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The effect of the Shanghai-Hong Kong Stock Connect program on market efficiency in China

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Abstract: We study the effect of the Shanghai-Hong Kong Stock Connect program on market efficiency in China. Applying a difference-in-differences model, we find that connected firms experience a higher about 4% price impact and significantly increased turnover, liquidity, and volatility in 20 days following the announcement. Our results support the evidence that investors demand a premium for volatility risk. Furthermore, in the Shanghai market, the participation of Hong Kong investors helps reduce the volatility of connected stocks, while in the Hong Kong market, the participation of Shanghai investors increases the volatility. The finding of this cross-market variation is consistent with the heterogeneity of investors' trading behavior across different markets and reflects the existence of risk spillovers between those two markets. The price revaluation and risk spillovers illustrate that the implementation of the program has greatly improved the efficiency of the Chinese market.

Keywords: Shanghai-Hong Kong Stock Connect; stock return; stock volatility; investor heterogeneity
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1 Introduction

In recent years, financial market liberalization has become one of the most important reform agendas in China. Despite the enforcement of QFII and QDII programs offers a feasible way for cross-border investments, China's capital account remains relatively closed. The Shanghai-Hong Kong Stock Connect (SHSC) program is seen as a huge step of financial market liberalization. Under this program, investors in Hong Kong and on the mainland could trade a range of stocks listed on the other side's bourse through securities firms in their own market. In this paper, we investigate the effect of the Shanghai-Hong Kong Stock Connect program on market efficiency.

Market efficiency in finance refers to the degree to which market prices reflect all available, relevant information. As equity markets are liberalized and more open to investors, equity prices should reflect the increased availability of information and be more efficiently priced. The Shanghai-Hong Kong Stock Connect program is similar to a cross-listing project that allows stocks to be traded in different markets. Fernandes and Ferreira[1] suggest that cross-listing in the U.S. affects the information environment. Using firm-specific return variation as a proxy variable, the empirical results demonstrate that cross-listing improves price informativeness.

The SHSC program introduces investors from other markets, and they trade the listed stocks with their private information. The trading of these investors helps price discovery of stocks. Existing studies manifest the liberalization of the equity market is usually accompanied by price revaluation. Foerster and Karolyi[2] indicate that non-U.S. firms cross-listing shares on the NYSE, AMEX, or Nasdaq as American depositary receipts would lead to unusual returns, which attribute to the expansion of the shareholder base. However, there has been little research on developed-market firms that are cross-listed in emerging markets. Most researchers focus on stocks in emerging markets cross-listed in a mature market such as the New York Stock Exchange (NYSE). The Shanghai-Hong Kong Stock Connect program includes two different types of markets, and we find that stocks cross-listed in the Shanghai market and the Hong Kong market totally experience positive price effects. The price revaluation happens in both markets.

The liberalization represents an enhancement to the degree of globalization for certain stocks in the local

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market. Hong Kong has a highly open market as an international finance center while the Shanghai market is relatively close. The risk of the world market has a limited impact on stocks in the Shanghai market. The SHSC program connects the Shanghai market and Hong Kong market which causes the risk spillover between these two markets simultaneously. Previous literature has revealed the impact of foreign capital on domestic firm volatility, although existing studies present mixed results. Bekaert and Harvey[3] investigate 17 emerging markets and reveal that volatility either remains the same or decreases in 13 countries after the capital liberalization. Bae et al.[4] find a positive relationship between return volatility and the accessibility to foreigners or the 'investibility', while Umutlu et al.[5] argue that there is a negative correlation between the degrees of market openness and aggregated total volatility. Li et al.[6] also document a negative relationship between large foreign ownership and volatility. Kim and Singal[7] reveal that the opening of stock markets significantly increases stock prices without a concurrent increase in stock return volatility. These studies prove that the participation of foreign investors may affect return volatility after the opening of domestic stock markets to foreign capital. Some studies further refine this topic according to the type of foreign investors. Chen et al.[8] demonstrate that foreign institutional holdings increase firm-level stock return volatility in the Chinese market, while foreign individual shareholdings reduce the volatility. Our empirical results demonstrate connected stocks have higher volatility after the program. Different from the results of Kim and Singal[7], we find a positive relation between volatility and price. We also prove that the heterogeneity of investors' trading behavior leads to different effects on volatility. In the Shanghai market, the participation of Hong Kong investors helps to reduce the volatility of connected stocks, while in the Hong Kong market, the participation of Shanghai investors increases the volatility.

As for the factors affecting the price change, some articles believe that the cost reduction after cross-listing may lead to the price increase. Bekaert and Harvey[9] indicate that the cost of capital always decreases after capital market liberalization in an emerging market. Baker et al.[10] note that international firms listing their shares on the NYSE or the London Stock Exchange (LSE) experience significant gains in visibility and are also associated with decreases in the cost of equity capital. Chan and Kwok[11] show that risk-sharing explains approximately one-fourth of the price revaluation of stocks in China during the liberation window. However, our empirical evidence demonstrates that price changes are associated with an increase in risk as measured by volatility. After applying a difference-in-differences model, we also find that the connected stocks have higher volatility, and investors demand a price premium for the volatility risk.

Liquidity improvement as an important part of cost reduction during the financial market liberalization has been studied by researchers. Levine and Zervos[12] show that liquidity increases after stock market liberalization in emerging economies. Lesmond[13] examines different liquidity measures for emerging markets and finds that countries with weak political and legal institutions have significantly higher liquidity costs than countries with strong political and legal systems. Bekaert et al.[14] indicate that local market liquidity is an important driver of expected returns in emerging markets after liberalization. Market openness provides an opportunity for foreign investors to invest in domestic securities and gives domestic investors the right to transact in foreign equities. The liquidity impact of foreign investments has also been studied. Stulz[15] indicates that participation by large international financial institutions enhances local market liquidity through better information disclosure and more active trading. Rhee and Wang[16] use data from Indonesia to prove that foreign holdings have a negative impact on future liquidity. Based on the theory of Bekaert et al.[14], the effect of liquidity on expected returns should be moderated after liberalization. Compared with the rest of the world, trading in Shanghai and Hong Kong is quite heavy. Hence, we assume that the liquidity effect will be mitigated even more obviously. Our results prove that there is no significant relationship between liquidity and return after the liberalization under the SHSC program.

After the Shanghai-Hong Kong Stock Connect program (SHSC program) was implemented in 2014, many investors started tracking the connected stocks. Shanghai Stock Exchange has also constructed SSE SH Equities Index and SSE HK Equities Index to reflect the price changes of those connected shares. For the Shanghai market, the SHSC program listed stocks are components of the SSE 180 index, the SSE 380 index, and A-shares of A + H shares. For the Hong Kong market, the SHSC program selects the HSCI Large Cap index, the HSCI Mid Cap index, and H-shares of A+H shares. The listing of stocks in the program is strongly associated with the index. Existing literature indicates the price increases when stocks are added to a certain stock index. The downward-sloping demand curve hypothesis proposed by Shleifer[17] shows that the price change is permanent. Shleifer[17] argues that the buying of index funds will result in an increase in price for stocks included in the index and that the effect is permanent. Beneish and Whaley[18], Lynch and Mendenhall[19], and Wurgler and Zhuravskaya[20]

present evidence consistent with this hypothesis. Chen et al.[21] find that there is a permanent increase in the price of added firms with enhanced awareness for stocks. The results support the investment awareness hypothesis inspired by Merton[22] and indicate that the price changes are permanent. The price pressure hypothesis proposed by Harris and Gurel[23] argues that the additions of shares do not have a permanent effect on stock prices, and the price effect exists only in the short term. Our results indicate that connected stocks experience significant positive returns on the announcement day. Similar to Beneish and Whaley[18], we also find a price reversal after the effective day, but it is temporary. We observe a permanent price effect that connected stocks experience significantly higher returns than unconnected stocks over the 20 days window.

Our paper contributes to the literature in several ways. First, it enriches the studies on financial liberalization. Most studies demonstrate that market liberalization reduces the cost of capital. Our results show that investors demand a price premium for volatility risk caused by the liberalization of the stock market. Second, we add new evidences that cross-listing may have different effects in developing and developed markets. Existing studies focus on stocks cross-listed in developed markets. Our paper shows that the heterogeneity of investors' trading behavior could lead to different effects. The participation of investors from institutional investor-dominated markets could reduce the volatility of connected stocks, while the participation of investors from individual investor-dominated markets could increase the volatility.

2 Background of the Shanghai-Hong Kong Stock Connect program

Before the SHSC program was implemented, Chinese regulators imposed a strong capital control policy. At that time, QFII and QDII programs dominated cross-border investments between the stock markets in Mainland China and the world market.

The Qualified Foreign Institutional Investor (QFII) program, which started in 2002, allows foreign institutional investors to invest in securities markets of Mainland China. The Qualified Domestic Institutional Investor (QDII) program, which started in 2006, allows institutional investors in Mainland China to invest in financial markets abroad. Both programs have limited quotas and are accessible only to foreign institutions that satisfy several qualifications and meet requirements for operational and asset scale. In 2011, the RMB Qualified Foreign Institutional Investor (RQFII) program was introduced. It allows foreign institutional investors to invest in Mainland China via offshore RMB accounts. However, this program is still not available to most investors.

Other potential channels for cross-border investment are through issuing B-shares (USD/HKD-denominated shares) in the Shanghai B-share market or by cross-listing in Hong Kong by issuing H-shares. The B-share market was established in the early 1990s and aimed to offer better access for foreign investors to invest in domestic firms. Initially, the B-share market was available only to foreign investors. In 2001, it was also opened to domestic investors with foreign currencies. However, since 2001, the B-share market has stopped issuing new shares, and currently, this market constitutes only a tiny portion of the market capitalization of the Shanghai market. The Hong Kong market is open to foreign investors, while H-shares are not available to most domestic investors.

The SHSC program was first officially announced by Chinese Premier Li Keqiang on April 10, 2014. However, the announcement only informed the public that the Chinese government had decided to execute the program soon, and the details about the implementation and the exact execution date of the program remained unclear to the market. Seven months later, detailed information on the program was released by the Shanghai Stock Exchange and the Hong Kong Exchanges on November 10, 2014 (which we define as the event start date), including the initial list of connected stocks and the effective date of the program. The SHSC program was finally implemented on November 17, 2014.

The SHSC program allowed investors from the Chinese Mainland to invest in the SHSC program target stocks in the Hong Kong stock market (Hong Kong Stock Connect, HSC). Hong Kong investors could also invest in the program target stocks in the Shanghai market (Shanghai Stock Connect, SSC). The program target stocks for the Shanghai stock market are components of the SSE 180 index, the SSE 380 index, and A-shares of A + H stocks. For the Hong Kong market, the program selects the HSCI Large Cap index, the HSCI Mid Cap index, and H-shares of A+H stocks as the connected stocks. On the first day of the program, 13 billion of net buying trading volume (in RMB) was made through SSC, and 1.768 billion of net buying trading volume (in RMB) was made through HSC. Huge amounts of capital flowed into both markets through this channel. In summary, the program is viewed as a huge step towards financial liberalization and is part of the Chinese financial reform.

Table 1. Summary statistics of connected stocks and unconnected stocks in the Shanghai market.

	Variables	*N*	Mean	S. D.	Min	P25	P50	P75	Max
Panel A: Connected stocks	Volatility	471	2.20	0.78	0.59	1.64	2.06	2.55	4.76
	Turnover	471	2.11	1.55	0.02	1.10	1.78	2.63	12.26
	Amihud	471	−0.93	3.56	−21.49	−2.05	−0.69	0.09	33.77
	Logsize	471	23.32	1.09	21.48	22.55	23.14	23.85	27.98
	ROA	471	2.46	3.10	−3.64	0.81	1.79	3.53	37.94
	Leverage	471	2.40	1.72	1.05	1.49	1.85	2.62	19.54
Panel B: Unconnected stocks	Volatility	287	2.46	0.78	1.14	1.90	2.35	2.82	6.17
	Turnover	287	2.58	1.78	0.44	1.51	2.14	2.99	13.37
	Amihud	287	15.75	209.98	−46.13	−3.95	−1.35	0.66	3127.74
	Logsize	287	22.15	0.55	21.06	21.75	22.09	22.46	25.53
	ROA	287	0.20	3.74	−49.28	−0.60	0.47	1.38	8.04
	Leverage	287	2.60	2.14	0.92	1.40	1.96	2.91	15.83

[Note] This table reports the mean, standard deviation, minimum, 25th percentile, median, 75th percentile, and maximum for the firm characteristics of connected firms and unconnected firms in the Shanghai market. Panel A reports the summary statistics for connected stocks, and Panel B reports the summary statistics for unconnected stocks. Volatility is return volatility, Turnover is the average daily turnover in the past one month, Amihud is Amihud's illiquidity measure in the past one month, and we adjust the results by multiplying by 10^8. Logsize is the natural logarithm of market capitalization one day before the announcement of the program, ROA is the return on assets, and Leverage is financial leverage as calculated by the ratio of total liabilities to total assets. Accounting variables are all defined using interim financial reporting of 2014.

3 Data and summary statistics

We obtain the SHSC program listed stocks from the Shanghai Stock Exchange and Hong Kong Exchange websites①, and we collect return, trading volume, turnover, market capitalization, and related accounting data from Wind and CSMAR. Our study focuses on Shanghai A-shares and the mainboard stocks of Hong Kong. We exclude stocks with IPOs within the period one year before the announcement day, stocks that do not trade for nonevent-related reasons such as asset restructuring or important unannounced matters, and firms with insufficient data during the event period. Overall, the sample includes 758 stocks from the Shanghai A-stocks, 568 stocks from the Shanghai Stock Connect stocks, 923 stocks from the Hong Kong main board stocks, and 268 stocks from the Hong Kong Connect stocks.

Table 1 summarizes the firm characteristics for the Shanghai market. Panels A and B present the summary statistics for connected and unconnected stocks, respectively. On average, unconnected stocks have a natural logarithm market capitalization of 15.75, a turnover ratio of 2.58, a return on assets ratio of 0.20, and a leverage ratio of 2.60 as calculated by the ratio of total liabilities to total assets. The average volatility is 2.46 computed by the standard deviation of daily stock returns, and liquidity (Amihud) is 15.75 using Amihud's illiquidity measure②. Compared with unconnected stocks, connected stocks on average are larger in size, less volatile, have a lower turnover ratio, better liquidity, a higher return on assets ratio, and a lower leverage ratio.

Table 2 summarizes the firm characteristics for the Hong Kong market. Panels A and B present the summary statistics of connected stocks and unconnected stocks, respectively. On average, unconnected stocks have a natural logarithm market capitalization of 21.48, a turnover ratio of 0.39, a return on assets ratio of 0.86, and a leverage ratio of 12.00. The average volatility and Amihud's illiquidity measure are 2.78 and 356.65. Similar to the Shanghai market, connected stocks in Hong Kong are also larger in size, less volatile, have a lower turnover ratio, better liquidity, a higher return on assets ratio, and a lower leverage ratio.

The results indicate that in both markets, connected stocks are larger in size and more mature than unconnected stocks, and the differences in firm characteristics may drive the selection bias. Therefore, in this paper, we use a difference-in-differences framework to identify the effect of the SHSC program.

① Shanghai Stock Exchange website: http://www.sse.com.cn/services/hkexsc/. Hong Kong Exchanges websites: https://www.hkex.com.hk/Mutual-Market/Stock-Connect?sc_lang=en.

② Amihud's illiquidity measure[24] is the absolute value of stock returns scaled by volume, we adjust the results by multiplying by 10^8.

Table 2. Summary statistics of connected stocks and unconnected stocks in the Hong Kong market.

	Variables	*N*	Mean	S. D.	Min	P25	P50	P75	Max
Panel A: Connected stocks	Volatility	226	1.72	0.74	0.53	1.18	1.61	2.15	4.76
	Turnover	226	0.28	0.30	0.01	0.08	0.18	0.36	1.85
	Amihud	226	58.04	97.87	0.21	9.78	23.89	62.79	728.63
	Logsize	226	24.50	1.27	22.38	23.51	24.34	25.21	28.31
	ROA	226	3.13	4.28	−2.03	0.91	2.20	3.75	46.53
	Leverage	226	2.33	1.67	1.06	1.40	1.80	2.53	12.83
Panel B: Unconnected stocks	Volatility	697	2.78	1.93	0.00	1.57	2.21	3.31	13.61
	Turnover	697	0.39	0.64	0.00	0.07	0.17	0.44	8.42
	Amihud	697	356.65	1055.43	0.00	32.53	81.93	255.42	15534.65
	Logsize	697	21.48	1.23	18.39	20.61	21.36	22.28	26.40
	ROA	697	0.86	9.75	−71.44	−1.01	1.02	3.03	141.10
	Leverage	697	12.00	101.95	0.46	1.67	2.48	4.02	2109.71

[Note] Definition of parameters is the same as Table 1.

4 Effect on price

For analyzing whether price revaluation happens in both markets, we use two different measurements to determine how prices react to the event, which are buy and hold returns and market-adjusted returns. Buy and hold is a strategy in which investors buy a stock at the beginning of the period and hold it until the end, and the buy and hold return is the geometrically compounded return on the stock:

$$\mathrm{BHR}_i[a,b] = \prod_{t=a}^{b}(1 + R_{it}) - 1 \qquad (1)$$

where $\mathrm{BHR}_i[a,b]$ is the buy and hold return for firm i from day a to b, and R_{it} is the firm's return in local currency.

We also calculate the cumulative abnormal returns (CAR) following Reference [2] during the event period. The market model is used to estimate the expected return. We select the Shanghai Composite Index return as the market return for the Shanghai market and the Hang Seng Composite Index return as the market return for the Hong Kong market. The market model parameters are estimated over one year before the event, and then, the residual is computed as the abnormal return. The cumulative abnormal return is the sum of the abnormal returns:

$$\varepsilon_{it} = R_{it} - (\alpha_i + \beta_i R_{mt}) \qquad (2)$$

$$\mathrm{CAR}_i[a,b] = \sum_{t=a}^{b}\varepsilon_{it} \qquad (3)$$

R_{it} is the firm's local currency return on day t, and R_{mt} is the local market return. $\mathrm{CAR}_i[a,b]$ is the cumulative abnormal return for firm i from day a to b.

We set the announcement day of the connect program as the event day of the program ($t=0$). The PRE window is 20 days before the announcement day (-20, -1), the POST window is 20 days after the event day ($+1$, $+20$), and the effective day is the day on which the program takes effect ($t=5$). We use a two-sample t-test and a two-sample Wilcoxon rank-sum (Mann-Whitney) test to examine the significance of the difference.

We focus on the difference in returns between connected stocks and unconnected stocks, which demonstrates the effect of the policy on the stock price. The difference is calculated as the average BHR(CAR) of connected stocks minus that of unconnected stocks. Panel A of Table 3 presents the results in the Shanghai market. During the PRE window, relative to unconnected stocks, connected stocks experienced an increase of 0.949% in BHR (0.047% per day on average). For CAR, the difference is 2.932% (0.147% per day on average). The results are all significant at the 1% level under both tests except that the BHR shows no statistical significance under the t-test①. Connected stocks have a slightly higher return before the program which may attribute to the difference of firm characteristics reported in Table 1.

① T-test assumes that the population is normally distributed while Wilcoxon rank-sum test is a nonparametric test that does not rely on the distribution of the population. In our study, the distribution of the population is unknown. Therefore, Wilcoxon rank-sum test is more convincing.

Table 3. Difference in buy and hold returns and cumulative abnormal returns between connected stocks and unconnected stocks.

	Period	BHR			CAR		
		Mean	T-Stat	Z-stat	Mean	T-stat	Z-stat
Panel A: Shanghai market	PRE (−20, −1)	0.949	1.271	2.747***	2.932	4.038***	5.091***
	Announcement day(t=0)	1.149	7.212***	8.053***	1.037	6.102***	8.009***
	POST (+1,+20)	9.450	8.478***	9.021***	8.601	8.402***	4.935***
	(0,+4)	2.908	7.330***	7.939***	3.182	7.637***	8.151***
	Effective day (t=+5)	−0.456	−3.000***	−3.010***	−0.334	−2.225**	−2.101**
	(+5,+10)	−0.941	−2.516**	−4.481***	−0.502	−1.445	−3.117***
	(0,+10)	2.100	4.058***	4.360***	2.680	5.167***	5.618***
	(0,+15)	4.062	5.346***	6.066***	4.465	5.848***	6.208***
	(0,+20)	10.867	9.263***	9.935***	9.638	8.951***	8.526***
Panel B: Hong Kong market	PRE (−20, −1)	−0.357	−0.318	2.681***	2.625	1.956*	3.425***
	Announcement day(t=0)	1.243	4.346***	4.549***	1.176	3.315***	3.311***
	POST (+1,+20)	4.974	4.047***	6.976***	7.751	3.545***	5.860***
	(0,+4)	2.367	4.136***	6.675***	2.443	3.367***	4.816***
	Effective day (t=+5)	−1.049	−4.134***	−4.014***	−0.563	−0.935	−1.643
	(+5,+10)	−0.684	−0.971	−1.143	2.158	0.832	2.149**
	(0,+10)	1.654	1.975**	5.975***	4.601	1.835*	5.065***
	(0,+15)	2.599	2.517**	5.862***	6.062	2.686***	5.203***
	(0,+20)	6.165	4.853***	8.120***	8.927	3.992***	6.465***

[Note] This table reports the difference in buy and hold returns and cumulative abnormal returns between connected stocks and unconnected stocks in different periods and markets. The BHR is the geometrically compounded return on the stock. The CAR is the sum of the abnormal returns, which is calculated based on the market model. Data are all shown as percentages (%). We set the announcement day of the program as the event day (t=0). The PRE period is from t=−20 to t=−1, the POST period is from t=+1 to t=+20, and the effective day is the day on which the program takes effect (t=+5). T-statistics are test statistics using a two-sample t-test, and Z-statistics are results using a two-sample Wilcoxon rank-sum (Mann-Whitney) test. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

On the announcement day, the difference is significantly positive and large, 1.149% in BHR, which indicates that connected stocks experience higher price impact afterwards. For CAR, the difference is also significant (1.037%).

Within the POST period, connected stocks increase 9.45% in BHR (0.473% per day on average) and 8.601% in CAR (0.43% per day on average). The difference of the returns is larger after 20 days of the announcement day, suggesting the impact on price lasts for a long time.

We also find that before the effective day, during the (0, +4) window, the difference in the returns is significantly positive, 2.908% for BHR and 3.182% for CAR. However, on the effective day (t=+5), we observe a remarkable reversal, −0.456% in BHR and −0.334% in CAR, both results are at least significant at the 5% level under two types of tests. The reversal continues in the (+5, +10) window: −0.941% and −0.502% for BHR and CAR respectively.

Although the return decline dramatically after the effective day, it does not appear to revert to the preannouncement level. During the (0, +10) period, the difference is still positive and significant: 2.1% in BHR and 2.68% in CAR. During the (0, +15) and (0, +20) windows, the results are higher than the (0, +10) window, showing that the difference in returns is permanent. After the announcement of the SHSC program, connected stocks experience a significant price appreciation, about 1.1% on the announcement day and 9% within the POST period. The results prove that the SHSC program affects the stock price permanently.

Panel B of Table 3 presents the results for the Hong Kong market, which are similar to those of the Shanghai

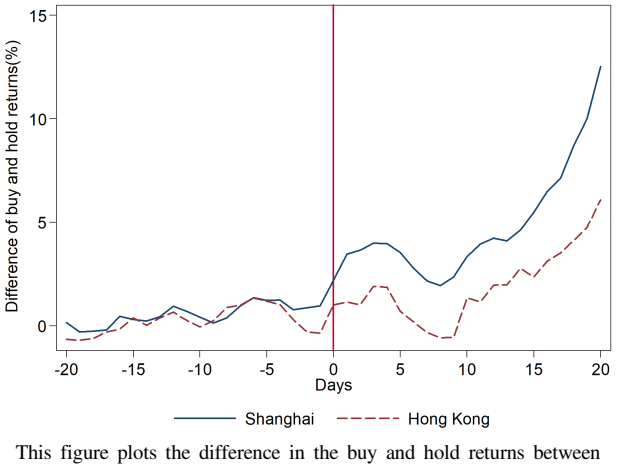
market. During the PRE period, the difference is −0.357% (−0.018% per day on average) in BHR and 2.625% in CAR (0.131% per day on average). On the announcement day, the differences are also large and significant: 1.243% in BHR and 1.176% in CAR. Within the POST period, the difference is significant but lower than that of the Shanghai market: 4.974% in BHR (0.249% per day on average) and 7.751% in CAR (0.388% per day on average).

We also find a significant reversal on the effective day ($t=5$) for BHR (−1.049%). The difference for CAR is negative (−0.563%) but not significant. During the (+5, +10) window, the decrease of BHR is not significant, and the difference in CAR becomes positive (2.158%) and significant at the 10% level. The reversal in the Hong Kong market appears smaller and shorter than that in the Shanghai market. During the (0, +15) and (0, +20) windows, the difference in returns remains positive and significant. Contributed to the SHSC program, connected stocks in the Hong Kong market also experience a significant price increase, about 1.2% on the announcement day and 6.4% within the POST period. The program influences the price of stocks in Hong Kong market as well.

All of these results indicate that relative to unconnected stocks, connected stocks have higher returns after the program in both markets. On the announcement day, this difference is especially significant and large, and within the POST window, this difference is larger in the Shanghai market than in the Hong Kong market. Buying and holding returns also offer us a feasible way to form a trading strategy that go long the connected stocks and go short the unconnected stocks 20 days before the announcement day and obtain a 12.526% payoff in the Shanghai market and a 6.078% payoff in the Hong Kong market.

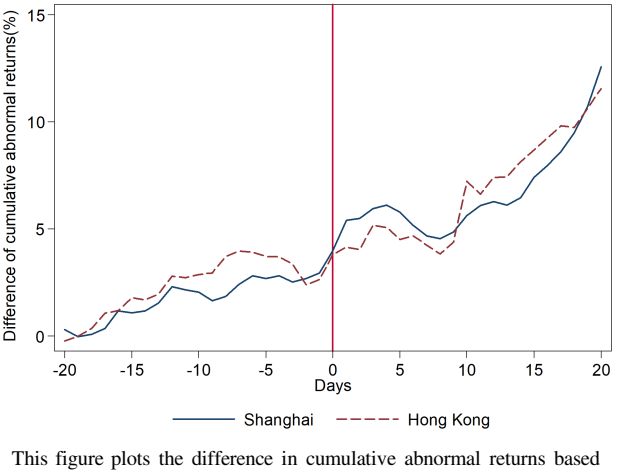
To better understand the effect of the connected program on stock prices, we plot the difference in buying and holding returns and cumulative abnormal returns among connected and unconnected stocks over the event window (−20, +20) in Figures 1 and 2, respectively. The rising, positive trends of BHR and CAR for connected stocks are significant in both markets. Focusing on the announcement day, there is a huge jump in BHR and CAR, which indicates that the price reacts to the policy immediately. During the (+5, +10) window, similar to the results in Table 3, a significant descending trend exists. The reversal after the effective day is similar to the findings of Beneish and Whaley[18], which they attribute to risk arbitrageur and name it the 'S&P 500 Game'. Risk arbitrageurs who overestimate the demand of investors that can only buy stocks after the effective day will sell their stocks, but this trend will be temporary. We find similar results: This reversal exists for only approximately 5 days. On the tenth day after the announcement of the program, the difference in BHR and CAR increase, and that trend never reverses. The price change is permanent after the SHSC program is applied in both markets.

In the analyses above, we only compare the differences in return. To investigate the effect of the SHSC program on price, we conduct the following regression analysis, controlling for various firm characteristics:



This figure plots the difference in the buy and hold returns between connected and unconnected stocks in the (−20, 20) window around the announcement of the Shanghai-Hong Kong Stock Connect program. A vertical bar is placed to mark the announcement day (day 0).

Figure 1. Difference in buy and hold returns in the Shanghai and Hong Kong markets.



This figure plots the difference in cumulative abnormal returns based on the market model between connected and unconnected stocks in the (−20, 20) window around the announcement of the Shanghai-Hong Kong Stock Connect program. A vertical bar is placed to mark the announcement day (day 0).

Figure 2. Difference in cumulative abnormal returns in the Shanghai and Hong Kong markets

Table 4. Regression analysis of buy and hold returns and cumulative abnormal returns in the Shanghai market

		(1) AD	(2) AD	(3) POST	(4) POST
Panel A: Buy and hold returns	Connect	1.149***	0.575***	9.450***	3.656***
		(7.212)	(3.098)	(8.478)	(3.111)
	Turnover		−0.086*		0.332
			(−1.875)		(1.142)
	Amihud		0.001		−0.008**
			(1.505)		(−2.269)
	Logsize		0.299***		3.765***
			(3.192)		(6.340)
	ROA		−0.001		−0.217
			(−0.059)		(−1.505)
	Leverage		−0.100**		−0.379
			(−2.418)		(−1.447)
	Industry fixed effect	NO	YES	NO	YES
	Constant	0.898***	−5.116**	2.936***	−80.276***
		(7.149)	(−2.378)	(3.341)	(−5.892)
	N	758	758	758	758
	adj. R^2	0.063	0.176	0.086	0.341
Panel B: Cumulative abnormal returns	Connect	1.037***	0.347*	8.601***	2.049*
		(6.102)	(1.771)	(8.401)	(1.920)
	Turnover		−0.179***		−0.646**
			(−3.682)		(−2.448)
	Amihud		0.001*		−0.006*
			(1.822)		(−1.805)
	Logsize		0.377***		4.325***
			(3.803)		(8.020)
	ROA		0.005		−0.111
			(0.204)		(−0.851)
	Leverage		−0.107**		−0.402*
			(−2.456)		(−1.690)
	Industry fixed effects	NO	YES	NO	YES
	Constant	−1.827***	−9.254***	−22.663***	−114.756***
		(−13.631)	(−4.072)	(−28.083)	(−9.276)
	N	758	758	758	758
	adj. R^2	0.046	0.177	0.084	0.355

[Note] In Panel A, we regress on buy and hold returns. In Panel B, we regress on cumulative abnormal returns. AD is the day that Shanghai-Hong Kong Stock Connect program is announced, and the POST period is 20 days after the announcement day. Connect is a dummy variable that equals one for connected stocks and zero for unconnected stocks. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

$$BHR_i = \alpha_0 + \alpha_1 \times Connect_i + X_i \times \beta_i + \varepsilon_i \quad (4)$$

$$CAR_i = \alpha_0 + \alpha_1 \times Connect_i + X_i \times \beta_i + \varepsilon_i \quad (5)$$

where the dependent variables BHR_i and CAR_i represent the buy and hold returns and cumulative abnormal returns for firm i, respectively. $Connect_i$ is a dummy variable that equals one for connected stocks and zero for unconnected stocks, and X_i are control variables including Turnover, Amihud, Logsize, ROA, and Leverage. Turnover and Amihud are measured one month before the announcement day. Most of the Shanghai and Hong Kong firms disclose their interim financial reports before the program.

Table 5. Regression analysis of buy and hold returns and cumulative abnormal returns in the Hong Kong market.

		(1)	(2)	(3)	(4)
		AD	AD	POST	POST
Panel A: Buy and hold returns	Connect	1.243***	1.083***	4.974***	4.275**
		(4.346)	(2.629)	(4.047)	(2.521)
	Turnover		0.069		−4.072***
			(0.288)		(−4.139)
	Amihud		−0.000		0.000
			(−0.612)		(0.217)
	Logsize		0.077		−0.110
			(0.752)		(−0.262)
	ROA		0.015		−0.057
			(1.034)		(−0.977)
	Leverage		0.000		−0.004
			(0.104)		(−0.603)
	Industry fixed effects	NO	YES	NO	YES
	Constant	0.563***	−2.371	−4.029***	−4.967
		(3.982)	(−1.053)	(−6.624)	(−0.536)
	N	923	923	923	923
	adj. R^2	0.019	0.046	0.016	0.123
Panel B: Cumulative abnormal returns	Connect	1.176***	0.869*	7.751***	5.619*
		(3.315)	(1.690)	(3.545)	(1.786)
	Turnover		−0.259		−8.137***
			(−0.867)		(−4.457)
	Amihud		0.000		0.001
			(0.006)		(0.500)
	Logsize		0.103		0.381
			(0.812)		(0.489)
	ROA		0.029		0.031
			(1.612)		(0.280)
	Leverage		0.000		0.003
			(0.020)		(0.227)
	Industry fixed effects	NO	YES	NO	YES
	Constant	0.076	−2.977	−6.760***	−16.345
		(0.431)	(−1.060)	(−6.248)	(−0.950)
	N	923	923	923	923
	adj. R^2	0.011	0.026	0.012	0.042

[Note] Definition of parameters is same as above. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

We focus on the difference in returns on the announcement day of the program (AD) and over the whole post-event period (POST). Table 4 examines the price effect in the Shanghai market. We first conduct a regression of BHR and CAR on the Connect dummy without other control variables. In Columns (1) and (3) of Panel A, the coefficients on Connect are 1.149 and 9.450 for AD and POST, respectively, measured by BHR, and are all significantly positive at the 1% level. We also find a positive and statistically significant coefficient on Connect for CAR in Panel B, 1.037 and 8.601 for AD and POST.

Next, we control for various firm characteristics and add firm fixed effects in the regression. The coefficients on the Connect dummy remain statistically significant. In Columns (2) and (4) of panel A, the BHR Connect coefficients become smaller at 0.575 and 3.656 for AD and POST. As reported in Panel B, the coefficients on Connect for CAR decrease to 0.347 and 2.049 and are statistically significant at the 10% level. The price appreciation is not eliminated by the inclusion of the control variables.

Table 5 reports the regression results in the Hong Kong market. Similar to the finding in the Shanghai market, the coefficients on Connect are significantly positive and the results are robust to the inclusion of controls. On average, a connected stock experiences a 1.083% increase in BHR and 0.869% growth in CAR on the announcement day. During the POST period, BHR raises to 4.275%, and CAR increases to 5.619%.

These findings suggest that after controlling for various firm characteristics, connected stocks still experience significantly higher returns than unconnected stocks in both markets. The price revaluation in these two markets is significant.

In conclusion, we indicate that in both the univariate and regression analyses, connected stocks experience significant price appreciation compared with unconnected stocks on the announcement day and during the POST period. The price appreciation is approximately 0.58% on the announcement day and 3.66% during the POST period in the Shanghai market. In the Hong Kong market, the price appreciation is even higher with 1.3% on the announcement day and 4.0% during the POST period. The SHSC program has a bigger influence on returns in the Hong Kong market.

5 Difference-in-differences analysis of returns

To eliminate the effect of endogeneity, we employ a difference-in-differences model for our analysis. We use BHR as the proxy of price change. ΔBHR estimates the difference in buy and hold returns between the post-event and pre-event periods, and the dummy variable Connect measures the difference in BHR between connected stocks and unconnected stocks. We conduct the following regression:

$$\Delta\mathrm{BHR}_i = \alpha_0 + \alpha_1 \times \mathrm{Connect}_i + X_i \times \beta_i + \varepsilon_i \quad (6)$$

where $\Delta\mathrm{BHR}_i$ is the difference in the return volatility of firm i between the month after the announcement day and the most recent month before the program. Control variables are defined in Table A1 of the Appendix.

Table 6. Regression analysis of change in buy and hold returns.

	(1)	(2)	(3)	(4)
	ΔBHR			
	Shanghai market		Hong Kong market	
Connect	9.917***	4.020***	6.522***	7.585***
	(7.515)	(2.760)	(3.917)	(3.227)
Turnover		−1.435***		−8.361***
		(−3.982)		(−6.131)
Amihud		−0.027***		−0.000
		(−5.967)		(−0.016)
Logsize		2.736***		−0.795
		(3.718)		(−1.366)
ROA		−0.101		0.120
		(−0.568)		(1.474)
Leverage		−0.197		0.014
		(−0.608)		(1.566)
Industry fixed effects	NO	YES	NO	YES
Constant	3.079***	−48.269***	−4.665***	10.576
	(2.960)	(−2.859)	(−5.662)	(0.823)
N	758	758	923	923
adj. R^2	0.068	0.264	0.015	0.081

[Note] T-statistics are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

The results are reported in Table 6. In Columns (1) and (3), we conduct the regression of ΔBHR on the Connect dummy without any controls. The coefficients of the Connect dummy are 9.917 with a t-statistic of 7.515 in the Shanghai market and 6.522 with a t-statistic of 3.917 in the Hong Kong market, both are significant at the 1% level. After controlling for various firm characteristics in the regression, as shown in Columns (2) and (4), the coefficients are still positive and significant in these markets. The results indicate that, after eliminating the endogeneity effect, connected firms still experience higher price impact.

6 Effect on turnover

Turnover reflects the frequency of trading. High turnover suggests the activity of arbitragers. Thus, equity prices could be more efficiently priced. We analyze the effect of the SHSC program on turnover through a regression analysis of the change in turnover on the Connect dummy:

$$\Delta\text{Turnover}_i = \alpha_0 + \alpha_1 \times \text{Connect}_i + X_i \times \beta_i + \varepsilon_i \quad (7)$$

where $\Delta\text{Turnover}_i$ is the difference in the return volatility of firm i between the month after the announcement day and the most recent month before the program. All other variables are defined in the Appendix.

We present the results in Table 7. In Columns (1) and (3), without any controls, the coefficients on Connect are economically significant at 1% level, with magnitudes of 0.441 and 0.154 in the Shanghai and Hong Kong markets respectively. After the inclusion of various controls, reported in Columns (2) and (4), the coefficients remain significant. In the Shanghai market, connected stocks have a 45.3% higher turnover. The increase of turnover is smaller in the Hong Kong market with 21.3% after the program. These results support that the SHSC program enhances the average daily turnover of connected stocks in both markets. It reflects listed stocks are traded more frequently after the SHSC program. Moreover, turnover measures the liquidity of stocks to some extent, higher turnover indicates the enhancement of liquidity. We will further discuss the correlation between liquidity and returns in Section 8.

Table 7. Regression analysis of change in turnover.

	(1)	(2)	(3)	(4)
	ΔTurnover			
	Shanghai market		Hong Kong market	
Connect	0.441***	0.453***	0.154***	0.213***
	(3.964)	(3.398)	(3.413)	(3.578)
Turnover		−0.174***		−0.454***
		(−5.273)		(−13.106)
Amihud		−0.001*		−0.000
		(−1.663)		(−1.223)
Logsize		−0.180***		−0.036**
		(−2.679)		(−2.468)
ROA		−0.026		−0.003
		(−1.622)		(−1.360)
Leverage		0.045		−0.000
		(1.519)		(−1.122)
Industry fixed effects	NO	YES	NO	YES
Constant	0.376***	5.220***	0.028	0.912***
	(4.290)	(3.381)	(1.238)	(2.797)
N	758	758	923	923
adj. R^2	0.019	0.089	0.011	0.196

[Note] T-statistics are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

7 Effect on return volatility

The introduction of investors from other markets brings higher turnover and liquidity, meanwhile, new investors joining in the trading of stocks may lead the stocks to be more volatile. Investors may demand a price premium for volatility risk. Therefore, the price change may be positively related to return volatility.

We first analyze whether the program improves volatility by the following regression:

$$\Delta\text{Volatility}_i = \alpha_0 + \alpha_1 \times \text{Connect}_i + X_i \times \beta_i + \varepsilon_i \quad (8)$$

where $\Delta\text{Volatility}_i$ is the difference in the return volatility of firm i between the month after the announcement day and the most recent month before the program. Following Chen[8], return volatility is measured as the standard deviation of daily stock returns.

We report the regression results in Table 8. In the Shanghai market, the coefficient on the Connect dummy is 0.294 with a t-statistic of 4.421 for the specification without controls and 0.131 with a t-statistic of 1.753 after controlling for various firm characteristics. While, in the Hong Kong market, the results are not significant without controls. After including various firm characteristics and adding firm fixed effects in the regression, as reported in Column (2), the Connect coefficient is significant at 1% level with the magnitude of 0.632. The empirical evidence support that after the program is announced, connected stocks experience higher volatility relative to unconnected stocks.

To further investigate the relation between price and volatility, we conduct the following regression:

$$\Delta\text{BHR}_i = \alpha_0 + \alpha_1 \times \text{Connect}_i + \alpha_2 \times \Delta\text{Volatility}_i + X_i \times \beta_i + \varepsilon_i \quad (9)$$

where ΔBHR and ΔVolatility are defined in the same way as in regression model (6) and (8), respectively. The specific definitions of the control variables are in Table A1 of the Appendix.

Table 8. Regression analysis of change in return volatility.

	(1)	(2)	(3)	(4)
	ΔVolatility			
	Shanghai market		Hong Kong market	
Connect	0.294***	0.131*	0.265	0.632***
	(4.421)	(1.753)	(1.595)	(2.700)
Turnover		−0.144***		−0.991***
		(−7.829)		(−7.293)
Amihud		−0.001***		−0.000*
		(−3.485)		(−1.755)
Logsize		0.033		−0.157***
		(0.871)		(−2.709)
ROA		−0.018*		−0.017**
		(−1.918)		(−2.058)
Leverage		0.001		−0.001
		(0.079)		(−0.694)
Industry fixed effects		YES		YES
Constant	0.129**	−0.129	0.386***	3.794***
	(2.469)	(−0.149)	(4.686)	(2.965)
N	758	758	923	923
adj. R^2	0.024	0.203	0.002	0.074

[Note] T-statistics are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 9. The relationship between volatility and price.

	(1)	(2)
	ΔBHR	
	Shanghai market	Hong Kong market
Connect	2.819**	5.111**
	(2.187)	(2.350)
Δ Volatility	9.182***	3.913***
	(14.441)	(12.728)
Turnover	−0.108	−4.483***
	(−0.326)	(−3.468)
Amihud	−0.019***	0.001
	(−4.861)	(0.724)
Logsize	2.435***	−0.180
	(3.744)	(−0.335)
ROA	0.060	0.185**
	(0.377)	(2.464)
Leverage	−0.209	0.016**
	(−0.730)	(1.993)
Industry fixed effects	YES	YES
Constant	−47.084***	−4.270
	(−3.158)	(−0.359)
N	758	923
adj. R^2	0.426	0.220

[Note] T-statistics are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 9 reports the results of the above regression model. In the Shanghai market, the coefficient on ΔVolatility is 9.182 with a t-statistic of 14.441, which is significant at the 1% level, suggesting the positive relationship between the price and the volatility. Comparing the results in Table 6, the coefficient of the Connect dummy declines from 4.020 to 2.81, the t-statistics decrease from 2.760 to 2.187, and the significance also drops from the 1% level to the 5% level. These findings indicate that the volatility change helps to explain the return difference between connected stocks and unconnected stocks. Investors demand a price premium for volatility risk.

In the Hong Kong market, similar to the findings in the Shanghai market, the coefficient on ΔVolatility is significantly positive. As we expected, the coefficient on the Connect dummy declines from 7.585 to 5.111 companying with a decrease in significance from the 1% level to the 5% level.

In sum, after the program, relative to unconnected stocks, connected stocks experience higher volatility, and the price is positively related to the volatility in both markets. The difference in returns can be partly explained by volatility①.

8 Liquidity test

We discover that the SHSC program brings higher turnover in Section 6, which also reflects the improvement of liquidity. According to Bekaert and Harvey[9], the participation of new investors could reduce the cost of capital by providing more liquidity. Therefore, the return change caused by liberalization could be related to liquidity. We examine the relationship between return and liquidity by the following regression:

$$\Delta BHR_i = \alpha_0 + \alpha_1 \times Connect_i + \alpha_2 \times \Delta Amihud_i + X_i \times \beta_i + \varepsilon_i \quad (10)$$

where ΔAmihud is the average daily Amihud's illiquidity measure in the month after the announcement day divided by that in the most recent month before the program, then minus one. All other variables are defined in Table A1 of the Appendix.

Columns (1) and (3) in Table 10 report the results in the Shanghai and Hong Kong markets, respectively. In both markets, liquidity does not appear to be related to returns as the coefficient of ΔAmihud is not significant. As we expect, the coefficient is negative as liquidity improvement may reduce cost, which would drive the price to change positively. Note that the coefficient of the Connect dummy does not change much compared to Table 6. This may implicate that liquidity cannot explain the difference in returns between connected stocks and unconnected stocks.

In addition, higher volatility is likely associated with a compensation for providing more liquidity. For instance, Vayanos[25] propose a dynamic equilibrium model which proves the preference for liquidity is increasing with volatility. We then add ΔVolatility into the regression (10). The results are similar to those in Table 9. In both markets, the significance and explanatory power of the ΔVolatility variable remain the same. After adding ΔAmihud as a control variable, the results still hold. Overall, the significant relationship between volatility and price is unlikely to be spuriously driven by their positive correlation with liquidity.

① We also test the risk-sharing mechanism following Chan and Kwok[11]. Shown in Table A2, the risk-sharing mechanism is not significant. Risk-sharing can not explain the price revaluation .

Table 10. Liquidity test.

	(1)	(2)	(3)	(4)
	ΔBHR			
	Shanghai market		Hong Kong market	
Connect	3.947***	2.805**	7.356***	5.104**
	(2.706)	(2.172)	(3.140)	(2.340)
Δ Volatility		9.174***		3.958***
		(0.637)		(12.105)
Δ Amihud	−0.037	−0.007	−0.360	0.027
	(−0.921)	(−0.208)	(−0.633)	(0.052)
Turnover	−1.440***	−0.110	−8.147***	−4.461***
	(−3.997)	(−0.332)	(−5.993)	(−3.437)
Amihud	−0.027***	−0.019***	−0.000	0.001
	(−5.966)	(−4.859)	(−0.021)	(0.728)
Logsize	2.700***	2.428***	−0.729	−0.181
	(3.662)	(3.726)	(−1.260)	(−0.335)
ROA	−0.098	0.060	0.119	0.186**
	(−0.549)	(0.381)	(1.468)	(2.472)
Leverage	−0.189	−0.208	0.013	0.016**
	(−0.583)	(−0.724)	−0.360	0.027
Industry fixed effects	YES	YES	YES	YES
Constant	−47.488***	−46.929***	9.151	−4.275
	(−2.808)	(−3.141)	(0.716)	(−0.359)
N	758	758	922①	922
adj. R^2	0.264	0.425	0.082	0.209

[Note] T-statistics are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

9 Heterogeneity of trading behavior in different markets

In Section 7, we find the SHSC program improves the volatility of listed stocks and investors demand a price premium for volatility risk. The SHSC program connects the Shanghai market and Hong Kong market which suggests the volatility risk in the local market could be affected by other side's markets. Moreover, the composition of investors in the Shanghai and Hong Kong markets is different. According to annual reports from the Shanghai Stock Exchange and Hong Kong Exchange and Clearing Limited, only 11.6% of the total trading volume is attributed to institutional investors in the Shanghai market, while individual investors contribute 85.19% annually. In the Hong Kong market, approximately 58% of the total trading volume is attributed to institutional investors, while individual investors contribute only 25%②. The data reveals that the main participants in the Hong Kong market are more professional and rational than those in the Shanghai market. Therefore, we assume that after the SHSC program, the composition of investors' trading may change. And the heterogeneity of trading behavior could have different impacts on the volatility of connected stocks and unconnected stocks. To capture this difference, we conduct the following regression:

$$\Delta\text{Volatility}_i = \alpha_0 + \alpha_1 \times \text{Connect}_i + \alpha_2 \times \Delta\text{Vol}_i + \alpha_3 \times \text{Connect}_i \times \Delta\text{Vol}_i + X_i \times \beta_i + \varepsilon_i \quad (11)$$

where $\Delta\text{Volatility}_i$ is the difference in return volatility of firm i between the month after the announcement day and the most recent month before the program. ΔVol is the average trading volume in the month after the announcement day scaled by that in the month before the program, then minus one. All other variables are defined in the Appendix.

① We omit one company. This company maintained a zero return during the event but it was trading normally. When calculating Amihud's illiquidity ratio, it results in a dividend of zero, so we omit it.

② Annual report of Shanghai market: http://www.sse.com.cn/aboutus/publication/yearly/. Hong Kong market: https://www.hkex.com.hk/Market-Data/Statistics/Consolidated-Reports/HKEX-Fact-Book?sc_lang=zh-hk.

Table 11. Heterogeneity of trading behavior in different markets.

	(1)	(2)	(3)	(4)
	ΔVolatility			
	Shanghai market		Hong Kong market	
Connect	0.128**	0.206***	−0.014	0.172
	(2.360)	(3.368)	(−0.079)	(0.752)
Δ Vol	0.955***	0.918***	0.229***	0.221***
	(16.254)	(15.284)	(17.047)	(16.814)
Connect×ΔVol	−0.256***	−0.234***	0.526***	0.456***
	(−3.827)	(−3.348)	(3.271)	(2.892)
Turnover		−0.045***		−0.799***
		(−3.000)		(−6.752)
Amihud		−0.001***		−0.000*
		(−2.993)		(−1.949)
Logsize		−0.091***		−0.084*
		(−3.020)		(−1.658)
ROA		−0.008		−0.015**
		(−1.155)		(−2.106)
Leverage		−0.017		−0.001
		(−1.292)		(−1.159)
Industry fixed effects	NO	YES	NO	YES
Constant	−0.145***	1.997***	0.211***	2.139*
	(−3.537)	(2.901)	(2.930)	(1.920)
N	758	758	923	923
adj. R^2	0.506	0.526	0.254	0.304

[Note] T-statistics are reported in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

The regression results are reported in Table 11. The key variable is the interaction term Connect×ΔVol. In the Shanghai market, without any controls, the coefficient is significantly negative, −0.256 with a t-statistic of −3.827. After controlling for various firm characteristics in the regression, reported in Column 2, the results remain significant, suggesting that relative to unconnected stocks, the volatility of connected stocks in Shanghai market is less sensitive to the trading volume. After the SHSC program, the composition of investors trading of connected stocks in Shanghai market changes, and the participation of Hong Kong market investors helps reduce the volatility of connected stocks.

However, in the Hong Kong market, without the controls, as reported in Column 3,the coefficient of the interaction term is positive and significant at the 1% level, 0.526 with a t-statistic of 3.271. The results still hold after the inclusion of controls. These findings indicate that the volatility of connected stocks in Hong Kong is more vulnerable to the trading volume. After the SHSC program, the participation of Shanghai market investors increases the volatility of connected stocks. The SHSC program causes the risk spillover between these two markets.

10 Conclusions

In this paper, we find that after the Shanghai-Hong Kong Stock Connect program is announced, connected stocks experience a higher price impact than unconnected stocks. The price impact is permanent and increases dramatically on the announcement day. Although there is a short reversal after the effective day, which does not exist over a longer window.

Connected stocks also have a higher turnover and volatility after the program. Furthermore, the volatility is positively related to the price change and could partly explain the difference in returns between connected stocks and unconnected stocks. These findings prove that investors demand a price premium for volatility risks. We also examine the liquidity hypothesis. But liquidity is not related to returns, suggesting that liquidity improvement is not the reason for the price change under the SHSC program.

The heterogeneity of trading behavior among investors has different impacts on volatility. In the Shanghai market, the participation of Hong Kong investors helps reduce the volatility of connected stocks, while in the Hong Kong market, the participation of Shanghai investors increases the volatility. The

participation of more professional institutional investors helps reduce the volatility, while the participation of irrational individual investors enlarges it.

The Shanghai-Hong Kong Stock Connect program allows listed stocks to be traded on two different markets which attract new investors from other markets. Under the program, the revaluation of stocks helps discover the intrinsic worth of the company, and the liquidity of stocks improved which reduces the transaction cost. Moreover, the heterogeneity of trading behavior among investors has different impacts on volatility indicates risk spillover between Shanghai and Hong Kong markets. The enforcement of the program improves the degree of globalization in Chinese markets and enhances the market efficiency in China.

According to the conclusion in this paper, we give the following suggestions. First, the Shanghai-Hong Kong Stock Connect program brings huge price appreciation to connected stocks. However, the volatility raises simultaneously. The volatility risk behind the profit should be informed to all investors to suppress speculative trading. Second, the SHSC program introduces new investors to each market. The cross-market variation in volatility is consistent with the heterogeneity of investors' trading behavior. The specific trading data of investors from other markets should be published, and their trading activity should be carefully supervised by the local government.

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Conflict of interest

The authors declare no conflict of interest.

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沪港通对中国市场效率的影响

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摘要:研究了沪港通对中国市场效率的影响. 应用双重差分模型,我们发现连通公司在公告后的 20 d 内价格增加约 4%,并且成交量、流动性和波动性显著增加. 我们的研究表明投资者对波动风险要求溢价. 此外,在上海市场,香港投资者的参与有助于降低连通股票的波动性,而在香港市场,上海投资者的参与增加了连通股票的波动性. 这种跨市场的差异与投资者交易行为在不同市场上的异质性是一致的. 这表明两个市场之间存在风险溢出效应. 价格重估和风险溢出表明,沪港通的实施提高了中国市场的效率.

关键词:沪港通;股票回报;股票波动;投资者异质性

Appendix

Table A1. Definition of variables

Logsize	Natural logarithm of the market capitalization on November 7, 2014.
Volatility	Stock return volatility, defined as the standard deviation of daily stock returns in the past one month.
Turnover	Average daily turnover over the past one month.
Amihud	Amihud's illiquidity measure[24], calculated by the absolute value of stock returns scaled by volume. We adjust the variable by multiplying by 10^8.
ROA	Return-on-assets in the most recent interim financial reporting, defined as net income divided by total assets.
Leverage	Financial leverage in the most recent interim financial reporting, defined as total liabilities divided by total assets.
BHR	Buy and hold returns, calculated from the geometrically compounded return on the stock.
CAR	Cumulative abnormal returns based on the market model. Aone-year pre-event window is used to estimate the market coefficients.
ΔBHR	The change in the buy and hold returns from the most recent month to the month after the announcement day.
ΔTurnover	Average daily turnover in one month after the announcement day minus that in the most recent month before the program.
ΔVolatility	Average daily volatility in one month after the announcement day minus that in the most recent month before the program.
ΔAmihud	Average daily Amihud's illiquidity measure in the month after the announcement day divided by that in the most recent month before the program, then minus one.
ΔVol	Average daily trading volume in one month after the announcement day divided by that in the most recent month before the program, then minus one.

Table A2. Regression analyse on risk-sharing.

	(1)	(2)
	ΔlnPrice	
	Shanghai market	Hong Kong market
Connect	0.000(1.142)	0.001(1.578)
Difcov	0.047(1.171)	0.011(0.454)
Connect × Difcov	0.095*(1.818)	−0.105(−1.371)
Turnover	0.000(1.036)	−0.001***(−6.273)
Amihud	−0.000**(−2.056)	0.000(0.874)
Logsize	0.001***(7.724)	0.000(1.117)
ROA	−0.000(−0.848)	0.000(0.077)
Leverage	−0.000*(−1.866)	0.000(0.239)
Industry fixed effect	YES	YES
Constant	−0.017***(−7.046)	−0.004**(−2.339)
N	758	923
adj. R^2	0.375	0.162

[Note] This table reports the regression analysis on risk-sharing following the method of Chan and Kwok[11]. ΔlnPrice is the averagedaily log return after the SHSC program. Difcov presents the difference of stock return's covariance with local market return minus its covariance with other market returns. Fllowing Chan and Kwok[11], stock's log return is used to compute Difcov. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

(Continued from p. 670)

在不同流动控制下欧洲 COVID-19 疫情的传播率

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摘要:在 2020 年,COVID-19 疫情引起全世界的关注,政府宣布了一系列非药物干预措施去遏制社会活动对传播的影响.各国不同力度的政策带来了相异的结果.为了评估这些行动的有效性,量化移动效应成为了关键问题.改变人群活动后,传播率是变化的且难以计算这种变化.因此,本文以一些欧洲国家为研究对象,收集各个国家在一些时期的人群移动情况以及每日的新增数据,并提出了流动-易感-暴露-感染-恢复(M-SEIR)模型。与 SEIR 模型不同,M-SEIR 模型中加入了一个量化控制措施影响的变量 $\sigma(t)$.采用随机抽样得到初始不同状态的人群数,对模型进行迭代.使用迭代-集成卡尔曼滤波技术(IF-EAKF)对后续的迭代结果进行调整,最后得到参数的变化趋势以及每日新增的估计值.在拟合部分,设置第一轮爆发为实验期,重复 100 次.它的拟合结果证实了模型的可行性和稳健性.此外,这项研究对受第二轮大流行影响的欧洲国家做出了合理的预测.通过调控政策的力度以及生效时间点,本文预测了非药物措施对流行病的影响,这为未来相关政策的部署提供了参考.最后,剔除人群移动、气温等外部因素后,研究得到了一个有趣的发现:尽管第三轮的每日报告远高于第一轮,但是第三轮的病毒传播参数要低于第一轮,进一步考察发现该下降与疫苗接种相关.

关键词:M-SEIR 模型;移动性;接触矩阵;传播率