

# Accepted Manuscript

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PII: S1042-4431(17)30434-1  
DOI: <http://dx.doi.org/10.1016/j.intfin.2017.09.006>  
Reference: INTFIN 972

To appear in: *Journal of International Financial Markets, Institutions & Money*

Received Date: 20 June 2016  
Accepted Date: 12 September 2017

Please cite this article as: Y. Bai, D. Yan Pang Chow, Shanghai-Hong Kong Stock Connect: An Analysis of Chinese Partial Stock Market Liberalization Impact on the Local and Foreign Markets, *Journal of International Financial Markets, Institutions & Money* (2017), doi: <http://dx.doi.org/10.1016/j.intfin.2017.09.006>

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# Shanghai-Hong Kong Stock Connect: An Analysis of Chinese Partial Stock Market Liberalization Impact on the Local and Foreign Markets<sup>1</sup>

by

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<sup>1</sup> This paper is based on and extends Yan Pang Chow's MBA Dissertation at University of Nottingham. Darien thanks his family and fiancé for their support. We thank the useful comments and suggestions made by participants in the Fourth International Symposium in Computational Economics and Finance (ISCEF), April 14-16, 2016, in Paris.

## Shanghai-Hong Kong Stock Connect: An Analysis of Chinese Partial Stock Market Liberalization Impact on the Local and Foreign Markets

### Abstract

Shanghai-Hong Kong Stock Connect is a partial liberalization providing domestic and foreign investors mutual access to stock markets. This study analyzes post-liberalization short- and medium-term impacts on both local and foreign markets. Our results suggest that contrasting to the expectation of homogeneous mutual benefits, the implementation of the Connect have asymmetric impacts on mainland and Hong Kong stock markets. They are driven by the unbalanced developments of both markets. In the medium-term, we find increasing market liquidity and size but also increasing risk persistence and exposure to systematic risk, though the magnitude of changes vary between two markets.

Keywords: Shanghai-Hong Kong Stock Connection, stock market liberalization, event study

JEL Classification: F21; G14; G18

## 1. Introduction

As the second largest economy, China is yet to fully liberalize its capital account and it has taken a gradualism approach (Harrold, 1992) to financial liberalization including its stock market liberalization. The implementation of Shanghai-Hong Kong Stock Connect (SHSC<sup>2</sup>) on 17 November 2014 is the first tangible progress on Chinese stock market liberalization post 2007/08 crisis. SHSC has a rather special feature compared with other liberalizations we have seen so far in the sense that it allows foreigners to purchase shares in Chinese stock market (normal sense of liberalization), simultaneously, it also allows domestic Chinese investors to purchase foreign<sup>3</sup> shares (reverse liberalization) (Henry, 2000). So far majority of the literature on Chinese stock market liberalization has focused on either the normal liberalization (e.g. B-share market (Chen, Lee and Rui, 2001; Chiang, Nelling and Tan, 2008); Qualified Foreign Institutional Investor scheme (QFII) (Hao, 2007; Alhaj-Yaseen, Rao, and Jin, 2016) ) or the reverse liberalization (e.g. opening of B-share market to Chinese local investors (Chan, Menkveld and Yang, 2007; Karolyi, Li and Liao, 2009; Sun, Tong and Yan, 2009); Qualified Domestic Institutional Investor scheme (QDII) (Liguang, 2010; Zhen, 2012) ). In both cases, the literature has focused primarily on the partially liberalized mainland market. Given the size and dynamism of Chinese economy, these financial reforms inevitably affect the global financial system especially China's regional trade and financial partners (Glick and Hutchison, 2013). SHSC provides a unique opportunity for us to analyze

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<sup>2</sup> Shanghai-Hong Kong Stock Connect (SHSC); Pilot Program for Direct Foreign Portfolio Investments by Domestic Individuals (Through Train); Shanghai Stock Exchange (SHSE); Qualified Foreign Institutional Investor scheme (QFII); Qualified Domestic Institutional Investor scheme (QDII); Hong Kong Stock Exchange (HKSE); China Securities Depository and Clearing Corporation Limited (ChinaClear); China Securities Regulatory Commission (CSRC); Hong Kong Securities and Futures Commission (SFC); Hong Kong Exchanges and Clearing Limited (HKEx); Hang Seng Index (HS\_I); Shanghai stock exchange Composite Index (SHI) and Shenzhen stock exchange Composite Index (SZI); Shanghai stock exchange 180 Index (SH180); Shanghai stock exchange 380 Index (SH380); Hang Seng Composite Index LargeCap Index (HSLC); Hang Seng Composite Index MidCap Index (HSMC); Seeming Unrelated Regression (SUR).

<sup>3</sup> Hong Kong officially is Hong Kong Special Administrative Region of the People's Republic of China. In the context of this study, it is treated as a separate financial market to the mainland China. Hence the word "foreign".

the impact of this mutual access liberalization on both of the host market (Shanghai stock market) and the destination market (Hong Kong stock market). From both geographical and strategic points of view, thriving as an intermediary, Hong Kong remains the most important offshore RMB hub. Hong Kong has maintained its competitive edge with the largest pool of liquidity from retail and wholesale RMB deposits and financial products in RMB. SHSC supports continuing growth in value and volume of RMB transactions (Fung and Yau, 2012). Before the implementation of SHSC, Chinese government and media have been promoting the expected benefits such as increasing new volumes of international investment into the Shanghai Stock Exchange (SHSE), increased integration of China's capital markets into the global economy, providing investors from both sides greater access to a broader range of equities and enhance Hong Kong's role as an offshore RMB trading hub. However, there are also uncertainties including tax, legal, and operational issues that may lead some investors to delay their full participation.<sup>4</sup> It is not self-evident how these expectations and uncertainties will materialize at different stages of the program in both markets. The aim of this study is to investigate i) whether and how both markets react differently in the short-term to the stock liberalization event; ii) how different market characteristics of both local and foreign markets explain the variations in their reactions and iii) the medium-term impacts of SHSC on market characteristics in both local and foreign markets.

To sum up, this study intends to contribute to the literature in the following areas: 1) SHSC is a unique liberalization event that involves foreign investors (likely to be institutional investors) entering an emerging market and at the same time, domestic retail investors entering into a mature market dominated by institutional investors. Unlike most studies on

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<sup>4</sup> According to trading data reported by Shanghai Stock Exchange and the Hong Kong Exchanges and Clearing Limited, by April 2016, there is only fractional usage of the daily quota (average daily buy trades/the daily quota) in both Southbound and Northbound trading. Even at the peak time of April 2015 (June 2015), the fractional usage of Southbound (Northbound) quota is only around 57% (45%) (based on authors' own calculations).

liberalization focusing primarily on the liberalized domestic market, we focus on comparing the liberalization impacts on both emerging and mature markets. 2) Unlike two existing studies (Huo and Ahmed, 2017; Lin, 2017) on SHSC, we focus more on the short-term and medium-term impacts of SHSC instead of trying to draw conclusions on any long-term impact considering SHSC was only implemented two years ago. 3) China has taken a gradualism approach to stock market liberalization. Pilot Program for Direct Foreign Portfolio Investments by Domestic Individuals (“Through Train”) is the first liberalization targeting at Chinese retail investors. “Through Train” bears important implications to the subsequent SHSC. As far as we are aware, this is the first study examines sequential partial liberalizations. 4) Our study provides indirect evidence to i) the debate on whether foreign investors have information disadvantage compared with the domestic investors especially when they enter an emerging market; ii) how government policy credibility affects investors including foreign investors.

The rest of the paper is organised as follows. Section 2 develops the hypotheses for testing based on critical review of literature and discussions of operational and market-specific issues. Section 3 discusses the data and methods. Section 4 presents empirical results and discussions. The last section concludes.

## **2. Literature Review and Hypotheses**

### *2.1 A brief review of the existing literature on Chinese market liberalization*

Learning from previous experiences, especially the Asian financial crisis, China has adopted a prudential and gradual process of financial openness (Prasad and Wei, 2007). The Chinese government first opened the B-share market to domestic investor in 2001; then opened up A-share market to overseas institutional investors under the QFII in 2002 and then gave

domestic institutional investors limited access to foreign markets under the QDII in 2006. Several literature focus on various impacts of these market liberalizations, for instance, positive effects on the B-share market (Sun, Tong and Yan, 2009), cointegration between the A- and B-share markets (Chan, et al., 2007) and the improved speed of adjustment to information (Chiang, Nelling, Tan, 2008) after ownership restrictions lifted in B-share market; eroded speculative trading as a result of market liberalization (Alhaj-Yaseen, Rao and Jin, 2017); mitigated degree of information asymmetry and B-share discount upon market liberalization (Karolyi, et al., 2009; Doukas and Wang, 2013); interdependence between China and other Asian markets (Glick and Hutchison, 2013). Most of these literature investigate a particular unilateral capital flow type of liberalization and the Chinese mainland market, i.e. the host in the liberalizations.

In contrast, only couple of studies investigate the recent liberalization, SHSC. The China Securities Regulatory Commission (CSRC) and the Hong Kong Securities and Futures Commission (SFC) made the joint announcement on 10 April 2014 for the establishment of SHSC for the mutual stock market access between Shanghai and Hong Kong stock markets. Then it was officially launched on 17 November 2014. Using dynamic forecasting method, Huo and Ahmed (2017) find that SHSC contributes to the increasing importance of the mainland market and economic activity but also increased conditional variance of both markets. They also suggest a weak and unstable cointegration relationship post-SHSC. It is hardly surprising since their sample period ends about five months after the launch of the programme. Applying ARMA-t-BEKK-AGARCH models to Hang Seng Index (HS\_I) and Shanghai stock exchange Composite Index (SHI), Lin (2017) shows that shocks spillover is still unidirectional from Hong Kong to Shanghai while the long-term volatility transmission persistence changes from being significant to insignificant post-SHSC. In contrast, using all

the eligible market indices under SHSC, part of our study examines the SHSC medium-term impact on volatility clustering, the magnitude of shock and market linkages.

## *2.2 Discussion and literature review of operational and market-specific issues*

Due to the poor performance of QDII funds (Robinson and Newman, 2008), the focus of Chinese market liberalization has moved from institutional to retail investors to further encourage the outflow of domestic capital. Chinese government announced the “Through Train” on 20 August 2007, which allows domestic residents in Tianjin<sup>5</sup> Binhai New Area to invest into Hong Kong Stock Exchange (HKSE) for the first time (Thomson Reuters, 2014). However, the “Through Train” was abandoned shortly by the Chinese government due to the fear of financial instability and excessive capital outflow (WSJ, 2008). The abandon of “Through Train” may have profound influence on the market reactions to the following announcement of SHSC. Literature suggest that domestic investors have an informational advantage over foreign investors as the latter face more severe information asymmetry in an emerging market such as China where there are relatively limited investor protection, ineffective legal enforcement and under-developed accounting–auditing systems (e.g. Chan et al., 2007; Chiang, Nelling and Tan, 2008; Yao, 2014; Yao, Ma and He, 2014). Literature on government policy credibility such as Sin (2015) also shows that in both short- and long-run, the impact of mainland economic policy uncertainty on Hong Kong's output, interest rate or price is generally insignificant.

Hong Kong faces some uncertain issues associated with SHSC. As the first tangible liberalization for retail investors post 2007/08 financial crisis, Chinese regulators have adopted various restrictions to limit the pace and the magnitude of capital outflows under

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<sup>5</sup> Tianjin is a northeast city next to Beijing. It has aspirations to become a financial centre.



SHSC compared with “Through Train” whilst they emphasize attracting more capital inflows.<sup>6</sup> For instance, SHSC imposes lower aggregate and daily quotas for Southbound trading than Northbound trading.<sup>7</sup> Similarly, in terms of participant eligibility, Northbound trading is open to all Hong Kong and overseas investors. While Southbound trading is only open to participants who have stock accounts with balances no less than RMB500,000 (approximately USD72,600). According to Wildau (2015), the majority of mainland retail investors have less than RMB500,000 in their stock accounts, which is crucial information for predicting capital inflow to Hong Kong market. Hong Kong also faces the following uncertainties: 1) increasing competitions from Shanghai stock market via Northbound trading; 2) restrictions on shareholder rights and shareholding ownership for Northbound trading<sup>8</sup> and 3) considerable differences in the composition of participants on each side. SHSC involves foreign investors (likely to be institutional investors) entering an emerging market whilst domestic retail investors entering into a mature market dominated by institutional investors.<sup>9</sup> Most retail investors are inexperienced traders with limited investment opportunities and are characterized by herding behavior based on rumours (Chan et al., 2007; Tan, et al., 2008). Therefore Hong Kong market could have concerns about noise rather than new information added by Southbound participants. Whilst it is uncertain whether Northbound foreign investors would trade differently and are more prone to herding in an emerging market due to information asymmetry (e.g. Chiang, et al., 2008; Doukas and Wang,

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<sup>6</sup> Table A1 shows the detailed comparisons between the above liberalization programmes.

<sup>7</sup> The whole trading arrangements of SHSC include two parts: Hong Kong and overseas investors can trade eligible A shares in SHSE (Northbound trading) and mainland investors can trade eligible main board shares in HKSE (Southbound trading).

<sup>8</sup> For example, aggregate foreign investors’ shareholding in an A share cannot be more than 30 percent of the total issued shares while single foreign investor’s shareholding in an A share cannot be more than 10 percent of the total issued shares (HKEx, 2015).

<sup>9</sup> Hong Kong stock market is an open and mature market with diversified investors from all over the world, in which 61% of share trading is driven by institutional investors by 2013 (Goldman Sachs, 2014). While about 85% trades (but less than 5% of the overall market value) are made by mainland retail investors in SHSE (Wildau, 2015).

2013; Yao, 2014; Yao, Ma and He, 2014). Those uncertainties may lead Hong Kong market to cast doubt on SHSC.

There are also expected benefits associated with SHSC: 1) uplifting market liquidity on both sides (HKEx, 2015); 2) to help remove one of the primary obstacles for the full inclusion of A shares in the MSCI EM index, which makes mainland stocks more attractive to global investors and 3) the “Home Market Rules”,<sup>10</sup> which implies that mainland investors can enjoy the absence of intraday trading restrictions and capital gains tax, whilst Hong Kong could arbitrage its comparative advantages to the mainland market with its freely convertible currency, long-established rule of law, sound regulatory framework, advanced clearing and settlement infrastructure and tax differences for international listings (HKEx, 2008).

Market reactions could be driven by the expected impacts of liberalization on various market characteristics (namely liquidity, market size and risk). By removing trading barriers between markets, liberalization has expected benefits including increasing liquidity and decreasing price premium due to better international risk sharing (Bekaert and Harvey, 2000; Funke and Fuchs-Schündeln, 2001; Levine, 2001; Sun, Tong and Yan, 2009). Empirical studies suggest that return increases with higher liquidity including higher turnover ratio, trading volume and lower spread (Jun, Marathe and Shawky, 2003; Dey, 2005). Martin and Rey (2000) suggest that in an international framework with segmented markets, market size effect translates into larger financial areas exhibiting higher asset prices. No matter to local or overseas investors, a larger and more liquid market due to liberalization should be more attractive. In terms of risk, emerging markets exhibit higher conditional volatility than mature markets (De Santis and Imrohoroğlu, 1997). Hence Northbound trader could have concerns over volatility in

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<sup>10</sup> It means that the current structure of the two stock markets stay the same.

mainland markets while the reverse for Southbound traders. However, post-SHSC risk may or may not decrease due to the uncertain relative importance of contagion and risk-sharing effects (Chari and Henry, 2004), though Huo and Ahmed (2017) find that post-SHSC the conditional variances of both markets have increased. Bekaert and Harvey (1997) find that market liberalization increases the correlation between host market and the world market returns. Sun, et al. (2009), Li (2012) and He, Chen, Yao and Ou (2014) draw similar conclusions based on financial liberalizations in China. Whilst some studies (Kose, Prasad and Terrones, 2009; Bai and Zhang, 2012) find at best a modest degree of international risk sharing in developing countries after financial liberalization. This is because financial systems need to be equipped with reasonable legal and institutional infrastructure such as clearly defined property rights, effective contract enforcement and good creditor protection to allow a market to benefit from liberalizations (Ito, 2006). As an important empirical feature of stock markets, volatility clustering is caused by agents' herding behavior (Engle, 1982; LeBaron and Yamamoto, 2007). Since it is inclusive whether foreign investors are less prone to herding, it is an empirical matter how volatility clustering changes post-SHSC.

As an important source of macroeconomic uncertainty, exchange rate movement affects international stock returns (Phylaktis and Ravazzolo, 2005; Abugri, 2006). Southbound participants trade securities quoted in HKD but settle the trades with China Securities Depository and Clearing Corporation Limited (ChinaClear) in RMB. As such, ChinaClear converts RMB into HKD for settlement with Hong Kong Securities Clearing Company Limited, and vice versa. An appreciating currency is commonly perceived as a signal of decreased (dollar) capital risk by international investors, which leads to higher returns (Bai and Green, 2011). Hence HKD appreciating against RMB makes holding HKSE securities more attractive to mainland investors. Similarly RMB appreciating against USD makes investments in mainland more promising to international investors.

Supported by the literature, the above discussions on operational and market-specific issues provide foundations for building hypotheses on the short-term market reactions to SHSC; which could be driven by the expected impacts on market characteristics and how these impacts materialize in medium-term.

### 2.3 Hypotheses

*H<sub>1</sub>: Hong Kong market has significant positive reactions to the announcement of the “Through Train” but the reverse for mainland markets.*

As the first partial reverse liberalization targeting at retail investors, “Through Train” sends promising signals to other markets especially Hong Kong in terms of increasing market liquidity, market depth and lowering funding cost.<sup>11</sup> While the increasing competition and worry for excessive capital outflow could damp the performance of the mainland markets, which explain partly the abandon of the “Through Train”.

*H<sub>2</sub>: Mainland investors show insignificant reactions but foreign investors show weakly significant reactions to the announcement of SHSC.*

When SHSC was announced, mainland investors who are exposed to a richer pool of primary and secondary sources of information have learned the lesson from the abandon of “Through Train” better than foreign investors. Hence they are not convinced enough to reflect this information in their trading. While foreign investors, who have information disadvantage and are less sensitive to government policy credibility, incorporate this information in their trading.

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<sup>11</sup> The main implications of stock market liberalization to a country includes facilitating risk sharing between domestic and foreign investors (Bekaert and Harvey, 2000), which in turn increases market liquidity (Funke and Fuchs-Schündeln, 2001); improving capital allocation efficiency due to better information availability (Funke and Fuchs-Schündeln, 2001; Levine, 2001) and strengthening financial integration and corporate governance (Levine, 2001; de Souza, 2004).

*H<sub>3</sub>: Mainland markets<sup>12</sup> react significantly and positively while Hong Kong market reacts weakly significant and negatively to the implementation of the SHSC.*

Hong Kong faces various restrictions and uncertainties linked with the SHSC program, which could damp their short-term reactions and lead them to delay their participation in Northbound trading. While mainland investors expect mainly benefits associated with the SHSC program.

*H<sub>4</sub>: Investors react positively to larger, more liquid and more stable market post-SHSC. Mainland investors react positively when HKD appreciates against RMB, similarly international investors react positively when HKD and RMB appreciate against USD.*

*H<sub>4\_1</sub>: The magnitudes of local market characteristics' impacts vary between mainland indices and Hong Kong indices.*

*H<sub>4\_2</sub>: The magnitudes of investment destination market characteristics' impacts vary between mainland indices and Hong Kong indices.*

*H<sub>4\_3</sub>: The impact magnitude of individual investment destination index-specific market characteristics varies.<sup>13</sup>*

Investors' short-term reactions can be driven by the expected impacts on market characteristics in both local and investment destination markets post-SHSC. Due to the asymmetric development levels between mainland and Hong Kong markets, the impact magnitudes vary between these markets too.

*H<sub>5</sub>: Market liquidity, market value and volatility increase on both sides post-SHSC. SHSE has increased link with HKSE and the world but HKSE has decreased exposure to regional and world systematic risks.*

<sup>12</sup> This includes both SHSE and Shenzhen Stock Exchange (SZSE), which is the next liberalization focus.

<sup>13</sup> The details of these hypotheses are explained in section 3.3.

Post-liberalization, the materialized impacts on both markets include increasing liquidity and market size. Due to limited risk sharing and increased interdependence between SHSE and HKSE, local risks increase. Compared with the mainland market, Hong Kong may have higher degree of risk sharing effect by exploiting its advantage in legal and institutional infrastructure.

*H<sub>6</sub>: Market characteristics exhibit structural breaks on 13<sup>th</sup> November 2014.*

The impact of SHSC could materialize as structure breaks in different market characteristics. According to LexisNexis news database, there are several important announcements associated with SHSC made on 13<sup>th</sup> November 2014. i) Standard Chartered Bank (Hong Kong) announced offering equities trading Global Custodians, which facilitates checking mechanism to reduce counterparty risk under the SHSC. ii) Industrial and Commercial Bank of China (Asia) announced that they would charge customers zero brokerage fee for Northbound trading. iii) The People's Bank of China has abolished the daily RMB20,000 conversion cap for Hong Kong residents. iv) China daily published that the SHSC program would offer preferential capital gains tax policies. v) Some media published that the CSRC and SFC jointly announced the approval of SHSC starting on 17 November. Hence we project the structure breaks can happen on 13<sup>th</sup> November 2014 rather than the actual implementation day of SHSC.

### **3. Data and Methodology**

#### *3.1 Stock market data*

We include all the stock indices that cover the eligible equities under “Through Train” and SHSC. HS\_I reflects the price movements of major industry sectors of Hong Kong stock market. The equivalent indices of SHSE and SZSE are SHI and Shenzhen stock exchange Composite Index (SZI) respectively. They are examined in the first event - the announcement of “Through Train”. In event 2 - the announcement of SHSC and event 3 - the

implementation of the SHSC, we also investigate Shanghai stock exchange 180 Index (SH180)<sup>14</sup> and Shanghai stock exchange 380 Index (SH380), which cover the rest of the eligible equities in Northbound trading. For Southbound trading, we also include Hang Seng Composite Index LargeCap Index (HSLC) and the Hang Seng Composite Index MidCap Index (HSMC), which cover the top 80% and the next 15% of the total market capitalization respectively (Hang Seng Indexes Company Limited, 2013). Following Green and Bai (2008), to control for the general market condition so that we can further exclude the influence of any major contemporaneous market shock, we also use the major market indices of Singapore (FTSE Straits Times Index); Japan (Nikkei 225 Index), the U.K. (FTSE 350 Index) and the U.S. (S&P 500 Index) as the controls. These are all USD denominated daily index data. The MSCI World Index is used as the worldwide index.<sup>15</sup>

### 3.2 *The event study*

Following seminal study on capital market liberalization (e.g. Bekaert and Harvey, 2000; Henry, 2000), we adopt the event study method to investigate the short-term market performance around the liberalization events.<sup>16</sup> Similar to Lakonishok and Smidt (1988), calendar time model<sup>17</sup> is applied to adjust the returns between Fridays and Mondays and after holidays<sup>18</sup>. We also follow Karafiath (1988) and Green and Bai (2008) using the event dummy approach<sup>19</sup> as eq.(1) to calculate the abnormal returns (ARs) across the estimation window (120 days) and the event window using daily dummies within the event window. It is

<sup>14</sup> SH180 includes 180 most representative traditional big-cap blue chips in finance, energy, material and industry sectors. In terms of the number, market capitalization and turnover, SH180 account for 20%, 73% and 55% of that of all SHSE listed companies respectively by November 2010. SH380 consists of top 380 companies (excluding those in SH180) mainly for an emerging blue-chip index enjoying good growth and profitability prospects. (Shanghai Stock Exchange, 2015).

<sup>15</sup> MSCI AC Asia ex JP index is used as the world index for all the mainland indices in the event study since it performs better as a market index for Chinese indices.

<sup>16</sup> MacKinlay (1997) provide detailed discussion of the event study method.

<sup>17</sup> In this model, returns are generated continuously suggesting that reported return distributions will be different among Mondays, post-holidays and other working days. Green and Bai (2008) provide detailed discussions.

<sup>18</sup> Markets were closed on different days over sample periods for three events (Table A2).

<sup>19</sup> See Karafiath (1988) and Green and Bai (2008) for details.

not unreasonable to assume that there could be information leakage before the actual events to the market due to the lengthy and complicated preparation processes involved in all three events hence any *a priori* assumption about the duration of these events on stock markets is likely to be speculative. Plots of the Cumulative Abnormal Returns (CARs) give an informal indication of the true length of the event window but the dummy approach provides a more rigorous test since  $t$  statistics for the dummy variables provides direct estimates of the significance of the ARs and it also enables us to conduct  $F$  tests on the estimated dummies to rigorously check the length of the event window. We therefore estimate the CARs in the standard way but use the event dummy approach eq.(1) to calculate  $F$  statistics to check the length of event window for each index.

$$R'_{c,t} = \alpha_c + \beta_c M'_t + \sum_{h=T-u}^{T+v} \gamma_{c,h} D_{h,t} + e_{c,t} \quad (1)$$

Where  $R'_{c,t}$  is the return in USD on index  $c$  (*all the indices mentioned in section 3.1*) between two consecutive days when the exchange is open for trading, from day  $t - n$  to day  $t$ , which include  $n$  calendar-day returns; and  $M'_t$  is the corresponding return in USD on the market index;  $D_{h,t}$  are daily dummies within the event window ( $D_{h,t} = 1$  for  $h = t$  and zero otherwise) and  $e_{c,t}$  is the error term. As discussed in section 2.2, it is not certain whether mainland or foreign investors have information advantage. Both may take longer to absorb information and reflect in their trading in the foreign market. Hence the event window  $(-5, 0, 50)$  is adopted to take any information leakage into consideration and to allow any delayed CARs to level out. In the robustness test, we extend the pre-event window to 30 days to further test any potential information leakage during the long process. However, 30-day pre-event window in the first event overlaps with the start of the 2007/08 crisis.<sup>20</sup> Furthermore 50-day post-event window leads event 2 post event window to overlap with event 3 estimation window. Hence

<sup>20</sup> The global financial crisis started from 9th August 2007, when bad news from French bank BNP Paribas triggered sharp rise in the cost of credit, and made the financial world realise how serious the situation was (BBC, 2009).



we also do robustness check with a shorter event window (-5, 0, 20). The event day for the first event (the announcement of implementation of the “Through Train”) is 20 August 2007; the event day for the second event (the announcement of SHSC) is 10 April 2014 and the event day for the third event (the implementation of SHSC) is 17 November 2014.

To minimize the problem of contemporaneous events occurring around the event dates, we surveyed the LexisNexis news database for a period of 2 months before and after the event date for Hong Kong and mainland China. We have identified some potentially important events including the start of the 2007/08 financial crisis on 9th August 2007, the time period of the Occupy Central Companion in Hong Kong (28/09/2014-11/12/2014). As robustness check, we have included dummies for these events in eq.(1), while they do not appear to have significant impacts during our event windows. To test hypotheses 1, 2 and 3, we also conduct Seeming Unrelated Regression (SUR) on eq.(1) for a pairwise comparison ( $C_{ml}$  and  $C_{hk}$  refer to pairs in Table 3) as eqs. (2a and b) and eq.(3). If eq.(3) stands, there is no difference in the ARs of the mainland and Hong Kong markets, and conversely.

$$R'_{C_{ml},t} = \alpha_{C_{ml}} + \beta_{C_{ml}} M'_t + \sum_{h=T-u}^{T+v} \gamma_{C_{ml},h} D_{h,t} + e_{ml,t} \quad (2a)$$

$$R'_{C_{hk},t} = \alpha_{C_{hk}} + \beta_{C_{hk}} M'_t + \sum_{h=T-u}^{T+v} \gamma_{C_{hk},h} D_{h,t} + e_{C_{hk},t} \quad (2b)$$

$$\frac{\gamma_{C_{ml},h}}{\gamma_{C_{hk},h}} = 1, h=t = (T-u, \dots, T, \dots, T+v) \quad (3)$$

$c_{ml}$ =SHI, SH180 SH380 or SZI;  $c_{hk}$ =HS\_I, HSLC or HSMC;

### 3.3 The determinants of short-term reactions (CARs)

To examine factors driving different dynamic patterns of CARs in different markets (hypothesis 4), we consider three groups of determinants. The first two groups contain market characteristics of the local market and of the destination market respectively. The third group

includes USD price in currency issued by the market where indices  $c_{ml}$  and  $c_{hk}$  locate, the HKD price in RMB and the conditional variance of the world market index. First, we regress individual mainland and Hong Kong index CARs as a function of these three groups of determinants as eqs.(4a and b) during the event window. Then we conduct SUR to test whether these impact magnitudes are the same in both markets (hypotheses 4\_1, 4\_2 and 4\_3) as eqs.(5a, b and c). Second, we run a pooled OLS regression eq.(6) to investigate their impacts on the aggregate markets (hypothesis 4) by using the interaction terms between the mainland index dummy ( $ml$ ), the Hong Kong index dummy ( $hk$ ) and the determinants.

$$CAR_{c_{ml,t}} = \alpha_1 + \alpha_2 risk_{M,t} + \alpha_3 HK\$\_RMB_t + \delta_1 mv_{c_{ml,t}} + \delta_2 LIQU_{c_{ml,t}} + \delta_3 exrate_{c_{ml,t}} + \delta_4 risk_{c_{ml,t}} + \delta_5 mv_{c_{hk,t}} + \delta_6 LIQU_{c_{hk,t}} + \delta_7 exrate_{c_{hk,t}} + \delta_8 risk_{c_{hk,t}} + \epsilon_{c_{ml,t}} \quad (4a)$$

$$CAR_{c_{hk,t}} = \beta_1 + \beta_2 risk_{M,t} + \beta_3 HK\$\_RMB_t + \gamma_1 mv_{hk,t} + \gamma_2 LIQU_{hk,t} + \gamma_3 exrate_{c_{hk,t}} + \gamma_4 risk_{c_{hk,t}} + \gamma_5 mv_{c_{ml,t}} + \gamma_6 LIQU_{c_{ml,t}} + \gamma_7 exrate_{c_{ml,t}} + \gamma_8 risk_{c_{ml,t}} + \mu_{c_{hk,t}} \quad (4b)$$

$$H_{4\_1}: \frac{\delta_1}{\gamma_1} = \frac{\delta_2}{\gamma_2} = \frac{\delta_3}{\gamma_3} = \frac{\delta_4}{\gamma_4} = 1 \quad (5a)$$

$$H_{4\_2}: \frac{\delta_5}{\gamma_5} = \frac{\delta_6}{\gamma_6} = \frac{\delta_7}{\gamma_7} = \frac{\delta_8}{\gamma_8} = 1 \quad (5b)$$

$H_{4\_3}$ : For example, the sizes of HS\_I, HSLC and HSMC have the same impact magnitudes on SHI or the sizes of SHI, SH180 and SH380 have the same impact magnitudes on HS\_I:

$$\frac{\delta_{5,HSI}}{\delta_{5,HSLC}} = \frac{\delta_{5,HSI}}{\delta_{5,HSMC}} = \frac{\gamma_{5,SHI}}{\gamma_{5,SH180}} = \frac{\gamma_{5,SHI}}{\gamma_{5,SH380}} = 1 \quad (5c)$$

The rejections of eqs. (5a, 5b and 5c) will support the hypotheses 4\_1, 4\_2 and 4\_3. The detailed explanation and hypothesis of each variable are summarized in Table 1. All the independent variables are standardized.

$$CAR_{c,t} = \alpha_1 + \alpha_2 ml + \alpha_3 hk + \delta_1 ml * mv_{c,t} + \gamma_1 hk * mv_{c,t} + \delta_2 ml * LIQU_{c,t} + \gamma_2 hk * LIQU_{c,t} + \delta_3 ml * exrate_{c,t} + \gamma_3 hk * exrate_{c,t} + \delta_4 ml * risk_{c,t} + \gamma_4 hk * risk_{c,t} + \delta_5 ml * risk_{M,t} + \gamma_5 hk * risk_{M,t} + \delta_6 ml * HK\$\_RMB_t + \gamma_6 hk * HK\$\_RMB_t + \delta_7 ml * mv_{c_{hk,t}} + \gamma_7 hk * mv_{c_{ml,t}} + \delta_8 ml * LIQU_{c_{hk,t}} + \gamma_8 hk * LIQU_{c_{ml,t}} + \delta_9 ml * exrate_{c_{hk,t}} + \gamma_9 hk * exrate_{c_{ml,t}} + \delta_{10} ml * risk_{c_{hk,t}} + \gamma_{10} hk * risk_{c_{ml,t}} + \alpha_4 \epsilon_{c_2,t} \quad (6)$$

[Table 1 about here]

### 3.4 The medium-term impacts of SHSC on market characteristics

To study the medium-term impacts of the SHSC, 1) we apply endogenous structural break test using the Bai and Perron (2003) Ordinary Least Square-type test to various market characteristics measures of mainland and Hong Kong indices between 21 August 2006 and 25 April 2016 (hypothesis 6). 2) We compute the statistical significance of the difference in index-specific market characteristics' means pre- and post-SHSC (hypothesis 5). 3) We apply the modified EGARCH model by considering the known financial liberalization dates and detected structural breakpoints (if they differ to the known liberalization dates) as equation (7) to examine how risks change pre- and post-SHSC (hypothesis 5).

$$R'_{c,t} = \vartheta + R'_{M,t} + \varepsilon_t$$

$$\log(\sigma^2) = \omega + \beta \log(\sigma_{t-1}^2) + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}}} \alpha \left[ \frac{|\varepsilon_{t-1}|}{\sqrt{\sigma_{t-1}}} - \sqrt{\frac{2}{\pi}} \right] + \theta_1 d\_fl2 + \theta_2 d\_fl3 + \theta_3 d\_bp \quad (7)$$

Where the dummy variables  $d\_fl2$ ,  $d\_fl3$  and  $d\_bp = 1$ , if it is event 2, event 3 and the break point identified by the structural break test respectively.  $\beta$  measures the impact of last period's forecast variance. A positive  $\beta$  indicates volatility clustering which means that positive stock price changes are associated with future changes and vice versa. The existence of persistence increases the uncertainty of future investment.  $\alpha$  captures the magnitude of the shock.  $\gamma$  is expected to be negative to reflect the asymmetric impacts of bad news versus good news of the same magnitude.

## 4. Results

### 4.1 Event Study

Table A3 in the appendix shows that the market model estimations are plausible. Results presented in Figure 1 and F-test results on ARs in Table 2 support the hypotheses 1, 2 and 3. In the first event, (Panel A), HS\_I has significant positive reactions in all the testing periods. On the other hand, both SHI and SZI have insignificant reactions and they are negative during most

of the event window. In the second event, there are only weakly significant positive but downward trend reactions in Hong Kong indices around the first ten days of the announcement of the SHSC. Most other indices have more erratic and insignificant reactions as we hypothesized. It lends support to the literature that foreign investors adjust to information more slowly than the domestic counterparties especially when they are in an emerging market. When the SHSC was eventually implemented, the mainland markets especially SHI and SH180 have shown significant strong positive reactions in all the testing periods. As hypothesized, the pattern of Hong Kong index CARs are less clear and its significant F-test results seem to coincide with the negative CARs. The SUR test results on ARs (Table 3) also show that the impact of SHSC on the mainland and Hong Kong indices are highly significantly different in event 3. In addition, as expected, investors of the next liberalization destination - SZSE react highly significantly and positively to this event too.

[Tables 2 and 3 and Figure 1 about here]

#### 4.2 The determinants of short-term reactions (CARs)

In line with hypothesis 4 (including hypotheses 4\_1, 4\_2 and 4\_3), results in this section show that different short-term reactions of both markets discussed in section 4.1 are driven by the market characteristics in both local and investment destination markets while the magnitudes of these impacts vary between mainland and Hong Kong market indices. SUR test results (Table 4) show that eqs. (5a, b and c) are rejected at 1% significance level so the three hypotheses 4\_1, 4\_2 and 4\_3 are supported.<sup>21</sup> According to the pooled OLS regression results of eq.(6) (Table 5), most of the significant variables have the expected signs as hypothesis 4 (Table 1). For the first event, in line with the event study results, there are highly significant negative reactions in mainland (*ml*) but positive ones in Hong Kong market (*hk*).

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<sup>21</sup> The time-series regression results in the SUR system are not included here to economise space but they are available upon request.

These reactions are driven by different market characteristics. Among all the local market characteristics, mainland market liquidity ( $vo_{ml}$ ) has the largest significant positive impact on mainland CARs. Every one standard deviation increase in liquidity leads to 3.6% increase in mainland CARs. As expected, mainland risk ( $risk_{ml}$ ) is weakly significant with positive sign, which supports our discussion in section 2.2 that the higher the local risk, the more desirable to widen mainland investors' investment horizon and diversify their portfolio via "Through Train". The interaction term of market value of HS\_I with ml dummy ( $mv_{hs\_i}*ml$ ) is the only significant investment destination market factor for mainland index CARs. It has even larger impact than  $vo_{ml}$ . The negative sign supports our discussion on concerns over competition from Hong Kong market. In terms of the Hong Kong market, the local market liquidity ( $spread_{hk}$ ) and the USD price in HKD ( $exrate_{hk}$ ) are highly significant with expected signs. Liquidity of SHI ( $va_{SHI}*hk$ ) is significant with negative sign, which is consistent with our discussion of competition between HKSE and SHSE in this reverse liberalization event. The second event has results consistent with hypothesis 4 as well. The main differences with the event 1 are the following: after financial crisis, mainland investors appreciate the relatively stable market condition in Hong Kong as the interaction term of HS\_I index risk level with the mainland dummy ( $risk_{hs\_i}*ml$ ) is significantly negative. Likewise, the negative impact of SH380 risk level on Hong Kong CARs ( $risk_{SH380}*hk$ ) suggests that investors in Hong Kong markets prefers a more stable Northbound trading environment especially SH380 for medium-sized non-traditional blue chips. When the SHSC is eventually implemented, results are consistent with the hypotheses.  $hk$  is significantly negative but positive for ml. Significant mainland market value ( $mv_{ml}$ ) shows positive reactions to the incoming capital flow due to SHSC. Whilst the RMB price in HKD is the most dominant factor with expected negative sign. In terms of investment destination factors, as we discussed in section 2.2, the prospect of entering into a liquid and more stable mature market is attractive to the Southbound

participants. The dominant determinant of Hong Kong CARs is still its own market size. The only weakly significant investment destination variable is the risk level of SHI. Its negative sign supports the discussion that risk level of the mainland market is an important consideration for international investors. We have conducted robustness checks using the alternative windows (-30, 0, 50) and (5, 0, 20) for these tests and the results do not have any economically significant difference.

[Tables 4 and 5 about here]

#### 4.3 The medium-term impacts of SHSC on market characteristics

Table 6 presents the identified break dates according to the Bai and Perron (2003) Ordinary Least Square-type structural break test.<sup>22</sup> They show that most of the index-specific market characteristics have structural breaks due to SHSC and the results are consistent across various tests. In line with hypothesis 6, the most commonly identified break date is 13<sup>th</sup> November 2014. Table 7 presents the statistical significance of the difference in the index-specific market characteristics' means pre- and post-SHSC. Following results in Table 6, we use 13<sup>th</sup> November 2014 as the dividing point. In general the results support hypothesis 5: Market value (*mv*), trading value (*va*) and trading volume (*vo*) of SHI, HS\_I, SH180 have increased significantly post-liberalization. While the daily price variation (*spread*) has also increased in all indices. As expected the link between mainland and Hong Kong has increased post-SHSC especially via exposure to systematic risk, for instance, conditional covariance have increased significantly between all the index pairs: SHI\_HS\_I; SH180\_HSLC; SH380\_HSMC. Furthermore, SHSE indices have increased exposure to the global and Asian systematic risks after the implementation of SHSC. As expected, the most representative index of HKSE, HS\_I shows decreasing exposure to Asia and world systematic risks by

<sup>22</sup> We present only breaks from 2014 in Table 7 and the full list of break dates are available upon request. Table A4 in the appendix shows the number of breaks identified by each test and associated F-statistics of the results. All the F-statistics are significant at 5%.

exploiting the risk sharing benefit post-SHSC but neither HSMC nor HSLC manages to do so. Although there is significant increase in the market interdependence post-liberalization, the magnitudes are very small. Bekaert and Harvey (2000) suggest that such small increase is unlikely to deter investors exploring portfolio diversification benefits.

The modified EGARCH results (Table 8) show how risk changes pre- and post-SHSC. Results show that all the world market excess returns in the mean equations are highly significant. Their magnitudes have decreased for Hong Kong indices but increased for mainland indices instead. There seems to be a convergence between the mainland and Hong Kong markets in terms of their exposure to world market shocks, which echoes what we find in the last step (differences in beta pre- and post-SHSC). In the variance equation, as expected, the magnitudes of shocks ( $\alpha$ ) have increased post-SHSC, even though the scale of increase is smaller after considering the structural breaks. The persistence of volatility ( $\beta$ ) has decreased in all the Hong Kong indices but increased in almost all the mainland indices (except SH380). The persistence of volatility is underestimated without considering structural breaks. As discussed in section 2.2 that volatility clustering could be caused by agents' herding behaviour. The empirical evidence lend support to the argument that foreigners in an emerging market have information disadvantages compared with the domestic counterparty and they herd in response to the unfamiliar market. And also it is in line with studies suggesting that institutional investors are more likely to herd than individual investors (e.g. Lakonishok et al., 1992; Welch, 2000).

[Tables 6, 7 and 8 about here]

## 5. Conclusion

This study focuses on investigating the short-term and medium-term impacts of a partial Chinese stock market liberalization event - Shanghai-Hong Kong Stock Connect. This unique event provides domestic retail investors access to a mature market dominated by institutional investors and at the same time, access to foreign investors to an emerging market. Unlike the existing literature focusing primarily on the host markets in financial liberalization, our study focuses on comparing the impacts on both emerging and mature markets. Post-SHSC, Hong Kong's intermediary role in offshore RMB financial transactions is further enhanced. These multilateral economic activities facilitate information dissemination, investment opportunities creation, and generating higher return, but they also expose both markets to higher uncertainties from these activities (Qiao, Chiang and Wong, 2008). Contrasting to the expectation of the homogeneous and mutual benefits to both markets brought by SHSC, by applying event study method, we find that the magnitudes of the short-term impacts on both markets are significantly different whilst the mainland market react significantly positively to the implementation of SHSC and conversely for Hong Kong market. Such heterogeneous reactions are driven by the expected impacts on different market characteristics in both markets. In line with the literature, in the medium-term, we have found the expected benefits and issues post financial liberalization including increasing market size, liquidity but also exposure to systematic risks for most of the eligible indices. The only exception is Hang Seng Index which seems to be able to exploit the risk sharing benefit stemming from financial liberalization. In these sequential partial liberalization events, the "Through Train" has profound influence to the confidence of mainland investors to the credibility of government policies, which is evident in their non-response to the announcement of SHSC. It is the actual implementation of SHSC allows uncertainties to be spelled out. The foreign investors' response to the announcement of SHSC together with the increasing risk persistence found in



mainland indices post-SHSC lend support to literature suggesting that foreign investors have information disadvantage compared with domestic investors especially in emerging markets and are prone to herding.

SHSC is the first step taken by Chinese government in financial liberalization for retail investors and an important step for the broader scheme of RMB internationalization. This study is timely as these first experiments have valuable information for the world to understand the liberalization process with Chinese characteristics and also this experience offers important lessons for China and the other emerging markets, for example, in the forthcoming QDII2, which will allow Chinese retail investors to snap up shares in New York, London or Paris (Reuters, 2015).

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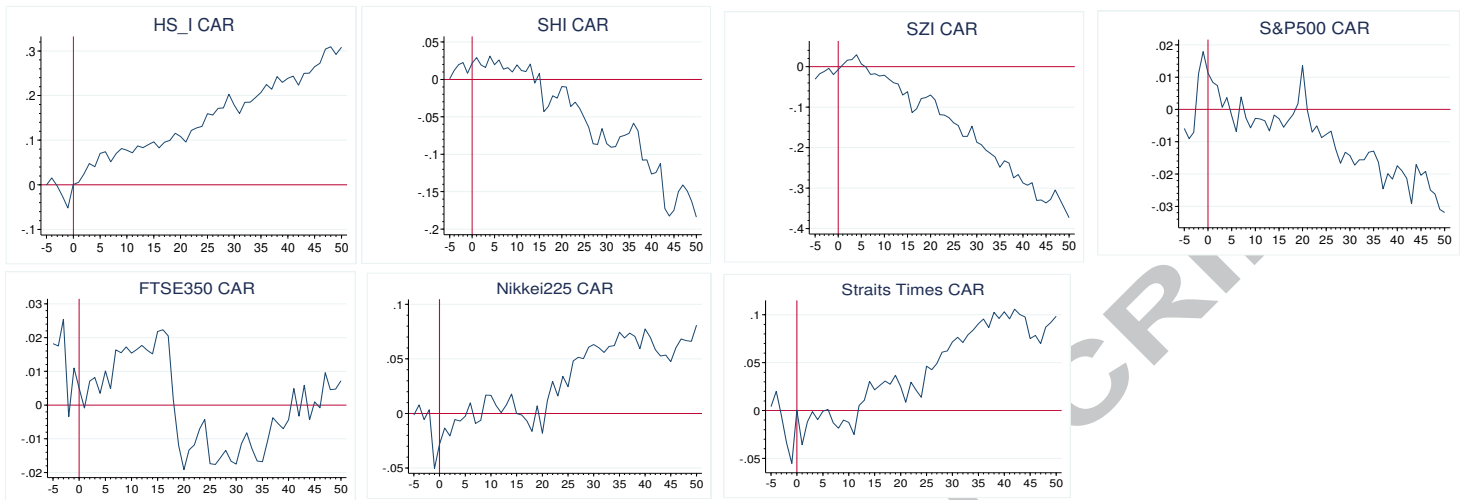
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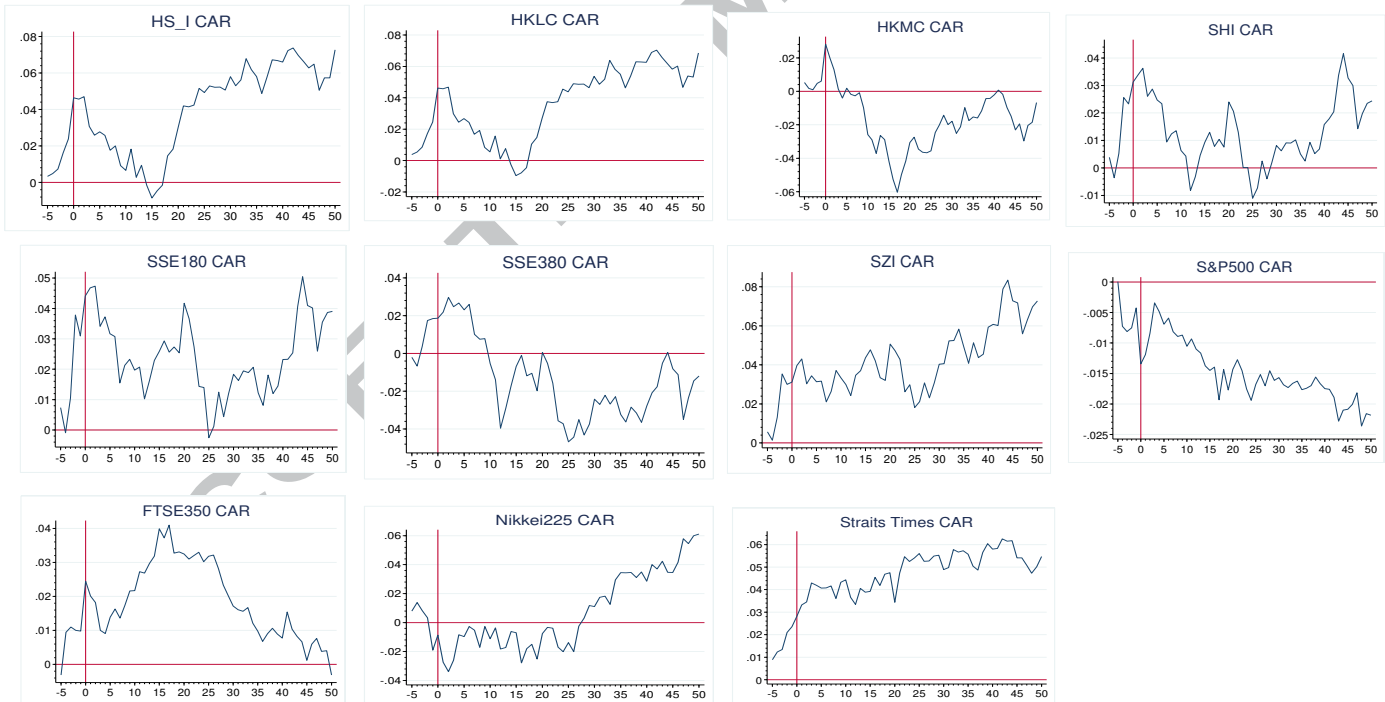


Figure 1 Panel A Event 1 CARs during event window (-5, 0, 50)



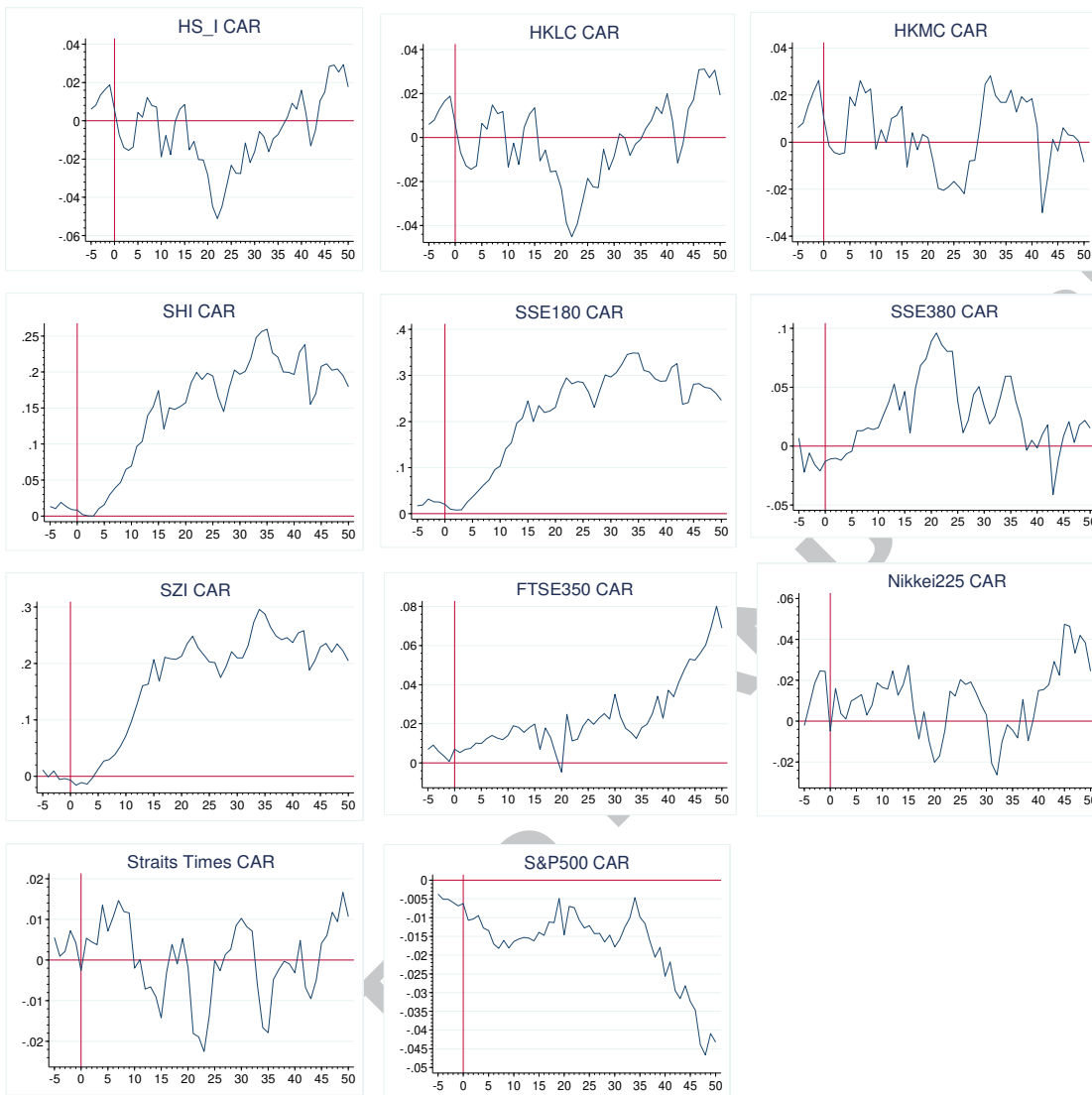
Note: 1. Panel A show the graphs of CARs in the first event. HS\_I has positive reactions since the event day till 50 days later. On the other hand, both SHI and SZI have small positive reactions in the first few days but uniformly become negative till the end of the event window.

Figure 1 Panel B Event 2 CARs during event window (-5, 0, 50)



Note: There are only weakly significant positive but downward trend reactions in Hong Kong indices around the first ten days of the announcement of the SHSC. Most other indices have more erratic and insignificant reactions. As expected, the announcement itself is not enough to convince mainland investors to reflect this information in their trading

Figure 1 Panel C Event 3 CARs during event window (-5, 0, 50)



Note: The markets especially SHI and SH180 have shown significant strong positive reactions. On the other hand, the pattern of Hong Kong indices CARs are less clear. As expected, investors from both sides do have heterogeneous responses to such asymmetric designs of SHSC. Although as discussed in section 2.2 that several existing comparative advantages could work in Hong Kong's favour in SHSC, there are also some uncertainties involved in the SHSC.

Table 1 Detailed variable definitions and hypotheses for section 3.3

Variable/vector	Variables in the vector	Definition	Hypo.	Explanation
$CAR_{c_{ml},t}$		CAR of index $c_{ml}$ at time $t$ ;		For eqs. (4a & b)
$CAR_{c_{hk},t}$		CAR of index $c_{hk}$ at time $t$ ;		For eqs. (4a & b)
$CAR_{c,t}$		CAR of index $c$ at time $t$ ; $c =$ SHI, SH180, SH380, SZI, HS_I, HSLC, HSMC, S&P 500, FTSE 350, Nikkei 225 or Straits Times		For eq. (5)
$risk_{M,t}$		conditional variance of market index at time $t$ ;	-	Investors prefer less volatile market conditions.
$HK\$_{RMB,t}$		the price of RMB in HK\$	-	Mainland investors would find southbound trading more attractive if HK\$ appreciates against RMB.
$mv_{c_{ml},t}$		market value of index $c_{ml}$ at time $t$	+	market size effect: larger financial areas exhibit higher asset prices
$LIQU_{c_{ml},t}$	$VA_{c_{ml},t}$	trading value of index $c_{ml}$ at time $t$	+	Higher trading value means higher liquidity maybe due to liberalization
	$VO_{c_{ml},t}$	trading volume of index $c_{ml}$ at time $t$	+	Higher trading volume means higher liquidity, maybe due to liberalization
	$spread_{c_{ml},t}$	difference between daily price high and price low of index $c_{ml}$ at time $t$	-	A measure of trading cost, lower spread means higher liquidity maybe due to liberalization
$EXRATE_{c_{ml},t}$		US dollar price RMB at time $t$ ;	-	International investors would find more attractive to invest in mainland and Hong Kong markets if US\$ depreciates against these currencies.
$risk_{c_{ml},t}$		conditional variance of index $c_{ml}$ at time $t$	-	Investors prefer less volatile market conditions.
$ml$		$ml=1$ if $c=SZI$ or SHI or SHI180 or SHI380, $ml =0$ otherwise	+/-	Its coefficient shows the mean event impact on the mainland compared with the four-country control group. “+”: if investors in mainland stock markets believe and emphasize the benefits from financial liberalization. “-”: if the market puts weight on the uncertainty level and unfavourable side of impacts.
$hk$		$hk=1$ if $c=HS\_I$ or HSLC or HSMC, $hk=0$ otherwise;	+/-	Same as above for Hong Kong market.
$mv_{c_{hkt}} * ml$		The interaction term between dummy $ml$ and market value of index $c_{hkt}$ at time $t$	+	For Southbound trading, mainland investors would prefer a large and deep market in Hong Kong.
$mv_{c_{ml,t}} * hk$		The interaction term between dummy $hk$ and market value of index $c_{ml}$ at time $t$	+	For Northbound trading, investors would prefer a large and deep mainland market.

Table 2 F-test statistics on abnormal returns during event window (-5, 0, 50)

Test period	(-5, 4)	(-5, 14)	(-5, 24)	(-5, 34)	(-5, 50)	(0, 10)	(0, 20)	(0, 30)	(0, 40)
	F(10, 118)	F(20, 118)	F(30, 118)	F(40, 118)	F(56, 118)	F(11, 118)	F(21, 118)	F(31, 118)	F(41, 118)
<b>Panel A: Event 1 - The announcement of "Through Train" on 20 August 2007</b>									
HS_I	3.86*	2.84*	2.51*	2.49*	2.33*	2.69*	1.95^	2.00*	2.1*
HSLC									
HSMC									
SHI	0.22	0.25	0.49	0.45	0.63	0.16	0.55	0.53	0.53
SHI180									
SHI380									
SZI	0.21	0.25	0.48	0.45	0.51	0.17	0.50	0.52	0.49
S&P 500	1.95^	1.43	1.51"	1.21	1.05	1.00	0.85	0.99	0.88
FTSE 350	3.91*	2.25*	2.06*	1.75^	1.56^	0.85	1.18	1.05	0.93
Nikkei 225	5.93*	4.02*	3.88*	3.24*	2.65*	2.34^	2.01^	2.45*	2.11*
Straits Times	4.81*	3.37*	2.6*	2.07*	1.68*	2.63*	2.18*	1.87*	1.55^
<b>Panel B: Event 2 - The announcement of SHHK Stock Connect on 10 April 2014</b>									
HS_I	1.78"	1.48	1.25	1.01	0.91	1.71"	1.47	1.16	1.00
HSLC	1.77"	1.41	1.17	0.96	0.87	1.69"	1.40	1.09	0.94
HSMC	1.65	1.10	1.08	0.98	0.88	1.69"	1.42	1.13	0.96
SHI	0.63	0.50	0.52	0.49	0.57	0.45	0.40	0.52	0.46
SHI180	0.96	0.61	0.56	0.53	0.59	0.57	0.40	0.52	0.48
SHI380	0.17	0.37	0.49	0.44	0.50	0.22	0.41	0.50	0.43
SZI	0.46	0.37	0.39	0.39	0.48	0.36	0.31	0.38	0.42
S&P 500	2.05^	1.15	1.12	0.90	0.77	1.35	1.19	0.93	0.72
FTSE 350	3.32^	2.04^	1.61^	1.34	1.24	2.36^	1.72^	1.30	1.07
Nikkei 225	1.11	0.81	0.70	0.63	0.53	0.90	0.70	0.63	0.51
Straits Times	1.20	0.96	0.92	0.84	0.79	0.85	0.80	0.77	0.78
<b>Panel C: Event 3 - The implementation of SHHK Stock Connect on 17 November 2014</b>									
HS_I	0.72	1.37	1.85^	1.58^	1.59^	1.09	2.04*	1.89*	1.62^
HSLC	0.70	1.35	1.86^	1.57^	1.59^	1.11	2.09*	1.89*	1.6^
HSMC	0.84	1.13	1.87*	1.67^	1.74*	1.22	2.2*	1.88*	1.6^
SHI	0.82	4.04*	7.05*	7.51*	7.81*	1.98^	8.24*	9.21*	8.15*
SHI180	1.41	5.36*	8.01*	8.44*	8.21*	2.7^	8.48*	10.49*	9.08*
SHI380	1.95^	1.94*	2.98*	3.08*	3.1*	0.48	3.2*	3.04*	2.87*
SZI	1.29	3.24*	4.84*	4.8*	4.51*	1.22	5.35*	5.37*	4.87*
S&P 500	0.57	0.44	1.32	1.22	1.73*	0.72	1.30	1.35	1.62^
FTSE 350	0.25	0.25	2.65*	2.28*	2.38*	0.13	1.11	2.8*	2.71*
Nikkei 225	1.49	1.02	1.44"	1.38"	1.63^	1.22	1.55"	1.29	1.64^
Straits Times	1.20	0.94	1.72^	1.54^	1.67*	1.08	1.38	1.64^	1.64^

Note: 1. Hang Seng Index (HS\_I); Shanghai stock exchange Composite Index (SHI) and Shenzhen stock exchange Composite Index (SZI); Shanghai stock exchange 180 Index (SH180); Shanghai stock exchange 380 Index (SH380); Hang Seng Composite Index LargeCap Index (HSLC); Hang Seng Composite Index MidCap Index (HSMC); 2. \* F-Stat Significant at the 1% level; ^ F-Stat Significant at the 5% level; " F-Stat Significant at the 10% level. 3. F-test results in Table 2 show that in the first event, in all the testing periods, HS\_I has significant ARs, while this is not the case for mainland indices. In terms of the second event, the announcement itself is not enough to convince mainland investors to reflect this information in their trading. When the SHSC eventually implemented, the markets especially mainland indices have shown significant strong positive reactions in all the testing periods in the event window. Similarly, F-test on all the Hong Kong indices ARs show significant reaction in most testing periods during the event window especially after 10 days when the SHSC was implemented.

Table 3 Chi-square value of SUR test on abnormal returns for event window (-5, 0, 50)

<b>Panel A: Event 1 - The announcement of "Through Train" on 20 August 2007</b>							
	<i>HS_I</i>	<i>HSLC</i>	<i>HSMC</i>	<i>SHI</i>	<i>SHI180</i>	<i>SHI380</i>	<i>SZI</i>
<i>HS_I</i>				54.53			46.84
<i>SHI</i>							
<i>SZI</i>				13.88			
<b>Panel B: Event 2 - The announcement of SHHK Stock Connect on 10 April 2014</b>							
<i>HS_I</i>				48.29			35.65
<i>HSLC</i>					52.49		
<i>HSMC</i>						63.02	
<i>SHI</i>							10.71
<i>SHI180</i>							
<i>SHI380</i>							
<i>SZI</i>							
<b>Panel C: Event 3 - The implementation of SHHK Stock Connect on 17 November 2014</b>							
<i>HS_I</i>				97.93***			90.03***
<i>HSLC</i>					673.32***		
<i>HSMC</i>						365.13***	
<i>SHI</i>							156.62***
<i>SHI180</i>							
<i>SHI380</i>							
<i>SZI</i>							

Note: 1. \*\*\* significant at 1%

2. The detailed name of each index refers to Table 1 and 2.

3. This table presents results of equations (2a and b) and (3).

4. The SUR test results on ARs show that the impact of SHSC on the Mainland and Hong Kong indices are highly significantly different in event 3.

Table 4 Chi-square value of SUR test on the determinants of CARs in time-series regressions for event window (-5, 0, 50)

<b>Panel A: Event 1 - The announcement of "Through Train" on 20 August 2007</b>							
	<i>HS_I</i>	<i>HSLC</i>	<i>HSMC</i>	<i>SHI</i>	<i>SHI180</i>	<i>SHI380</i>	<i>SZI</i>
H <sub>1</sub>	<i>HS_I</i> <i>SHI</i>			55.32***			6.36 19.12***
H <sub>2</sub>	<i>HS_I</i> <i>SHI</i> <i>SZI</i>			8149.89***			3510.59*** 24.62***
H <sub>3</sub>	<i>HS_I</i>			97.88***			86.27***
<b>Panel B: Event 2 - The announcement of SHHK Stock Connect on 10 April 2014</b>							
H <sub>1</sub>	<i>HS_I</i> <i>HSL</i> <i>C</i> <i>HSM</i> <i>C</i> <i>SHI</i>			115.25***	25.55***	40.39***	46.88*** 21.33***
H <sub>2</sub>	<i>HS_I</i> <i>HSL</i> <i>C</i> <i>HSM</i> <i>C</i> <i>SHI</i>			305.45***	237.21***	17.53***	59.15*** 29.86***
H <sub>3</sub>	<i>HS_I</i> <i>HSL</i> <i>C</i> <i>HSM</i> <i>C</i> <i>SHI</i>			394.48***	832.95***	845.01***	1186.30*** 2187.94***
<b>Panel C: Event 3 - The implementation of SHHK Stock Connect on 17 November 2014</b>							
H <sub>1</sub>	<i>HS_I</i> <i>HSL</i> <i>C</i> <i>HSM</i> <i>C</i> <i>SHI</i>			62.03***	24.21***	20.83***	96.50*** 6.03
H <sub>2</sub>	<i>HS_I</i> <i>HSL</i> <i>C</i> <i>HSM</i> <i>C</i> <i>SHI</i>			9.16	32.11***	119.09***	5.88*** 10.16
H <sub>3</sub>	<i>HS_I</i> <i>HSL</i> <i>C</i> <i>HSM</i> <i>C</i> <i>SHI</i>			2605.54***	1582.58***	43.36***	185.34*** 2931.54***

Note: 1. \*\*\* significant at 1%. 2. The detailed name of each index refers to Table 1. 3. This table presents results of hypotheses of H<sub>4\_1</sub> (eq.5a), H<sub>4\_2</sub> (eq.5b) and H<sub>4\_3</sub> (eq.5c). 4. The significant results in Table 5 show that SUR tests reject the three hypotheses (eqs. 5a, b and c). It means that in all three events, the local market factors have significantly different impacts on mainland index CARs compared with their counterparties in Hong Kong market. Furthermore, the rejection of eq.(5b) indicates that the impacts of Hong Kong market factors on mainland index CARs are significantly different to the impacts of mainland market factors on Hong Kong index CARs. Finally, the rejection of eq.(5c) means that the impact of a particular characteristics (e.g. mv) of individual Hong Kong (mainland) indices on mainland (Hong Kong) index CARs is significantly different to each other.

Table 5 Pooled OLS regression results of the determinants of CARs in three events during event window (-5, 0, 50)

	<i>Panel A: Event 1 - The announcement of "Through Train" on 20 August 2007</i>			<i>Panel B: Event 2 - The announcement of SHHK Stock Connect on 10 April 2014</i>			<i>Panel C: Event 3 - The implementation of SHHK Stock Connect on 17 November 2014</i>		
	coeff	t-stat		coeff	t-stat		coeff	t-stat	
ml	-0.102	-16.570	***	0.012	5.490	***	0.385	5.590	***
mv <sub>ml</sub>	0.009	0.810		0.006	2.370	**	0.073	10.570	***
vo <sub>ml</sub>	0.036	4.660	***	0.009	3.580	***			
spread <sub>ml</sub>				-0.004	-1.880	*			
exrate <sub>ml</sub>							-0.024	-2.180	**
risk <sub>ml</sub>	0.012	1.830	*						
HK\$_RMB*ml							-0.241	-3.410	***
exrate <sub>hk</sub> *ml				-0.009	-2.700	***			
va <sub>hs_i</sub> *ml							0.006	2.130	**
mv <sub>hs_i</sub> *ml	-0.066	-5.490	***						
spread <sub>hs_i</sub> *ml							0.027	1.430	
risk <sub>hs_i</sub> *ml	0.000	-0.070		-0.005	-1.970	**	0.088	6.830	***
spread <sub>hslc</sub> *ml							-0.024	-1.270	
risk <sub>hslc</sub> *ml							-0.065	-5.150	***
risk <sub>hsmc</sub> *ml							-0.007	-2.300	**
hk	0.105	10.140	***	0.022	6.670	***	-0.011	-2.210	**
mv <sub>hk</sub>				0.018	4.620	***	0.019	3.740	***
va <sub>hk</sub>							-0.002	-0.420	
spread <sub>hk</sub>	-0.016	-2.350	**						
exrate <sub>hk</sub>	-0.098	-9.970	***				-0.006	-1.250	
risk <sub>M</sub> *hk	-0.048	-0.920							
risk <sub>SHI</sub> *hk							-0.009	-1.880	*
risk <sub>SH380</sub> *hk				-0.010	-2.000	**			
va <sub>SHI</sub> *hk	-0.017	-2.170	**						
Constant	0.012	2.980	***	0.014	9.880	***	0.011	4.240	***
Adj R-squared	0.868			0.267			0.931		

Notes: 1. \*\*\* significant at 1%, \*\* significant at 5%; \* significant at 10%

2. The detailed explanations of the variables refer to Table 1.

3. This table presents results of eq(6).

4. The results show that in the first event, the reaction of Hong Kong market is mainly driven by Shanghai stock market and its own liquidities and US\$/HK\$ exchange rate. Similarly, the reactions of Shanghai stock market are positively linked with its own liquidity but negatively linked with the size of HS\_I. This shows that there is indeed a concern about capital outflow and competitions between stock markets due to the financial liberalization act. In the second and third events, the main factor determining the Hong Kong market reactions is its own size. The other factor that affects Hong Kong market is the risk level of mainland indices. For the mainland investors, the main factors driving their reactions seem to be the local market size, liquidity on both sides and US\$/HK\$ exchange rate in the second event. It is related to the expected benefits of uplifting of the market liquidity and portfolio diversification benefit due to market liberalization. In the third event, on top of these main factors, the risk levels of three Hong Kong indices also play the key roles for the mainland investors.

5. Data source of market characteristics: Datastream.

Table 6 Multiple structural break test results

Panel A: Hong Kong	A		B	C	D	
	A3	A4			D1	D2
<b>HS_I_variance</b>		13/11/14	13/11/14	13/11/14		
HS_I_mv			26/06/14	02/07/14	02/07/14	02/07/14
HS_I_spread		07/11/14	03/10/14	03/10/14	03/10/14	
<b>HS_I_va</b>	07/11/14	07/11/14	07/11/14	07/11/14	07/11/14	07/11/14
<b>HS_I_vo</b>		10/11/14	10/11/14	10/11/14	10/11/14	
<b>HS_I_corr_world</b>	-	-	-	-	-	-
HS_I_corr_Asia	13/11/14	13/11/14	07/11/14	06/11/14	06/11/14	06/11/14
<b>HS_I_corr_SHI</b>			30/09/14	30/09/14	30/09/14	30/09/14
<b>HS_I_beta_Asia</b>		13/11/14	13/11/14	13/11/14		
<b>HS_I_beta_SHI</b>	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14
<b>HS_I_beta_world</b>	13/11/14	13/11/14	13/11/14	13/11/14		
<b>HSLC_variance</b>		08/05/14	08/05/14	22/04/14		
	09/04/15	09/04/15	09/04/15	09/04/15	09/04/15	09/04/15
<b>HSLC_spread</b>		06/03/14				
	08/04/15	08/04/15	08/04/15	08/04/15	08/04/15	08/04/15
<b>HSLC_corr_Asia</b>		02/06/14	02/06/14	02/06/14	02/06/14	02/06/14
	26/05/15	26/05/15	26/05/15	26/05/15	26/05/15	26/05/15
<b>HSLC_corr_world</b>	26/05/15	26/05/15	26/05/15	26/05/15	26/05/15	26/05/15
<b>HSLC_beta_Asia</b>	26/05/15	26/05/15	26/05/15	26/05/15	26/05/15	26/05/15
<b>HSLC_beta_world</b>		11/04/14				
	26/05/15	26/05/15	26/05/15		26/05/15	26/05/15
<b>HSMC_variance</b>	09/04/15	09/04/15	09/04/15	09/04/15	09/04/15	09/04/15
<b>HSMC_spread</b>		16/04/14				
	08/01/15	08/04/15	08/04/15	08/04/15	08/04/15	08/04/15
<b>HSMC_corr_Asia</b>			29/04/14	29/04/14	29/04/14	29/04/14
			08/05/15	08/05/15	08/05/15	08/05/15
<b>HSMC_corr_world</b>	24/06/14	24/06/14	24/06/14	24/06/14	24/06/14	24/06/14
	26/05/15	26/05/15	26/05/15	26/05/15	26/05/15	26/05/15
<b>HSMC_beta_Asia</b>	-	-	-	-	-	-
<b>HSMC_corr_world</b>		08/05/14				
	09/04/15	09/04/15	09/04/15	09/04/15	09/04/15	09/04/15
<b>HSMC_beta_world</b>		24/06/14				
	26/05/15	26/05/15	26/05/15	26/05/15	26/05/15	26/05/15

Panel B: mainland	A		B	C	D	
	A3	A4			D1	D2
<b>SHI_variance</b>	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14
<b>SHI_mv</b>	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14
<b>SHI_spread</b>	11/11/14	11/11/14	11/11/14	11/11/14	11/11/14	11/11/14
<b>SHI_va</b>	17/11/14	17/11/14	17/11/14	17/11/14	17/11/14	17/11/14
<b>SHI_vo</b>	29/10/14	29/10/14	29/10/14	29/10/14	29/10/14	29/10/14
<b>SHI_corr_Asia</b>			11/09/14	11/09/14	11/09/14	11/09/14
<b>SHI_corr_world</b>	-	-	-	-	-	-
<b>SHI_beta_Asia</b>	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14
<b>SHI_beta_world</b>	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14
<b>SH180_return</b>	-	-	-	-	-	-
<b>SH180_variance</b>	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14
<b>SH180_mv</b>	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14
<b>SH180_spread</b>	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14
SH180_va	11/01/14	11/11/14	11/11/14	11/11/14	11/11/14	11/01/14
<b>SH180_vo</b>	30/10/14	30/10/14	30/10/14	30/10/14	30/10/14	30/10/14
<b>SH180_corr_Asia</b>			30/09/14	30/09/14	30/09/14	30/09/14
<b>SH180_corr_world</b>			13/11/14	13/11/14	13/11/14	13/11/14



SH180_corr_HSLC	02/01/14	02/01/14	02/12/14	02/12/14	02/12/14	02/12/14
<b>SH180_beta_Asia</b>	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14
<b>SH180_beta_HSLC</b>		04/02/14				
	26/05/15	26/05/15	26/05/15	26/05/15	26/05/15	26/05/15
<b>SH180_beta_world</b>	13/11/14	13/11/14	13/11/14	13/11/14	13/11/14	
<b>SH380_variance</b>	26/11/14	26/11/14	26/11/14	26/11/14	26/11/14	26/11/14
<b>SH380_spread</b>	26/11/14	26/11/14	26/11/14	26/11/14	26/11/14	26/11/14
<b>SH380_Asia</b>			11/09/14	11/09/14	11/09/14	11/09/14
<b>SH380_world</b>			17/09/14	17/09/14	17/09/14	17/09/14
<b>SH380_HSMC</b>			27/01/14	27/01/14	27/01/14	
			26/05/15	26/05/15	26/05/15	
<b>SH380_beta_Asia</b>	26/11/14	26/11/14	26/11/14	26/11/14	26/11/14	26/11/14
<b>SH380_beta_world</b>		26/11/14	26/11/14	26/11/14	26/11/14	26/11/14
<b>SH380_beta_HSMC</b>		24/06/14				
	26/05/15	26/05/15	26/05/15	26/05/15	26/05/15	26/05/15

Note: 1. Column A: Bai-Perron tests of 1 to M globally determined breaks (The sup F type test has the null hypothesis of no structural breaks ( $m=0$ ) versus alternative hypothesis that there are  $m=k$  breaks.); A1: Sequential F-statistic determined breaks; A2: Significant F-statistic largest breaks; A3: Udmax; A4: Wdmax (the double maximum test the null hypothesis of UDmax and WDmax of no structural breaks against an unknown number of breaks given some upper bound M.); column B: Bai-Perron tests of L+1 vs. L sequentially determined breaks; column C: Bai-Perron tests of L+1 vs. L globally determined breaks; column D: Compare information criteria for 0 to M globally determined breaks; D1: Schwarz criterion; D2: LWZ criterion. The full list of break points is available upon request. To economise space, this table only shows structure break points since 2014.

2. \_variance: conditional variance; \_mv: market value; \_spread: daily price high-daily price low; \_va: trading value; \_vo: trading volume; \_corr\_world: conditional correlation with the world index; \_corr\_Asia: conditional correlation with Asia market index; HS\_I\_corr\_SHI: conditional correlation between HS\_I and SHI; \_cov\_world: conditional covariance with the world index; \_cov\_Asia: conditional covariance with Asia market index; HS\_I\_cov\_SHI: conditional covariance between HS\_I and SHI; SH180\_corr\_HSLC: conditional correlation between HSLC and SH180; SH180\_cov\_HSLC: conditional covariance between HSLC and SH180; SH380\_corr\_HSMC: conditional correlation between HSMC and SH380; SH380\_cov\_HSMC: conditional covariance between HSMC and SH380. HSLC, HSMC and SH180 have no information on mv, vo and va in Datastream hence they are not included here.

3. Those results consistent across various tests are indicated by using bold font for the variable names. The most commonly identified break date in 2014 is 13th November 2014, which is four days before the implementation of SHSC. This is consistent with our discussion in section 2.3.

Table 7 The statistical significance of the difference in the characteristics' means before and after the liberalisation event

Index_specific market characteristics	difference in mean	mean $\neq$ 0	mean > 0	mean < 0
hs_i_mv	422487.20	***	***	
hs_i_spread	15.92		*	
hs_i_va	617.42	***	***	
hs_i_vo	110259.70	**	**	
hs_i_corr_world	4.92E-04			
hs_i_corr_Asia	5.46E-08			
hs_i_corr_SHI	-0.019	***		***
hs_i_beta_Asia	-7.70E-05	***		***
hs_i_beta_SHI	1.76E-05	***	***	
hs_i_beta_world	-2.75E-05	***		***
HSLC_spread	6.820	***	***	
HSLC_corr_Asia	0.004	**	***	
HSLC_corr_world	0.005			
HSLC_beta_Asia	8.58E-06	**	**	
HSLC_beta_world	3.32E-06	**	**	
HSMC_spread	25.975	***	***	
HSMC_corr_Asia	-0.014	***		***
HSMC_corr_world	-0.016	***		***
HSMC_beta_Asia	0.0000169	***	***	
HSMC_beta_world	5.39E-06	**	***	
SHI_mv	2081941	***	***	
SHI_spread	39.286	***	***	
SHI_va	5.79E+07	***	***	
SHI_vo	2.72E+08	***	***	
SHI_corr_Asia	-0.034	***		***
SHI_corr_world	-0.017	***		***
SHI_beta_Asia	3.46E-06			
SHI_beta_world	5.25E-06	***	***	
SH180_mv	1153833	***	***	
SH180_spread	88.214	***	***	
SH180_va	2.91E+07	***	***	
SH180_vo	1.41E+08	***	***	
SH180_corr_Asia	-0.030	***		***
SH180_corr_world	-0.017	***		***
SH180_corr_HSLC	-0.076	***		***
SH180_beta_Asia	-4.05E-06			
SH180_beta_HSLC	4.35E-05	***	***	
SH180_beta_world	2.53E-06			
SH380_spread	123.302	***	***	
SH380_corr_Asia	-0.005			
SH380_corr_world	0.006		*	
SH380_corr_HSMC	-9.55E-05			
SH380_beta_Asia	1.71E-05	***	***	
SH380_beta_world	1.14E-05	***	***	
SH380_beta_HSMC	1.23E-04	***	***	

Note: 1. In general the results have provided support to the previous literature on both associated benefits and issues of stock market liberalization. 2. \*\*\* Significant at the 1% level; \*\* Significant at the 5% level; \* Significant at the 10% level. 3. Variable definitions refer to table 6. 4. In general, as expected we find increasing market liquidity and size but also increasing exposure to systematic risk after the partial liberalization

Table 8 Examination of EGARCH model for indices with and without breaks in conditional variance

<b>Panel A: Hong Kong</b>	<b>Pre-liberalization</b>			<b>Post-liberalization without breaks</b>			<b>Post-liberalization with breaks</b>		
<b>HS_I</b>									
<b>Mean equation</b>									
<b>market excess return</b>	<b>0.956</b>	<b>[113.29]</b>	<b>***</b>	<b>0.675</b>	<b>[10.20]</b>	<b>***</b>	<b>0.674</b>	<b>[13.51]</b>	<b>***</b>
constant	-0.001	[-3.24]	***	-0.001	[-1.36]		0.000	[-1.22]	
ma(1)	-0.277	[-12.87]	***	-0.142	[-3.01]	***	-0.137	[-2.91]	***
<b>Variance Equation</b>									
$\omega$	-0.164	[-7.02]	***	-0.974	[-2.06]	**	-0.919	[-3.51]	***
$\alpha$	<b>0.127</b>	<b>[11.86]</b>	<b>***</b>	<b>0.229</b>	<b>[2.68]</b>	<b>***</b>	<b>0.224</b>	<b>[5.37]</b>	<b>***</b>
$\gamma$	-0.018	[-2.17]	**	-0.059	[-1.06]		-0.056	[-2.44]	**
$\beta$	<b>0.992</b>	<b>[456.53]</b>	<b>***</b>	<b>0.913</b>	<b>[19.10]</b>	<b>***</b>	<b>0.918</b>	<b>[34.32]</b>	<b>***</b>
Dummy_event2							-0.172	[-0.24]	
Dummy_event3							2.059	[0.54]	
dummy_structural break							-1.558	[-0.30]	
<b>Diagnostics tests</b>									
Ljung–Box (12) Q stat.-levels	1.038			1.230			0.960		
Ljung–Box (12) Q stat.-squares	8.186	***		1.363			1.556		
ARCH LM test	6.416	**		0.707			0.772		
<b>HSLC</b>									
<b>Mean equation</b>									
<b>market excess return</b>	<b>0.903</b>	<b>[107.48]</b>	<b>***</b>	<b>0.610</b>	<b>[11.615]</b>	<b>***</b>	<b>0.449</b>	<b>[8.34]</b>	<b>***</b>
constant	-0.002	[-7.32]	***	0.001	[-1.823]	*	-0.001	[-2.32]	**
<b>Variance Equation</b>									
$\omega$	-0.273	[-6.81]	***	-0.922	[-3.548]	***	-0.154	[-116.53]	***
$\alpha$	<b>0.159</b>	<b>[10.06]</b>	<b>***</b>	<b>0.217</b>	<b>[4.951]</b>	<b>***</b>	<b>-0.076</b>	<b>[-13.82]</b>	<b>***</b>
$\gamma$	0.030	[3.19]	***	-0.068	[-2.615]	***	-0.115	[-8.72]	***
$\beta$	<b>0.984</b>	<b>[249.64]</b>	<b>***</b>	<b>0.917</b>	<b>[34.925]</b>	<b>***</b>	<b>0.977</b>	<b>[41681.78]</b>	<b>***</b>
Dummy_event2							-1.205	[-9.36]	***
Dummy_event3							0.562	[2.26]	**
dummy_structural break							1.989	[9.06]	***
<b>Diagnostics tests</b>									
Ljung–Box (12) Q stat.-levels	0.159			2.475			2.537		
Ljung–Box (12) Q stat.-squares	0.445			0.479			1.050		
ARCH LM test	0.444			0.475			1.077		
<b>HSMC</b>									
<b>Mean equation</b>									
<b>market excess return</b>	<b>0.904</b>	<b>[105.26]</b>	<b>***</b>	<b>0.593</b>	<b>[9.39]</b>	<b>***</b>	<b>0.594</b>	<b>[9.67]</b>	<b>***</b>
constant	-0.002	[-7.58]	***	0.000	[-0.40]		0.000	[-0.24]	
<b>Variance Equation</b>									
$\omega$	-0.246	[-6.62]	***	-0.566	[-4.48]	***	-0.508	[-4.25]	***
$\alpha$	<b>0.167</b>	<b>[9.24]</b>	<b>***</b>	<b>0.303</b>	<b>[6.84]</b>	<b>***</b>	<b>0.314</b>	<b>[7.08]</b>	<b>***</b>
$\gamma$	0.021	[2.30]	**	-0.001	[-0.07]		0.009	[0.68]	
$\beta$	<b>0.987</b>	<b>[277.93]</b>	<b>***</b>	<b>0.961</b>	<b>[72.11]</b>	<b>***</b>	<b>0.968</b>	<b>[76.04]</b>	<b>***</b>
Dummy_event2							-0.383	[-0.56]	
Dummy_event3							0.948	[1.29]	
dummy_structural break							-0.706	[-0.55]	
<b>Diagnostics tests</b>									
Ljung–Box (12) Q stat.-levels	0.657			1.348			1.544		
Ljung–Box (12) Q stat.-squares	0.011			0.437			0.302		
ARCH LM test	0.011			0.432			0.300		

Panel B: mainland	Pre-liberalization			Post-liberalization without breaks			Post-liberalization with breaks		
<b>SHI</b>									
<b>Mean equation</b>									
<b>market excess return</b>	<b>0.552</b>	<b>[29.73]</b>	<b>***</b>	<b>0.843</b>	<b>[15.72]</b>	<b>***</b>	<b>0.859</b>	<b>[15.62]</b>	<b>***</b>
constant	-0.002	[-1.86]	*	0.001	[1.79]	*	0.001	[1.92]	*
AR(1)	0.996	[857.56]	***						
MA(1)	-0.984	[-239.58]	***						
<b>Variance Equation</b>									
$\omega$	-0.137	[-7.58]	***	-0.190	[-4.51]	***	-0.132	[-3.52]	***
$\alpha$	<b>0.103</b>	<b>[10.56]</b>	<b>***</b>	<b>0.180</b>	<b>[6.08]</b>	<b>***</b>	<b>0.148</b>	<b>[5.24]</b>	<b>***</b>
$\gamma$	-0.036	[-5.81]	***	0.036	[2.29]	**	0.033	[1.93]	*
$\beta$	<b>0.993</b>	<b>[559.53]</b>	<b>***</b>	<b>0.993</b>	<b>[228.10]</b>	<b>***</b>	<b>0.998</b>	<b>[265.62]</b>	<b>***</b>
Dummy_event2							0.785	[1.74]	*
Dummy_event3							1.087	[1.72]	*
dummy_structural break									
<b>Diagnostics tests</b>									
Ljung-Box (12) Q stat.-levels	2.206			1.66			1.360		
Ljung-Box (12) Q stat.-squares	1.847			0.8052			0.351		
ARCH LM test	0.058			0.798			0.348		
<b>SH180</b>									
<b>Mean equation</b>									
<b>market excess return</b>	<b>0.773</b>	<b>[47.86]</b>	<b>***</b>	<b>0.915</b>	<b>[16.24]</b>	<b>***</b>	<b>0.909</b>	<b>[15.89]</b>	<b>***</b>
constant	-0.001	[-4.07]	***	0.001	[1.64]		0.001	[1.61]	
AR(1)	0.064	[2.82]	***						
<b>Variance Equation</b>									
$\omega$	-0.150	[-6.96]	***	-0.176	[-4.17]	***	-0.144	[-3.69]	***
$\alpha$	<b>0.091</b>	<b>[7.90]</b>	<b>***</b>	<b>0.162</b>	<b>[5.41]</b>	<b>***</b>	<b>0.139</b>	<b>[4.82]</b>	<b>***</b>
$\gamma$	-0.030	[-4.42]	***	0.041	[2.62]	***	0.023	[1.42]	
$\beta$	<b>0.990</b>	<b>[457.92]</b>	<b>***</b>	<b>0.993</b>	<b>[247.07]</b>	<b>***</b>	<b>0.995</b>	<b>[280.21]</b>	<b>***</b>
Dummy_event2									
Dummy_event3							1.425	[2.15]	**
dummy_structural break									
<b>Diagnostics tests</b>									
Ljung-Box (12) Q stat.-levels	0.395			1.416			0.896		
Ljung-Box (12) Q stat.-squares	1.907			0.573			0.620		
ARCH LM test	0.124			0.568			0.614		
<b>SH380</b>									
<b>Mean equation</b>									
<b>market excess return</b>	<b>0.765</b>	<b>[43.41]</b>	<b>***</b>	<b>0.897</b>	<b>[11.78]</b>	<b>***</b>	<b>0.892</b>	<b>[11.28]</b>	<b>***</b>
constant	-0.002	[-4.29]	***	0.001	[1.70]	*	0.001	[1.94]	*
AR(1)	0.163	[7.85]	***						
<b>Variance Equation</b>									
$\omega$	-0.112	[-6.16]	***	-0.272	[-5.55]	***	-0.173	[-4.05]	***
$\alpha$	<b>0.080</b>	<b>[7.10]</b>	<b>***</b>	<b>0.193</b>	<b>[5.92]</b>	<b>***</b>	<b>0.156</b>	<b>[5.73]</b>	<b>***</b>
$\gamma$	-0.030	[-4.50]	***	-0.018	[-0.84]		0.000	[-0.01]	
$\beta$	<b>0.994</b>	<b>[521.23]</b>	<b>***</b>	<b>0.984</b>	<b>[178.7]</b>	<b>***</b>	<b>0.993</b>	<b>[203.41]</b>	<b>***</b>
Dummy_event2							1.253	[3.09]	***
Dummy_event3							-0.644	[-1.08]	
dummy_structural break							1.199	[1.71]	*
<b>Diagnostics tests</b>									
Ljung-Box (12) Q stat.-levels	0.807			0.932			1.237		
Ljung-Box (12) Q stat.-squares	25.407	***		0.147			0.075		
ARCH LM test	16.855	***		0.145			0.074		

Note:1. \*\*\* Significant at the 1% level; \*\* Significant at the 5% level; \* Significant at the 10% level. 2. There are asymmetric changes in the results between the mainland and Hong Kong indices in terms of the magnitude of market excess returns, the magnitude of shock ( $\alpha$ ) and the persistence of volatility ( $\beta$ ). 3. Most of the diagnostics tests for both periods indicate absence of serial correlation at lags (12). The ARCH Lagrange Multiplier (LM) test also indicates no ARCH effect. 4. The results are based on eq.(7) .  $R'_{c,t} = \vartheta + R'_{M,t} + \varepsilon_t$

$$\log(\sigma^2) = \omega + \beta \log(\sigma_{t-1}^2) + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}}} \alpha \left[ \frac{|\varepsilon_{t-1}|}{\sqrt{\sigma_{t-1}}} - \sqrt{\frac{2}{\pi}} \right] + \theta_1 d_{fl2} + \theta_2 d_{fl3} + \theta_3 d_{bp} \quad (7)$$

## Appendix

Table A1 A comparison between “Through Train”, SHSC, QFII and QDII

	SHSC	QFII	QDII	Through Train
Eligible Investor	SHI Members, institutional investors & individual investors* in Mainland for HK Stock Connect trades All Hong Kong and overseas investors for Shanghai Stock Connect trades	Qualified non-Chinese institutional investors	Qualified Chinese institutional investors	Chinese domestic residents in Tianjin Binhai New Area
Currency	Transactions in RMB	Transactions in USD and other foreign currencies	Transactions in USD and other foreign currencies	Transactions in US\$ and other foreign currencies
Quota	Applies to market as a whole	Allocated to each institutional investor	Application for quota made to SAFE but No official concept of a capped total quota	No restriction on investment quota
Eligible Products	Selected A and H-shares and main board shares in Hong Kong stock exchange	RMB denominated products approved by CSRC**	Offshore markets such as bank deposits, common stocks and bonds	Securities publicly listed in Hong Kong Stock Exchange
Regulation of Funds	Funds must return to origin; No lock up period	Funds subject to lock up period and can stay in mainland afterwards	No more than 50 percent of the QDII product's net assets may be invested in equities, and any investment in a single issue should not exceed 5 percent of the QDII product's net assets;	Investment will be handled through the Bank of China (BOC) Tianjin Branch and Hong Kong BOCI Securities Limited
Investors' Rights	Subject to limitations***	No limitations	No limitations	No limitations
*Individual investors must have balance of at least 500,000 in their cash and securities accounts.				
**Stocks, bonds, warrants, funds, index futures fixed income products in interbank-market; primary market activities such as IPO, convertible bond issuance, additional shares issuance and seasoned equity offerings.				
***Shares acquired as entitlements can only be sold if they are not one of the eligible stocks of the Stock Connect but are Heng Sheng Index-listed and cannot be bought or sold using the Stock Connect scheme if they are not are Heng Sheng Index -listed.				

Source: Shanghai Stock Exchange (2015); Robinson and Newman (2008)

Table A2 List of market closing dates during the sample periods

Market	Hong Kong	Japan	mainland China	Singapore	U.K.	U.S.
Jan-07	1	1, 2, 3, 8	1, 2, 3	1	1	1, 2, 15
Feb-07	19, 20	12	19, 20, 21, 22, 23	18, 19, 20		19
Mar-07		21				
Apr-07	5, 6, 9	30		6	6, 9	6
May-07	1, 24	3, 4	1, 2, 3, 4, 7	1, 31	7, 28	28
Jun-07	19					
Jul-07	2	16				4
Aug-07				9	27	
Sep-07	26	17, 24				3
Oct-07	1, 19	8	1, 2, 3, 4, 5	13		
Nov-07		23		8		22
Sep-13	20	16, 23	19, 20			2
Oct-13	1, 14	14	1, 2, 3, 4, 7	15		
Nov-13		4		3		28
Dec-13	25, 26	23, 31		25	25, 26	25
Jan-14	1, 31	1, 2, 3, 13	1, 2, 3, 31	1, 31	1	1, 20
Feb-14	3	11	3, 4, 5, 6	1		17
Mar-14		21				
Apr-14	18, 21	29	7	18	18, 21	18
May-14	1, 6	5, 6	1, 2	1, 13	5, 26	26
Jun-14	2		2			
Jul-14	1	21		28		4
Aug-14				9	25	
Sep-14	9	15, 23	8			1
Oct-14	1, 2	13	1, 2, 3, 6, 7	5, 23		
Nov-14		3, 24				27
Dec-14	25, 26	23, 31		25	25, 26	25
Jan-15	1	1, 2, 12	1, 2	1	1	1, 19

Note: 1. Table A2 list the holidays of the sample markets when the markets were closed for trading during our sample periods. These are the dates we have adjusted in our event studies when we apply the calendar time model.

2. Data sources: the main stock exchanges of each market.

Table A3 Market model estimation results

Events	Event 1: The announcement of “Through Train” on 20 August 2007					Event 2: The announcement of SHHK Stock Connect on 10 April 2014					Event 3: The implementation of SHHK Stock Connect on 17 November 2014				
Indices	$\beta$		t-stat	$R^2$	F-stat	$\beta$		t	$R^2$	F	$\beta$		t-stat	$R^2$	F-stat
HS_I	0.7145	***	6.31	0.2520	39.76	0.6002	***	4.71	0.1581	22.15	0.2069	*	1.75	0.0253	3.06
HSLC						0.6068	***	4.78	0.1625	22.89	0.2113	*	1.81	0.0269	3.27
HSMC						0.5121	***	4.24	0.1322	17.97	0.1614		1.47	0.0179	2.15
SHI	0.5329	***	3.27	0.0833	10.72	0.6590	***	5.51	0.2048	30.40	0.5417	***	4.93	0.1709	24.32
SHI180	0.5599	***	3.27	0.0831	10.69	0.8042	***	5.89	0.2270	34.65	0.5919	***	4.95	0.1718	24.48
SHI380	0.4374	*	1.99	0.0326	3.98	0.7316	***	4.37	0.1395	19.13	0.5175	***	3.55	0.0966	12.62
SZI	0.5522	***	2.95	0.0688	8.72	0.7422	***	4.46	0.1444	19.92	0.6565	***	4.73	0.1596	22.41
S&P 500	1.0471	***	16.87	0.7070	284.67	1.0575	***	20.77	0.7852	431.41	1.1757	***	26.39	0.8552	696.69
FTSE 350	1.2356	***	17.20	0.7150	295.98	1.0674	***	15.61	0.6738	243.74	0.9675	***	11.90	0.5455	141.63
Nikkei 225	0.1490		1.47	0.0179	2.15	0.5741	***	2.88	0.0658	8.30	-0.0676		-0.46	0.0018	0.21
Straits Times	0.9921	***	7.67	0.3325	58.78	0.5543	***	6.46	0.2613	41.73	0.1600	**	2.02	0.0334	4.08

Note: 1. MSCI World Index proxies for market return in the market model estimations for all indices except four Chinese Indices. MSCI AC Asia ex Japan Index proxies for market returns in the market model estimations of four Chinese Indices.

2. Estimation windows (-126, -6), 120 observations in all estimations.

3. HS\_I=Hang Seng Index; HSLC=Hang Seng Composite LargeCap Index; HSMC=Hang Seng Composite MidCap Index; SHI= Shanghai SE Composite Index; SHI180=Shanghai SE Composite 180 Index; SHI380= Shanghai SE Composite 380 Index; SZI= Shenzhen SE Composite Index; Straits Times= Straits Times Index (Singapore)

4. \*\*\* Significant at the 1% level or higher; \*\* Significant at the 5% level or higher; \* Significant at the 10% level.

5. The results presented here show that the market model estimations are plausible.

Table A4 The number of structural break days and F-statistics of all the multiple structural break tests

Panel A: Hong Kong	A				B	C	D	
	A1	A2	A3	A4			D1	D2
hs_i_return	0	0	0	0	0	0	0	0
	[-]	[-]	[3.17]	[3.76]	[2.00]	[2.00]	[-8.23]	[-8.23]
hs_i_variance	5	5	1	5	4	4	3	2
	[-]	[-]	[298.18]	[506.32]	[208.71]	[208.71]	[-16.95]	[-16.91]
hs_i_dy	5	5	1	5	5	5	4	4
	[-]	[-]	[1692.73]	[2143.98]	[21.84]	[22.44]	[-1.59]	[-1.53]
hs_i_mv	5	5	1	1	5	4	4	4
	[-]	[-]	[3550.20]	[3550.20]	[20.22]	[49.97]	[24.18]	[24.24]
hs_i_pe	5	5	2	2	5	5	4	4
	[-]	[-]	[4950.99]	[5883.58]	[33.71]	[22.98]	[1.23]	[1.29]
hs_i_spread	5	5	1	5	4	4	4	1
	[-]	[-]	[159.59]	[170.01]	[22.86]	[70.51]	[10.51]	[10.56]
hs_i_va	5	5	2	3	4	4	3	2
	[-]	[-]	[82.33]	[102.34]	[15.63]	[15.63]	[14.46]	[14.50]
hs_i_vo	5	5	1	5	4	4	3	2
	[-]	[-]	[102.25]	[115.00]	[17.24]	[18.26]	[27.26]	[27.30]
hs_i_corr_world	5	5	2	2	2	2	2	2
	[-]	[-]	[88.14]	[104.74]	[133.40]	[133.40]	[-4.77]	[-4.74]
hs_i_corr_Asia	5	5	4	5	4	5	5	5
	[-]	[-]	[130.66]	[250.86]	[53.12]	[61.52]	[-6.90]	[-6.83]
hs_i_corr_SHI	5	5	1	1	4	4	4	4
	[-]	[-]	[1020.83]	[1020.83]	[74.30]	[74.63]	[-5.23]	[-5.18]
hs_i_beta_Asia	5	5	1	5	4	4	3	2
	[-]	[-]	[257.32]	[541.05]	[148.71]	[145.94]	[-16.97]	[-16.93]
hs_i_beta_SHI	5	5	4	4	4	4	4	4
	[-]	[-]	[370.18]	[636.50]	[597.33]	[596.54]	[-18.67]	[-18.62]
hs_i_beta_world	5	5	4	5	3	4	3	2
	[-]	[-]	[170.73]	[332.77]	[102.25]	[102.25]	[-18.26]	[-18.22]
HSLC_return	0	0	0	0	0	0	0	0
	[-]	[-]	[2.86]	[4.22]	[2.22]	[2.22]	[-8.87]	[-8.86]
HSLC_variance	5	5	3	5	4	4	3	3
	[-]	[-]	[155.88]	[233.53]	[34.60]	[47.52]	[-19.46]	[-19.40]
HSLC_spread	5	5	2	5	4	4	3	2
	[-]	[-]	[71.25]	[88.68]	[20.41]	[20.41]	[4.96]	[5.02]
HSLC_corr_Asia	5	5	3	4	4	4	4	4
	[-]	[-]	[287.60]	[416.63]	[112.06]	[112.06]	[-7.57]	[-7.49]
HSLC_corr_world	5	5	2	4	4	4	4	4
	[-]	[-]	[92.58]	[144.68]	[86.48]	[69.30]	[-5.00]	[-4.92]
HSLC_beta_Asia	5	5	4	5	4	4	4	3
	[-]	[-]	[243.25]	[418.55]	[149.63]	[122.36]	[-19.65]	[-19.59]
HSLC_beta_world	5	5	4	5	3	4	4	4
	[-]	[-]	[220.90]	[423.59]	[322.05]	[134.51]	[-21.28]	[-21.20]
HSMC_return	0	0	0	0	0	0	0	0
	[-]	[-]	[3.88]	[5.88]	[3.02]	[3.02]	[-8.46]	[-8.45]
HSMC_variance	5	5	2	4	4	4	3	3
	[-]	[-]	[151.88]	[232.05]	[88.35]	[127.57]	[-17.46]	[-17.40]
HSMC_spread	5	5	1	5	4	4	3	3
	[-]	[-]	[77.27]	[102.78]	[14.12]	[14.12]	[7.35]	[7.41]
HSMC_corr_Asia	5	5	1	1	4	4	4	4
	[-]	[-]	[421.40]	[421.40]	[61.15]	[61.15]	[-6.50]	[-6.43]
HSMC_corr_world	5	5	2	2	2	2	2	2
	[-]	[-]	[133.15]	[158.23]	[227.53]	[227.53]	[-4.78]	[-4.74]
HSMC_beta_Asia	-	-			4	4	4	3
	[-]	[-]	[264.11]	[508.10]	[100.48]	[194.65]	[-18.80]	[-18.74]
HSMC_beta_world	5	5	4	5	4	4	4	3
	[-]	[-]	[218.86]	[391.01]	[39.08]	[237.31]	[-20.59]	[-20.53]

Note: Column A: Bai-Perron tests of 1 to M globally determined breaks; A1: Sequential F-statistic determined breaks; A2: Significant F-statistic largest breaks; A3: Udmax; A4: Wdmax; column B: Bai-Perron tests of L+1 vs. L sequentially determined breaks; column C: Bai-Perron tests of L+1 vs. L globally determined breaks; column D: Compare information criteria for 0 to M globally determined breaks; D1: Schwarz criterion; D2: LWZ criterion. All the F-statistics are significant at 5%.



Panel B: mainland	A				B	C	D	
	A1	A2	A3	A4			D1	D2
SHI_return	0	0	0	0	0	0	0	0
	[-]	[-]	[8.53]	[8.53]	[8.53]	[8.53]	[-8.05]	[-8.04]
SHI_variance	5	5	2	5	4	5	4	3
	[-]	[-]	[974.72]	[1337.42]	[112.50]	[90.71]	[-17.48]	[-17.43]
SHI_mv	5	5	1	1	4	5	3	3
	[-]	[-]	[2517.40]	[2517.40]	[26.30]	[34.40]	[26.43]	[26.48]
SHI_spread	5	5	3	3	4	4	4	3
	[-]	[-]	[369.41]	[531.80]	[35.88]	[36.58]	[7.64]	[7.68]
SHI_va	5	5	1	1	4	4	4	1
	[-]	[-]	[728.95]	[728.95]	[229.28]	[229.28]	[33.28]	[33.33]
SHI_vo	5	5	1	1	4	4	4	4
	[-]	[-]	[983.71]	[983.71]	[146.52]	[247.00]	[36.22]	[36.28]
SHI_corr_Asia	5	5	1	1	4	4	4	3
	[-]	[-]	[611.79]	[611.79]	[39.59]	[40.24]	[-4.93]	[-4.88]
SHI_corr_world	5	5	1	1	4	4	4	3
	[-]	[-]	[310.89]	[310.89]	[40.95]	[42.98]	[-5.09]	[-5.04]
SHI_beta_Asia	5	5	4	5	4	4	4	4
	[-]	[-]	[365.73]	[644.75]	[635.78]	[649.74]	[-19.14]	[-19.08]
SHI_beta_world	5	5	4	5	5	5	4	4
	[-]	[-]	[130.66]	[250.86]	[53.01]	[61.70]	[-20.60]	[-20.55]
SH180_return	1	1	1	1	1	1	0	0
	[-]	[-]	[11.38]	[11.38]	[11.38]	[11.38]	[-7.91]	[-7.91]
SH180_variance	5	5	2	5	4	5	4	3
	[-]	[-]	[878.00]	[1085.21]	[61.36]	[39.69]	[-17.35]	[-17.30]
SH180_mv	5	5	1	1	4	5	4	3
	[-]	[-]	[2028.89]	[2028.89]	[56.30]	[150.84]	[25.76]	[25.81]
SH180_spread	5	5	2	2	4	4	4	3
	[-]	[-]	[359.87]	[427.66]	[19.90]	[19.90]	[9.41]	[9.46]
SH180_va	5	5	1	4	4	4	4	1
	[-]	[-]	[516.22]	[575.87]	[282.20]	[277.17]	[32.23]	[32.26]
SH180_vo	5	5	1	1	4	4	4	1
	[-]	[-]	[648.29]	[648.29]	[367.19]	[367.19]	[35.24]	[35.28]
SH180_corr_Asia	5	5	1	1	4	4	5	3
	[-]	[-]	[675.47]	[675.47]	[31.85]	[33.21]	[-4.91]	[-4.86]
SH180_corr_world	5	5	1	1	5	5	4	3
	[-]	[-]	[346.14]	[346.14]	[19.28]	[19.28]	[-5.06]	[-5.01]
SH180_corr_HSLC	5	5	1	1	4	4	4	2
	[-]	[-]	[493.03]	[493.03]	[58.80]	[58.80]	[-5.69]	[-5.62]
SH180_beta_Asia	5	5	4	5	4	4	4	4
	[-]	[-]	[289.52]	[499.14]	[490.26]	[552.05]	[-18.91]	[-18.86]
SH180_beta_world	5	5	1	5	4	4	4	3
	[-]	[-]	[290.24]	[330.15]	[90.18]	[104.42]	[-20.73]	[-20.66]
SH180_beta_HSLC	5	5	4	5	5	5	4	2
	[-]	[-]	[102.05]	[190.50]	[38.72]	[38.72]	[-20.34]	[-20.30]
SH380_return	0	0	0	0	0	0	0	0
	[-]	[-]	[3.69]	[5.66]	[3.69]	[3.69]	[-7.70]	[-7.69]
SH380_variance	5	5	2	4	4	4	3	3
	[-]	[-]	[676.30]	[991.17]	[102.50]	[102.50]	[-16.43]	[-16.39]
SH380_spread	5	5	1	3	4	4	3	2
	[-]	[-]	[226.50]	[243.97]	[24.73]	[20.96]	[8.62]	[8.66]
SH380_corr_Asia	5	5	1	1	4	4	3	3
	[-]	[-]	[691.75]	[691.75]	[14.94]	[14.94]	[-5.05]	[-5.00]
SH380_corr_world	5	5	1	1	4	4	4	4
	[-]	[-]	[515.68]	[515.68]	[99.14]	[69.03]	[-5.59]	[-5.53]
SH380_corr_HSMC	5	5	1	2	3	3	3	2
	[-]	[-]	[205.05]	[242.92]	[22.34]	[22.34]	[-5.13]	[-5.08]
SH380_beta_Asia	5	5	4	4	4	4	4	4
	[-]	[-]	[344.46]	[592.27]	[628.99]	[643.77]	[-19.40]	[-19.35]
SH380_beta_world	5	5	1	5	5	5	4	4
	[-]	[-]	[154.66]	[208.26]	[40.17]	[40.17]	[-21.08]	[-21.02]
SH380_beta_HSMC	5	5	1	5	4	4	3	2
	[-]	[-]	[247.47]	[332.96]	[82.08]	[127.74]	[-18.84]	[-18.79]

**Highlights**

- Mainland markets react positively to SHSC but conversely for Hong Kong market.
- Different market characteristics in both markets drive the heterogeneous reactions.
- As expected market size, liquidity and market interdependence increase post-SHSC.
- “Through Train” has profound influence to the subsequent SHSC.

ACCEPTED MANUSCRIPT