

The Effect of China's Reform Policies on Stock Market Information Transmission

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This study focuses on the effect of four major reform policies on the level of China's stock market integration within its four domestic markets and with regional markets and with global markets. The findings indicate that China's security law implementation strengthens return relationships within its two domestic exchanges while market liberalization from opening its A-share markets to foreign investors facilitates volatility transmission between China's stock markets and world markets. Overall, China's market reform is somewhat ineffective, and its segmented markets continue to provide foreign investors with the benefits of international diversification.

Introduction

Since China opened its stock markets on December 19, 1990, the Chinese government has employed various policies in an attempt to reform its under-developed stock markets. The reforms are for attracting foreign investors and enhancing financial market development. Despite the fact that investors continue to raise questions about information transparency and corporate governance of Chinese companies, China's stock market has become the fastest-growing stock market in the world. According to the 2006 Yearbook of the Shanghai Stock Exchange, the market capitalization of public-listed A-share companies on the Shanghai Stock Exchange increased from 63.59 billion Chinese yuan with 29 listed companies in 1992 to 2571.97 billion Chinese yuan with 827 listed companies in 2004. The rapid growth of China's stock market has attracted the attention of various emerging market policymakers who are concerned about the impact of reform policies on their financial markets and ultimately on their economic growth. In addition, investment profes-

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sionals looking for international diversification opportunities are interested in this available emerging equity market. Because the benefits of international diversification are decreasing on a global basis, diversification benefits currently result primarily from investing in emerging markets rather than in developed markets (Goetzmann et al., 2005). Much of the recent literature indicates that financial market liberalization will increase emerging markets' integration into global markets, will attract foreign investment, and will reduce the cost of equity capital thereby ultimately increasing economic welfare. See, for example, Phylaktis (1999), Henry (2000), Bekaert and Harvey (2000, 2003), and Bekaert et al. (2005).

This paper focuses on the Chinese stock market because of its increasing global importance and changing regulatory environment. China's stock market presents a unique market structure with two national exchanges, Shanghai Stock Exchange and Shenzhen Stock Exchange, each with dual classes of stocks. A-share stocks are traded by domestic residents, and B-share stocks are traded primarily by foreign investors on both the Shanghai and the Shenzhen exchanges, effectively creating four separate markets. Because most B-share stocks also are listed as A-share stocks, the dual classes of stocks would be expected to move together, particularly after equity market liberalizations when domestic residents were allowed to trade B-share stocks (February 20, 2001) and when foreign investors were able to make their first trades in A-share stocks (July 9, 2003). Thus, this study investigates the Shanghai and Shenzhen exchanges and the relationships between A-share index returns and B-share index returns within each exchange and across the two Chinese exchanges. In addition, relationships between two selected regional markets (Hong Kong and Japan) and with two measures of global markets (the U.S. and the MSCI World) are studied. The degree of market integration is measured using correlation, Granger causality, and vector autoregressive (VAR) methodologies. Both return causality and volatility transmission of index returns are analyzed. Evolving market integration is investigated based on the event date of reforms (new policy effective date) using pre-event and post-event periods.¹

The study provides a perspective of what one can learn from the emerging Chinese stock market where the government has employed various policies in an attempt to reform its underdeveloped stock market. When reviewing reform policies, policymakers can decide whether or not to employ similar reform policies and which, if any, specific policies to pursue. The four major Chinese reform policies studied are: (1) daily price-limit regulation—December 16, 1996, (2) implementation of new People's Republic of China (PRC) Securities Law—July 1, 1999, (3) removal of trading restrictions allowing domestic residents to trade B-share stocks—February

¹It should be noted that in some regards the impact of effective law enforcement on stock markets is greater than that of law implementation. Because it is difficult to identify the day of effective security law enforcement, this study employs the day of law implementation as the event date.

20, 2001, and (4) opening A-share markets to foreign investors—July 9, 2003. Among the four reform policies, the first aimed to reduce speculation and stabilize the market, the second to protect investors and strengthen corporate governance, and the third and fourth reforms to strengthen market liberalization by reducing trade restrictions for domestic and foreign investors.

In summary, this study contributes to the literature by investigating the effect of reform policies on the emerging internal Chinese stock markets and on China's stock market integration with regional and world markets.

Chinese Stock Market

The Shanghai Stock Exchange (SHSE) and Shenzhen Stock Exchange (SZSE) were established on December 19, 1990 and July 3, 1991, respectively. In general, SHSE-listed companies tend to be large and state-owned, while most SZSE-listed companies are small, joint ventures, and export oriented. The Chinese stock market has a unique feature with dual classes of stocks: A-shares and B-shares. Moreover, only domestic residents initially were permitted to trade A-shares, which are denominated in the Chinese currency Renminbi. On the other hand, B-shares are issued in the form of registered shares and are subscribed and traded in foreign currencies. Shanghai B-shares are traded in the U.S. dollar, and Shenzhen B-shares are traded in the Hong Kong dollar. B-share markets are designed to provide an additional channel for foreign capital inflows, thereby enhancing the involvement of China's securities market. The first IPO of B-shares traded on February 21, 1992. B-share markets have not expanded as fast as A-share markets, however, in terms of the number of listed companies, market capitalization, and trading volumes. Listed companies and market values in B-share markets have been relatively unchanged since 1997. The lagging B-share markets are consistent with the argument of Chen et al. (2001) that illiquidity in the B-share markets relative to A-share markets causes large price discounts on B-shares relative to A-shares. They find that prices of B-shares are closely related to a firm's fundamentals, while a portion of the A-share premium is associated with market sentiment in the A-share markets (where shares are traded primarily by local individuals). Wang and Jiang (2004) further document that B-shares are unable to attract foreign investors because of their insufficient liquidity and trading at a discount relative to their counterpart A-shares. Nevertheless, China's 2003 liberalization policy, opening its A-share markets to foreign investors, should provide an additional opportunity to attract foreign capital inflows. Table 1 lists the relative growth of A-share and B-share markets.

As emerging markets are gradually liberalizing their financial markets in order to attract foreign capital inflow, measuring the effect of reform policies on financial market development is of prime concern. Bekaert and Harvey (2003) find that financial market liberalization in emerging countries is able to attract foreign investment, increase economic growth, reduce the cost of capital, and lead to a small increase in

Table 1—Market Statistics

Year	A Shares		B Shares	
	No. of Companies	Market Capitalization	No. of Companies	Market Capitalization
Panel A: Listed Companies on Shanghai Stock Exchange				
1992	29	63.59	N/A	N/A
1993	101	209.10	22	12.99
1994	169	248.88	34	11.63
1995	184	244.56	36	8.97
1996	287	533.96	42	16.25
1997	372	912.31	50	18.64
1998	425	1060.51	52	10.07
1999	471	1460.90	54	14.33
2000	559	2674.30	55	34.64
2001	591	2707.79	55	68.76
2002	661	2496.34	54	45.65
2003	726	2943.35	54	42.43
2004	827	2571.97	54	30.43
Panel B: Listed Companies on Shenzhen Stock Exchange				
1992	24	45.75	9	3.22
1993	76	124.81	19	8.53
1994	118	102.59	24	5.95
1995	127	87.08	34	6.70
1996	227	416.68	43	22.38
1997	348	812.59	51	18.92
1998	400	878.67	54	10.91
1999	450	1175.53	54	16.41
2000	499	2097.02	58	27.10
2001	494	1538.56	56	51.90
2002	494	1263.41	57	36.14
2003	491	1215.85	57	52.21
2004	522	1060.64	56	46.09

Notes: Market capitalization is in billion Chinese yuan

correlation with the world market. Chen (2003) points out that, at the beginning, the Chinese government established the two stock exchanges primarily for the purpose of helping state-owned enterprises raise capital from the public to solve their money-losing problems rather than to provide investors with investment opportunities. In early 1990, no security law provided investor protection such as requiring fair information disclosure and recognizing shareholder's rights. Over time, however, the Chinese government realized that financial market reform and liberalization were necessary to attract foreign investors. Since 1996, when China implemented its security law, China has reformed its two stock exchanges. Even so, studies find evidence of continued market segmentation and price differentials in A-share markets and B-share markets even though both A-shares and B-shares are entitled to identical rights and earnings streams. The asymmetric characteristics of A-shares and B-shares, which are denominated in local and foreign currencies and designed for domestic and foreign investors, respectively, have attracted growing interest among

researchers. Various theories have been provided to explain the price discount puzzle in B-shares relative to A-shares. Little work has been done to identify the impact of recent reform policies on market integration.

Literature Review

Indications of stock market integration have been found in different contexts where national stock markets move together, where one market is affected by the other markets, or where a national market is integrated with the global market. Many factors affect stock market integration such as market liberalization, policy reform, close trading partnerships, stock market crisis, regional interrelationships, and related macroeconomic influences. By measuring the linkages of real interest rates, Phylaktis (1999) finds that integration of six Asian countries with Japan and with the U.S. increases after these countries reduce restrictions on their financial markets. He also finds that after market deregulation, real interest rates in a group of Asia-Pacific countries tend to co-move with world interest rates and that the influence of Japan is greater than that of the U.S. This study indicates that stock market integration is closely related to financial market deregulation and liberalization.

Connolly and Wang (2003) test the comovements among stock markets in the U.S., Japan, and U.K. and find that returns of domestic markets are closely associated with previous returns of foreign markets rather than macroeconomic factors. Barberis et al. (2005) argue that price comovements reflect both fundamental-based news and sentiment-based noise. The fundamental-based comovement depends primarily on news correlation between stocks, while the sentiment-based comovement depends on noise traders who allocate funds by fund category, on the distinct difference in trader's preferred habitats, or on heterogeneous rates of information incorporated into stock prices. Froot and Dabora (1999) document that the location of trade causes the return of Royal Dutch shares to differ significantly from the return of Shell shares even though these two stocks have the same earnings streams and fundamental values. Ng (2003) examines return and volatility spillovers from Japan and the U.S. to six Pacific-Basin equity markets and finds that both world factors and regional factors play important roles. Karolyi and Stulz (1996) also find stock market comovements between the U.S. market and the Japanese market. Hsin (2004) measures transmission of stock market indexes among major developed markets and finds strong evidence of regional transmission effects in market returns and return volatility. Forbes and Rigobon (2002) report high levels of market comovements during stable periods as well as during crisis periods. In addition, estimates of cross-market correlations tend to be biased upward during a crisis when stock market volatility tends to increase. Johnson and Soenen (2003) investigate equity market integration among eight Latin American countries with the U.S. and find that comovements of these markets are associated with macroeconomic factors, conclusions supporting Campbell and Hamao (1992).

Bracker et al. (1999) argue that the degree of comovement represents the level of stock market integration and find that the extent of market integration is closely related to the degree of bilateral import dependence and geographical distance between the markets. Based on four Asian countries that continue to liberalize their financial markets and improve market surveillance, Chelley-Steeley (2004) documents that regional integration is occurring at a faster pace than global integration with the region. Brooks and Negro (2004) find that the degree of comovement across national stock markets has increased dramatically since 1990 and that this phenomenon is driven primarily by stock market bubbles rather than by global integration. They argue that international diversification is still effective in reducing risk after the tech stock market bubble broke in 2000.

Specifically, this study focuses on the effect of four major reform policies on the level of China's stock market integration within its four domestic markets and with regional markets and with global markets. The four policy issues are discussed below.

Regulation on Price Limits

The first policy in the study is a market stabilization regulation that imposes 10 percent price limits on daily stock price movements effective December 16, 1996. Imposing limits on daily price movements is designed to reduce trader speculation and stabilize extreme market fluctuations.² Chen, Kim, and Rui (2005) investigate the effect of price limits on illiquid stocks in China's stock market and find that illiquid B-share stocks are more likely to hit price limits than more liquid A-share stocks. They suggest that an exchange that imposes price limits should employ a wider limit for illiquid stocks, as less liquid stocks typically have wider spreads. Westerhoff (2003) develops a laboratory study to evaluate the effectiveness of price limits and finds that price limits are able to reduce price volatility and lower price distortion, particularly when traders engage in feedback trading and herding behaviors. Also Berkman and Lee (2002) find that relatively strict price limits can result in benefits of reducing price volatility and of increasing trading volume in the Korean stock market. For Taiwan and Thailand, Kim and Limpaphayom (2000) find that volatile, actively-traded, and small-size stocks are affected more often by price limit rules than are other stocks. Thus, certain characteristics of stocks are associated with the frequency of hitting the price limits. These findings support the argument that price-limit regulation has a significant influence on price movements.

²Imposing price limits is a market stabilization policy rather than a policy for promoting market liberalization. On one hand, price limit regulation may reduce market volatility and stabilize the market. On the other hand, it may have an adverse impact on market liberalization, in that price limits delay price discovery and restrict prices from fully reflecting fundamentals. Thus, the effect of price limits on market integration could be mixed; that is, market integration could be strengthened or weakened after imposing price limits.

Implementation of PRC Security Law

The second policy is the implementation of PRC (People's Republic of China) Securities Law, which is intended to protect investors and strengthen corporate governance of exchange-listed stocks as of July 1, 1999. Under the supervision of China Securities Regulatory Commission, Article 1 of the PRC Security Law states:

This law is enacted in order to standardize the issuing and trading of securities, protect the lawful rights and interests of investors, safeguard the economic order and public interests of society, and promote the development of the socialist market economy.

The law regulates the rules of corporate governance for listed companies, provides protection for market participants, and requires listed companies to disclose financial information. Brockman and Chung (2003) document that China's weak investor protection increases the bid-ask spreads and that China-based stocks suffer higher transaction costs than Hong Kong-based stocks. La Porta et al. (1998) examine the relationship between law and finance in 49 countries around the world and find that differences in law origins explain why investor protections and law enforcements differ across countries. There is significant evidence that a legal system with strong investor protection is associated with effective corporate governance and leads to better financial development and economic growth. Allen et al. (2005) point out that China adopted a gradual, dual-track path in its reform process in that China's fast-growing financial markets mesh well with its planned economic system which the government still heavily regulates. The gradual and dual-track approaches in financial market reforms, as taken by China, appear to work better than fast-track approaches that have been taken by other transition economies such as Russia and other former communist countries.

Removal of Trade Restrictions

The third reform is the removal of trading restrictions by allowing domestic residents to trade B-share stocks on February 20, 2001. Because China imposes strict restrictions on foreign currency trading and B-shares are traded in foreign currency, Chinese residents were not allowed to trade B-share stocks until this trade restriction was removed. This market liberalization policy is expected to increase the demand for B-share stocks as they become available to a wider investment group, which in turn should push prices up and attract foreign capital investments. China's restrictions on local investors are unique in global equity markets where, in general, foreign investors are restricted in trading local stocks rather than domestic investors. Because Chinese residents have to open foreign currency accounts to trade B-shares, this market liberalization reform will take time to influence markets. Bekaert et al. (2003) examine equity market liberalization and explore the impact of market liberalization on the economy. They argue that effective liberalization leads to market integration, which would reduce the cost of capital and attract foreign capital inflow.

Conversely, ineffective liberalization has little effect because either the regulatory reform is only temporary or other market imperfections still exist. In a subsequent study, Bekaert et al. (2005) find that equity market liberalizations that allow foreigners to trade local stocks or allow local residents to trade foreign stocks result in a 1 percent increase in real economic growth on average and usually coincides with reforms in financial and economic systems.

Opening to Qualified Foreign Institutional Investors (QFII)

China allowed foreigners to invest in A-share stocks by developing a QFII (qualified foreign institutional investors) system on December 1, 2002, and the approved QFII was able to make its first trade in A-share stocks on July 9, 2003. The QFII system is regulated by China Securities Regulatory Commission (SRC) and by the People's Bank of China. Article 1 of the QFII regulation states:

... Based upon China's relevant laws and administrative regulations, this regulation was promulgated for the purpose of governing Qualified Foreign Institutional Investors' investments in China's securities market and promoting developments of China's securities market.

The QFII are defined as overseas fund management firms, insurance companies, securities companies, and other asset management institutions that must be approved by China SRC to invest in China's securities market and are granted investment quotas by the State Administration of Foreign Exchange. Table 2 presents the list of QFII approved by the Chinese government at the end of 2004. Most of the foreign investors are well-known institutional investors in the West. According to *China Economic Times*, a Chinese local newspaper, UBS Limited was the first QFII approved by China's authorities and made its first A-share trades on July 9, 2003. Lin (2006) examines Taiwan's QFII system, which the Chinese government closely studies and follows, and finds that foreign investors continue to increase their holdings and play an increasingly important role in Taiwan's stock market after Taiwan gradually removed its trade restrictions on foreign investors. Berument and Dincer (2004) find that increases in foreign capital inflows lead to output increases and local currency appreciation in Turkey. The authors suggest that policymakers should be cautious in opening equity markets to foreigners because portfolio investments are volatile and unstable relative to foreign direct investment. Since China implemented the QFII system in 2003, the Chinese government has approved 3,500 million U.S. dollars for QFII to invest in A-share markets at the end of 2004. It is expected that foreign institutional investors will continue to increase their equity investment in China's A-share markets, gradually improving market efficiency.

Data and Methodology

Daily data of market price indexes of Shanghai A-shares, Shanghai B-shares, Shenzhen A-shares, Shenzhen B-shares, Hong Kong Hang Seng market index,

Table 2—Qualified Foreign Institutional Investors

Approved QFII	Country of Origin	Approved Quota Million US dollars
UBS Limited	Switzerland	800
Nomura Securities	Japan	50
Citigroup Global Markets Limited	USA	400
Morgan Stanley & International Limited	USA	300
Goldman Sachs & Co.	USA	50
HSBC Limited	UK	200
Deutsche Bank AG	Germany	300
ING Bank N.V.	Netherlands	50
JP Morgan Chase Bank	USA	50
CSFB (Hong Kong) Limited	Switzerland (HK)	50
Nikko Asset Management Co., Ltd	Japan	250
Standard Chartered Bank Hong Kong	UK (HK)	75
Hang Seng Bank Limited	HK	50
Daiwa Securities SMBC Co., Ltd.	Japan	50
Merrill Lynch International	USA	75
Lehman Brothers International Europe	UK	75
Bill & Melinda Gates Foundation	USA	100
ABN AMRO Bank N.V.	Netherlands	75
Societe Generale	France	50
Barclays Bank PLC	UK	75
BNP Paribas	France	75
Dresdner Bank Aktiengesellschaft	Germany	75
Fortis Bank	Belgium	100
Power Corporation of Canada	Canada	50
Calyon S.A.	France	75
Total		3500

Notes: Approved QFII in million U.S. dollars at the end of 2004

Japan's Nikkei 225 market index, S&P500 market index, and MSCI World index are obtained from DataStream/MSCI databases. The data about reform policies and the number of listed stocks on two stock exchanges are from various editions of *Shanghai Stock Factbook* and *Shenzhen Stock Factbook*. The QFII data are collected from the website of China Securities Regulatory Commission. The study period covers January 1, 1993 to March 31, 2005. Because the Chinese government imposed daily price limits to stabilize its markets on December 16, 1996, the sample period is separated into pre-price-limit periods and post-price-limit periods. The post-price-limit period is further divided into four sub-sample periods, each covering the time period between an event date after the selected reform policy went into effect and the date before the subsequent reform policy started. The four reform policies and the sub-sample periods are presented in Table 3. It should be noted that each sub-sample period introduces the difficulty of trying to disentangle separate policy effects because the impact of a subsequent policy on market integration also may be associated with the previous policy. Therefore, we conduct Chow tests to analyze whether each pre-specified breakpoint has changed the underlying process signifi-

Table 3—Reform Policy

Event Time Period	Shanghai Stock Market			Shenzhen Stock Market			Hong Kong			Japan			US			MSCI World		
	A Shares Mean	A Shares S.D.	B Shares Mean	B Shares S.D.	A Shares Mean	A Shares S.D.	B Shares Mean	B Shares S.D.	Market Index Mean	Market Index S.D.	Market Index Mean	Market Index S.D.	Market Index Mean	Market Index S.D.	Market Index Mean	Market Index S.D.	Market Index Mean	Market Index S.D.
Entire Sample																		
1/1/93 - 3/31/05	0.0139	2.601	0.0061	2.385	0.0053	2.509	0.0308	2.481	0.0341	1.862	-0.0141	1.506	0.0374	1.129	0.0316	0.911		
Pre Price-Limit Regulation Time: 1/1/93 - 12/15/96	0.0288	3.865	-0.0003	1.929	0.0635	3.506	0.0329	2.050	0.0951	1.579	0.0215	1.250	0.0589	0.633	0.0550	0.527		
Regulation on Price Limits Event Day: 12/16/96	-9.9196		-9.9579		-9.9974		-9.9975		-0.9483		-0.0420		0.6994		0.3157			
Post-Event: 12/16/96 - 6/30/99	0.0689	1.982	-0.0543	2.875	0.0124	2.326	-0.0701	2.948	-0.0196	2.713	-0.0389	1.756	0.1107	1.298	0.0771	1.014		
Securities Law Implementation Event Day: 7/1/99	-6.1027		-8.2306		-6.3366		-5.8700		1.3169		0.6573		-0.2231		0.3875			
Post-Event: 7/1/99 - 2/19/01	0.0424	1.532	0.0738	2.883	0.0426	1.591	-0.0098	2.759	0.6057	1.995	-0.0962	1.388	-0.0334	1.367	-0.0291	0.997		
Removal of Trade Restrictions Event Day: 2/20/01	-2.3001		0.0000		-2.8205		0.0000		-1.1390		-1.1255		-1.8681		-1.3510			
Post-Event: 2/20/01 - 7/8/03	-0.0646	1.521	0.0240	2.611	-0.0869	1.607	0.0667	2.860	-0.0969	1.502	-0.0712	1.792	-0.0598	1.560	-0.0598	1.311		
First Trade of Approved QFII Event Day: 7/9/03	1.8913		1.5065		1.6484		2.5036		-0.4408		-0.3542		-1.3572		-1.1006			
Post-Event: 7/9/03 - 3/31/05	-0.0744	1.301	-0.1120	1.517	-0.1042	1.373	0.0231	1.637	0.0721	1.095	0.0302	1.333	0.0411	0.762	0.0644	0.682		

Notes: Daily index returns and standard deviation of these daily index returns (S.D.) are presented in percentage (%). The mean daily index return represents the mean return during the selected sample period. The return in the event day is a one-day return in the selected event day.

*** indicates 1 percent significant level, ** indicates 5 percent significant level, and * indicates 10 percent significant level for F-statistics

cantly. Nonetheless, we must be cautious in interpreting our empirical results because of this overlapping event effect.

As mentioned above, the first policy to be implemented was the price-limit regulation on December 16, 1996. The Chinese government imposed 10 percent price limits upward and downward on daily stock prices in order to stabilize volatile market movements related to China's stock markets being considered highly speculative. This policy was expected to reduce speculation, cool investor overreaction, and turn market participants toward a more fundamental approach. It was expected to strengthen China's integration within its domestic markets because these four domestic markets are closely associated with China's economic development. The second policy was the implementation of PRC Securities Law on July 1, 1999, a law designed to protect investors and to improve corporate governance of China's exchange-listed stocks. The expectation is that market integration within China's four markets should be strengthened after market participants understand and follow the rules of the PRC Securities Law. Third was the removal of trading restrictions, which allowed domestic residents to trade B-share stocks on February 20, 2001. Because domestic investors would be able to trade both A-shares and B-shares after the deregulation, integration between A-share and B-share markets was expected to be enhanced. Fourth, China allowed foreigners to invest in A-share stocks by developing a QFII (qualified foreign institutional investors) system on December 1, 2002, and the approved QFII made its first trade in A-share stocks on July 9, 2003. This last market liberalization move was expected to increase the integration of China's A-share markets with regional markets and global markets because foreign investors were able to trade A-share stocks for the first time. Other important events, such as the first issuance of B-share stock in February 1992 and the introduction of mutual funds in August 2001, are not included because the B-share market was opened immediately after the A-share market and the introduction of mutual funds occurred just a few months after the third reform of trade restrictions allowing domestic residents to trade B-shares.

Before conducting any hypothesis tests for the degree of integration between China's two stock exchanges, between China's markets and regional markets, or between China's markets and global markets, the stationarity of all time series is investigated using the augmented Dickey-Fuller (ADF) test, shown as follows:

$$\Delta y_t = a_0 + \lambda y_{t-1} + \sum_{i=2}^p \beta_i \Delta y_{t-i+1} + \varepsilon_t \quad (1)$$

where the coefficient of interest is λ . The time series $\{y_t\}$ contains a unit root when λ is equal to zero. The error term ε_t is an independent and identically distributed disturbance term, and optimal lags are determined using Akaike information criterion (AIC). Results indicate that none of the time series contain a unit root and are stationary.

Domestic Integration

Initial analysis encompasses the four internal Chinese markets. The relationships between A-shares and B-shares on China's two exchanges are investigated using Granger causality tests in a four-factor vector autoregression (VAR) model. The daily market return, r , is derived by taking first differenced logs of the market price index at the end of each trading day. If returns in the two markets Granger cause each other, these two markets are viewed as integrated. Several authors have used the VAR methodology to investigate dynamic relationships between variables of interest. This study follows the method proposed by Froot et al. (2001), Karolyi (2002), and Berument and Dincer (2004). The four-factor VAR method is shown as follows:

$$\begin{aligned}
 r_{1,t} &= u_{10} + A_{11}(L)r_{1,t-1} + A_{12}(L)r_{2,t-1} + A_{13}(L)r_{3,t-1} + A_{14}(L)r_{4,t-1} + e_{1,t} \\
 r_{2,t} &= u_{20} + A_{21}(L)r_{1,t-1} + A_{22}(L)r_{2,t-1} + A_{23}(L)r_{3,t-1} + A_{24}(L)r_{4,t-1} + e_{2,t} \\
 r_{3,t} &= u_{30} + A_{31}(L)r_{1,t-1} + A_{32}(L)r_{2,t-1} + A_{33}(L)r_{3,t-1} + A_{34}(L)r_{4,t-1} + e_{3,t} \\
 r_{4,t} &= u_{40} + A_{41}(L)r_{1,t-1} + A_{42}(L)r_{2,t-1} + A_{43}(L)r_{3,t-1} + A_{44}(L)r_{4,t-1} + e_{4,t}
 \end{aligned} \tag{2}$$

where $r_{i,t}$ represents the four index returns ($i = 1, 2, 3, 4$) at time t , that is, $r_{1,t}$ is Shanghai A-share market returns, $r_{2,t}$ is Shenzhen A-share market returns, $r_{3,t}$ is Shanghai B-share market returns, and $r_{4,t}$ is Shenzhen B-share market returns; A_{ij} ($i = 1, 2, 3, 4$ and $j = 1, 2, 3, 4$) is the polynomials in the lag operator L ; and $e_{i,t}$ is independent and identically distributed disturbance terms such that $E(e_{i,t}e_{j,t})$ is not necessarily zero. It should be noted that $e_{i,t}$ and $e_{j,t}$ may be correlated although both $e_{i,t}$ and $e_{j,t}$ are white-noise processes and have zero means and constant variance. The number of lags in the VAR model explains how one variable is affected by its own past values and by past values of the remaining variables in the model. Optimal lags are determined using the Schwarz Bayesian information criterion (SBC) in that the model is selected with the lowest SBC value. Granger causality tests measure whether lags of one variable contribute to explaining the value of another variable. In a four-equation VAR model as in equation (2), for example, $\{r_{2,t}\}$ does not Granger cause $\{r_{1,t}\}$ if and only if all coefficients of $A_{12}(L)$ are equal to zero. It is straightforward to generalize this notion to our case in equation (2). Because all $A_{ij}(L)$ represent the coefficients of lagged values of variable j on variable i , the direct way to determine whether variable j Granger causes variable i is to test the restriction: $A_{ij}(L) = 0$. If $A_{ij}(L)$ is equal to zero, that is, all coefficients of lagged values of variable j on variable i are equal to zero, then variable j does not Granger cause variable i .

Equation (2) can be written more compactly:

$$R_t = u + \Gamma(L)R_{t-1} + e_t \tag{3}$$

where R_t represents a 4×1 vector of index returns at time t ; u is a 4×1 vector of intercepts; $\Gamma(L)$ is a matrix of autoregressive lag polynomials; and e_t is a 4×1 vector of error terms at time t .

Further information can be gleaned from impulse response functions that analyze how one index return responds to shocks of the other index returns. The moving average representation of equation (3) can be shown as:

$$R_t = \omega + \sum_{k=1}^P \Phi_k \varepsilon_{t-k} \quad (4)$$

The impulse response function Φ_k is a 4×4 matrix that can be used to measure the k -period response of a one-unit change in one variable shocks on the other variable; ε_t is a 4×1 vector of residuals at time t . The accumulated effects of unit impulses in ε can be obtained by appropriate summation of the coefficients of the impulse response functions. Because an estimated VAR is underestimated and is often orthogonalized using Choleski decomposition before deriving impulse responses, the results are not invariant to the ordering of the variables in the VAR. To solve this shortcoming, Koop et al. (1996) have proposed generalized impulse response functions that adjust the influence of a different ordering of the variables. The generalized impulse response functions examine the innovation in one variable and integrate the effect of other innovations by using the historical patterns of correlations observed among the different innovations. Generalized impulse response functions are plotted to show the behavior of the time sequence of responses to various shocks.

Regional and Global Integration

The regional integration analysis focuses on the relationship between the two Chinese A-share markets and the regional markets of Hong Kong and Japan. A-share markets are selected because they represent China's stock markets better than B-share markets as A-share markets are expanding rapidly while B-share markets have remained relatively unchanged since 1997. The two A-share markets represent approximately 98 percent of total market capitalization of China's publicly traded companies while the two B-share markets only represent approximately 2 percent of total market capitalization.

Based on studies such as Bracker et al. (1999) that find financial market integration to be closely related to the degree of bilateral import dependence between the markets, Hong Kong and Japan are chosen for testing regional relationships. Hong Kong and Japan are important trading partners for China and capital providers to the Asian region, suggesting that interactions of stock markets among China, Hong Kong, and Japan should be appropriate indicators of the degree of China's integration with its regional markets. For global markets, the U.S., as it is an important trading partner for China and capital provider to the world, is selected together with a

global index (MSCI world index). Thus, the interactions of stock markets among China, the U.S., and the MSCI world index should provide indications of the degree of China's integration with global markets.

Regional relationships for China, Hong Kong, and Japan stock markets are investigated using equation (2) where the Shanghai B-share return and Shenzhen B-share return variables are replaced with the Hong Kong Hang Seng index return (new r_3) and the Japanese Nikkei 225 index return (new r_4), respectively.

When testing global integration, the B-share returns (r_3 and r_4) in equation (2) are replaced with the U.S. S&P500 market index return and the MSCI world index return, respectively. Thus, the same methodology is employed for testing regional and global integration.

Volatility Transmission

In addition to testing return causality, volatility transmission among China's stock markets, regional markets, and global markets is studied. Market index returns are replaced with market index return volatility. The return volatility, rv , is derived by using a five-day moving average variance,

$$\sum_{i=1}^n \frac{(r_i - \bar{r})^2}{n-1},$$

where $\bar{r}$ is the mean of the roll-over five-day index returns. Returns are replaced with return volatilities and equation (3) can be rewritten for volatilities as follows:

$$RV_t = u + \Gamma(L)RV_{t-1} + e_t \quad (5)$$

where RV_t represents a 4×1 vector of index return volatility at time t . The same methodologies used in original equations (2), (3), and (4) are employed to investigate volatility transmission among China's stock markets, regional markets, and global markets.

Empirical Evidence

Table 3 reports summary statistics of daily stock market returns for each reform policy period. Despite China's fast-growing economy during the sample period, the stock markets experienced only small positive returns with a mean daily return of 0.0139 percent and 0.0053 percent for Shanghai A-share and Shenzhen A-share markets, respectively. Japan's stock market declined, while stock markets in Hong Kong, the U.S., and the world advanced slightly. Surprisingly, markets responded negatively to China's market stabilization reform when price-limit rules were imposed on December 16, 1996 when the A-share and B-share markets hit their 10 percent downward limits. In the subsequent two reforms, markets also declined sharply in response to the events. This seemingly irrational behavior possibly reflects China's

stock market characteristic that market participants are primarily individual investors (Fend and Seasholes, 2004). In a recent study, Fend and Seasholes (2004) find that individual investors in China engage in correlated trading behavior. If individual investors tend to buy or sell together and focus more on market sentiment than on fundamentals, market reforms may cause speculative capital outflows, selling pressure, and lower prices. The falling price in turn leads to pessimistic market sentiment which may make prices fall even further, as indicated in the first three reforms in Table 3. On the other hand, the market responded positively to A-share openness to foreign institutional investors, as expected. Investors' initial positive response is consistent with prior literature (Henry, 2000 and Bekaert et al., 2005) that documents that market liberalization attracts foreign capital inflows and creates new demand for local securities which in turn drives up local market prices.

Table 4 presents correlation coefficients among Chinese markets, regional markets, and world markets. It is worth noting that A-share (B-share) markets in Shanghai and Shenzhen are closely related with a correlation coefficient of 80.61 percent (72.37 percent) during the entire sample period. Panels B to E indicate that the correlation coefficient between A-shares and B-shares tends to increase through time, suggesting that China's four markets are becoming more closely related. Both correlation coefficients between the HK index and the JP index and those between the U.S. index and the MSCI World index, however, also increase through time, indicating a global trend of increasing correlation coefficients. Thus, we should be careful in explaining the increasing correlation coefficients between A-shares and B-shares over time. This phenomenon may result from a global trend or may be driven by market reforms. Although the correlations between Chinese markets and regional markets and the correlations between Chinese markets and global markets increase after the security law was implemented, these correlations are relatively small. For example, over the entire period, the correlation coefficient between the Shanghai A-share market with the Japanese market is 0.0294 and that between the Shanghai A-share market with the MSCI world market is -0.0022. These low correlations suggest that Chinese stock markets remain segmented from both regional and global markets. From this preliminary analysis, China's reform policies appear to have had a stronger impact on strengthening domestic market integration than integration with regional and world markets.

Table 5 reports results of Granger causality tests within China's domestic markets. Over the entire sample, return causality (Panel A) indicates no relation for the Shanghai A-share and B-share markets while Shenzhen A-share market Granger causes Shenzhen B-share market at a 5 percent significance level. Wang et al. (2004) argue that listed companies on the Shanghai exchange, which tend to be large and state-owned firms, are sheltered from a global slowdown. Listed companies in the Shenzhen exchange, which tend to be small and export-oriented firms, are vulnerable to world economic fluctuations. Moreover, the A-share market is much more liquid

Table 4—Correlation Coefficients

	Shanghai A	Shenzhen A	Shanghai B	Shenzhen B	HK Index	JP Index	US Index	MSCI World
Panel A: Entire Sample (1/1/93 - 3/31/05)								
SA	1.0000	0.8061	0.3387	0.3329	0.0448	0.0294	-0.0181	-0.0022
ZA	-	1.0000	0.3545	0.3720	0.0605	0.0350	-0.0161	-0.0036
SB		-	1.0000	0.7237	0.2312	0.0722	0.0109	0.0542
ZB			-	1.0000	0.1890	0.0943	0.0256	0.0633
HK				-	1.0000	0.3926	0.1911	0.3944
JP					-	1.0000	0.1528	0.4279
US						-	1.0000	0.8630
Panel B: Pre Price-Limit Regulation (1/1/93 - 12/15/96)								
SA	1.0000	0.7443	0.2066	0.1319	0.0082	0.0130	-0.0005	0.0282
ZA	-	1.0000	0.1853	0.1394	0.0243	0.0183	-0.0038	0.0126
SB		-	1.0000	0.3462	0.2181	0.0592	0.0048	0.0910
ZB			-	1.0000	0.0232	0.0190	0.0083	0.0133
HK				-	1.0000	0.2045	0.1137	0.3606
JP					-	1.0000	0.1057	0.5690
US						-	1.0000	0.6024
Panel C: Regulation on Price Limits (12/16/96 - 6/30/99)								
SA	1.0000	0.9284	0.4222	0.5383	0.0818	0.0334	-0.0645	-0.0616
ZA	-	1.0000	0.3973	0.5306	0.0941	0.0350	-0.0380	-0.0371
SB		-	1.0000	0.7819	0.3123	0.1134	0.0186	0.1003
ZB			-	1.0000	0.2897	0.1104	0.0191	0.0812
HK				-	1.0000	0.4014	0.2238	0.4807
JP					-	1.0000	0.1423	0.4598
US						-	1.0000	0.8448
Panel D: Securities Law Implementation (7/1/99 - 2/19/01)								
SA	1.0000	0.9856	0.6282	0.6747	0.0560	-0.0390	-0.0998	-0.1207
ZA	-	1.0000	0.6251	0.6764	0.0466	-0.0329	-0.1095	-0.1305
SB		-	1.0000	0.8514	0.1780	-0.0530	-0.0341	-0.0551
ZB			-	1.0000	0.2067	0.0181	-0.0130	0.0046
HK				-	1.0000	0.4485	0.0772	0.2838
JP					-	1.0000	0.0701	0.3072
US						-	1.0000	0.9004
Panel E: Removal of Trade Restrictions (2/20/01 - 7/8/03)								
SA	1.0000	0.9832	0.6596	0.6449	0.1216	0.1030	0.0068	0.0346
ZA	-	1.0000	0.6699	0.6614	0.1290	0.0971	0.0098	0.0365
SB		-	1.0000	0.8930	0.1795	0.1078	0.0347	0.0583
ZB			-	1.0000	0.1932	0.1437	0.0496	0.0819
HK				-	1.0000	0.5776	0.3261	0.4631
JP					-	1.0000	0.2122	0.3925
US						-	1.0000	0.9337
Panel F: First Trade of Approved QFII (7/9/03 - 3/31/05)								
SA	1.0000	0.9584	0.7658	0.7433	0.1546	0.1136	0.0339	0.0957
ZA	-	1.0000	0.7810	0.7704	0.1552	0.1251	0.0428	0.1058
SB		-	1.0000	0.7724	0.1450	0.0949	0.0355	0.0790
ZB			-	1.0000	0.2319	0.2211	0.1102	0.1875
HK				-	1.0000	0.5421	0.2209	0.4494
JP					-	1.0000	0.2325	0.4824
US						-	1.0000	0.8694

Notes: SA (SB) represents Shanghai A (B) share index returns and ZA (ZB) represents Shenzhen A (B) share index returns

Table 5—Integration between China's Domestic Stock Markets

Panel A Return Causality	Granger Causality of A Share and B Share				Granger Causality of Index Returns across Exchanges				Four-Factor VAR Model	
	Shanghai Stock Market		Shenzhen Stock Market		A-Share Stock Market		B-Share Stock Market		lags	SBC
	SA causes SB	SB causes SA	ZA causes ZB	ZB causes ZA	SA causes ZA	ZA causes SA	SB causes ZB	ZB causes SB		
Entire Sample	0.8083	1.1757	4.8437**	0.2507	0.2507	3.5853*	0.3841	3.4739*	1	-20.16
Pre Price-Limit Regulation										
Period 1/1/93 - 12/15/96	0.6178	0.0714	0.0460	0.0136	0.01356	3.2292*	2.5188	46.0202***	1	-18.63
Regulation on Price Limits										
Period 12/16/96 - 6/30/99	0.0109	0.0712	2.5993	0.3173	1.8648	2.8194*	0.9478	0.0018	1	-21.21
Securities Law Implementation										
Period 7/1/99 - 2/19/01	4.115**	0.0336	4.8479**	0.5558	3.6965*	4.0935**	0.4779	0.7407	1	-24.75
Removal of Trade Restrictions										
Period 2/20/01 - 7/8/03	0.9469	2.4810	0.0007	0.5775	0.1527	0.6274	2.4898	0.5363	1	-25.24
First Trade of Approved QFII										
Period 7/9/03 - 3/31/05	0.7171	7.6689***	3.2396*	0.3557	2.1523	2.5284	1.0306	2.0359	1	-26.92
Panel B										
Volatility Transmission	Granger Causality of A Share and B Share				Granger Causality of Index Returns across Exchanges				Four-Factor VAR Model	
	Shanghai Stock Market		Shenzhen Stock Market		A-Share Stock Market		B-Share Stock Market		lags	SBC
	SA causes SB	SB causes SA	ZA causes ZB	ZB causes ZA	SA causes ZA	ZA causes SA	SB causes ZB	ZB causes SA		
Entire Sample	3.3717	4.5545	18.2592**	1.9821	8.5165	17.4801**	16.7206**	32.7297***	7	-50.26
Pre Price-Limit Regulation										
Period 1/1/93 - 12/15/96	14.6538**	5.4258	2.8577	0.2635	4.2855	11.7523*	44.2580***	18.1960***	6	-48.33
Regulation on Price Limits										
Period 12/16/96 - 6/30/99	35.1242***	31.5745***	113.8281***	44.2973***	212.6881***	71.2695***	25.5331***	18.1690**	8	-53.85
Securities Law Implementation										
Period 7/1/99 - 2/19/01	33.3068***	6.4063	44.2526***	24.6917***	13.0833**	13.2640**	29.4505***	30.0954***	6	-57.97
Removal of Trade Restrictions										
Period 2/20/01 - 7/8/03	6.2050	15.6263**	7.0090	9.9253	8.5349	12.4965*	18.9958***	4.5615	6	-57.96
First Trade of Approved QFII										
Period 7/9/03 - 3/31/05	4.0791	5.0860	5.4890	1.5762	14.9920**	6.1382	4.9799	2.6173	6	-64.84

Notes: SA (SB) represents Shanghai A (B) share index and ZA (ZB) represents Shenzhen A (B) share index
 *** indicates 1% significant level, ** indicates 5% significant level, and * indicates 10% significant level for F-statistics

than the B-share market, suggesting that A-shares are able to reflect market sentiment more quickly than B-shares. The different characteristics between A-shares and B-shares may help explain why the Shenzhen A-share market Granger causes the Shenzhen B-share market. Across exchanges, only a weak relationship is identified for the A-share market and the B-share markets. Neither regulation of price limits nor removal of trade restrictions caused any significant changes. Securities law implementation, however, created significant return causality from Shanghai A-share market to Shanghai B-share market, from Shenzhen A-share market to Shenzhen B-share market, and dual causality between Shanghai and Shenzhen A-share markets. QFII trade approval, like security law implementation, created causality within exchanges but none across exchanges.

Volatility effects of the policies shown in Panel B are more significant than return effects. Volatility impacts are greatest for the price limit regulation, with all pairs exhibiting bidirectional causality. Similar to return effects, volatility impacts are also great for the security law implementation, with all relations being significant except for B share volatility to A share volatility in Shanghai. This strong bidirectional causality is weakened after the removal of trading restrictions and the QFII trade approval indicates no relation within exchanges and only one significant causality across exchanges. The combined effects of return and volatility causalities indicate that the security law had a major impact on market integration, particularly via volatility transmission. The removal of trade restrictions on B-shares for Chinese residents and A-share openness to approved foreign investors, however, only marginally increases causality among China's stock markets. This finding does not support the hypothesis that market liberalization strengthens integration within domestic markets. One possible explanation is ineffective liberalization. Bekaert et al. (2003) argue that ineffective liberalization has little effect because either the regulatory reform is short-lived or other market imperfections remain. Although the Chinese authority partially opened its stock markets to foreign investors, China's foreign exchange markets are still strictly regulated and foreign ownership of Chinese stocks is restricted and limited. Thus, while China's security law implementation increased return causality and volatility transmission among Chinese stock markets, these relationships were not strengthened after China opened its A-share markets to foreign investors.

Table 6 reports causality tests between China's markets and regional markets. Panel A indicates that for the entire sample period there is no significant return causality between Chinese markets and regional markets. None of the reform policies creates significant causality, suggesting that China's stock markets remain segmented from regional markets. The approved QFII lists in Table 2 provide a clue. As most approved foreign investors are from the U.S. and Europe rather than from Hong Kong and Japan, A-share market liberalization may be ineffective for investors from the Asian region. This ineffective liberalization would have little impact on

Table 6—Integration between China's Stock Markets and Regional Markets

Panel A	Granger Causality of China and Hong Kong				Granger Causality of China and Japan				Four-Factor VAR Model lags
	Shanghai Stock Market HK causes SA	Shanghai Stock Market SA causes HK	Shenzhen Stock Market HK causes ZA	Shenzhen Stock Market ZA causes HK	Shanghai Stock Market JP causes SA	Shanghai Stock Market SA causes JP	Shenzhen Stock Market JP causes ZA	Shenzhen Stock Market ZA causes JP	
Entire Sample	0.1724	0.0061	0.0286	0.3364	0.6144	0.3985	1.1241	0.3119	-20.87
Pre Price-Limit Regulation									
Period 1/1/93 - 12/15/96	0.1560	0.3372	0.1380	0.0371	0.2295	2.6432	0.7012	1.1139	-19.64
Regulation on Price Limits									
Period 12/16/96 - 6/30/99	1.2619	1.4853	0.0921	0.4079	0.9087	1.7125	0.6361	2.8279	-21.28
Securities Law Implementation									
Period 7/1/99 - 2/19/01	0.0470	0.6023	0.0384	1.2201	1.6831	1.8197	2.0297	0.9759	-25.13
Removal of Trade Restrictions									
Period 2/20/01 - 7/8/03	0.3401	2.1030	0.2679	1.5561	0.2303	0.0236	0.1164	0.0019	-25.36
First Trade of Approved QFII									
Period 7/9/03 - 3/31/05	0.5380	0.4862	0.4422	1.1812	0.3498	0.5668	0.6713	0.3048	-26.25
Panel B									
Volatility Transmission	Granger Causality of China and Hong Kong				Granger Causality of China and Japan				Four-Factor VAR Model lags
	Shanghai Stock Market HK causes SA	Shanghai Stock Market SA causes HK	Shenzhen Stock Market HK causes ZA	Shenzhen Stock Market ZA causes HK	Shanghai Stock Market JP causes SA	Shanghai Stock Market SA causes JP	Shenzhen Stock Market JP causes ZA	Shenzhen Stock Market ZA causes JP	
Entire Sample	0.9334	1.9245	0.9177	1.9827	2.3378	2.4384	2.8710	1.8566	-53.22
Pre Price-Limit Regulation									
Period 1/1/93 - 12/15/96	3.6777	6.4697	2.4782	4.8856	1.3222	4.6235	1.3584	3.8968	-53.04
Regulation on Price Limits									
Period 12/16/96 - 6/30/99	4.8500	11.9050	6.6666	7.8143	2.0771	10.5630	2.5743	17.6720**	-54.20
Securities Law Implementation									
Period 7/1/99 - 2/19/01	17.6446***	8.9795	16.6205**	12.6949**	3.1131	2.6294	3.1685	2.7766	-61.70
Removal of Trade Restrictions									
Period 2/20/01 - 7/8/03	5.9891	3.7500	6.0773	4.5055	2.4476	0.5957	2.5802	1.3963	-62.14
First Trade of Approved QFII									
Period 7/9/03 - 3/31/05	1.8103	5.3689	3.2067	4.9780	2.6526	7.9695	6.1422	7.8654	-66.63

Notes: SA represents Shanghai A-share index, ZA represents Shenzhen A-share index, HK represents Hang Seng market index, and JP represents Nikkei 225 market index

Panel A (B) tests the return causality (volatility transmission) among Shanghai A-share market, Shenzhen A-share market, Hong Kong's market, and Japan's market using a four-factor VAR model. Optimal lags are determined using the Schwarz Bayesian Information Criterion (SBC) in that the model is selected with the lowest SBC value

*** indicates 1% significant level, ** indicates 5% significant level, and () indicates 10% significant level for F-statistics

market integration, as anticipated by Bekaert et al. (2003). Panel B shows volatility transmission similar to return causality for the entire period, with little significant causality between Chinese markets and regional markets. Security law implementation causes significant bidirectional volatility causality among Hong Kong and China's A-share markets. This indicates that risk transmission is stronger than return causality between China and Hong Kong. A part of this equity market influence between China and Hong Kong no doubt is related to the close economic (trading) ties between the two countries and to the political power of China over Hong Kong. When Hong Kong became a Special Administration Region of China in July 1997, some degree of integration between China and Hong Kong was inevitable in spite of Hong Kong's high degree of autonomy and liberty. The Chinese government developed a so-called principle of one country with two systems where China has a planned economic system and Hong Kong maintains its market-oriented economic system although Hong Kong is a part of China. Thus, transmission from China to Hong Kong without reverse transmission effects is not surprising. In contrast, the integration of China with Japan is weak based on both return causality and volatility transmission.

Table 7 presents results of causality tests between China's stock markets and global markets. Similar to China's integration with regional markets, the return causality and volatility transmission between China's markets and world markets is weak. The major influence of the reforms occurs with the opening of China's A-share markets to foreign institutional investors where both U.S. return volatility and world return volatility Granger cause return volatility in China's two A-share markets. This suggests that allowing foreign portfolio investment has a large impact on risk transmission between China's stock markets and world stock markets making China's markets more susceptible to U.S. and global influences. Even though market returns between China and the world are not closely linked, return volatility of the U.S. stock market and global stock markets plays an important role in China's stock market. If foreign institutional investors gradually increase their holdings of China's stocks, they should contribute further to linking China with the world, a finding for Taiwan's stock market documented by Lin (2006).

Tests are conducted to determine if each pre-specified breakpoint has changed the underlying process. Table 8 reports the results of Chow tests that indicate structural change between China's domestic stock markets after the reform policies, but indicate little structural change for the causality between China's stock markets and regional stocks. The tests use the entire sample for the model and the dates of policy reforms serve as breakpoints for the Chow test. Panel A indicates that three policies (price limit regulation, security law implementation, and removal of trade restriction) have changed the relationship of China's domestic stock market. The causality that Shanghai (Shenzhen) B-share market is affected by Shanghai (Shen-

Table 7—Integration between China's Stock Markets and World Markets

Panel A		Granger Causality of China and US				Granger Causality of China and the World				Four-Factor VAR Model	
Return Causality		Shanghai Stock Market		Shenzhen Stock Market		Shanghai Stock Market		Shenzhen Stock Market		lags	SBC
		US causes SA	SA causes US	US causes SA	SA causes US	WR causes SA	SA causes WR	WR causes SA	SA causes WR		
Entire Sample		0.0459	0.9580	0.2577	2.7433*	0.4068	0.5240	0.9672	1.5201	1	-24.21
Pre Price-Limit Regulation											
Period 1/1/93 - 12/15/96		0.1400	0.2396	0.8523	3.4553*	0.0222	0.4730	0.4585	2.0628	1	-23.69
Regulation on Price Limits											
Period 12/16/96 - 6/30/99		0.4711	5.7342**	0.9444	7.9718***	0.4360	1.3092	0.0298	2.2191	1	-25.09
Securities Law Implementation											
Period 7/1/99 - 2/19/01		1.6401	0.0006	1.4237	0.0026	0.3686	0.1522	0.3170	0.1511	1	-28.19
Removal of Trade Restrictions											
Period 2/20/01 - 7/8/03		0.0762	1.1105	0.3484	1.2103	0.2621	0.4063	0.7641	0.3934	1	-27.78
First Trade of Approved QFII											
Period 7/9/03 - 3/31/05		0.9294	1.0804	1.5422	0.9230	0.3467	0.3967	0.7280	0.3173	1	-29.53
Panel B		Granger Causality of China and US				Granger Causality of China and World				Four-Factor VAR Model	
Volatility Transmission		Shanghai Stock Market		Shenzhen Stock Market		A-Share Stock Market		B-Share Stock Market		lags	SBC
		US causes SA	SA causes US	US causes SA	SA causes US	WR causes SA	SA causes WR	WR causes SA	SA causes WR		
Entire Sample		1.3947	0.9696	0.9584	0.6798	0.9064	0.1583	1.3349	0.4523	7	-58.86
Pre Price-Limit Regulation											
Period 1/1/93 - 12/15/96		6.0630	6.6359	3.5286	1.8370	2.1715	5.3401	3.7937	6.2304	6	-61.29
Regulation on Price Limits											
Period 12/16/96 - 6/30/99		2.2506	9.3970	4.6163	7.2016	1.0642	0.7169	2.6847	1.2996	6	-60.86
Securities Law Implementation											
Period 7/1/99 - 2/19/01		1.5138	6.9713	1.7258	7.6333	3.3092	12.5560*	3.6658	12.881**	6	-66.56
Removal of Trade Restrictions											
Period 2/20/01 - 7/8/03		3.9544	3.3285	3.9323	3.1381	4.7110	3.4225	4.4470	4.0005	6	-64.37
First Trade of Approved QFII											
Period 7/9/03 - 3/31/05		12.63**	5.1210	14.1800**	4.4880	12.9400**	2.0190	14.1300**	1.3910	6	-71.39

Notes: SA represents Shanghai A-share index, ZA represents Shenzhen A-share index, US represents the S&P500 market index, and WR represents the MSCI world index

Panel A (B) tests the return causality (volatility transmission) among Shanghai A-share market, Shenzhen A-share market, the U.S. market, and the MSCI world market using a four-factor VAR model. Optimal lags are determined using the Schwarz Bayesian Information Criterion (SBC) in that the model is selected with the lowest SBC value

*** indicates 1% significant level, ** indicates 5% significant level, and * indicates 10% significant level for F-statistics

Table 8—Chow Test

Panel A		Chow Test of A Share and B Share				Chow Test of China's Index Returns across Exchanges			
		SA causes SB	SB causes SA	ZA causes ZB	ZB causes ZA	SA causes ZA	ZA causes SA	SB causes ZB	ZB causes SB
12/16/1996	Regulation on Price Limits	12.7704***	0.8898	13.8628***	2.2188*	1.1410	2.5783*	7.2703***	17.7719***
7/01/1999	Securities Law Implementation	9.3617***	1.7446	8.7658***	2.3430*	0.6626	1.5372	6.1227***	8.5318***
2/20/2001	Removal of Trade Restrictions	4.1302***	1.3667	4.3570***	1.3165	0.6400	1.0780	3.0507**	3.7651**
7/09/2003	First Trade of Approved QFII	0.9187	0.9407	0.1876	0.3204	0.3534	0.6774	0.2616	0.9588
Panel B		Chow Test of China and HongKong				Chow Test of China and Japan			
		HK causes SA	SA causes HK	HK causes ZA	ZA causes HK	JP causes SA	SA causes JP	JP causes ZA	ZA causes JP
12/16/1996	Regulation on Price Limits	0.2924	2.9960**	0.6657	2.1249*	0.0270	1.2600	0.6443	0.6188
7/01/1999	Securities Law Implementation	0.2003	0.7884	0.3431	0.6297	0.4001	2.8776**	0.5702	2.3560*
2/20/2001	Removal of Trade Restrictions	0.3143	1.1372	0.5274	1.1591	0.6986	0.8349	1.0242	0.6396
7/09/2003	First Trade of Approved QFII	0.1349	0.5238	0.2348	0.6480	0.2446	0.3452	0.4365	0.2821
Panel C		Chow Test of China and US				Chow Test of China and the World			
		US causes SA	SA causes US	US causes ZA	ZA causes US	WR causes SA	SA causes WR	WR causes ZA	ZA causes WR
12/16/1996	Regulation on Price Limits	0.2383	0.3742	1.0318	0.3267	0.1081	0.3949	0.5651	0.3920
7/01/1999	Securities Law Implementation	0.5197	1.7849	0.5593	2.2414*	0.5297	1.0211	0.6607	1.0886
2/20/2001	Removal of Trade Restrictions	0.3078	0.9111	0.5336	1.1849	0.3196	0.4797	0.5194	0.4987
7/09/2003	First Trade of Approved QFII	0.1537	0.2903	0.2797	0.2816	0.1372	0.1977	0.2407	0.1897

Notes: SA (SB) represents Shanghai A (B) share index, ZA (ZB) represents Shenzhen A (B) share index, HK represents Hang Seng market index, and JP represents Nikkei 225 market index, US represents the S&P500 market index, and WR represents the MSCI world index.

*** indicates 1% significant level, ** indicates 5% significant level, and * indicates 10% significant level for F-statistics

zhen) A-share market and the causality that Shanghai B-share market and Shenzhen B-share market affect each other has changed at a 5 percent significance level after the three breakpoints. The causality between Shanghai A-share market and Shenzhen A-share market does not change significantly after policy reforms. Panels B and C indicate that, in most cases, each breakpoint has not significantly changed the causality between China's stock market and regional stock markets as well as between China's stock market and global stock markets. Furthermore, Tables 5, 6, and 7 reveal that the numbers of lags in returns and in volatility (no more than eight lags) have only short memories. This suggests that the impact of a subsequent policy may be only weakly associated with the previous policy. Thus, event-based subsamples appear to be appropriate for testing the impact of each reform on market integration.

Impulse response functions investigate how one variable responds to the innovation of the other variables. Generalized impulse response functions (IRF) for the four domestic Chinese markets are shown in Figure 1 where Panels A, B, C, and D indicate the IRF for the four reform policies, respectively. In general, return responses of one Chinese market to return innovations in its remaining three markets decay to zero in approximately four trading days for each sub-sample. This suggests that the impact of one domestic market's response to return innovation from another domestic market is short term and does not change after each market reform. IRFs for regional markets and world markets are not reported, as they are almost identical to domestic market results. In all cases, responses of Chinese markets to innovations in the regional and world markets decay to zero in approximately four trading days. Thus, Chinese stock market's response to return shocks from its own domestic market, from regional markets, and from world markets are short term, and this short-term effect does not change when China implements its four major reform policies.

Conclusions

This paper measures the effect of major reform policies on Chinese stock market information transmission by investigating whether the policies facilitate causality of the four stock markets (two exchanges) within China, of China with regional markets and of China with global markets. China's reform policies appear to have had a stronger impact on domestic market integration than on regional or global integration. In general, initial responses of investors to regulation of price limits, security law implementation, and removal of trade restrictions are negative. Opening A-share markets to foreign investors, however creates positive responses for domestic Chinese markets.

For internal domestic markets, causality effects are stronger via volatility transmission than return causality, and causality relationships indicate that security law impacts are not strengthened after China opens its A-share markets to foreign investors. The existence of weak return causality and minimal volatility transmission

between Chinese markets, regional markets, and global markets indicates that China's stock markets remain segmented from the rest of the world. The greatest impact on regional or global relationships occurs for volatility transmission with global markets after China opened its A-shares markets for foreign institutional investors in 2003. That event initiated significant volatility effects from the U.S. and from the world to the Chinese markets. Thus, market liberalization in allowing foreign portfolio investment has had greater impact on risk transmission than on return causality between China's stock markets and global stock markets.

To summarize, the evidence indicates that China's security law implementation was able to strengthen integration within its four domestic stock markets and facilitate volatility transmission between China and Hong Kong. Moreover, market liberalization by opening A-share markets to foreign investors facilitated volatility transmission between China's stock markets and world markets, but had little impact on China's integration with regional markets. On the other hand, effects of regulation of price limits and removal of trade restrictions did not increase integration at any level. Therefore, China's segmented markets continue to provide benefits for international diversification. The results of China's reform policies in security law implementation and stock market liberalization provide useful information for policymakers from other countries, particularly those in transition economies, who may be considering whether to employ similar reform policies.

Figure 1—Impulse Response Functions for Domestic Markets (vertical axis is response; horizontal axis is time)

Panel A: Regulation on Price Limits

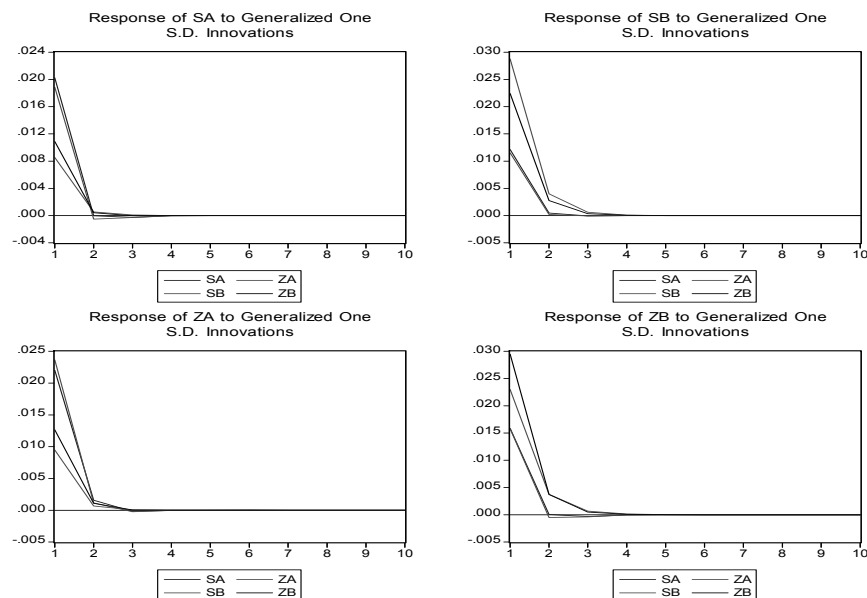


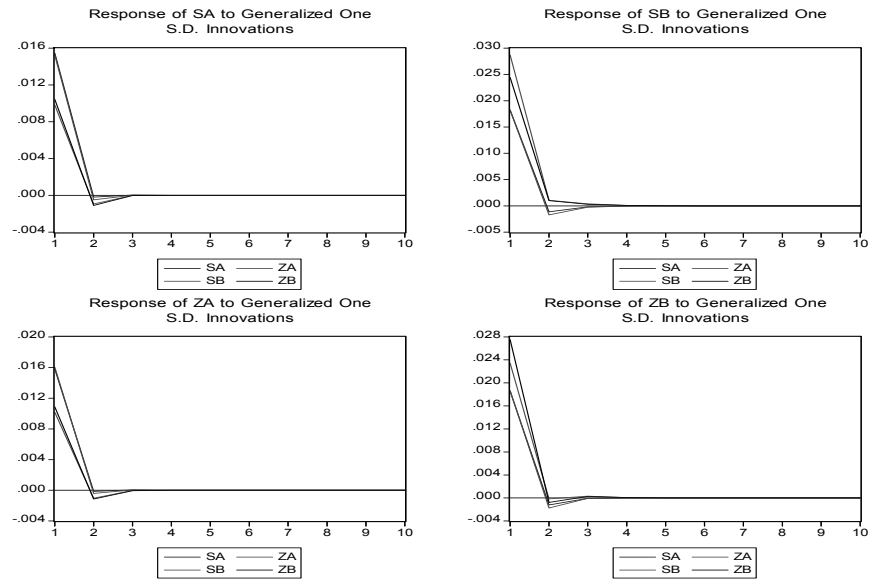
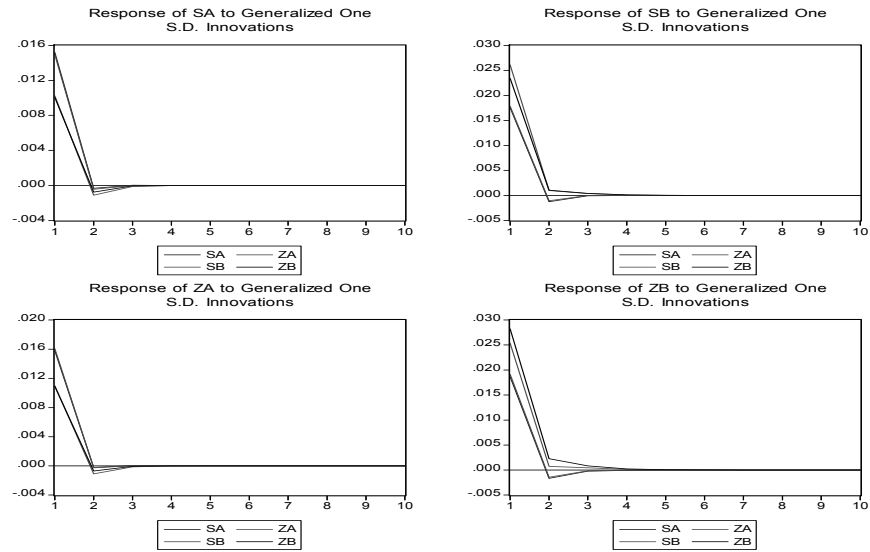
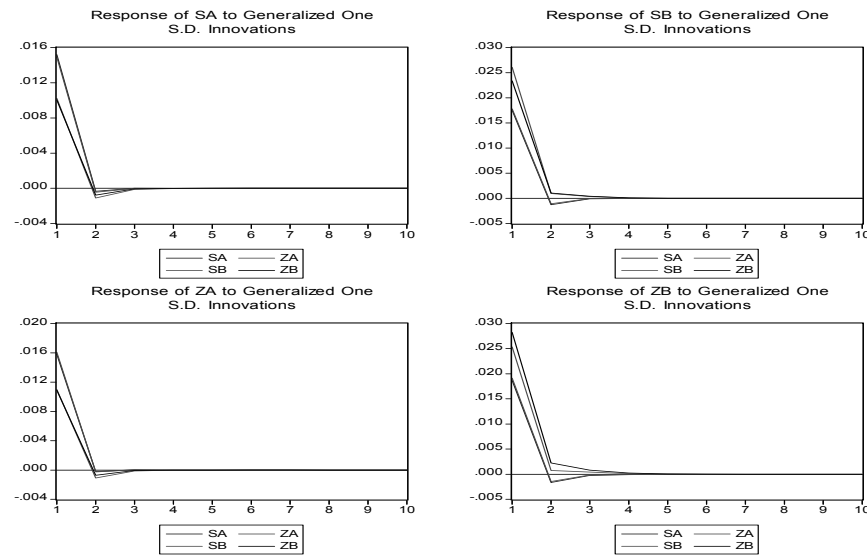
Figure 1 (cont.)—Impulse Response Functions for Domestic Markets (vertical axis is response; horizontal axis is time)**Panel B: Security Law Implementation****Panel C: Removal of Trade Restrictions**

Figure 1 (cont.)—Impulse Response Functions for Domestic Markets (vertical axis is response; horizontal axis is time)

Figure D: First Trade of Foreign Investors



Notes: SA (SB) represents Shanghai A (B) share index, ZA (ZB) represents Shenzhen A (B) share index. The horizontal axis represents time periods (days) and the vertical axis represents the responses of one market to generalized one standard deviation (S.D.) innovation in its remaining three markets. Impulse response functions investigate how one variable responds to the innovation of the other variable. Return responses of one Chinese market to return innovations in its remaining three markets decay to zero in approximately four trading days for each sub-sample. This suggests that the impact of one domestic market's response to return innovation from another domestic market is short term and does not change after each market reform

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