, there is no Granger causality relationship between GDP growth rate and SHSECI yield. There is also no causality relationship between GDP growth rate and SZSECI yield.

V. Conclusion and Discussion

According to the results of empirical study, we conclude that both Shanghai Securities Exchange Composite Index and Shenzhen Securities Exchange Composite Index are not co-integrated with Chinese GDP. Meanwhile, there is no Granger causality relationship between stock index yield and GDP growth rate. Furthermore, the results indicate that there is no long-run equilibrium relationship between GDP and stock index in China.

There could be many possible reasons to explain the seemingly abnormal relationship between Chinese stock index and the national economy. The following facts come up to our mind when we try to figure out the findings we have just obtained. First of all, the composition of Chinese GDP is inconsistent with the structure of its stock market. In recent years, private sector played an important role in contributing to the GDP growth in China. For instance, the domestic private economy accounted for 49.7% of the GDP in the year 2005. However, as for private sector's financing, 90.5% of the capital depended on self-financing, 4% was supported by bank loan, and even less financing could be acquired from stock market. Most of the listed companies in China are state owned enterprises (SOEs). The purpose for listing of SOEs is just getting out of distress for these enterprises. Stock market performance of the listed companies in China can hardly reflect their real economic competency. Therefore, the stock indexes do not show the actual situation of the macro economy.

Secondly, the finance structure disequilibrium also accounts for the phenomenon we have observed. As we can see from the well-developed market economy countries' experiential data, finance provide by bank and by stock market accounted for almost the same amount. However, most of Chinese financing is supported by commercial bank loans. For example, the capital raised from the stock market was RMB151.094 billions in 2004, which made the total volume of bank loan to be RMB26,672.087 billions. However, the total capital raised from stock market accounted for only 0.57% of the volume of bank loan in the same period. In China, commercial banks financing relied to a significant extent on the Big Four state-owned commercial banks—Bank of China, Industrial & Commercial Bank of China, China Construction Bank, and Agricultural Bank of China. Hence, the credit of the commercial banks is to same extent supported by the government. This indicates that Chinese banking industry is not self sufficient. The dominant commercial banking industry weakened the role played by the stock market and leaves the financial risks undiversified. Hence, the unbalanced financial structure could explain at least partly why Chinese finance market is not playing an important role in the development of the national economy.

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