Does Co-integration and Causal Relationship Exist between the Non-stationary Variables for Chinese Bank's Profitability? An Empirical Evidence

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ABSTRACT

This study aims to give the analysis of the determinants of banks' profitability in the Kingdom of China over the period 2003-2007. This paper investigates the co-integration and causal relationship between total assets (TA) and total equity (TE) of Chinese banks. The analysis employs Augmented Dickey Fuller (ADF) test, Johansen's co integration test, Granger causality test. Analyzing the co integration and other tests on Chinese banking sector over the study period, the relationships between the two variables are examined. The empirical results have found strong evidence that the variables are co-integrated.

JEL Classifications: G15, G21

Keywords: banking; bank profitability; total assets; total equity; co-integration

I. INTRODUCTION

In the last two decades economists have developed a number of tools to examine whether economic variables trend together in ways predicted by theory, most notably co-integration tests. Co-integration methods have been very popular tools in applied economic work since their introduction about twenty years ago. However, the strict unit-root assumption that these methods typically rely upon is often not easy to justify on economic or theoretical grounds. The multivariate testing procedure of Johansen (1988, 1991) has become a popular method of testing for co integration of the I(1)/I(0) variety, where I(1) and I(0) stand for integration of orders one and zero, respectively. In the Johansen methodology, series are pre-tested for unit roots; series that appear to have unit roots are put into a vector auto regression from which one can test for the existence of one or more I(0) linear combinations.

Utilizing the co integration and error correction models on all Chinese's banks over the study period, various potential internal and external determinants are examined to identify the most important determinants of profitability. Co-integration methodology has been extensively used as a convenient way of testing for the weak-form of asset market efficiency, which states that no asset price should be predictable from the prices of other assets The Johansen (1988) method of testing for the existence of co-integrating relationships has become standard in the econometrics literature.

Since unit-root tests have very limited power to distinguish between a unit-root and a close alternative, the pure unit-root assumption is typically based on convenience rather than on strong theoretical or empirical facts. This has led many economists and econometricians to believe near-integrated processes. Near-integrated and integrated time series have implications for estimation and inference that are similar in many respects. Co-integration, however, simply requires that co-integrating linear combinations have lower orders of integration than their parent series Granger (1986). Granger and Joyeux (1980) and Hosking (1981), where continuous orders of integration from the real line are considered, the case where there exists an I(d−b) linear combination of two or more I(d) series has become known as fractional co-integration

The co-integration approach is one of the recent methodologies employed to identify the determinants of profitability in banking. It enables the estimation of a relationship among non-stationary variables by revealing the long-run equilibrium relationship among the variables. This paper will help to determine the most important factors of profitability in Chinese banks, and is supposed to help banks' stakeholders especially the managers and regulatory authorities to improve the sector soundness by boosting the impact of positive factors and lessening the impact of the negative factors.

A good econometric practice is to always include tests on the co-integrating vectors to establish whether relevant restrictions are rejected or not. If such restrictions are not tested, a non-zero co-integrating rank might mistakenly be taken as evidence in favor of co-integration between variables. This is particularly relevant when there are strong prior opinions regarding which variables "have to" be in the co-integrating relationship. Unit root tests are performed on unvaried time series in order to test the order or integration. If individual time series are found to be integrated of same order after the unit root tests, then these variables may be co-integrated. Co-integration deals

with relationships among the group of variables where each has a unit root. Application of co-integration test in the estimation of money demand were analyzed by Johansen and Juselius (1990) and Dickey, Thansen and Thornton (1991).

The purpose of this paper is to investigate the effect of deviations from the unit-root assumption on the determination of the co-integrating rank of the system using Johansen's (1988, 1991) maximum Eigen value and trace tests. The paper will contribute towards the existing literature by interrogating the determinants of profitability of Chinese bank's using a co-integration approach. First we test for the stationary roots using augmented Dickey-Fuller test, then the Johansen's unit root test and granger causality test are applied to these variables.

The paper is divided into five sections. Section II describes about the previous existing literatures, Section III describes an overview of Chinese banking system, Section TV will give a complete description about the methodologies of the various tests performed in this paper, and Section V contains the empirical results, finally Section VI concludes with a short summary.

II.   LITERATURE REVIEW

Despite an extensive literature on savings behavior, there are not many studies, which focused primarily on the factors that determine the level of deposits made by various categories of depositors at the commercial banks. These studies, however, concentrated mainly on private and household savings and not on the business and government sectors. Lambert and Hoselitz (1963) were among the first researchers to compile the works of others on savings behavior. They extended the works of researchers who studied the savings behavior of households in Sri Lanka, Hong Kong, Malaysia, India, Philippines. Snyder (1974) and Browning and Lusardi (1996) also presented a similar study which reviewed micro theories and econometric models.

Masood, Akhtan & Chaudhary (2009) studied the co-integration and causal relationship between Return on Equity and Return on Assets of Saudi Arabia, they found that there are stable long run relationships between the two variables. They also argued that unidirectional causality from ROE to ROA implies that sustainable development strategies with higher levels of ROE may be feasible and fast economic growth of Saudi Arabia may be achievable. Loayza et al. (2000b) listed papers and publications of the saving research project of a particular country and gave general reference in this area. Thereafter, lots of work has been done on this area Cárdenas and Escobar (1998), Rosenzweig (2001), Kiiza and Pedreson (2001), Athukorala and Kunal Sen (2003), Dadzie et al. (2003), Ozcan, et al. (2003), Athukorala and Tsai (2003), Qin (2003) and Hondroyiannis (2004) have studied the savings behavior of a particular country. A large empirical literature was developed on the cross country comparison, which was contributed by Doshi (1994), Masson et al. (1998), Loayza et al. (2000a), Agrawal (2001), Anoruo (2001), Sarantis and Stewart (2001), Cohn and Kolluri (2003), Ruza and Montero (2003).

The first works on cointegration methods were first studied by, Wallace and Warner (1993), Malley and Moutos (1996) that cointegration-based tests of foreign exchange market efficiency, Cardoso (1998), Bremnes et al. (2001), Jonsson (2001), Khamis and Leone (2001) and Bagchi et al. (2004). Studies arguing the stationary of these variables include Song and Wu (1997, 1998), Taylor and Sarno (1998), Wu and

Chen (2001) and Basher and Westerlund (2006). Sephton and Larsen (1991) showed that inference based on Johansen cointegration tests of foreign exchange market efficiency suffers from structural instability. Cheung and Lai (1993) argued that significant finite-sample bias in the performance of the Johansen test statistics when asymptotic critical values are used for inference in finite samples.

As unit-root tests have very limited power to distinguish between a unit-root and a close alternative, the pure unit-root assumption is typically based on convenience rather than on strong theoretical or empirical facts Stock (1991), Cavanagh et al. (1995) and Elliott (1998) argued that near-integrated processes, which explicitly allow for a small deviation from the pure unit-root assumption, to be a more appropriate way to describe many economic time series. Phillips (1988) concluded that spurious regressions are a problem when variables are near-integrated as well as integrated and presented an analytical discussion Elliott (1998) shows that large size distortions can occur when performing inference on the co-integration vector in a system where the individual variables follow near-unit-root processes rather than pure unit-root processes.

The bank's profitability is generally classified into two broad categories i.e. internal and external. The internals factors are in the control and framework of the bank for instance number or employees, investments, etc., whereas the external factors are out of control and framework of the bank for instance, market share, competition, inflation etc.

Lots of literature has already been developed interrogates the profitability of banks of the particular country in question. Hester and Zoellner (1966) argued that the balance sheet structure has a significant impact on profitability. Smirlock (1985) found a significant positive relationship between demand deposits and profits. Lambert and Hoselitz (1963) were among the first researchers to compile the works of others on savings behavior. Heggested (1977) interrogated the profitability of commercial banks and reports that time and savings deposits have negative impact on profitability. Steiner and Huveneers (1994) found similar association while studying overhead expenditure. Bourke (1989), and Molyneux and Thorton (1992) found that capital and staff expenses are positively related to bank's profitability.

Mullineaux (1978) found a positive impact for bank's size on profitability. Studies of Pelzman (1968), Vernon (1971), Emery (1971), Mullineaux (1978) and Smirlock (1985) concluded that regulation have a significant impact on banks' profitability. Emery (1971) examined the effect of competition on banks' profitability and found insignificant association between the two variables. Smirlock (1985) further examined the effect of concentration on profitability and the findings of these studies were mixed and inconclusive. Demirgüç-Kunt and Huizinga (1998) concluded that that the well-capitalized banks have higher net interest margins and are more profitable.

Keynes (1936), despite arguing the quantitative importance of the interest rate effect, believes that in the long run substantial changes in the rate of interest could modify social habits considerably, including the subjective propensity to save. The importance of the rate of interest on consumption, many researchers using various methodologies tried to establish the strength of relationship between these two elements. Wright (1967), Taylor (1971), Darby (1972), Heien (1972), Juster and Watchel (1972), Blinder (1975), and Juster and Taylor (1975) in their studies found an inverse relationship between interest rate and consumption. Modigliani (1977) based on his works and after seeing evidence on the effect of interest rate on consumption concludes

that the rate of interest effects on demand, including the consumption component, are pervasive and substantial.

Alrashdan (2002) found that the return on asset (ROA) is positively related to liquidity and total assets while ROA is negatively related to financial leverage and cost of interest. Naceur (2003) examined the determinants of Tunisian banks' profitability over the period 1980-2000, and found that the capital ratio, loans and stock market development have positive impact on profitability while the bank's size has a negative impact. Hassan and Bashir (2003) stressed the importance of customer and short-term funding, non-interest earning assets, and overhead in promoting profits. They also argued that profitability measures respond positively to increases in capital ratio and negatively to loan ratios. Liu and Hung (2006) examined the relationship between service quality and long-term profitability of Taiwan's banks and found a positive link between branch number and long-term profitability and also proved that average salaries are detrimental to banks' profit.

III.   AN OVERVIEW OF CHINESE BANKING SYSTEM

More than 85% of financial resources in China are allocated through the banking system hence the economic reforms of China are dominated by Chinese commercial banks. The measurement of profitability and competitive conditions of banking system depicts the economic growth of China. Since 1978, the Chinese economy has experienced an impressive annual growth rate of about 10 percent. China's financial assets have grown at the annual rate of about 18 percent, or more than twice the growth rate of GDP.

Since the People's Republic of China was founded in 1949, the People's Bank of China (PBOC) has been the only bank in Mainland China until 1978. During this period, the PBOC played a dual role in China's financial system: as a central bank and as a commercial bank. Upon nationalization of private banks in the 1949, bank management in China essentially followed the approach of centrally-planned economy.

During the period of 1953-1978, four of the Chinese banks had operated intermittently as separate units as four Chinese banks had operated intermittently as separate units or as a single entity. During the period 1978-1984, People's Bank of China (PBC), Agriculture Bank of China (ABC), Bank of China (BOC), and Construction Bank of China (CBC). During the period 1978-1984, the PBC retained the central banking activities, while four other banks—ABC, BOC, CBC, and ICBC, were carved out from the PBC to provide specialized services. The modern Chinese banking system comprises of four state-owned commercial banks, as well as several joint-stock commercial banks, city commercial banks, rural credit cooperatives, finance companies, and trust and investment companies, foreign banks have been allowed to be an integral part of the banking system

As the economy started shifting toward market-orientation, profitability and liquidity—if any—of state-owned enterprises suffered due to their inability to adapt to the challenges imposed. State-owned banks have been hampered by non-paying or delinquent loans to other state-owned enterprises. Both the state-owned and private banks had to extend credit to the inefficient, monopolist, state-owned enterprises or public projects.

In 1994, three policy banks, China Development Bank (CDB), Agricultural Development Bank of China (ADBC), and the Export-Import Bank of China (China

Eximbank), were established. They undertook most part of policy loans business from the four national specialty banks. Meanwhile, the four national specialty banks became state-owned commercial banks. In 2003, China Banking Regulatory Commission (CBRC) was established to take over most supervisory function of PBOC, becoming a main regulator of China's banking industry. By the end of 2007, there were 3 policy banks, 5 large state-owned commercial banks, 12 joint-stock commercial banks, 124 city commercial banks, and 29 locally incorporated foreign bank subsidiaries as well as other banking institutions.

Chinese authorities have adopted more flexible approach in seeking help from foreign banks in rescuing weak banks. Foreign banks, when they are well-capitalized and have an access to external markets, are less likely to turn off the credit when monetary authorities pursue tight monetary policies. Foreign banks' presence also provided needed competition to domestic banks unburdened of non-performing loans. Competitive pressure in turn provided incentives to local banks to improve management practices.

According to Commercial Banking Law of the People's Republic of China which began to be in effect on July 1st of 1995, one of the prerequisites to establish commercial banks is "Having directors and senior management personnel with professional knowledge for holding the post and work experiences". In June 2002, the People's Bank of China promulgated Guidance on Independent Directors and External Supervisors of Joint-Stock Commercial Banks, which aims to establish and enhance the arrangement of independent directors.

For the Chinese banking, most crucial issues is to convert the four state-owned commercial banks, with 70 percent of the nation's financial assets and loans, into share-holding companies. During system-wide crisis, state-owned banks often become safe havens because the public perceives that their funds will be fully guaranteed by the state. Chinese banks have suffered from bad loans and high operating costs for a long time. A sound banking industry is essential for development of efficient financial markets, in turn, efficient markets are crucial for ensuring effectiveness of the market-oriented economy. Excessive bad debts reflecting inefficient bank management are thus antithetical to the goal of market orientation for the Chinese economy.

They were underperforming their counterparts in other countries. In recent years, Chinese government has carried out a series of reforms aiming at making banks more market driven, more profitable, and well managed. One important reform among these is to establish a board of directors system in existing banks to improve corporate governance. In this context, how effective the role of board of directors have played in the profitability of Chinese banks is up to close examination.

IV.   METHODOLOGY

The estimation of the long run relationship between the variables, time series properties of the individual variables are examined by conducting Augmented Dickey Fuller (ADF) stationary tests, then the short run dynamic and long run co-integration relationship are investigated by using the multivariate Johansen's co-integration test and Granger Causality test

A.   Unit Root Tests

The Augmented Dickey-Fuller (ADF) unit root test method put forward by American scholars Dickey and Fuller is widely used in the academia to examine the stationary property of the time series and determine the integration order of non-stationary time series. Unit root tests are first conducted to establish the stationary properties of the time series data sets. Stationary entails long run mean reversion and determining a series with stationary property avoids spurious regression relations. It occurs when series having unit roots are regressed into one another.

The presence of non-stationary variables might lead to spurious regressions and nonobjective policy implications. Augmented Dickey Fuller (ADF) tests are used for this purpose in conjunction with the critical values, which allows for calculation of critical values for any number of regressors and sample size. The ADF model used in the study is as follows:

$$\Delta \ln Y = \alpha + T + \omega \ln Y_{t-1} + \sum_{i=1}^{p} \delta\, \Delta \ln Y_{t-1} + \varepsilon \qquad (1)$$

Here Y: variable used for unit root test, α is the constant, T represents the trend, $\omega = p-1$ and ε is the white noise series. The null hypothesis is H_O: $\omega = 0$. If the ADF value of the lnY is bigger than the McKinnon value at 5% significant level, the null hypothesis is accepted, which means lnY has unit root and is non-stationary. If it is less than the McKinnon value then the H_0 is rejected and lnY is stationary. As for the non-stationary series, we should test the stationary of its 1st difference. If the 1st difference is stationary, the series has unit root and it is first order integration I (1).

B.   Johansen's Co-integration Test

According to the co-integration theory, there may be co-integration relationship between the variables involved if they are 1 order integration series, i.e. their 1st difference is stationary. There are two methods to examine this co-integration relationship, one is EG two-step procedure, put forward by Engle and Granger in 1987, the other is Johansen co-integration test (Johansen(1988) and Juselius1990) based on Vector Auto Regression (VAR).

For co-integration test, we will conduct the Johansen's multivariate co-integration tests. The Johansen's multivariate co-integration test involved testing the relationships between the variables following vector auto-regression (VAR) model:

$$\Delta \ln Y = \sum_{i=1}^{p} \Gamma_i\, \Delta \ln Y_{t-1} + \Pi\, \ln Y_{t-1} + BX_t + \varepsilon \qquad (2)$$

where $\Gamma_i = -\sum_{j=i+1}^{p} A_j$ and $\Pi = \sum_{i=1}^{p} A_i - I_m$. Y_t represents n*1 vector of I (1) variables. Γ and Π are n*n matrix of coefficients to be tested. B denoted n*h matrix and X_t denoted h*1 vector of I(0) variables. Π denoted the rank of the matrix and interrogates the long-run

relationships in the variable and is equal to the number of independent co-integrating vectors. If rank of Π is 0, the variables in are not co-integrated.

Johansen developed two test statistics: the trace test and the maximum eigen value test. λ_{trace} statistic tests the null hypothesis that r= 0 (no co-integration) against a general alternative hypothesis of r>0 (co-integration). The K_{max} statistic tests the null hypothesis that the number of co-integrating vectors is r against the specific alternative of r+1 co-integrating vectors. The test statistics obtained from λ_{trace} and K_{max} tests are compared against the asymptotic critical values of the two test statistics by Johansen and Juselius.

C.   Granger Causality Test

The pair wise Granger causality tests are used to examine whether the past value of a series X_t, will help to predict the value of another series at present Y_t taking into account the past value of the previous value of Y_t. The two series are first tested for stationary using the ADF unit root test, followed by the Johansen co integration test before performing the Granger causality test. If the time series of a variable is stationary or I(0) from the ADF test, or if the time series are found to be I(1) and co integrated. The Granger causality test is as follows:

$$X_i = \sum_{i=1}^{n} \alpha_{x,i} X_{t-i} + \sum_{i=1}^{n} \beta_{x,i} Y_{t-i} + \mu_{x,t} \qquad (3)$$

$$Y = \sum_{i=1}^{n} \alpha_{y,i} Y_{t-i} + \sum_{i=1}^{n} \beta_{y,i} Y_{t-i} + \mu_{y,t} \qquad (4)$$

where X_t is the log of the first variable at time t, and Y_t is the log of the second variable at time t. $\mu_{x,t}$ and $\mu_{y,t}$ are the white noise error terms at time t. $\alpha_{x,i}$ is the parameter of the past value of X, which tells us how much past value of X explains the current value of X and $\beta_{x,i}$ the parameter of the past value of Y, which tells us how much past value of Y explains the current value of X. Similar meanings apply to $\alpha_{y,i}$ and $\beta_{y,i}$.

C.   Data

The data used in this paper was collected from 16 most significant banks of China, which includes banks like Agriculture Bank of China, Agricultural Development bank of China, China Development Bank, China Merchant bank, Bank of Communication, Indrustrial and Commercial bank of China, China Everbright bank, China Construction Bank, Bank of China, Hua Xia Bank, Export-Import bank of China, Shen Zhen Ping An, Shen Zhen Development Bank, Xia Men International bank, Min Sheng, Shangai Pudong Development bank. The dataset was developed by collecting the information from these banks.

The pooled data was made by combining the datasets from all the banks, and the regression analysis was performed on this pooled data to obtain the results which are mentioned in the next section. The mean square and double accounting techniques were also used on the dataset, wherever required.

V.   EMPIRICAL ANALYSIS

A.   Unit Root Test

We test for the presence of unit roots and identify the order of integration for each variable using the Augmented Dickey–Fuller (ADF). The null hypothesis is considered as non-stationary. The test on the variable total assets gave the following result.

The computed ADF test-statistic (1.331162) is greater than the critical values (-8.033476, -4.541245, -3.380555 at 1%, 5% and 10% significant level, respectively), thus we can conclude that the variable total assets has a unit root i.e. it is a non-stationary series.

Table-1
ADF test statistics
Null Hypothesis: total assets has a unit root
Exogenous: Constant, Linear Trend. Lag Length: 1 (Fixed)

	t-statistic		Prob[*]
Augmented Dickey Fuller Test Statistic		1.331162	0.9773
Test critical values	1% level	-8.033476	
	5% level	-4.541245	
	10% level	-3.380555	

*MacKinnon (1996) or Augmented Dickey-Fuller Test Equation Dependent Variable: D(total assets). Method: Least Squares.

Augmented Dickey fuller test equation
Dependent variable - D(total assets)
Method – Least Squares

Variable	Coefficient	Standard error	t-statistic	Prob.
Total assets	0.523410	0.393198	1.331162	0.4102
R-squared	0.639249	Mean dependent variable	1.29E + 08	
Adjusted R-squared	0.278497	S.D. dependent variable	615510168	
S.E. of regression	52281516	Akaike info Criterion	38.61691	
Sum squared resid.	2.73E + 15	Schwarz Criterion	38. 01598	
Log likelihood	-55.92536	Hannan Quinn Criterion	37.40897	
F-statistic	1.771993	Dublin Watson stat	2.997813	
Prob (F-statistic)	0.410164			

In order to eliminate the heteroskedasticity of total assets and total equity as, we take their natural logarithm and define them as LnTA and LnTE. Similarly, ADF tests were conducted on total equity and the logged variables of total assets and total equity differentiated by their order of integration are reported in Table 2.

Table2

Results of ADF unit root test

Variable	ADF-statistic	Critical value	AIC	SC (5%)	Result
Total assets	1.331162	-4.541245	38.61691	38.01598	non- stationary
Total equity	-0.831217	-4.542245	32.61347	32.01255	non- stationary
LnTA	0.646288	3.850555	-2.03242	-2.63335	stationary
LnTE	0.599704	3.380555	9.10595	8.50487	stationary

The lag is added to make the residual be white noise, AIC is Akaike Info.Criterion and SC is the Schwarz Criterion.

As shown in Table 2, for the variables of total assets and total equity, the results shows that it is evident that we found the presence of a unit root at conventional levels of statistical significance for the variables of total assets and total equity. To see whether they are integrated of order one I(1) at the 1% level, we performed augmented Dickey–Fuller tests on their first difference. The results of the unit root test show that the first differences of both series are stationary which are found to reject the null hypothesis of unit root. Therefore we can conclude that all series involved in the estimation procedure are regarded as I(1), and it is suitable to make co integration test.

B.   Johansen's Co-integration Test

As proved by previous test the variables under analysis are integrated of order 1 (namely I(1)), hence now the co-integration test is performed. The proper way to test for the relationship between total assets and total equity is certainly to test for a co-integrating equation. In testing co-integration relationships, we use the Johansen and Juselius method of testing. For selecting optimal lag length for the co-integration test, we adopt the Schwartz Information Criterion (SIC) and Schwarz criterion (SC) Criterion. The co-integration tests results performed on the variables gave the following result.

Table 3

Cointegration rank test Series: total_assets___total_equity
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of	Eigen values	Trace statistic	0.05 critical value	Prob[*]CE(s)
None[**]	0.87456	44.57638	12.64738	0.0010
At most 1[**]	0.59829	8.746002	4.983491	0.0194

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
** denotes rejection of the hypothesis at the 0.05 level
* MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of	Eigen values	Trace statistic	0.05 critical value	Prob[*]CE(s)
None[**]	0.874563	38.98723	11.56473	0.0010
At most 1[**]	0.598298	8.746002	4.983491	0.0194

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
** denotes rejection of the hypothesis at the 0.05 level
* MacKinnon-Haug-Michelis (1999) p-values

Therefore, by applying Johansen test on total assets and total equity series we found the presence of two co-integration vectors. Hence our findings imply that there is a stable relationship between the two variables i.e. total assets and total equity. The results for the Johansen's test are concluded in Table 4.

Table4

Results of Johansen's cointegration test

Eigen-value	t-statistic	Critical value	Prob.	Null-hypothesis (0.05)
0.874563	44.57638	12.64738	0.0010	r =0
0.598298	8.746002	4.983491	0.0194	r ≤1

Trace test indicates 2 co-integrating eqn(s) at the 0.05 level.

C.   Granger Causality Test

Granger causality test demands that the economic variables should be stationary series. So we need to examine the stationary property of the 1st difference. Hence we test variables LnTA and LnTE so as to observe the causality between total assets and total equity. As the sample of observation for this test is small, we take the lag to be 1. The results of Granger Causality test are shown in table 5.

Table 5

Pairwise granger Causality test

Null Hypothesis	F-statistic	Prob.
LN_TA does not granger cause LN_TE	3.91826	0.1632
LN_TE does not granger cause LN_TA	6.02545	0.0984

Hence by applying the granger causality test to the variables can interpret that total assets is a granger cause to total equity and total equity is also a granger cause to total assets . In other words total assets can affect total equity input, similarly total equity can also affect the total assets in the Chinese Banking sector. Therefore, there exist a bi-direction cause-effect relationship between total assets and total equity. The results of the Granger Causality are concluded in Table 6

Table 6

Results of Granger Causality Test

Lag	Ho	F-value	P-value	Result
1	LnTA	3.91826	0.1632	Accept Ho
1	LnTE	6.02545	0.0984	Accept Ho

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D.   Graphical Comparison

To further illustrate the relationship between total assets and total equity in the Chinese Banking sector, we also conducted a graphical comparison of the two variables over a four year period. Figure 1 depicts that both the variables show similar kind of trend till 2006. After 2006, the total assets observed a positive growth while total equity experienced a small decrement.

Figure 1
The relationship between total assets and total equity in the Chinese Banking sector
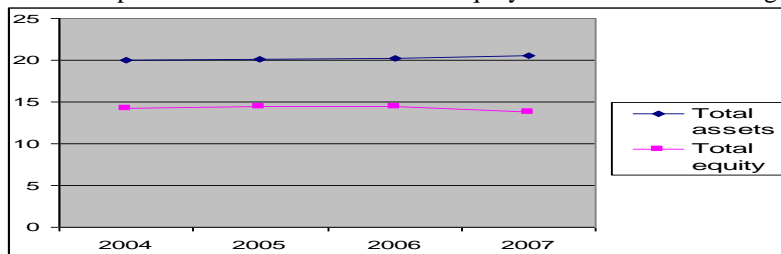
VI.   CONCLUSIONS

In testing the co-integration and causal relationship between total assets and total equity, the time series model of ADF unit-root test, Johansen co-integration test, Granger causality test and graphical comparison model are employed. The empirical results have found strong evidence that the variables are co-integrated and feedback.

By applying Johansen decision rule, we found that there are two co-integration vectors for the model. Hence our findings imply that there are stable long run relationships between the two variables i.e. total assets and total equity. Furthermore after the granger causality test to the variables we found that there exist a bi-directional cause-effect relationship between total assets and total equity in the Chinese banking sector. By applying the granger causality test to the variables we found that total assets are a granger cause to total equity and total equity is also a granger cause to total assets. The evidences of long-run bi-directional causality from total assets to total equity implies that sustainable development may be feasible and fast economic growth of China may be achievable. Furthermore by graphical comparison we found that both the variables were observed having similar kinds of trends over the period of last four years.

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