Centre for Global Finance
Working Paper Series (ISSN 2041-1596)
Paper Number: 03/10

Title:
International Determinants of Stock Market Performance in China: A Cointegration Approach

Author(s):
J.G. Garza-Garcia; Y. Yue.

Centre for Global Finance
Bristol Business School
University of the West of England
Coldharbour Lane
Bristol BS16 1QY

Telephone: 0117 32 83906
Email: cgf@uwe.ac.uk
Website: http://www.uwe.ac.uk/bbs/research/cgf/

International Determinants of Stock Market Performance in China: A Cointegration Approach

Jesús G. Garza-García[a]
Banco de México
jgarza@banxico.org.mx

Yue Yu[b]
University of the West of England
Yue.Yu@uwe.ac.uk

This version: 2 March 2010

Abstract

This paper examines the macroeconomic determinants of the Shanghai Composite Index (SCI) performance including the influence of US macro-variables in Chinese stock prices. We employ the Johansen Maximum Likelihood to determine whether a cointegration relationship exists between domestic and international macroeconomic variables and the SCI and Granger-causality tests to determine whether the SCI is a leading indicator for macroeconomic variables. The main findings suggest that Chinese stock prices are determined by changes in domestic variables, namely: inflation, industrial production, money supply, short-term interest rates and the exchange rate. This paper also finds arguments that suggest that US economic and financial indicators, namely the Dow Jones Industrial Average, industrial production and the consumer confidence index, are significantly related to Chinese stock prices. The Granger-causality test provides evidence that the Shanghai Composite Index is a leading indicator for macroeconomic variables and that the US stock index is related to the Chinese stock index performance.

Key words: stock market, macroeconomic variables, cointegration, Granger-causality.
JEL Classification: G10, G15

[a] (Corresponding author) Direction of the Analysis of the Financial System, *Banco de México*, Ave. 5 de mayo # 1 piso 1, Del. Cuauhtémoc, México, D.F. Phone: + 52 (55)523-723175, Email: jgarza@banxico.org.mx. Centre for Global Finance at Bristol Business School (*UWE*). Email: Jesus.Garzagarcia@uwe.ac.uk.
[b] Department of Economics. Bristol Business School. *University of the West of England.* yue.yu@live.uwe.ac.uk.

1. Introduction

Over the last few decades, various studies have examined stock price movements in response to changes in a range of macroeconomic and financial variables, across a number of different stock markets over a range of different time horizons (e.g. Chen, Roll and Ross, 1986, Geske and Roll, 1983, Mukherjee and Naka, 1995, Nasseh, and Strauss, 2000). Anecdotal evidence suggests that investors are normally convinced of the direct relationship between macroeconomic and financial news and the performance in the stock markets (Gan et. al., 2006). However, it is interesting to understand the real relationship between fundamentals and stock markets.

Most of the stock market studies that have been published argue about the relationships between stock prices and macroeconomic variables in developed countries such as the US (Chen, Roll and Ross, 1986, Fama, 1981), Japan (Mukherjee and Naka, 1995) and European countries (Nasseh and Strauss, 2000). Emerging stock markets, however, are much less explored. Recently, increasing attention has been drawn from academic researchers into less developed markets (see Adel (2004) for Jordan; Gan et. al. (2006) for New Zealand; Maysami and Koh (2000) for Singapore; Samitas and Kenourgios (2007) for Central Eastern European countries, among others).

This paper aims to investigate the relationships between stock prices and macroeconomic variables for the period Jan 1992 - Dec 2008 in China using cointegration and Granger-causality tests. We draw upon theory and existing empirical work as a motivation to select a number of domestic macroeconomic variables that we might expect to be strongly related to real stock price changes in China. In addition to that, we investigate whether the stock prices in China are cointegrated with the world markets, namely the US.

This paper is organized as follows. Section 2 discusses the recent development of the Chinese stock market, Section 3 reviews previous literature on the relationship between macroeconomic variables and stock prices, Section 4 presents the methodology and data used in the study, Section 5 present the empirical results and finally, Section 6 concludes.

2. The development of the Chinese stock market

China established two stock exchanges (Shanghai and Shenzhen) during the early 1990s in order to raise capital and improve the operating performance for state-owned enterprises (SOEs).[a] In 1992, China had only 53 public listed companies and a total market value of $732 million US dollars. China's stock markets have grown into the eighth largest in the world, with a market capitalization of over US$500 billion by 2002 (Bai, 2004). Nowadays, it has 1,602 listing companies and the total market value has risen to $2,154 billion US dollars (SSE, 2009).[b] For the past several years, it has drawn increasing attention from academics because of its rapid expansion in terms of capitalization, turnover and the number of firms listed.

China's stock market is also characterized as less developed and highly speculative. Azad (2009) indicates that Chinese investors speculate with stock shares disregarding their fundamental value and companies' performance. Individuals focus on short-term price fluctuation based on news through the grapevine; such price movement or volatility is attributed to excessive speculation. Given the special features of the Chinese stock market, it is interesting to analyse if there are any long-term relationships between the Chinese stock markets and some underlying macroeconomic variables.

The current financial world is dominated by integrated and independent markets within which geographic and sector boundaries have limited impacts (Walker, 2007). Market participants are aware that independent markets transcend beyond national borders and are highly sensitive to economic and political developments anywhere in the world (Bernanke, 2007). Zhang and Zhao (2004) point out that the Chinese market is segmented from the world market as domestic investors lack legitimate access to international arbitrage opportunities because of foreign exchange and investment control.[c] The process of integration of the Chinese stock market continues to be influenced by the restrictions imposed by the Chinese government, particularly on capital flows and currency convertibility (Wang and Iorio, 2007).

[a] Two types of shares are currently traded in these markets: Class A shares denominated in local currency to domestic investors and Class B shares listed on the Shanghai Stock Exchange (denominated in US dollars) and Class B shares listed on the Shenzhen Stock Exchange (denominated in Hong Kong dollars).

[b] According to Bloomberg (2009), China overtook Japan as the world second-largest stock market by value. The rise of the Shanghai Composite Index in July 16, 2009 led the value of China's domestic market to $3.21 trillion, compared with Japan's $3.20 trillion.

[c] The Chinese government adopted a pegged exchange rate against US dollar since 1998, a stable parity around 8.27yuan/dollar. Meanwhile, the Class-A share market did not open to international investors until 2002.

However, the Chinese government has been making progress on relaxing both controls on capital flows and currency convertibility.[a] The restrictions relaxation has benefited foreign investors and has lead to an increase in foreign investment into the Chinese stock market. In addition, technological advances are making trading activities between markets and nations easier than ever before.

As pointed out by Fedorov and Sarkissian (2000), the integration across global markets within a single country has largely been ignored, especially in Asian emerging markets. The impact of international globalisation and increased capital market integration has drawn attention from researchers. Masih and Masih (1999) find that financial integration among international markets has increased since the Asian financial crisis in 1997. However, Chan and Lo (2000) find that Chinese A-share markets were closely related with domestic macroeconomic variables but not with International stock markets.

The interaction between the Chinese economy and other economies, particularly the US, and has intensified because of recent global financial crisis and other relative polices in China. However, few studies have contributed to the literature on the relationship between the Chinese stock market prices and international macroeconomic activities. With the acceleration of the process of openness, the stock market of China has consistently shared the positive economic growth trends in the country, whilst at the same time benefitting from an integral international global market. It seems interesting to observe if any foreign macroeconomic or financial variables have a direct relationship with the Chinese stock market.

3. Literature Review

Chen, Roll and Ross (1986, pp. 384) state that "no satisfactory theory would argue that the relation between financial markets and the macro economy is entirely in one direction." A long term equilibrium relation between stock prices and relevant macroeconomic variables in the US market has been fairly extensively researched (e.g. Fama 1981, and, Chen, Roll and Ross 1986). They applied a vector autoregressive model and concluded that macroeconomic variables including industrial production,

[a] In 2002, the Chinese A-share market was opened to the Qualified Foreign Institutional Investors (QFII). Twelve foreign institutions had been approved to invest by the end of 2003 with a total approved investment quota of $1.7 billion US dollars (Wang and Iorio, 2007). Moreover, the Chinese government has eliminated all the restrictions outlined in the QFII policy in an attempt to attract more foreign capital. As a result, 65 QFII licences have been granted by China's securities regulator and over $ 30 billion US dollars quota have been given to these institutions in August, 2008 (Walker et. al, 2009).

inflation, US Treasury-bill rate, the long-term government bond rate, consumption and oil prices are causally related to share prices in the US. However, Poon and Taylor (1991) parallel to the Chen, Roll and Ross (1986) study the UK market, finding that macroeconomic variables do not appear to affect share prices in the UK. Nassheh and Stauss (2000) apply the Johansen's (1990) vector error correction model (VECM) to analyse the long run stock prices and domestic and international economic activity in six European economies. They concluded that a cointegrating relation indeed existed and stock prices are significantly related to domestic industrial production, business surveys of manufacture orders, short and long-term interest rates. Mukherjee and Naka (1995) analyse the relationship between the Japanese stock market and industrial production, inflation, money supply, long-term government bond rate and call money rate[a], and the exchange rate. They also find a cointegrating relation between Japanese stock prices and these underlying macroeconomic variables.

Earlier studies by Fama (1981) and Geske and Roll (1983) demonstrate that stock prices are strongly related to measures of domestic activity such as changes in the real industrial production growth or interest rates by using US data. They also suggest the US stock index is a leading indicator for economic variables. Kwon and Shin (1999) find that the Korean stock market is cointegrated with a set of macroeconomic variables using the Engle-Granger cointegration test. But they find that the Korean stock index is not a leading indicator of economic variables by using the Granger-causality test. Gan et. al. (2006) also suggest that the New Zealand stock index is not a leading indicator of economic variables.

A number of studies have already applied both cointegration tests and Granger causality tests to address the issue of the relationship between equity market and domestic macroeconomic variables in different markets (Kwon and Shin, 1999, Gan et. al., 2006). Other studies applied both tests to address the issue of the relationships among different market indexes (Laurence et. al., 1997, Kim and Shin, 2000)

Huang et. al. (2000) study the relationship between the US, Japanese and Chinese stock prices by using the Granger causality test and do not find any cointegration. Groenewold et. al. (2004) argue that using three or four years post crisis data is not sufficient to test cointegration because the tested cointegration could be a temporary phenomenon and disappear quickly. Tian (2007), in contrast with previous work,

[a] Lending rate for loans in the Tokyo call money market i.e. short term interest rate

finds that there is cointegration between Chinese stock prices and the US stock market after the Asian financial crisis. His data covers the period since the Chinese A-share was opened to the Qualified Foreign Institutional Investors (QFII) in 2002. He suggests that the introduction of foreign investments has increased the linkage between the Chinese and the international stock markets. Wang and Iorio (2007) find there is no evidence that the A-share market index is becoming increasingly integrated with International markets for the period from 1995-2004. Gao et. al. (2007) find that the Chinese stock market has not only short run, but also long-term cointegration relationships with the world's primary markets including the Dow Jones. However, their study on a long-term relationship was based on the Johansen co-integration test, and their data period only covers 2005-2006. The evidence is insufficient to identify this long-term relationship. The ongoing debates on this topic are still controversial.

3. Methodology

This study employs the Johansen cointegration test and Granger-causality test to determine whether selected macroeconomic variables are cointegrated and possibly causally related with stock prices in China.

3.1 Johansen Cointegration Test

The most important approach to analyze non-stationary time series data is the vector autoregression (VAR) and cointegration methods.[a] Cointegration is a method of defining the long-term relationship among a group of time series variables. It uses the idea of integrated time series in describing the long run interaction and arose in the context of the spurious regression problem. To be related to one another statistically in the long run, variables must be of the same order of integration. The presence of cointegration among relevant variables implies that a linear combination of non-stationary time series variables is stationary. Cointegration refers to a linear combination of non-stationary time series that result in a stationary time series in the presence of cointegration among the variables (Granger, 1986).

[a] To analyze the long-term equilibrium relationship between stock returns and macroeconomic variables, cointegration analysis is more appropriate compared to the VAR model because the cointegration method can explore the dynamic co-movements among the variables (Mukherjee and Naka, 1995).

The Johansen's (1991) vector error correction model yields more efficient estimators of cointegrated vectors compared to Engle and Granger cointegration tests.[a]

Johansen (1991) developed the vector error correction model as:

$$\Delta Y_t = \mu + \sum_{j=1}^{k-1} \Gamma_j \Delta Y_{t-j} + \alpha\beta' Y_{t-k} + \varepsilon_t \tag{1}$$

where Δ is a first difference notation, Y_{t-j} is $p \times 1$ vector integrated of order one; μ is $p \times 1$ constant vector representing a linear trend in a system, k is a lag structure; ε_t is $p \times 1$ Gaussian white noise residual vector; Γ_j is $p \times p$ matrix indicating short-term adjustments among variables cross p equations at the j_{th} lag; α is $p \times r$ speed of adjustment; β is $p \times r$ cointegrating vectors. A long term equilibrium relationship (stationary linear cominbations of $\beta' Y_{t-k}$) is found when variable are cointegrated even if Y_t is non-stationary. As evident from equation above, in the presence of cointegration, a VAR in first differences is misspecified, as it omits the error correction term ($\alpha\beta' Y_{t-k}$) and thus overlooks the long-term equilibrium relation (Johansen, 1988).

We first examine the stationarity of all the variables using the augmented Dickey-Fuller unit root test to insure that the regression results obtained are robust.[b] If all the variables are not stationary in the form of a unit root, the first order difference should be used in the modeling procedure. We then check for cointegration in terms of stock prices and macroeconomic variables. If cointegration exists among all variables, an error correction term should be added to the estimation procedure (Engle and Granger, 1987).

The application of Johansen likelihood ratio tests the number of cointegration vectors (r): the trace test and the maximum Eigenvalue test. The trace statistics tests the null hypothesis of $r = 0$ (i.e. no cointegration) against the alternative that $r > 0$ (i.e. there is one or more cointegration vectors). The maximum Eigenvalue statistics test the null hypothesis that the number of cointegrating vectors is r against the specific alternative of $r + 1$ cointegrating vectors.

---

[a] This is because the Johansen's (1991) VECM is a full information maximum likelihood estimation model, which allows for testing cointegration in a whole system of equations in one step, without requiring a specific variable to be normalized.

[b] The optimal lag length determined by the Akaike Information Criterion (AIC), the Schwarz Bayesian Criterion (SBC) and the Hannan-Quinn Criterion (HQC).

We establish a model using the vector error correction model which is stated in the following equations. Both equations below aim to estimate the cointegrated vector using Chinese data along with the US data as follows:

$$SCI_t = \alpha_t + \beta_1 CPI_t + \beta_2 IP_t + \beta_3 SIR_t + \beta_4 LIR_t + \beta_5 IR_t + \beta_6 ER_t + \beta_7 DJIA_t + \beta_8 USIP_t + \beta_9 USCCI_t + \beta_{10} USSIR_r + \beta_{11} USIR_r + \varepsilon_t \tag{2}$$

$t = 1.....n$

where SCI is the Shanghai composite index, α is the constant, CPI is consumer price index, IP is industrial production, M1 is money supply, SIR is short-term interest rate, LIR is long-term interest rate, ER is exchange rate, DJIA is Dow Jones Industrial Average, USIP is the US industrial production, USCCI is the US consumer confidence index, USSIR is the US 3-months Treasury bill yield, USLIR is the US 20 years maturity bonds yield.

3.2 Granger Causality Test

Granger (1969) proposes a method of describing the relationship between two (or more) variables in order to observe the direction of causality. Consider the variables: X_t and Y_t, the Granger-causality test can be applied as follows:

$$Y_t = \sum_{i=1}^{p} \alpha_i Y_{t-1} + \sum_{j=1}^{q} \beta_j X_{t-j} + \mu_t \tag{3}$$

The restricted model is therefore:

$$Y_t = \sum_{i=1}^{p} \alpha_i Y_{t-1} + \nu_t \tag{4}$$

where μ_t and ν_t are white noise, p is the order of lag Y, and q is the order of lag X. The null hypothesis for equation (5) is:

$$H_0 = \sum_{j=1}^{q} \beta_j = 0 \tag{5}$$

suggesting that the lag terms X_{t-j} does not Granger cause Y_t in the regression. The hypotheses are tested using an F test.

3.3 Data

We select seven domestic macroeconomic variables and five international macroeconomic variables based on their hypothesized effect on either the cash flows or the required rate of return. The definition of the variables used to proxy the Chinese stock market and the macroeconomic variables are provided in Table 1.

Table 1
Definition of variables

Variable	Definition
Shanghai Composite Index (SCI)	Index of market-value-weighted average of monthly closing prices for all shares listed on the Shanghai Stock Exchange
Inflation (CPI)	Consumer price index
Industrial Production (IP)	Seasonally adjusted industrial production index
Money supply (M1)	Narrowly defined money supply
Short term interest rate (SIR)	One-year time deposit rate set by the central bank
Long term interest rate (LIR)	Five-year time deposit rate set by the central bank
Exchange rate (ER)	End-of-month price of U.S. dollar in terms of Chinese Yuan
Chinese exports (EXPORT)	Monthly Chinese exports
Dow Jones Industrial Average (DJIA)	Monthly closing index of Dow Jones Industrial Average
U.S. industrial production (USIP)	US seasonally adjusted industrial production index
U.S. Consumer confidence index (USCCI)	Monthly index of the US household survey of consumer's opinions on current conditions and future expectations of the economy
U.S. short term interest rate (USSIR)	US three months treasury bill yield
U.S. long term interest rate (USLIR)	End-of-month arithmetic averages yield to maturity of the US bonds with 20 years to maturity

Table 2 provides the descriptive statistics of the variables. The data in table 2 are in levels, and table 3 below shows the data in first differences. The sample period consists of 204 observations. The starting date is the earliest date for which the information of the Shanghai A-share index available in DataStream. We select the Shanghai Stock Composite index, Dow Jones Industrial Average as the stock price indexes for China and the US respectively. This study focuses on the mainland

Chinese stock market and considers the Shanghai Composite Index (SCI) because of its size and market value. We choose the industrial production, consumer confidence index, short-term interest rate and long-term bond yield as proxies for international macroeconomic activities in the US. We chose the consumer confidence index over private consumption because the consumer confidence index is surveyed on a monthly basis.

Table 2
Descriptive Statistics of All Variables: January 1992 to December 2008

Variable	Observation	Mean	Standard Deviation	Min	Max
log_SCI	204	7.226	0.546	5.747	8.741
log_CPI	204	4.655	0.064	4.583	4.850
log_IP	204	2.682	0.145	2.474	3.099
log_M1	204	6.369	0.762	5.085	7.798
log_SIR	204	1.009	0.482	0.536	1.896
log_LIR	204	1.684	0.599	1.026	2.629
log_ER	204	2.053	0.127	1.688	2.164
log_EXPORT	204	5.488	0.897	3.514	7.220
log_DJIA	204	8.952	0.446	8.078	9.542
log_USIP	204	4.544	0.145	4.230	4.722
log_USCCI	204	4.57	0.276	3.653	4.975
log_USSIR	204	1.15	0.741	-4.605	1.852
log_USLIR	204	1.749	0.168	1.157	2.104

Notes: log means all series are in natural logarithms. SCI is Shanghai composite index, CPI is consumer price index, IP is industrial production, M1 is money supply, SIR is short-tem interest rate, LIR is long-term interest rate, ER is exchange rate, EXPORT is Chinese exports, DJIA is Dow Jones Industrial Average, USIP is the US industrial production, USCCI is the US consumer confidence index, USSIR is the US 3-months Treasury bill yield, USLIR is the US 20 years maturity bonds yield.

From Table 2, the standard deviation of Shanghai Composite Index and Dow Jones are 0.546 and 0.446 respectively. It can be observed that the Chinese stock market possesses higher volatility than the US. This high volatility can attributed to excessive speculation in China.

Table 3
Summary Statistics of Time Series Transformation

Variable	Observations	Mean	Standard Deviation	Min	Max
△log[SCIt -SCIt-1]	203	0.009	0.153	-0.381	1.063
△log[IPt -IPt-1]	203	-0.001	0.049	-0.377	0.160
△log[M1t -M1t-1]	203	0.013	0.041	-0.435	0.103
△log[ERt -1-ERt-1]	203	0.001	0.029	-0.016	0.405
△log[DJIAt -DJIAt-1]	203	0.005	0.042	-0.164	0.101
△log[USIPt -USIPt-1]	203	0.002	0.006	-0.040	0.021
Notes: ∆ means all data are in first difference, log means all series are in natural logarithms, t is current period, t-1 is previous period, SCI is Shanghai composite index, IP is industrial production, M1 is money supply, ER is exchange rate, DJIA is Dow Jones Industrial Average, USIP is the US industrial production.					

Table A1 provides the economic interpretation of the first difference in the logarithm of the selected variables.[a] Table 3 reveals that over the period studied, the Shanghai Composite Index (SCI) grew at an impressive rate of 0.9% per month compared to the Dow Jones Industrial Average (DJIA) at 0.5%. The monthly growth rate of money supply is higher than the growth rate of the Chinese stock index, at a rate of 1.3%. This result supports Kraft and Kraft (1977) who argue that an increase in the money supply provides excess liquidity for stock purchases. The Chinese industrial production grew at relatively low rate compared to the US.

4. Results

4.1. Unit Root Test

The first stage of the analysis is to determine if the time series data is non-stationary by using the Augmented Dickey-Fuller (ADF) test. The appropriate lag lengths of each individual variable have to be determined before the ADF test (see Table A2 in the appendix). The null hypothesis states that each time series contains a unit root that cannot be rejected for all variables. The Augmented Dickey-Fuller results are shown in Table 4 below, and show that the null hypothesis of a unit root cannot be rejected for all variables at the 5% level except Chinese exports (log_EXPORTS). Therefore, it is concluded that all time series except Chinese exports (log_EXPORTS) under investigation follow an I(1) process and cointegration tests can now be applied.

[a] See appendix for table A1.

Table 4
Unit Root Test

Variables	ADF Test Statistics	5% Critical value	Stationary or not
log_SCI	-3.416	-3.437	No
log_CPI	-1.797	-3.437	No
log_IP	-2.285	-3.437	No
log_M1	-3.191	-3.437	No
log_SIR	-2.229	-3.437	No
log_LIR	-1.645	-3.437	No
log_ER	-2.294	-3.437	No
log_EXPORT	-3.59	-3.437	Yes
log_DJIA	-0.205	-3.437	No
log_USIP	0.981	-3.437	No
log_USCCI	-0.66	-3.437	No
log_USGILL3	-0.109	-3.437	No
log_USIR	-2.492	-3.437	No

Notes: All series are in natural logarithms. SCI is Shanghai composite index, CPI is consumer price index, IP is industrial production, M1 is money supply, SIR is short-tem interest rate, LIR is long-term interest rate, ER is exchange rate, EXPORT is Chinese exports, DJIA is Dow Jones Industrial Average, USIP is the US industrial production, USCCI is the US consumer confidence index, USSIR is the US 3-months Treasury bill yield, USLIR is the US 20 years maturity bonds yield.

4.2. Multivariate Cointegration Test

In the second stage, we present the Johansen cointegrating estimates between Chinese stock prices and both domestic and the US macroeconomic variables. Table 5 shows the Johansen-Juselius cointegration test results based on the trace statistics (λ trace) and maximum eigenvalues (λ max). VECM involves first differences and error correction terms, so that there are two lags. The lag lengths are chosen so that the errors of the VECM are not correlated.

Table 5
Johansen Cointegration Rank Test
(US macroeconomic variables)

Chinese stock prices and both domestic and US macroeconomic variables, 1992.1-2008.12 (Johansen cointegration rank test)			
H_0	**Eigenvalue (λmax)**	**Trace statistic (λtrace)**	**5% critical value**
r=0		464.1832*	277.71
r=1	0.44209	346.3057*	233.13
r=2	0.35859	256.6002*	192.89
r=3	0.29168	186.9378*	156
r=4	0.2401	131.4762*	124.24
r=5	0.18685	89.6947	94.15
Notes: = the number of cointegrating vectors. * denotes the statistics are significant at 5% level.			

A cointegration analysis is applied in order to model the long run equilibrium relationship between Chinese stock prices and macroeconomic variables. We reject the null hypothesis of no cointegrating equilibrium at the 5% level. Based on the data, more than one cointegrating vectors among stock prices, industrial production, consumer price index, money supply, both short and long-term interest rate, exchange rate, and international macroeconomic variables exist. We then proceed to estimate the VECM model.

In the presence of more than one cointegrating vector, Johansen and Julius consider the first eigenvector to be the most useful. The corresponding vector is thus:

$\beta_1' =$(26.48 -68.76 -25.22 -2.91 0.61 -67.88 -5.69 16.06 -4.77 0.43 -2.79 200.25).

These values represent the coefficients for SCI (normalized to 1), and they can be interpreted as long-term elasticity measures due to logarithmic transformation. The vector then can be expressed as (Table 6):

Table 6
Johansen Cointegration Test
(US macroeconomic variables)

Variable	Coefficient	Standard Deviation
log_SCI	1	
log_CPI	-26.48296 *	5.41
log_IP	68.76021 *	6.007
log_M1	25.21913 *	7.605
log_SIR	2.911015 *	1.076
log_LIR	-0.6081446	0.815
log_ER	67.87856 *	6.811
log_DJIA	5.685336 *	2.223
log_USIP	-16.05585 *	7.692
log_USCCI	4.766522 *	1.407
log_USGILL3	-0.430035	0.457
log_USLIR	2.790788	1.932
_cons	-200.2474	

Notes: All series are in natural logarithms. SCI is Shanghai composite index, CPI is consumer price index, IP is industrial production, M1 is money supply, SIR is short-tem interest rate, LIR is long-term interest rate, ER is exchange rate, DJIA is Dow Jones Industrial Average, USIP is the US industrial production, USCCI is the US consumer confidence index, USGILL3 is the US 3-months Treasury bill yield, USLIR is the US 20 years maturity bonds yield.
* denotes the statistics are significant at 5% level.

Given the evidence in favor of at least one cointegrating vector, we normalize the cointegrating vector on the stock price and find significant positive coefficients on industrial production; short-term interest rate, money supply and exchange rate (see Table 6). Table 6 also shows that the stock price is negatively related to inflation. However, long-term interest rate has no significant impact on the Chinese stock index. The error correction model shows that the Shanghai Composite Index, inflation, industrial production, money supply, short-term interest rate and exchange rate all contribute to the error correction process.

The results using Chinese data are partially consistent with the existing literature and evidence. As expected we find a positive relationship between industrial production and the stock prices. Fama and Schwet (1977) and Geske and Roll (1983) find a positive relationship between stock prices and industrial production. We find that the inflation (CPI) has a negative impact on stock prices, which is also consistent with other studies (Chen, Roll and Ross 1986, Mukherjee and Naka 1995). Since genuine inflation is likely to be distorted by financial repression, an increase in Chinese inflation may still play the role to change the expectation of investors' required rate of return by increasing the nominal risk-free rate as well as the discount rate. The effect of money supply on stock prices is found to be significantly positive, which is consistent with the literature. Mukherjee and Naka (1995) also find a positive relationship between stock price and money supply in Japan. Short-term interest rates have a significant positive impact on Chinese stock prices, which is consistent with Mukherjee and Naka (1995). However, long-term interest rates are not significant. A possible explanation for this result is that long-term interest rates do not serve as proxy for the nominal risk-free component used in the discount rate in the stock valuation models. The excessive volatility of Chinese stock prices perhaps cancels out the sensitivity of market reaction towards long-term interest rate. Liu and Shrestha (2008) apply the Johansen's cointegration test and do not find significant relationships between Chinese stock prices and both short and long-term interest rates. The relationship between the Chinese stock prices and the exchange rate is positive. This is similar to the findings of Maysami and Koh (2000), suggesting that a high volume of trade (imports and exports) in the Chinese economy provides a stronger domestic currency, which lowers the cost of imported inputs and allows domestic producers to be more competitive internationally.

Since we are interested in the relationship between stock prices, domestic variables and international variables, we added the US stock prices (DJIA), industrial production (IP), the US consumer confidence index; 3-month Treasury bill and US long-term bond yield these five variables and test the cointegrating relationships. According to table 6, the Chinese stock prices have a significant positive relationship with the Dow Jones Industrial Average and the US consumer confidence index. The US industrial production presents a negative relationship with the Chinese stock index. Both the 3-month Treasury bill and bond yields, however, are insignificant. The number of cointegrating relationships in most cases is similar, more importantly, the domestic variables possess similar signs and coefficients to the results reported, hence the results are robust to the addition of international variables.

The results indicate that the Dow Jones Index is significantly related to Chinese stock prices. Our findings are consistent with Tian (2007); an increase in the US industrial production significantly affects stock price movements in China. The US consumer confidence index has a significant and positive impact on Chinese stock prices, which is consistent with the literature. Clearly, an increase of the US consumer expenditure will lead to greater cash flow, hence higher stock prices for Chinese companies. According to the table 6, both short and long-term US interest rates have insignificant impacts on Chinese stock prices. This is not consistent with Nasseh and Strauss (2000) who find a positive relationship between German interest rates and four European stock markets. This is perhaps caused the fact that Chinese interest rates do not affect the discount rate, hence the stock prices.

4.3 Granger-Causality Test

The Granger-causality test is conducted to study the lead-lag relationships between the macroeconomic variables and the Shanghai Composite Index. The results are reported in table 7. They indicate that the Shanghai Composite Index Granger causes inflation, money supply, both short and long-term interest rate as well as Chinese exports in the sample period. This suggests that the Shanghai Composite Index is a leading indicator for economic variables in China, which is consistent with empirical results conducted in the US (Fama, 1991). A rational explanation is that the ratio of capitalization of the stock market to gross domestic product (GDP) in China is considerably large, therefore, the impact of capital market on the whole economy is also high.

Table 7
Granger-Causality: Test 1

H_0	Lag	F-statistic	P-value	Reject H_0 or Not
Log_SCI does not Granger Cause Log_CPI	3	22.69	0.00	Yes
Log_SCI does not Granger Cause Log_IP	3	1.03	0.38	No
Log_SCI does not Granger Cause Log_M1	1	357.08	0.00	Yes
Log_SCI does not Granger Cause Log_SIR	4	23.77	0.00	Yes
Log_SCI does not Granger Cause Log_LIR	1	110.15	0.00	Yes
Log_SCI does not Granger Cause Log_ER	1	1.45	0.23	No
Log_SCI does not Granger Cause Log_EXPORTS	4	60.09	0.00	Yes
Log_SCI does not Granger Cause Log_DJIA	1	0.47252	0.40	No
Notes: All series are in natural logarithms. SCI is Shanghai composite index, CPI is consumer price index, IP is industrial production, M1 is money supply, SIR is short-tem interest rate, LIR is long-term interest rate, ER is exchange rate, DJIA is Dow Jones Industrial Average. H_0 is null hypothesis of Granger-Causality test. Lag is lag length.				

Table 8
Granger-Causality: Test 2

H_0	Lag	F-statistic	P value	Reject H_0 or Not
Log_DJIA does not Granger Cause Log_SCI	1	359.54	0.00	Yes
Notes: All series are in natural logarithms. SCI is Shanghai composite index, DJIA is Dow Jones Industrial Average. H_0 is null hypothesis of Granger-Causality test. Lag is lag length.				

According to table 8, by applying the Granger causality test, log_DJIA does Granger cause log_SCI. The result suggests that the stock price changes in the US can be used to predict the Chinese stock market. The finding is consistent with Laurence et. al. (1997). They also find a strong causal effect from the US stock market to Chinese stock markets.

5. Conclusion

This paper examined the relationships between the Shanghai Composite Index and a set of macroeconomic variables for the period of January 1992 to December 2008. The time series data set employed in this study includes monthly observations of the Shanghai Composite Index (SCI), industrial production (IP), the inflation rate (CPI), narrowly defined money supply (M1), both short and long-term interest rate (SIR, LIR), and the exchange rate (ER). The study includes US macroeconomic variables as well as their stock market indices. W use the Johansen multivariate cointegration tests to examine whether the Chinese stock market is cointegrated with a set of macroeconomic variables in the long run. We also examine whether the Chinese stock market is a leading indictor for economic variables by employing Granger-causality tests.

By employing the Johansen (1991) cointegration analysis, we find that a long-term relationship exists between stock prices and the macroeconomic variables. While the industrial production, money supply, short term interest rate and the exchange rate are positively related to Chinese stock prices, inflation is negatively related. This study shows that the Chinese stock market does react to changes in the macroeconomic variables in the long run, despite its high degree of speculation, immaturity and short-term volatility. However, long-term interest rates are insignificant. A possible explanation for this result is that long-term interest rates do not serve as proxy for the nominal risk-free component used in the discount rate in the stock valuation models.

This paper has made contributions to the literature on the long-term relationships between Chinese stock prices and international macroeconomic variables, particularly, the US macroeconomic variables. The cointegration equations are robust to the addition of international variables, suggesting that the Chinese stock market is also sensitive to the US macroeconomic factors, namely, Dow Jones stock index, the US industrial production and consumer confidence index. The Dow Jones Industrial Average (DJIA) and the US consumer confidence index have positive impacts on the Chinese stock prices; the US industrial production presents a negative impact. The implication is that the Chinese stock markets will become more integrated with the US stock markets as the Chinese macroeconomic activity becomes increasingly integrated through trade.

Finally, the Granger (1969) causality tests indicates statistically significant relationships between Chinese stock prices and inflation, money supply, both short and long-term interest rates and Chinese exports. The result shows that the Shanghai Composite Index is a leading indicator for macroeconomic variables in China. The results also show that the Dow Jones Granger-causes the Shanghai Composite Index suggesting that changes of the US stock index can be used to predict Chinese stock market.

References

Adel, A.S., The Dynamic Relationship between Macroeconomic Factors and the Jordanian Stock Market//International Journal of Applied Econometrics and Quantitative Studies, 2004. - No. 143. - pp. 91-114.

Azad, S. Efficiency, Cointegration and Contagion in Equity Markets: Evidence from China, Japan and South Korea//Asian Economic Journal, 2009.- No. 23. -pp. 93-118

Bai, C.E. Corporate Governance and Market Valuation in China//Journal of Comparative Economics, 2004. - No. 32. -pp. 599-616

Bernanke, B.S. Globalization and Monetary Policy//Fourth Economic Summit, 2007.

Bloomberg. China's market value overtakes Japan as world's No. 2 [online] Available from http://www.bloomberg.com/apps/news?pid=20601087&sid=a_84o9PPPGqk (Assessed at 16th July, 2009).

Chen, N. F., R. Roll, S. Ross. Economic Forces and the Stock Market//Journal of Business, 1986. -No. 59. -pp. 383-403.

Engle, R., C.W.J. Granger. Cointegration and Error Correction: Representation Estimation, Testing" Econometrica, 1987. -No. 55. -pp. 251-276.

Fama, E.F. Stock Returns, Real Activity, Inflation and Money//The American Economic Review, 1981. -No. 71. -pp. 545-565

Fama, E.F., G.W. Schwert. Asset returns and inflation//Journal of Financial Economics, 1977.-No. 5. -pp. 115-146.

Fedorov, P., S. Sarkissian. Cross-sectional Variation in the Degree of Global Integration: The Case of Russian Equities//Journal of International Financial Markets Institutions & Money, 2000. –No. 10. -pp. 131-150.

Gan, C., A.Y. Hua, J. Zhang, M. Lee. Macroeconomic variables and stock market interactions: New Zealand Evidence//Investment Management and Financial Innovation, 2006. –No. 3. –pp. 89-101.

Gao, Y., L.L. Jin, Y. Zou. Analysis of Relations between Shanghai-Shenzhen 300 Index in China and the World's Primary Stock Indexes//Sixth Wuhan International Conference on E-Business, 2007.

Geske, R., R. Roll. The Fiscal and Monetary Linkage between Stock Market Returns and Inflation// Journal of Finance, 1983. –No. 38. -pp. 7-33.

Granger, C.W. Developments in the Study of Cointegrated Economic Variables//Oxford Bulletin of Economics and Statistics, 1986. –No. 48. –pp. 213-228.

Granger, C.W. Investigating Causal Relations by Econometric Models and Cross-Spectral Methods//Econometrica, 1969. –No. 37. –pp. 424-438.

Groenewold, N., S. Tang, Y. Wu. The Dynamic Interrelationships between the Greater China Share Markets//China Economic Review, 2004. –No. 14. -pp. 45-62.

Huang, B.N., C.W. Yang, W.S. Hu. Causality and Cointegration of Stock Markets Among the United States, Japan and the South China Growth Triangle//International Review of Financial Analysis, 2000. -No. 9. -pp. 281-297.
Johansen, S. Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models//Econometrica, 1991. –No. 59. –pp. 1551-1580.

Johansen, S. Statistical Analysis of Cointegration Vectors//Journal of Economic Dynamics and Control, 1988. –No. 12. –pp. 231-254.

Kwon, C., S. Shin. Cointegration and Causality between Macroeconomic Variables and Stock Market Returns//Global Finance Journal, 1999. –No. 10. -pp. 71-81.

Kraft, J., A. Kraft, A. Determinants of Common Stock Prices: A Time Series Analysis//Journal of Finance, 1977. -No. 32. - pp. 417-425.

Liu, M.H., K.M. Shrestha. Analysis of the Long-Term Relationship between Macroeconomic Variables and the Chinese Stock Market Using Heteroscedastic Cointegration//Managerial Finance, 2008. –No. 34. - pp. 744-755.

Masih, A., Masih, R. Are Asian Stock Market Fluctuations due Mainly to Intra-Regional Contagion Effects//Pacific-Basin Finance Journal, 1999. -No. 7. -pp. 251-282.

Maysami, R.C., T.S. Koh. A Vector Error Correction Model of the Singapore Stock Market//International Review of Economics and Finance, 2000. -No. 9. -pp. 79-96.

Mukherjee, T.K., A. Naka. Dynamic Relations between Macroeconomic Variables and the Japanese Stock Market: An Application of a Vector Error Correction Model//Journal of Financial Research, 1995. -No. XVII. -pp. 223-237.

Nasseh, A., J. Strauss. Stock Prices and Domestic and International Macroeconomic Activity: A Cointegration Approach//The Quarterly Review of Economics and Finance, 2000. –No. 40. -pp. 229-245.

Poon, S., S.J. Taylor. Macroeconomic Factors and the UK Stock Market//Journal of Business and Accounting, 1991. –No. 18. - pp.619-636.

Samitas, A., D.F. Kenourgios. Macroeconomic Factors' Influence on "New" European Countries Stock Returns: The Case of Four Transition Economies//International Journal of Financial Services, 2007. –No. 2. –pp. 34-49.

SSE., (2009) "Shanghai Stock Exchange" [online] Available from: http://www.sse.com.cn/sseportal/ps/zhs/home.html [Accessed 1st May,2009]

Tian, G. Are Chinese Stock Markets Increasing Integration with Other Markets in the Greater China Region and Other Major Markets//Australian Economics Papers, 2007. –No. 46. -pp. 240-253.

Walker, G. Credit Crisis: Regulatory and Financial Systems Reform//Journal of International Banking and Financial Law, 2007. –No. 2. –pp. 567.

Walker, J., M. Shipman, T. Yang, C., Z.B. Fan. China's QFII regime: Compliance Risks and Possible Changes//Journal of Securities Law, Regulation & Compliance, 2009. –No. 2. -pp. 144-152.

Wang, Y., A. Iorio. Are the China-Related Stock Markets Segmented with Both World and Regional Stock Markets?//Journal of International Financial Markets Institutions &Money, 2007. –No. 17. -pp. 277-290.

Zhang, Y., Zhao, R., (2004) "The valuation differential between Class A and B shares: country risk in the Chinese stock market" *Journal of International Financial Management and Accounting, 2004. –No.* 15. –pp. 44-59.

Appendix

Table A1
Time Series Transformation

Variables	Definition
$\triangle\log[SCI_t-SCI_{t-1}]$	Return on the SCI
$\triangle\log[IP_t-IP_{t-1}]$	Growth rate of industrial production
$\triangle\log[M1_t-M1_{t-1}]$	Growth rate of money supply
$\triangle\log[ER_t-ER_{t-1}]$	Changes in exchange rate
$\triangle\log[DJIA_t-DJIA_{t-1}]$	Return on the Dow Jones Industrial Average
$\triangle\log[USIP_t-USIP_{t-1}]$	Growth rate of US industrial production

Notes: ∆ means all series are in first difference form, log means all series are in natural logarithms, t is current period, t-1 is previous period, SCI is Shanghai composite index, IP is industrial production, M1 is money supply, ER is exchange rate, DJIA is Dow Jones Industrial Average, USIP is the US industrial production..

Table A2
Lag lengths of variable

Variable	lag	LL	AIC	HQC	SBC
log_SCI	0	-152.1	1.531	1.53768	1.5475
	1	94.8962*	-0.92896*	-0.91561*	-0.89598*
	2	95.551	-0.92555	-0.90553	-0.97608
	3	96.1985	-0.92199	-0.89529	-0.85602
	4	96.1986	-0.91199	-0.87862	-0.82953

Log_SCI= Shanghai Composite Index, lag= lag length, LL = Maximized log-likelihood, AIC= Akaike Information Criterion, HQC= Hannan-Quinn Criterion, SBC= Schwarz Bayesian Criterion, "*" denotes AIC, HQC and SBC are all minimised at a lag length of 1.

Variable	lag
log_SCI	1
log_CPI	3
log_IP	3
log_M1	1
log_SIR	4
log_LIR	1
log_ER	1
log_EXPORT	4
log_DJIA	1
log_USIP	4
log_USCCI	1
log_USGILL3	4
log_USLIR	3

Notes: log means all series are in natural logarithms. SCI is Shanghai composite index, CPI is consumer price index, IP is industrial production, M1 is money supply, SIR is short-tem interest rate, LIR is long-term interest rate, ER is exchange rate, EXPORT is Chinese exports, DJIA is Dow Jones Industrial Average, USIP is the US industrial production, USCCI is the US consumer confidence index, USSIR is the US 3-months Treasury bill yield, USLIR is the US 20 years maturity bonds yield. Lag is lag length.