THE IMPACT OF THE SHANGHAI–HONG KONG CONNECT ON MARKET LIQUIDITY AND PRICE DIVERGENCE

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Abstract - The economic growth of China has seen an increase in its demand for capital, fueling its local stock markets. This paper examines a market liberalization event between China and Hong Kong and its impact on market liquidity and price convergence for cross-listed stocks in the two markets. On November 17, 2014, the Shanghai Stock Exchange and the Hong Kong Stock Exchange introduced the Shanghai-Hong Kong Stock Connect (SHHKConnect), a bilateral investment channel between the two markets. The new channel brings with it accesses to new capital for domestic firms and trading expertise from new foreign participants for both regions. The SHHKConnect permits mutual market access for market participants, facilitating trade in each market using existing trading infrastructure. This study adopts a difference-in-difference methodology and finds that market liquidity as proxied by transaction costs, improves in both markets, for eligible stocks that are traded through the bilateral investment channel, three-months post November 17, 2014. Over a longer event horizon of six-months, liquidity in China continues to improve, whereas in Hong Kong it decreases. In addition, reported results identify that the pre-existing price premium between cross-listed China A-shares and Hong Kong H-shares, increases following the market design change. We attribute the increase in price divergence to the incremental improvement in liquidity in China vis-à-vis Hong Kong.

JEL Classification - G140; G180
Keywords - Liquidity, Cross-listed securities, Bilateral investment, China, Hong Kong

1. INTRODUCTION

One aspect of equity market liberalization is to enable foreign investors to participate in domestic stock markets, effectively allowing for the flow of investment capital across international borders. When governments open their previously closed capital markets, this signifies an important shift in policy. Previous literature suggests that market liberalization brings with it benefits in the forms of a lower domestic cost of capital, higher economic growth and an increase in private investment (see Henry, 2000; Edison et al. 2002; Bekaert, Harvey and Lundblad 2003; Bekaert and Harvey 2000; Edison and Warnock 2003 and Levine and Zervos 1998). On November 17, 2014 with the approval of the Securities and Futures Commission in Hong Kong and the China Securities Regulatory Commission in Beijing, the Shanghai–Hong Kong Stock Connect (SHHKConnect) was launched. The SHHKConnect, enables Mainland China investors to purchase designated shares listed on the Stock Exchange of Hong Kong (SEHK) and similarly, Hong Kong based investors (domestic or international that trade via a Hong Kong broker) to purchase designated shares listed on the SSE. The introduction of the SHHKConnect represents a substantial break from China's traditionally closed market position. Mainland China's stock markets have a long history of being closed to overseas retail and institutional investors[1]. The mutual-market access provided via the SHHKConnect allows overseas investors, in particular retail investors, the opportunity to invest in China with fewer restrictions, and effectively opens China's financial market to the rest of the world.

The SSE, is the second largest market by turnover (0.8 trillion USD) and is the 4th largest by market capitalization in the world (4.7 trillion USD).[2] Comparatively, the SEHK as an open market has a turnover of 0.4 trillion USD (9th in the world), and a market capitalization of 3.4 trillion USD (5th in the world). Chinese investors historically have had limited access to the SEHK due to restrictions in place pertaining to the flow of funds out of China to other markets, including Hong Kong. Considering the growing wealth of Chinese households and their limited investment opportunities[3], the introduction of the SHHKConnect is of significant interest to policy makers and market observes in that it is expected to attract a significant funds flow between Mainland China and Hong Kong's market. In addition to the

[1] Only Qualified Foreign Institutional Investors (QFII) and Renminbi QFII are permitted to invest in China's stock markets under programs launched in 2006 and 2011. However, QFII and Renminbi QFII are subject to trade restrictions.
[2] Exchange data from the World Federation of Exchanges as of March 2015.
[3] Chinese households' portfolio has an average of 72% investment in real estate and only 6% in equities.

capital flow with fewer restrictions between the two markets, the inception of this mutual market access is expected to also stimulate local investors' trading in the local market (Henry, 2000). Investors, foreign and domestic, may expect regulators in both markets to implement greater governance and oversight, as has traditionally been the case. Bekaert, Harvey and Lundblad (2003) find that the introduction of foreign capital typically facilitates market reform to enhance investor protection, which encourages trade in the domestic market and a reduction in information asymmetry. This may be particularly pertinent to Mainland China markets where retail investors account for approximately 85% of trade.[4]

In contrast to previous literature concerning market liberalization, which focuses on the changes in cost of capital and economic growth (Bekaert and Harvey, 2000; Quinn and Toyoda, 2008), this study contributes to the literature by examining its impact on two components of market quality: liquidity and price convergence. Liquidity is critically important to listed companies as it has a major bearing on a company's ability to raise capital and at the same time lower the cost of the capital. Amihud and Mendelson (1986), Brennan and Subramanyam (1996) and O'Hara (2003) show improvements in liquidity decreases the required return of investors and therefore the cost of capital for companies. In relation to price convergence, a number of studies have identified a price premium between China (i.e. A-shares) and Hong Kong (i.e. H-shares) cross-listed stocks. This result is puzzling given A- and H-shares have almost identical underlying income streams.[5] Economic agents should, in theory, arbitrage away any price differential for such assets (Ross, 1976; Roll et al., 1980). However, this literature has examined the issue in the presence of capital restrictions. This study will provide the first examination of changes in the price divergence between the two classes of shares, under the condition of partial ownership liberalization.

Two tests are carried out to address how liquidity and the price premium between SSE and SEHK change following the introduction of the SHHKConnect. First, we adopt a difference-in-differences research design to test if the SHHKConnect had a significant effect on market liquidity. Second, we examine the price premium between cross-listed A- and H- shares, in the light of the removal of trade restrictions. We report that stocks eligible to trade through the SHHKConnect, experience a significant decrease in trading costs following its launch. This is true for both markets three-months post the launch of the SHHKConnect. On the SSE, eligible stocks traded via the SHHKConnect experience a significant decrease in transaction costs of 1.1 bps as measured by effective spreads. Adverse selection costs also decrease by 1.4 bps for firms listed on the SSE, indicative of improved information flows. Meanwhile, on the SEHK, eligible SHHKConnect stocks experience a reduction of 3.2 bps in effective spreads. Accompanying the decrease in transaction costs, market depth decreases in both markets. Quoted depth on the SSE (SEHK) for eligible SHHKConnect securities decreases by 17% (4.7%) in the three-months post the launch of the SHHKConnect.

Liquidity is also examined six-months, pre and post the event date. Results for SSE-listed securities traded via the SHHKConnect indicate a sustained improvement in liquidity, however, on the SEHK liquidity decreases. In relation to tests of price convergence between A- and H-shares, the premium for A-shares increases by approximately 1.9% to 5.5% after the launch of the SHHKConnect. This result is attributed to the persistent liquidity improvement for cross-listed stocks on the SSE than is the case for the SEHK. Both these results provide regulatory insights especially considering new market connectivity agreements to be in operation between several markets.

The remainder of this study is constructed as follows. Section 2 provides institutional details on the SHHKConnect. Section 3 reviews previous literature. Section 4 describes the data and the research design is outlined in Section 5. The results are reported and discussed in Section 6, and Section 7 provides a summary and conclusions.

II. INSTITUTIONAL BACKGROUND - SHANGHAI-HONG KONG CONNECT

The Shanghai – Hong Kong Connect (SHHKConnect) commenced operation on November 17, 2014. SHHKConnect creates mutual market access for designated stocks listed on either the SSE or the SEHK. Eligible SSE-listed stocks that can be traded under the SHHKConnect include all the constituent stocks of the SSE 180 and 380 Indices, as well as A-shares that have corresponding H-shares cross-listed on the SEHK (but not included in the indices mentioned). The eligible SEHK-listed stocks under the SHHKConnect include all the constituents of Hang Seng Composite LargeCap and MidCap Indices, as well as all the H-shares that are not included in the indices mentioned above.

Figure 1 illustrates trade flow across the two markets. When Hong-Kong based investors invest in stocks listed on the SSE (approximately 90% of the total market capitalization), this is referred to as 'Northbound' trading. Conversely, when mainland Chinese investors invest in SEHK-listed stocks (approximately 80% of market capitalization), this is referred as 'Southbound trading'.

[4] See http://www.reuters.com/article/2015/07/09/us-china-stocks-idUSKCN0PI04Q20150709

[5] Taxes for example may cause differences.

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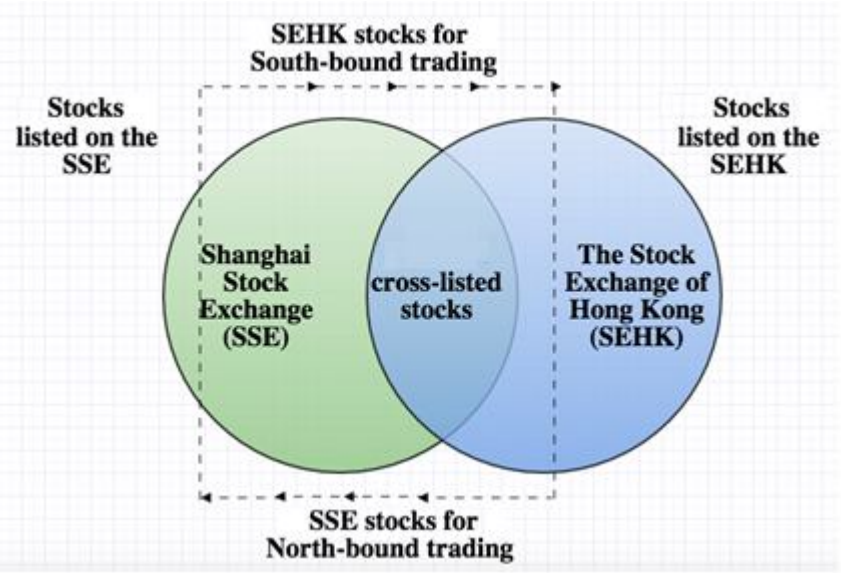


Figure 1 Shanghai Hong Kong Connect

Mainland Chinese investors, who have at least CNY 500,000 (i.e. USD 80,514) or more in their security and cash accounts with brokers, are eligible to invest in the SEHK through the SHHKConnect. Consequently, SHHKConnect delivers mainland Chinese investors easier access to the Hong Kong marketplace. While Chinese investors could trade in HK stocks before the reform by opening a trading account with a Hong Kong based broker, mainland investors were subject to various constraints regarding funds flow in and out of China[6].

Although overseas institutional investors could invest in the SSE by acquiring QFII licenses prior to the SHHKConnect[7], the market liberalization offers greater freedom for international investors in respect of their opportunity to invest in China. Moreover, SHHKConnect offered an unprecedented opportunity for international retail investors to access the historically closed Chinese capital market. Instead of purchasing ETF products that invest in Chinese securities, or investing in mutual funds via their brokers, investors can directly select and hold stocks listed on the SSE.

Under the SHHKConnect, the SSE and the SEHK established two subsidiaries, namely, the SSE Subsidiary and the SEHK Subsidiary, to act as non-member trading participants of the other market. The function of the subsidiaries is to facilitate cross-boundary order-routing for exchange participants (EPs) for their home market. For example, the SEHK Subsidiary is established and located at the SSE as a local trading participant. The SEHK Subsidiary receives orders to trade stocks listed in China from EPs who are registered with the SEHK. It then routes the orders received to the trading system at the SSE for matching and execution. Similar arrangements are in place for the SSE subsidiary. The trading activities in both directions are limited to secondary market trading only, investors cannot participate in IPOs via the bilateral channel.

Clearing and settlement under SHHKConnect is conducted by the China Securities Depository and Clearing Corporation Limited (ChinaClear) and the Hong Kong Securities Clearing Company Limited (HKSCC). ChinaClear and HKSCC established a clearing link whereby the two clearing houses act as a participant of each other. Under the SHHKConnect,

[6] Chinese residents can only purchase up to 50,000 US dollars (or equivalent foreign currency) each year; see State Administration of Foreign Exchange http://www.safe.gov.cn/ .

[7] Qualified Foreign Institutional Investor (QFII) Scheme came into operation on July 9, 2003. It enabled select foreign institutional investors to invest in China's stock markets directly. Foreign investments under the scheme were strictly regulated in terms of quota, products, accounts and fund conversion eligible to be traded. Data released by the Chinese State Administration of Foreign Exchange showed that the aggregate QFII quota permitted were USD 72.1 billion, and as of 26 March 2015 there were 267 QFII accounts.

Northbound or Southbound, securities are traded in the local currency but settled in CNY. For instance, for Southbound trades, Chinese investors will trade SEHK listed stocks in Hong Kong dollars. These trades are settled with ChinaClear or its clearing participants in Chinese CNY. For Northbound trades, HKSCC will settle such trades with its clearing participants and ChinaClear in CNY. This implies that all currency conversions are conducted outside of China, which strategically supports the Chinese government's internationalization of the Chinese CNY. The stock and money settlements in both directions follow clearing and settlement cycles in the other market. That is, the Northbound trades are settled following settlement rules in the SSE, which is T day for stock settlement and T+1 for money settlement; *vice versa* for the Southbound trades.

During the period examined in this study, quotas were imposed for trading in either direction (i.e. North- and South-bound). The trades are subject to a maximum cross-boundary investment quota, namely, Aggregate Quota, as well as a Daily Quota[8]. The quotas aim to cap the amount of fund inflow and outflow of Mainland China under Northbound and Southbound Trading, respectively. Purchasing activities through the SHHKConnect is suspended when either quota is reached. Sell orders are always allowed regardless of quota level.

In general, under the SHHKConnect, home rules apply to the trading parties. For Northbound Trading, Hong Kong based investors are subject to rules of the SSE and *vice versa*. However, there are some trading arrangements under SHHKConnect that are modified based on the original trading rules in the home market. The exceptions include acceptable order types, order submission time, permitted trade type and permitted trading strategy (uncovered short selling is not allowed for Southbound Trading).

III. LITERATURE REVIEW

3.1 Market liberalization and market liquidity

Henry (2000) defines "stock market liberalization [a]s a decision by a country's government to allow foreigners to purchase shares in that country's stock market." Previous studies in stock market liberalization have focused on the impact of market liberalization on stock returns (Kwan and Teyes 1997; Cajueiro et al. 2009) and information efficiency (Cajueiro et al. 2009). To date, the impact of market liberalization on market liquidity has been limited. Levine and Zervos (1998), examine the effect of capital liberalization for 16 emerging markets and find that markets become more liquid and volatile following such events. However, Levine and Zervos (1998), proxy liquidity as the ratio of trading turnover to a countries' GDP and market capitalization. While this is a valid measure of market liquidity in macroeconomic settings, it is not a direct proxy for the efficiency of financial markets. The current study contributes to existing literature by examining market liquidity as it relates to market efficiency, in particular transaction costs, following market liberalization.

3.2 Measure of liquidity

Kyle (1985) defines three properties of a liquid market: tightness, depth, and resilience. Tightness measures the difference between prices quoted by buyers and sellers; depth reflects the ability to absorb large order flow without moving market price; and resilience measures how quickly prices bounce back from temporary random shocks. Liquidity plays an important role in financial markets as it directly affects asset pricing and security returns. Two traditional quote based measures of liquidity and transaction costs exist: depth and effective spreads (see Chung et al. (1999), Chordia, Roll and Subrahmanyam (2000), Goldstein and Kavajecz (2000), Chordia et al. (2002), Aitken and Comerton-Forde (2003), Frino et al. (2013), Baker and Stein (2004), Lee (2009)).

Market depth is a measure that captures the thickness of a market. It determines the ability and quantity participants can trade over a short time interval. Effective spreads, measure the round trip of a transaction, and can be viewed as the gross revenue earned by a liquidity provider. It incorporates prices and quotes to reflect how much a particular trade consumes one side of the order book. As a part of the gross revenue liquidity providers make, realized spreads, measures that part of transaction costs that is non-informational, the net profit for liquidity providers. The difference between effective spreads and realized spreads is the permanent impact on the prevailing price or adverse spread. It can be interpreted as the loss of a liquidity provider from trading with an informed counterparty. Among these measures, effective spreads best reflect both dimensions of market liquidity. By incorporating trading price in the calculation, effective spreads captures orders which 'eat' into the limit-order book by moving across quote levels or beyond the inside quote due to limited depth at prevailing prices in the market.

3.3 Price Divergence in Cross-listed Stocks

Extant literature reports firms that list in multiple markets or issue different classes of shares, exhibit price differentials that stem from varying liquidity provisions for each class of share. Furthermore, such

[8] Northbound Trading was limited to an aggregate quota of RMB300 billion and a daily quota of RMB13 billion, and the Southbound Trading was limited to an aggregate quota of RMB250 billion and a daily quota of RMB10.5 billion (China Securities Regulatory Commission website: http://www.csrc.gov.cn/pub/csrc_en/newsfacts/release/201404/t20140417_247191.html)

liquidity differences arise due to, for example, ownership restrictions and/or investors demand for a certain class of stocks. Several studies on China's stock markets support this liquidity hypothesis. Chen and Xiong (2001) study price differences between common shares and restricted institutional shares (RIS). RIS can only be traded privately or through irregularly scheduled auctions that incur high illiquidity costs. Chen and Xiong (2001) find that the prices of RIS are largely discounted compared to their corresponding common shares. Wang and Jiang (2004) and Lee (2009) exam the price difference between A- and H- shares, and both of their models include liquidity proxies. These studies report a negative relationship between the A-to-H share premium (return premium) and the liquidity of the H-share. Wang and Jiang (2004) also incorporate H-share trading volume relative to total shares outstanding, as well as a market index and volatility ratio from the two markets, to reflect the influences of market-wide risk on the price premium between the two classes of shares.

IV. DATA DESCRIPTION

The data used in this study is obtained from the Market Quality Dashboard (MQD)[9] database developed and managed by Capital Markets CRC. The data includes end-of-day security level metrics, which are calculated from source data maintained by Securities Industry Research Centre of Asia-Pacific (SIRCA) and distributed via the Thomson Reuters Tick History (TRTH) database. The TRTH data includes the best level bid and ask quotes, and trading statistics for each quote and trade message in the two markets. The trading statistics include trading price, trading volume and trading value. For each quote and trade, TRTH provides a time stamp up to millisecond. **Error! Reference source not found.** describes each of the metrics obtained from the Market Quality Dashboard. [10]

Table 1 Metric Description and Estimation Procedure

This table presents descriptions and calculations of four operational measure of liquidity.

Variable	Description	Calculation
Quoted depth in dollar value ($Depth) $Var[1]$	For each security, end-of-day quoted depth in dollar value is the aggregate value of the time-weighted best bid and ask value throughout a day. This variable measures the thickness of the supply and demand of a security, at certain price.	$QuotedBid_{s,d} = \sum_{i=1}^{i} BidPrice_{i,s,d} \times BidVolume_{i,s,d} \times TW_{i,s,d}$ $QuotedAsk_{s,d} = \sum_{i=1}^{i} AskPrice_{i,s,d} \times AskVolume_{i,s,d} \times TW_{i,s,d}$ $\$Depth_{s,d} = QuotedBid_{s,d} + QuotedAsk_{s,d}$
Effective Spread $Var[3]$	Effective spread compares the execution price to the prevailing midpoint before the trade.	$Effective\ spread_{s,d} = \sum_{i=1}^{i} 200 \times \frac{D_{i,s,d} \times (P_{i,s,d} - Mid_{i,s,d})}{Mid_{i,s,d}} \times VW_{i,s,d}$
Realized Spread $Var[4]$	Realized spread compares the execution price to the prevailing midpoint price 10-minute after the trade. Modified upon the classification of trading direction in Lee and Ready (1991)[11].	$Realised\ spread_{s,d} = \sum_{i=1}^{i} 200 \times \frac{D_{i,s,d} \times (P_{i,s,d} - Mid_{i+10min,s,d})}{Mid_{i,s,d}} \times VW_{i,s,d}$
Adverse Selection Cost $Var[5]$	Adverse selection cost measures the price movement against liquidity providers after a trade. It	

[9] https://www.mqdashboard.com/

[10] We winsorize all variables at the 5th and 95th percentiles.

[11] Trading direction ($D_{i,s,d}$) is assigned as 1 for buyer-initiated trades and -1 for seller-initiated trades. Following the extant literature (see Lee & Ready (1991) and Ellis Michaley and'Hara (2000): if $P_{i,s,d} > Mid_{i,s,d}$ then $D_{i,s,d} = 1$; if $P_{i,s,d} < Mid_{i,s,d}$ then $D_{i,s,d} = -1$; in any other cases, $D_{i,s,d} = 0$.

is the difference between effective spread and realized spread.	$Adverse\ selection\ cost_{s,d} = effective\ spread_{s,d} - realised\ spread_{s,d}$

i: stands for the number quote or trade;
s: stands for security;
d: stands for date
$TW_{i,s,d}$: is the time weight of a quote over the total trading time of the day
$VW_{i,s,d}$: is the value weigh of the transaction over the total turnover of that security on the day;
$Mid_{i,s,d}$: is the prevailing midpoint before the trade;
$D_{i,s,d}$: indicates trading direction;
$P_{i,s,d}$: is the trade price.

To evaluate the impact of the SHHKConnect, two event sample windows are identified. The first sample period covers three months pre- and post- the launch of SHHKConnect, specifically 18 August 2014 to 17 February 2015. Another one-year event period is also examined in this paper, six months pre and post- the launch of the SHHKConnect, specifically 19 May 2014 to the 15 May 2015[12].

Considering, that the SHHKConnect does not liberalize trading for all listed stocks on the both exchanges, three security groups are created, as follows:

1. *SHHKConnect stocks*: includes all stocks that are eligible to be traded through SHHKConnect.
2. *Non-Connect stocks*: the second group consists of stocks that are not eligible to be traded through SHHKConnect.
3. *Cross-listed stocks*: this security group includes the pair of cross-listed stocks that are listed on both the SSE and SEHK. All cross-listed stocks are eligible for trading through SHHKConnect but have had a pre-existing arrangement for cross-listing prior to November 17, 2014.

Both the SSE and SEHK review and adjust stock eligibility for trading through SHHKConnect on a frequent basis.[13] Included in the sample are only those stocks eligible for trading via SHHKConnect throughout the entire sample period examined. Moreover, stocks that trade less than 80% of the trading days throughout the entire sample period are excluded.

[12] On July 1, 2015, the Chinese regulator implemented tightened rules regarding to the margin trading and security lending on the China's stock markets. The SSE has experienced volatile market since then. Consequently, tests are only conducted over a maximum of a one-year period.

[13] The date that the two markets adjust the eligible stocks to be traded through SHHKConnect is not synchronized. On the first day of SHHKConnect there were 541 SSE-listed stocks connected, and as of March 30, 2015 the number was 543. In the SEHK, on the first day, there were 269 SEHK-listed stocks connected, and as of March 9, 2015 the number was 285.

V. METHODOLOGY

5.1 Liquidity hypothesis

To examine whether liquidity is on the SSE and SEHK is affected following the launch of the SHHKConnect, we conduct pre and post univariate tests of the following liquidity proxies: effective spreads, realized spreads, adverse selection costs and quoted depth. Tests are conducted pre- and post-November 17, 2014 across the various categories of securities (i.e. *Overall Market*, *SHHKConnect stocks*, *Non-connect stocks* and *Cross-listed stocks*) traded on and across the SSE and SEHK. In addition to liquidity metrics, we also examine and control for known variables identified in the extant literature to influence market liquidity, specifically volatility and turnover. The theory underpinning these variables is outlined in Stoll (1978) and Copeland and Galai (1983). Both volatility and trading activity reflect various dimensions of risk faced by liquidity providers. Price volatility measures the risk to liquidity providers per unit of time (e.g. offering to buy stock at a price level of $10 when price volatility causes the price to fall to $9). Hence, the higher the price volatility, the greater the compensation sought by liquidity providers. Trading activity reflects the length of time the inventory provider is exposed to this risk (e.g. the amount of time that the limit order is expected to be 'alive'). Hence the lower the trading activity, the longer a limit order will be 'alive'.

Turning to the multivariate analysis, the SHHKConnect permits the opportunity to employ the difference-in-differences methodology. The difference-in-differences method attempts to capture the impact of an event by distinguishing the changes for treatment stocks that are eligible to trade via the SHHKConnect from stocks that are excluded from trading via the bilateral investment channel. Specifically, the following model is estimated for four measures of liquidity:

$$Liqudity_{i,t} = \beta_0 + \beta_1 \ln Value_{i,t} + \beta_2 Volatility_{i,t} + \beta_3 D_{connect} + \beta_4 D_{nov2014} + \beta_5 D_{connect} * D_{nov2014} + \varepsilon_{i,t} \quad Eq[1]$$

where *Liquidity* is either effective spreads, realized spreads, adverse selection costs or quoted depth, for security i on day t; $lnValue$ is the natural logarithm

of the total on-market turnover for security *i* on day *t* ; $Volatility$ is calculated as the standard deviation of intraday returns for security *i* on day *t*; $D_{connect}$ is a dummy variable that captures miscellaneous differences between the treatment group and the control group. The treatment group is the group of stocks eligible for trading through the SHHKConnect (i.e. *SHHKConnect stocks*). The control group includes all the *Non-connect stocks*. If a stock is a *SHHKConnect stock*, $D_{connect}$ is equal to 1, otherwise it is equal to 0. $D_{nov2014}$ is a time period dummy, if the stock-day is observed after SHHKConnect is launched $D_{nov2014}$ takes value of 1, otherwise it is equal to 0. $D_{connect} * D_{nov2014}$ is an interaction term and our key variable of interest.[14]

5.2 Price Premium Hypothesis

To evaluate the impact of the introduction of the SHHKConnect on the price premium between cross-listed A- and H-shares, we follow Wang and Jiang (2004) who use a multi-factor model as is the case in Boduratha et al. (1995) and Froot and Dabora (1999). The model estimated is:

$$\begin{aligned} Ah_ratio_{i,t} &= \alpha_0 + \alpha_1 \mathrm{Ah_ratio}_{i,t-1} + \alpha_2 SSEIndex_t \\ &+ \alpha_3 SEHKIndex_t + \alpha_4 HVol/Hshare_{i,t} \\ &+ \alpha_5 \Delta Qtd_{i,t} + \alpha_6 VolaRatio_{i,t} + \alpha_7 Xrate_t \\ &+ \alpha_8 D_{nov2014} \\ &+ \varepsilon_{i,t} \end{aligned} \qquad Eq[2]$$

where Ah_ratio is calculated as, $\frac{A-share's\ Price_{i,t}}{H-share's\ Price_{i,t}}$, consistent with the Hang Seng China AH Premium Index, compiled and maintained by Hang Seng Indexes Company Ltd [15] In order to control for possible autocorrelation in the price ratio between A- and H-shares, the model includes a first-order autoregressive term of A-/H- share price ratio, $\mathrm{Ah_ratio}_{i,t-1}$. $\mathrm{SSEIndex}_t$ and $\mathrm{SEHKIndex}_t$ are the inter-day returns of the market indices of the two exchanges, namely the A-Share Index and Hang Seng Index, respectively. These are included as controls for overall market performance. Previous studies have noted that price differences between effectively identical shares on two markets may result from variations in liquidity and the ability of investors to trade desired volumes.

Chen et al. (2001) study the price differences between A- and B-shares and find that the A-share price premium over B-shares is primarily caused by the illiquidity in the B-share market. Longstaff (2001) argues that security prices will be substantially discounted where investors cannot trade the desired amount of a stock. Considering the likely relevance of liquidity for the price of A- and H-shares, a liquidity proxy for H-shares is added to the model for this study, following Wang and Jiang (2004). $\frac{HVol}{Hshare}$ is a volume-based liquidity proxy. It is calculated as daily H-share trading volume divided by the total number of free-floated H-shares. As the proxy aims to reflect how quickly the H-shares are exchanging hands, it is scaled by the total number of free-floating shares since a portion may not be available to the market due to for example state ownership. $\Delta\mathrm{Qtd}_{i,t}$ is the difference between the time-weighted quoted spreads by percentage of A- and H-shares. $\mathrm{VolaRatio}$ is calculated as the intra-day volatility of an A-share over the intra-day volatility of its corresponding H-share, i.e. $\frac{\delta_A^2}{\delta_H^2}$. This variable measures the relative risk level of corresponding stocks. Its purpose is to test the differential risk hypothesis (Eun and Janakiramanan, 1986; Sun and Tong, 2000; Chan and Kwok, 2014). Xrate is the exchange rate between the Chinese CNY and the Hong Kong dollar. $\mathrm{D}_{\mathrm{nov2014}}$ is a time period dummy, it takes value of 1 if the date of the observation is on or after the SHHKConnect date (17 November, 2014), otherwise it equals to 0. This dummy variable is of primary interest when testing the impact of SHHKConnect on the change of A/H share premiums.

VI. EMPIRICAL RESULTS

6.1 Univariate Tests of Difference

Error! Reference source not found. and Table 3 report summary statistics of market quality variables for stocks listed on the SSE, three-months and six-months pre- and post- the launch of the SHHKConnect, respectively. Table 2, Panel A indicates SSE listed stocks are more actively traded after the launch of SHHKConnect. The market's average daily volume increases by approximately 60% and average daily trade count increases by more than 60%. The increase in turnover is also accompanied by a significant increase in market volatility. In addition, the average value of turnover increases by around 5% post the launch of SHHKConnect. In relation to liquidity, effective spread increases by 0.3 bps across the SSE listed securities. The net profit for liquidity providers, measured by realized spread, decreases by 1.7 bps, while adverse selection costs increase by 2bps, consistent with higher adverse selection costs. Market depth on average decreases by 10.13.

Panels B and C in **Error! Reference source not found.** report summary statistics for the subsample of *SHHKConnect stocks* and *Non-Connect stocks* listed on the SSE. Panels B and C report for both

[14] All standard errors are double-cluster adjusted.

[15] See http://www.hsi.com.hk/HSI-Net/HSI-Net for detailed methodology for the calculation of the Hang Seng China AH Premium Index

groups of securities changes in liquidity are aligned with the market-wide changes post the SHHKConnect launch. With respect to trading activity, *SHHKConnect stocks* exhibit an increase in volume of approximately 74% (versus 6% for *Non-Connect stocks*), and trade frequency increases by 80% (versus 14% for *Non-Connect stocks*). Effective spreads decrease for *SHHKConnect stocks* and increases for *Non-Connect stocks*. Compared to the market level changes (Panel A) and *Non-Connect stocks* (Panel C), *SHHKConnect stocks* (Panel B) experience the largest reduction in transaction costs. Realized spreads decrease for both stock groups by approximately 1.6 bps. Similarly, market depth for *SHHKConnect* and *Non-Connect stocks* decreases after the event date.

Panel D Table 2 reports univariate results for the sub-sample of cross-listed A-shares listed on the SSE. Cross-listed stocks experience the most significant changes among the three stock groups across all market measures. On average, trading volume increases by more than 165%, trade count increases by 211% and trade size increases by 14%. Transaction costs also significantly improve. On average, effective spreads decrease by 2.1 bps. Realized spreads for cross-listed A shares decrease by 2.3 bps following the launch of the SHHKConnect (versus 1.7 bps for *SHHKConnect stocks*). Note however, that the change in adverse selection costs is not statistically significant at 5% level. The market depth in dollar value decreases for the cross-listed stocks in the SSE after the introduction of the SHHKConnect.

Table 3 reports summary statistics covering an event window six-months pre- and post- the launch of the SHHKConnect. The reported results are consistent with three-month pre- and post- event sample period for market depth and realized spreads. During the extended event window, market depth increases for all the stock groups except for the cross-listed stocks. The change in market depth is accompanied by further reductions in transaction costs. On average, effective spreads decrease 4.1 bps and 1.0 bps for the cross-listed A shares and *SHHKConnect stocks*, respectively. The average decrease in effective spreads is 0.7 bps for the overall market, and 0.4 bps for the *Non-Connect stocks*. The changes in transaction costs for all the stock groups is significant at the 5% confidence level. There is also a significant reduction in adverse selection costs for the cross-listed A-shares during the one year testing period.

Table 2 Univariate Test for the Shanghai Stock Exchange For Three-months Pre- and Post- the SHHKConnect

This table reports univariate test results for the changes in trading activities and liquidity proxies in the Shanghai Stock Exchange during the three-months pre- and post- the launch of Shanghai-Hong Kong Connect on November 17, 2014.

Liquidity measures and proxies for pre- and post- SHHKConnect of the Shanghai Stock Exchange (SSE). Sample period extends August 18, 2014 to February 17, 2015. *Volume* measures total number of shares traded each day; *Volatility* is a value-weighted measure of intraday price variation; *Trade size in dollar value* (Trade Size$) is the average value of each trade on a day; *Trade Count* measures the total numbers of trades occur for a security on a particular day. *indicates the significance at the 5% level.

	Volume		*Volatility*		*Trade Size$*		*Trade Count*	
	Pre	*Post*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
Panel A: Overall Market (Number of Stocks: 801)								
Mean	22,401,144	35,737,215	0.002	0.003	21,198	22,415	8,047	13,236
S.d	39,799,384	90,749,046	0.001	0.001	7,192	8,499	9,078	22,776
Difference	13,336,071		0.000		1,217		5,189	
	25.12*		47.52*		20.39*		39.51*	
Panel B: SHHKConnect stocks (Number of Stocks: 490)								
Mean	28,986,784	50,320,863	0.002	0.003	22,199	24,079	10,035	18,084
S.d	48,149,192	112,740,000	0.001	0.001	7,751	9,141	10,389	27,556
Difference	21,334,079		0.001		1,880		8,049	
	25.45*		52.70*		22.93*		39.98*	
Panel C: Non- Connect stocks (Number of Stocks: 311)								
Mean	11,926,860	12,696,067	0.003	0.003	19,606	19,785	4,885	5,575
S.d	15,407,879	17,324,462	0.001	0.001	5,857	6,562	5,055	6,541
Difference	769,207		0.000		179		691	
	3.85*		8.59*		2.36*		9.70*	
Panel D: Cross-listed stocks (Number of Stocks: 63)								
Mean	56,276,374	149,250,000	0.002	0.003	21,905	24,912	13,595	42,292
S.d	77,787,132	225,280,000	0.001	0.001	10,198	13,676	13,886	51,064
Difference	92,973,626		0.001		3,007		28,697	
	21.02*		32.29*		9.35*		29.29*	

Table 2 (Continued)

The logarithm of *Quoted depth in dollar value (lnDepth)* measures the aggregate value of its time-weighted best bid and ask throughout a day; *Effective Spread* is calculated as the value weighted 200*(price-midpoint)*direction/midpoint; *Realized spread* compares the execution price to the prevailing midpoint price 10-minute after the trade, it is calculated as value-weighted 200*(price - midpoint ten-minutes later)*direction/midpoint; *Adverse selection cost* is calculated as the difference between effective spread and realized spread; * indicates the significance at the 5% level.

	lnDepth		*Effective Spread*		*Realized Spread*		*Adverse Selection Cost*	
	Pre	*Post*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
Panel A: Overall Market (Number of Stocks: 801)								
Mean	13.365	13.294	0.191	0.194	0.047	0.030	0.144	0.164
S.d	0.964	0.885	0.076	0.065	0.082	0.084	0.090	0.092
Difference	-0.071		0.003		-0.017		0.020	
	-10.13*		6.05*		-26.83*		29.17*	
Panel B: SHHKConnect stocks (Number of Stocks: 490)								
Mean	13.635	13.541	0.180	0.180	0.048	0.030	0.132	0.150
S.d	1.021	0.920	0.078	0.060	0.078	0.079	0.084	0.083
Difference	-0.094		0.000		-0.017		0.018	
	-9.97*		-0.02		-22.98*		21.64*	
Panel C: Non- Connect stocks (Number of Stocks: 311)								
Mean	12.935	12.903	0.207	0.216	0.045	0.029	0.163	0.187
S.d	0.668	0.659	0.070	0.065	0.088	0.091	0.097	0.100
Difference	-0.032		0.008		-0.016		0.024	
	-3.99*		10.09*		-14.58*		20.18*	
Panel D: Cross-listed stocks (Number of Stocks: 63)								
Mean	14.624	14.480	0.230	0.209	0.087	0.064	0.143	0.145
S.d	1.304	1.147	0.112	0.076	0.087	0.083	0.097	0.085
Difference	-0.144		-0.021		-0.023		0.002	
	-4.36*		-8.30*		-9.92*		0.49	

Table 3 Univariate Test for the Shanghai Stock Exchange For Six-months Pre- and Post- the SHHKConnect

This table reports univariate test results for the changes in trading activities and liquidity proxies in the Shanghai Stock Exchange during six-months pre- and post- the launch of Shanghai-Hong Kong Connect on November 17, 2014.

Liquidity measures and proxies for pre- and post- SHHKConnect of the Shanghai Stock Exchange (SSE). Sample period extends May 19, 2014 to May 15, 2015. *Volume* measures total number of shares traded each day; *Volatility* is a value-weighted measure of intraday price variation; *Trade size in dollar value* (Trade Size$) is the average value of each trade on a day; *Trade Count* measures the total numbers of trades occur for a security on a particular day. *indicates the significance at the 5% level.

	Volume		*Volatility*		*Trade Size$*		*Trade Count*	
	Pre	*Post*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
Panel A: Overall Market (Number of Stocks: 801)								
Mean	18,857,786	39,598,193	0.002	0.003	19,996	24,025	7,028	15,634
S.d	33,277,431	96,956,058	0.001	0.001	7,126	9,391	8,038	26,385
Difference	20,740,407		0.001		4,029		8,606	
	50.24*		104.90*		83.74*		77.57*	
Panel B: SHHKConnect stocks (Number of Stocks: 490)								
Mean	24,228,387	55,238,032	0.002	0.003	21,074	25,713	8,725	21,133
S.d	40,286,364	120,260,000	0.001	0.001	7,710	10,134	9,203	31,836
Difference	31,009,645		0.001		4,640		12,408	
	47.52*		97.01*		69.86*		72.86*	
Panel C: Non- Connect stocks (Number of Stocks: 311)								
Mean	10,382,110	14,815,394	0.002	0.003	18,296	21,350	4,350	6,921
S.d	13,279,809	19,400,488	0.001	0.001	5,689	7,315	4,604	8,331
Difference	4,433,284		0.000		3,054		2,571	
	28.83*		46.65*		50.23*		41.47*	
Panel D: Cross-listed stocks (Number of Stocks: 63)								
Mean	45,795,616	161,450,000	0.002	0.003	21,238	26,317	11,426	48,967
S.d	65,527,780	238,600,000	0.001	0.001	10,503	14,442	12,010	57,031
Difference	115,654,384		0.001		5,078		37,541	
	33.34*		47.96*		19.79*		46.06*	

Table 3 (Continued)

The logarithm of *Quoted depth in dollar value (lnDepth)* measures the aggregate value of its time-weighted best bid and ask throughout a day; *Effective Spread* is calculated as the value weighted 200*(price-midpoint)*direction/midpoint; *Realized spread* compares the execution price to the prevailing midpoint price 10-minute after the trade, it is calculated as value-weighted 200*(price - midpoint ten-minutes later)*direction/midpoint; *Adverse selection cost* is calculated as the difference between effective spread and realized spread; * indicates the significance at the 5% level.

	lnDepth		*Effective Spread*		*Realized Spread*		*Adverse Selection Cost*	
	Pre	*Post*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
Panel A: Overall Market (Number of Stocks: 801)								
Mean	13.310	13.358	0.194	0.187	0.054	0.027	0.141	0.160
S.d	0.970	0.884	0.081	0.062	0.081	0.083	0.089	0.091
Difference	0.048		-0.007		-0.027		0.019	
	8.93*		-17.52*		-55.54*		36.56*	
Panel B: SHHKConnect stocks (Number of Stocks: 490)								
Mean	13.577	13.605	0.183	0.173	0.053	0.029	0.130	0.144
S.d	1.030	0.922	0.083	0.058	0.078	0.078	0.083	0.083
Difference	0.028		-0.010		-0.024		0.014	
	3.86*		-18.10*		-41.83*		23.58*	
Panel C: Non- Connect stocks (Number of Stocks: 311)								
Mean	12.889	12.968	0.212	0.208	0.055	0.024	0.158	0.184
S.d	0.679	0.649	0.075	0.063	0.087	0.091	0.095	0.099
Difference	0.079		-0.004		-0.030		0.026	
	12.64*		-5.77*		-36.57*		29.36*	
Panel D: Cross-listed stocks (Number of Stocks: 63)								
Mean	14.564	14.550	0.235	0.194	0.090	0.061	0.145	0.133
S.d	1.300	1.178	0.120	0.073	0.089	0.080	0.098	0.083
Difference	-0.014		-0.041		-0.029		-0.012	
	-0.55		-19.51*		-16.52*		-6.3*	

Table 4 and 5 report results for the SEHK, for test periods three- and six-months pre- and post- the introduction of the SHHKConnect, respectively. Panel A of Table 4 reports two results. Firstly, in terms of trading activity, a small decrease in trading volume, trade size, and trade frequency of approximately 2%, is observed following the introduction of the SHHKConnect. Volatility, similarly exhibits a small increase. Second, Panel A of Table 4 reports effective spreads, realized spreads and adverse selection costs, increase on average, while market depth on the SEHK decreases, post the launch of the SHHKConnect.

Panels B and C, Table 4 report tests of difference three-months pre and post the introduction of SHHKConnect, on the SEHK for *SHHKConnect stocks* and the *Non-Connect stocks*, respectively. Unlike on the mainland, trading volume on the SEHK increases by approximately 15% for the *SHHKConnect* stocks and decreases by approximately 12% for the *Non-Connect stocks*. Average trade size does not change significantly for *SHHKConnect stocks*, whereas for the *Non-Connect stock*, a statistically significant decrease of 3% is documented. Three months following the launch of the SHHKConnect, on average there are 14% more trades in *SHHKConnect stocks*, although, approximately 3% less in *Non-Connect stocks*. It should be noted that while *SHHKConnect* stocks experience significant market activity changes (in the form of volume and trade count), the changes in volatility between the two stock groups are similar. Volatility increases by a very small magnitude for both stock groups. In addition, market depth at best price level decreases for both stock groups, and the magnitude is larger for *Non-Connect stocks* listed in the SEHK, vis-à-vis *SHHKConnect stocks*.

Effective spreads and adverse selection costs reported in Panel B and C of Table 4 increase for both *SHHKConnect stocks* and *Non-Connect stocks*. However, the change in the effective spreads is not significant at 5% level for *SHHKConnect stocks*. Another, difference between the *SHHKConnect* and *Non-Connect stocks* is their change in realized spread. For the *SHHKConnect stocks*, realized spreads decrease by 0.5 bps. On the other hand, the average post-event realized spreads for *Non-Connect stocks* increase by 4.4 bps.

Panel D Table 4 reports changes in market quality for cross-listed H-shares listed on the SEHK. Consistent with results reported for cross-listed A-shares on the SSE, univariate results highlight that this subgroup of stocks experience the most significant changes in trading activity among the three SEHK-based stock groups. On average, volume increases 35%, trade size increases 4%, and trade frequency increases 33%. However, the results do not show a larger change in volatility for the cross-listed stocks compared to other stock groups. Similarly, no significant differences are reported for liquidity metrics.

Table 5 reports univariate tests of difference six-months pre- and post- SHHKConnect, on the SEHK. Over a longer event window changes in market quality are more systematic among the stock groups

compared to the shorter event window. For example, trading activity proxies (volume, average trade size and trade count), increase for all three stock groups. Cross-listed H-shares exhibit the largest increase in trading activity. In terms of volatility, all stock groups report minor increases in volatility.

For all the stock groups examined on the SEHK, except for *Non-Connect* stocks, no significant change in market depth is reported. With respect to transaction costs, the overall market experiences a minor increase in effective spreads. Similar changes are reported for *Non-Connect* stocks, whereas, for *SHHKConnect* and cross-listed stocks, a minor decrease in effective spreads is reported. A systematic and significant decrease in realized spreads is also reported across the stock subgroups.

Table 4 Univariate Test for the Stock Exchange of Hong Kong For Three-months Pre- and Post- the SHHKConnect

This table reports univariate test results for the changes in trading activities and liquidity proxies in the Stock Exchange of Hong Kong during three-months pre and post the launch of Shanghai-Hong Kong Connect on November 17, 2014.

Liquidity measures and proxies for pre- and post- SHHKConnect of the Stock Exchange of Hong Kong (SEHK). Sample period extends August 18, 2014 to February 17, 2015. *Volume* measures total number of shares traded each day; *Volatility* is a value-weighted measure of intraday price variation; *Trade size in dollar value* (Trade Size$) is the average value of each trade on a day; *Trade Count* measures the total numbers of trades occur for a security on a particular day. *indicates the significance at the 5% level.

	Volume		*Volatility*		*Trade Size$*		*Trade Count*	
	Pre	*Post*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
Panel A: Overall Market (Number of Stocks: 1419)								
Mean	8,238,530	8,108,473	0.003	0.003	25,493	24,926	538	605
S.d	24,767,431	25,863,222	0.002	0.002	28,434	24,500	1,157	1,416
Difference	- 130,057		0.000		-568		67	
	-0.87		11.64*		-3.61*		8.70*	
Panel B: SHHKConnect stocks (Number of Stocks: 256)								
Mean	14,973,501	17,169,843	0.002	0.002	38,188	37,420	1,970	2,236
S.d	37,251,806	43,921,867	0.001	0.001	31,962	31,698	1,988	2,475
Difference	2,196,342		0.000		-769		267	
	3.92*		16.23*		-1.76		8.62*	
Panel C: Non- Connect stocks (Number of Stocks: 1163)								
Mean	6,763,376	5,962,096	0.004	0.004	22,713	21,966	225	218
S.d	20,778,637	18,611,150	0.002	0.002	26,810	21,417	467	499
Difference	- 801,280		0.000		-746		-7	
	-6.18*		11.13*		-4.67*		-2.03*	
Panel D: Cross-listed stocks (Number of Stocks: 63)								
Mean	27,726,078	37,376,033	0.002	0.002	41,300	43,125	2,525	3,367
S.d	57,450,122	75,806,256	0.001	0.001	32,995	33,452	2,104	3,225
Difference	9,649,955		0.000		1,825		843	
	5.30*		14.25*		2.03*		11.44*	

Table 4 (Continued)

The logarithm of *Quoted depth in dollar value (lnDepth)* measures the aggregate value of its time-weighted best bid and ask throughout a day; *Effective Spread* is calculated as the value weighted 200*(price-midpoint)*direction/midpoint; *Realized spread* compares the execution price to the prevailing midpoint price 10-minute after the trade, it is calculated as value-weighted 200*(price - midpoint ten-minutes later)*direction/midpoint; *Adverse selection cost* is calculated as the difference between effective spread and realized spread; * indicates the significance at the 5% level.

	lnDepth		*Effective Spread*		*Realized Spread*		*Adverse Selection Cost*	
	Pre	*Post*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
Panel A: Overall Market (Number of Stocks: 1419)								
Mean	12.472	12.398	1.302	1.367	0.451	0.479	0.851	0.888
S.d	1.272	1.271	1.111	1.185	0.910	0.973	0.883	0.945
Difference	-0.074		0.065		0.029		0.037	
	-9.83*		9.54*		5.13*		6.70*	
Panel B: SHHKConnect stocks (Number of Stocks: 256)								
Mean	13.928	13.867	0.291	0.297	0.018	0.013	0.273	0.284
S.d	1.189	1.149	0.220	0.223	0.179	0.173	0.173	0.179
Difference	-0.061		0.005		-0.005		0.011	
	-3.81*		1.73		-2.23*		4.40*	
Panel C: Non- Connect stocks (Number of Stocks: 1163)								
Mean	12.153	12.050	1.523	1.620	0.545	0.590	0.978	1.031
S.d	1.047	1.026	1.105	1.178	0.976	1.049	0.924	1.000
Difference	-0.103		0.097		0.044		0.053	
	-15.14*		12.95*		6.68*		8.36*	
Panel D: Cross-listed stocks (Number of Stocks: 63)								
Mean	14.163	14.096	0.298	0.299	0.002	0.001	0.300	0.300
S.d	1.349	1.314	0.171	0.186	0.132	0.135	0.171	0.173
Difference	-0.067		0.001		-0.001		0.000	
	-1.86		0.20		-0.33		0.47	

Table 5 Univariate Test for the Stock Exchange of Hong Kong For Six-months Pre- and Post- the SHHKConnect

This table reports univariate test results for the changes in trading activities and liquidity proxies in the Stock Exchange of Hong Kong during six-months pre and post the launch of Shanghai-Hong Kong Connect on November 17, 2014.

Liquidity measures and proxies for pre- and post- SHHKConnect of the Stock Exchange of Hong Kong (SEHK). Sample period extends May 19, 2014 to May 15, 2015. *Volume* measures total number of shares traded each day; *Volatility* is a value-weighted measure of intraday price variation; *Trade size in dollar value* (Trade Size$) is the average value of each trade on a day; *Trade Count* measures the total numbers of trades occur for a security on a particular day. *indicates the significance at the 5% level.

	Volume		*Volatility*		*Trade Size$*		*Trade Count*	
	Pre	*Post*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
Panel A: Overall Market (Number of Stocks: 1419)								
Mean	7,930,748	9,557,267	0.003	0.004	25,321	25,763	522	634
S.d	24,318,168	29,723,494	0.002	0.002	26,511	23,327	1,102	1,424
Difference	1,626,519		0.000		442		112	
	13.85*		40.63*		4.06*		20.37*	
Panel B: SHHKConnect stocks (Number of Stocks: 256)								
Mean	14,090,913	17,422,041	0.002	0.002	38,359	38,992	1,885	2,334
S.d	35,222,242	43,188,461	0.001	0.001	32,494	32,377	1,861	2,492
Difference	3,331,128		0.000		634		448	
	8.38*		30.71*		1.93		20.25*	
Panel C: Non- Connect stocks (Number of Stocks: 1163)								
Mean	6,548,635	7,781,399	0.003	0.004	22,396	22,775	216	250
S.d	20,863,777	25,391,025	0.002	0.002	24,020	19,542	445	534
Difference	1,232,764		0.001		379		34	
	11.09*		38.13*		3.59*		14.49*	
Panel D: Cross-listed stocks (Number of Stocks: 63)								
Mean	26,612,215	36,571,419	0.002	0.002	41,771	45,466	2,410	3,448
S.d	55,801,348	72,829,895	0.001	0.001	33,496	34,368	2,047	3,263
Difference	9,959,204		0.000		3,696		1,037	
	7.57*		22.40*		5.34*		18.85*	

Table 5 (Continued)

The logarithm of *Quoted depth in dollar value (lnDepth)* measures the aggregate value of its time-weighted best bid and ask throughout a day; *Effective Spread* is calculated as the value weighted 200*(price-midpoint)*direction/midpoint; *Realized spread* compares the execution price to the prevailing midpoint price 10-minute after the trade, it is calculated as value-weighted 200*(price - midpoint ten-minutes later)*direction/midpoint; *Adverse selection cost* is calculated as the difference between effective spread and realized spread;* indicates the significance at the 5% level.

	lnDepth		*Effective Spread*		*Realized Spread*		*Adverse Selection Cost*	
	Pre	*Post*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
Panel A: Overall Market (Number of Stocks: 1419)								
Mean	12.472	12.461	1.306	1.330	0.465	0.443	0.841	0.887
S.d	1.278	1.261	1.144	1.128	0.939	0.910	0.894	0.911
Difference	-0.010		0.023		-0.023		0.046	
	-1.87		4.73*		-5.65*		11.76*	
Panel B: SHHKConnect stocks (Number of Stocks: 256)								
Mean	13.928	13.909	0.291	0.288	0.023	0.009	0.268	0.279
S.d	1.189	1.137	0.215	0.213	0.177	0.169	0.169	0.175
Difference	-0.020		-0.003		-0.014		0.011	
	-1.68		-1.49		-8.11*		6.32*	
Panel C: Non- Connect stocks (Number of Stocks: 1163)								
Mean	12.145	12.135	1.534	1.565	0.564	0.540	0.970	1.025
S.d	1.049	1.037	1.144	1.117	1.009	0.978	0.939	0.952
Difference	-0.010		0.031		-0.024		0.055	
	-2.05*		5.67*		-5.02*		12.06*	
Panel D: Cross-listed stocks (Number of Stocks: 63)								
Mean	14.170	14.127	0.300	0.290	0.009	0.001	0.291	0.289
S.d	1.365	1.313	0.175	0.179	0.133	0.130	0.169	0.172
Difference	-0.043		-0.011		-0.008		-0.002	
	-1.56		-3.01*		-3.06*		-0.76	

Table 6 reports changes in the price premium and daily return between corresponding cross-listed A- and H-shares. The results in Panel A and Panel B, report consistent results across the three and six-month event windows receptively. Table 6 reports that, three (six) prior to the launch of SHHKConnect, A-shares traded at a minor premium (discount) to their corresponding H-shares on average. A-shares also experience higher returns than their corresponding H-share counterparts on the SEHK, between 5.8 bps to 17.2 bps. Following the introduction of the SHHKConnect, the differences magnify. A-shares trade at a much higher premium and daily returns also increase significantly, approximately 19.2 bps to 24.8 bps for cross-listed A-shares over H-shares. On the whole, these differences are contrary to expectations given the increase in market access via the SHHKConnect.

Table 6 Univariate Test for A- and H-Share Price Premium

This table reports univariate test results for the changes in the A- and H- share price premium and return differences during three-months and six-months pre- and post- the launch of Shanghai-Hong Kong Connect on November 17, 2014. 63 pairs of cross-listed stocks are tested for the two testing periods.

Ah_ratio is measured as the ratio of daily closing prices between the two markets i.e. A-share's price/H-share's price; Daily Return (%) is calculated as (Close price/Previous Close price-1)*100%. *indicates the significance at the 5% level.

Panel A: Three-months Pre-/Post-the Connect

	Ah_ratio		Daily Return Difference (%)	
	Pre	Post	Pre	Post
Mean	1.009	1.316	0.172	0.248
Standard Deviation	0.293	0.416	1.899	2.579
Differences	0.307		0.076	
	26.62 *		1.05	

Panel B: Six-months Pre-/Post-the Connect

	Ah_ratio		Daily Return Difference (%)	
	Pre	Post	Pre	Post
Mean	0.982	1.353	0.058	0.192
Standard Deviation	0.291	0.444	1.885	2.483
Differences	0.371		0.134	
	39.69*		2.42*	

6.2 Liquidity Tests –Shanghai Stock Exchange

Table 7 reports parameter estimates of multivariate tests of changes in four liquidity proxies on the SSE during the two event windows. We report for the most part consistent results across the three and six-month event windows, pre and post the introduction of SHHKConnect. The results show that effective spreads on the SSE are negatively related to trading activity and positively related to volatility, consistent with theoretical models of Stoll (1978), Bagehot (1971) and Copeland and Galai (1988). In relation to quoted depth, trading value and price volatility are positively and negatively related, consistent with theoretical and empirical findings of Stoll (1978) and Amihud and Mendelson (1989).

After controlling for known determinates, Table 7 documents effective spreads, decrease for *SHHKConnect stocks* post the introduction of the SHHKConnect, as observed by a significant and negative coefficient on our interaction term, $D_{connect} * D_{nov2014}$. This results supports conclusions that following the launch of SHHKConnect, transaction costs decrease and liquidity improves. Net profit earned by liquidity makers in the three-months post the introduction of SHHKConnect do not change, however, result in Panel B Table 7 shows that realized spreads increase significantly over the longer term. Results for adverse selection costs reported in the Table 7 suggest that liquidity traders incur less adverse selection costs after the launch of SHHKConnect in *SHHKConnect stocks.* Furthermore, our test result for the relation between adverse selection and volatility is consistent with the finding in Van et al. (2001). They find a positive relationship between the two variables. That is, higher adverse selection costs may occur in a more volatile market or to a stock with high volatility.

Table 7 provides additional insight relating to market depth over and above the univariate results. The estimation for the first dummy variable, $D_{connect}$ is significant and positive, and it is consistent for the two sample periods tested. This suggests that in general, the market depth for *SHHKConnect stocks* is higher compared to the *Non-Connect stocks*. This is expected as most of *SHHKConnect stocks* traded on the SSE are index constituents. Parameter estimates for our key variable of interest $D_{connect} * D_{nov2014}$ are negative and significant during the two test periods. This suggests that after the launch of the SHHKConnect, market depth decreases for the *SHHKConnect stocks.*

Overall, on the SSE, for *SHHKConnect stocks*, trading costs have decreased and market depth has declined following the launch of SHHKConnect. Although contradictory conclusions might be drawn from decreased trading costs and decreased market depth, we follow Frino et al. (2013) and others who offer that effective spreads are a better proxy to evaluate market liquidity when there are aggressive orders that trade through the order book, and hence conclude that liquidity improves on the SSE, following the launch of SHHKConnect.

Table 7 Liquidity Test Results- the Shanghai Stock Exchange

This table reports multivariate test results of four liquidity proxies for the Shanghai Stock Exchange. Two event windows of three-months and six-months pre- and post- Shanghai-Hong Kong Connect are examined

The estimated regression is as follow:

$$Liquidity\ Proxies_{i,t} = \beta_0 + \beta_1 \ln Value_{i,t} + \beta_2 Volatility_{i,t} + \beta_3 D_{connect} + \beta_4 D_{nov2014} + \beta_5 D_{connect} * D_{nov2014} + \varepsilon_{i,t}$$

For the liquidity proxies, effective spread, realized spread, adverse selection cost and quoted depth (lnDepth) are used. For each security-day, *Effective spread* is aggregated by value weight of each trade, the metric is calculated by comparing the execution price to the previous prevailing midpoint before the trade; *Realized spread* compares the execution price to the prevailing midpoint price 10-minute after the trade, it is calculated as value-weighted 200*(price - midpoint ten-minutes later)*direction/midpoint; *Adverse selection cost* is calculated as the difference between effective spread and realized spread; *lnDepth* is the logarithm taken over the quoted depth by value, which is the aggregate value of its time-weighted best bid and ask depth throughout a day; *lnValue* is the logarithm taken over daily value; *Volatility* is calculated using value-weighted intraday volatility; $D_{connect}$ is a dummy variable, which indicates a stock's eligibility to trade under SHHKConnect. It equals to 1 if a stock can be traded under SHHKConnect, otherwise, it equals to 0; $D_{nov2014}$ is a time period dummy, it equals to 1 if a sample is observed after November 17th, 2014, otherwise, it equals to 0; $D_{connect} * D_{nov2014}$ is a interaction variable, it equals to 1 if a sample observed is of a Connected stock after SHHKConnect date, it equals to 0 otherwise. *indicates the significance at the 5% level.

	Intercept	lnValue	*Volatility*	$D_{connect}$	$D_{nov2014}$	$D_{connect} * D_{nov2014}$	*R- square*
Panel A: Three-months Pre-/Post-the Connect							
Effective Spread	0.529 (13.83*)	-0.021 (-9.306*)	23.177 (16.07*)	-0.004 (-0.89)	0.007 (3.60*)	-0.011 (-5.02*)	0.158
Realised Spread	-0.048 (-1.621)	0.007 (4.383*)	-16.173 (-11.40*)	-0.007 (-2.39*)	-0.015 (-3.77*)	0.003 (1.55)	0.044
Adverse Selection Cost	0.577 (22.13*)	-0.029 (-19.10*)	39.350 (27.16*)	0.003 (1.13*)	0.022 (4.57*)	-0.014 (-5.346*)	0.215
lnDepth	2.000 (4.44*)	0.643 (23.90*)	-256.614 (-13.27*)	0.116 (2.55*)	-0.045 (-3.19*)	-0.174 (-7.65*)	0.473

Table 7 (Continued)

	Intercept	lnValue	*Volatility*	$D_{connect}$	$D_{nov2014}$	$D_{connect} * D_{nov2014}$	*R- square*
Panel B: Six-months Pre-/Post-the Connect							
Effective Spread	0.605 (16.83*)	-0.025 (-11.58*)	20.995 (14.65*)	-0.004 (-0.76)	0.001 (0.34)	-0.005 (-1.98*)	0.161
Realised Spread	0.028 (1.13)	0.004 (2.49*)	-16.056 (-13.36*)	-0.009 (-2.95*)	-0.025 (-8.74*)	0.010 (5.56*)	0.061
Adverse Selection Cost	0.576 (27.71*)	-0.029 (-23.02*)	37.051 (31.22*)	0.005 (1.81)	0.026 (7.24*)	-0.015 (-6.19*)	0.203
lnDepth	3.092 (7.06*)	0.588 (22.18*)	-271.932 (-14.26*)	0.143 (2.97*)	-0.128 (-7.61*)	-0.140 (-6.36*)	0.436

6.3 Liquidity Tests – Stock Exchange of Hong Kong

Table 8 reports parameter estimates for Equation 1 to determine the impact of the SHHKConnect for SEHK listed stocks. Panel A Table 8 reports liquidity improves for *SHHKConnect stocks* after November 17, 2014, as measured by lower effective spreads and adverse selection costs. However, if the event window is extended to six-months, effective spreads for *SHHKConnect stocks* remain unchanged. Realized spreads in *SHHKConnect stocks* also exhibit asymmetric changes over the short and long run. In terms of market depth Table 8 reports a significant decline in the short term and long-run. Collectively, these results suggest that the improvement in the market liquidity for the *SHHKConnect stocks* listed on the SEHK is not persistent.

Table 8 Liquidity Test Results- the Stock Exchange of Hong Kong

This table reports multivariate test results of four liquidity proxies for the Stock Exchange of Hong Kong. Two event windows of three-months and six-months pre- and post- Shanghai-Hong Kong Connect are examined

The estimated regression is as follow:

$$Liquidity\ Proxies_{i,t} = \beta_0 + \beta_1 \ln Value_{i,t} + \beta_2 Volatility_{i,t} + \beta_3 D_{connect} + \beta_4 D_{nov2014} + \beta_5 D_{connect} * D_{nov2014} + \varepsilon_{i,t}$$

For the liquidity proxies, effective spread, realized spread, adverse selection cost and quoted depth (lnDepth) are used. For each security-day, *Effective spread* is aggregated by value weight of each trade, the metric is calculated by comparing the execution price to the previous prevailing midpoint before the trade; *Realized spread* compares the execution price to the prevailing midpoint price 10-minute after the trade, it is calculated as value-weighted 200*(price - midpoint ten-minutes later)*direction/midpoint; *Adverse selection cost* is calculated as the difference between effective spread and realized spread; *lnDepth* is the logarithm taken over the quoted depth by value, which is the aggregate value of its time-weighted best bid and ask depth throughout a day; *lnValue* is the logarithm taken over daily value; *Volatility* is calculated using value-weighted intraday volatility; $D_{connect}$ is a dummy variable, which indicates a stock's eligibility to trade under SHHKConnect. It equals to 1 if a stock can be traded under SHHKConnect, otherwise, it equals to 0; $D_{nov2014}$ is a time period dummy, it equals to 1 if a sample is observed after November 17th, 2014, otherwise, it equals to 0; $D_{connect} * D_{nov2014}$ is a interaction variable, it equals to 1 if a sample observed is of a Connected stock after SHHKConnect date, it equals to 0 otherwise. * indicates the significance at the 5% level.

	Intercept	lnValue	*Volatility*	$D_{connect}$	$D_{nov2014}$	$D_{connect} * D_{nov2014}$	*R- square*
Panel A: Three-months Pre-/Post-the Connect							
Effective Spread	5.198 (41.08*)	-0.321 (-36.06*)	238.895 (43.44*)	0.236 (6.34*)	0.008 (0.81)	-0.032 (-2.70*)	0.554
Realised Spread	3.102 (31.33*)	-0.181 (-27.03*)	-2.248 (-0.57)	0.071 (2.77*)	0.016 (1.66)	-0.012 (-1.14)	0.159
Adverse Selection Cost	2.100 (35.02*)	-0.140 (-32.74*)	241.143 (63.02*)	0.165 (9.00*)	-0.007 (-0.95)	-0.020 (-2.49*)	0.415
lnDepth	6.416 (49.81*)	0.432 (44.46*)	-99.872 (-18.27*)	0.170 (2.82*)	-0.019 (-1.55)	-0.046 (-2.49*)	0.645

Table 8 (Continued)

	Intercept	lnValue	*Volatility*	$D_{connect}$	$D_{nov2014}$	$D_{connect} * D_{nov2014}$	*R- square*
Panel B: Six-months Pre-/Post-the Connect							
Effective Spread	5.201 (43.55*)	-0.320 (-38.48*)	238.379 (49.58*)	0.224 (6.38*)	-0.019 (-1.96*)	0.017 (1.40)	0.558
Realised Spread	3.078 (32.84*)	-0.179 (-28.64*)	0.180 (0.05)	0.061 (2.54*)	0.001 (0.17)	0.020 (1.98*)	0.160
Adverse Selection Cost	2.123 (42.05*)	-0.141 (-39.16*)	238.200 (72.63*)	0.163 (10.10*)	-0.020 (-3.37*)	-0.003 (-0.44)	0.423
lnDepth	6.387 (52.08*)	0.434 (46.75*)	-97.292 (-19.12*)	0.165 (2.84*)	-0.033 (-2.79*)	-0.047 (-2.59*)	0.643

6.4 Results for Price-Premium Convergence Test

Turning to tests of the price-premium between A- and H-shares, Table 9 reports two sets of results across the three and six-month pre and post event windows in Panels A and B, respectively. Table 9, reports that the price premium between cross-listed shares is positively correlated to the market index of the SSE and negatively correlated to the market index of the SEHK. The correlations between the price premium and market indices are significant at the 5% level. The coefficient of the difference between quoted spreads of A- and H-shares is negative and significant. This suggests that, when the difference between the quoted spread of A- and H-shares increases (i.e. the transaction cost of H-shares become smaller), the price premium of A- to H-shares will decrease. $\boldsymbol{HVol/Hshare}$, another indicator of liquidity in H-shares, measured as the proportion of floated H-shared that are traded each day, is negative suggesting lower liquidity risk and a higher price premium. The coefficient on $\boldsymbol{VolaRatio}$ is positive and significant, supportive of the differential risk hypothesis set out in Brennan and Subramanyam (1996) and Eun and Janakiramanan (1986). Contrary to findings in Wang and Jiang (2004), results in Table 9 suggest that exchange rates do play a significant role in the price divergence of A- and H-shares over the longer event window, which is not the case over the short term three-month period. This may be a byproduct of China's intention to internationalize Chinese CNY with the liberalization of its stock market. To examine the impact of the SHHKConnect on the price premium, Table 9 documents that the coefficient on $\boldsymbol{D_{nov2014}}$ is positive and significant at a 5% level. This suggests that after SHHKConnect, the price premium increases by 1.5-5.5%, over the two test windows. Interestingly, these result show that following the launch of the SHHKConnect, the prices of the two classes of shares does not converge, but rather the price differential increases. We attribute this result to the improvement in the liquidity of the SSE, over and above the SEHK in the long run.

Table 9 Price – Premium Test Result

This table reports multivariate test results of changes in A- and H-share price premium three-months and six-months pre- and post-Shanghai-Hong Kong Connect.

The estimated regression is as follow:

$Ah_ratio_{i,t} = \alpha_0 + \alpha_1 Ah_ratio_{i,t-1} + \alpha_s \Delta Qtd_{i,t} + \alpha_2 SSEIndex_t + \alpha_3 SEHKIndex_t + \alpha_4 HVol/Hshare_{it} + \alpha_6 VolaRatio_{i,t} + \alpha_7 Xrate_t + \alpha_8 D_{nov2014} + \varepsilon_{i,t}$

Ah_ratio_{t-1} is the A/H price ratio from the last trading day; ΔQtd is the difference between the time-weighted, quoted spreads of A- and H-shares; ; SSEIndex and SEHKIndex are the inter-day return of Shanghai A-Share Index and Hang Seng Index, respectively; HVol/Hshare is calculated as daily H-share trading volume divided by the total number of free-floated H-shares; VolaRatio is a ratio calculated as the intra-day volatility of an A-share over the intra-day volatility of its corresponding H-share; Xrate is the exchange rate between the Chinese CNY and the Hong Kong dollar; $D_{nov2014}$ is a time period dummy, it equals to 1 if a sample is observed after November 17th, 2014, otherwise, it equals to 0; * indicates the significance at the 5% level.

Panel A: Three-months Pre-/Post-the Connect			*Panel B: Six-months Pre-/Post-the Connect*		
R-square	0.988		***R-square***	0.985	
Parameter	**Estimate**	**T-Stats**	**Parameter**	**Estimate**	**T-Stats**
Intercept	0.031	(4.02*)	*Intercept*	0.103	(4.16*)
Ah_ratio_{t-1}	0.928	(83.51*)	Ah_ratio_{t-1}	0.809	(22.38*)
ΔQtd	-0.036	(-1.70)	ΔQtd	-0.145	(-3.34*)
SSEIndex	0.008	(10.70*)	*SSEIndex*	0.010	(9.98*)
SEHKIndex	-0.009	(-8.73*)	*SEHKIndex*	-0.014	(-8.14*)
HVol/Hshare	-0.010	(-0.75)	*HVol/Hshare*	-0.031	(-2.38*)
VolaRatio	0.014	(6.70*)	*VolaRatio*	0.028	(6.42*)
Xrate	-0.002	(-0.31)	*Xrate*	0.021	(2.33*)
$D_{nov2014}$	0.019	(4.50*)	$D_{nov2014}$	0.055	(4.22*)

CONCLUSION

The launch of Shanghai-Hong Kong Connect liberalized the SSE to international retail and institutional investors, permitting enhanced capital flows between the capital markets of mainland China and Hong Kong. This event provides a unique and natural experiment to examine the impact of partial capital liberalization and market connection in China on market liquidity and price divergence. More importantly, the study of this event sheds light on the possible impact of the forthcoming market connectivity projects between China's next largest listing market, the Shenzhen Stock Exchange and Honk Kong, as well as the proposed market connectivity between Shanghai and London exchanges.

Tests of changes in market liquidity are carried out over three-months and six-months periods pre- and post the SHHKConnect project using four operational measures of liquidity. The results show that in the case of the SSE, the SHHKConnect has a consistent and positive impact on the market liquidity with reduced transaction costs for the stocks that are eligible for trading via the SHHKConnect. Effective spreads decrease persistently following the launch of the SHHKConnect. In addition, adverse selection costs incurred by traders who make markets in such stocks also decrease post November 2014. However, for the SEHK, our results are sensitive to the length of the event window considered. Three-months post the introduction of SHHKConnect, liquidity as measured by effective spreads and adverse selections improves for stocks eligible for trading via the SHHKConnect, but such changes are not observed at the market level on the SEHK, highlighting differential effects for both markets. Further, when the event window is extended, no significant change is observed, either in terms of trading costs or information flow efficiency for *SHHKConnect* stocks traded in Hong Kong. However, our results do find a consistent decrease in market depth.

In light of the SHHKConnect permitting Chinese investors to purchase cross-listed H-shares in Hong Kong at cheaper prices than buying corresponding A-shares in China, our results show that the price premium of A-shares over H-shares has increased, contrary to expectations. We speculate that this result may be driven by the improved liquidity for cross-listed A-shares.

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