Co-integrated or not? After the Shanghai-Hong Kong and Shenzhen-Hong Kong Stock Connection Schemes

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Abstract

This paper examines stock market comovements between China and Hong Kong. The integration test results confirm that a substantial number of A-share and H-share stocks began to co-integrate after the launch of the Shanghai-Hong Kong Stock Connection Scheme[1] and the Shenzhen-Hong Kong Stock Connection Scheme[2], which demonstrates the effects of the two schemes in promoting financial integration and cross-border capital flows.

Keywords: cointegration, A&H shares

1. Introduction

The landscape of the A-share stock market has changed tremendously since it was established in 1991. As of September 2017, there were 1342 and 2044

[1] Shanghai-Hong Kong Stock Connection Scheme is an investment scheme that connects the Shanghai Stock Exchange and the Stock Exchange of Hong Kong.

[2] Shenzhen-Hong Kong Stock Connection Scheme is an investment scheme that connects the Shenzhen Stock Exchange and the Stock Exchange of Hong Kong.

companies listed on the Shanghai Stock Exchange and Shenzhen Stock Exchange respectively, with a market capitalization of 32.97 trillion and 24.15 trillion RMB - 5211 times the market capitalization in 1991. Rapid growth in the domestic market has exposed the demand for greater financial openness. Compared with developed capital markets, the Chinese stock exchanges still have significant room for capital internationalization and cross-border investment. A close channel and adjacent offshore capital center is the Hong Kong market. Indeed, an ensemble of companies choose an equity structure comprised of A- and H-shares. As of July 2015, 190 companies have issued both A- and H-shares, according to the China Securities Regulatory Commission (CSRC).

A number of researchers have examined the co-movement of A- and H-shares. Among them, Su et al. (2007), Chong and Su (2006) investigated the existence of co-movements between A- and H- shares after the launch of the Qualified Foreign Institutional Investors (QFII) scheme and the Closer Economic Partnership Arrangement (CEPA), implemented respectively on June 27, 2003 and January 1, 2004. They found that stocks became more cointegrated after the QFII and CEPA were implemented. In recent years, as the two economies found it necessary to further expand the market, the Shanghai-Hong Kong Stock Connect Scheme and Shenzhen-Hong Kong Stock Connect Scheme were launched respectively on November 17, 2014 and December 5, 2016. The two schemes allow the flow of northbound and southbound investment, within a quota, between the mainland stock exchanges and the Stock Exchange of Hong Kong(SEHK). This paper investigates the effects of these two schemes on A- and H-stocks; as discussed below, we find them to have become more integrated over time.

The investigation of common stochastic trends in stock markets in the literature plays an important role in both academic study and practical use. Our paper contributes to the literature in several ways. Firstly, the Efficient Market Hypothesis in Fama (1970) implies that no arbitrage of stocks from the same company can occur between stock markets. Thus the cointegration results prove that there are little long-run gains from portfolio diversification in cointegrated markets. Secondly, the market unification implied from the cointegration between A- and H- share markets with the implementation of the two schemes demonstrates the rapid development of the mainland capital

market from perspectives of the scale as well as openness. Thirdly, as the Shenzhen-Hong Kong stock connect scheme is launched within one year, it is a first work to test the effects of the stock connect schemes on the two markets' co-integration.

The structure of the paper is as follows. In Section 2, we describe the data in use, the model to test and the results observed; in Section 3, a conclusion is made.

2. Data and Model Interpretation

The daily adjusted closing prices of A-shares, H-shares, the Shanghai A- share Index (SHA) and the Hong Kong Hang Seng Index (HSI) from November 30, 2012 to September 8, 2017 were collected from the Yahoo Finance. We convert the H-share prices to Chinese RMB prices with the daily exchange rate presented by the Pacific Exchange Rate Service, Sauder School of Business, University of British Columbia. Of the 190 companies that have issued A- and H- shares as of July 2015, 32 companies with 64 stocks have complete data prices during the sampling period. Tables 1 and 2 list their names, stock codes, and IPO dates in the Hong Kong and Mainland China markets. Since stock markets in mainland China and Hong Kong have different calendars, we keep both trading prices available.

The tests are carried out in several steps. First, we perform the Augmented Dickey-Fuller test for the unit root, since it is the pre-requisite for the cointegration test. Secondly, we use Johansen (1988)'s method to test for cointegration. We repeat the tests for two samples. The first sample covers all days from Nov 30, 2012 to September 8, 2017. The second sample is from November 18, 2014 , the launch day of the Shanghai-Hong Kong Stock Connect Scheme, to September 8, 2017, the end of the sample. This period covers the launches of both the Shanghai-Hong Kong and Shenzhen-Hong Kong stock connection schemes.

We test for the presence of unit root on the daily prices of the A- and H- shares of each firm and the log of HSI and SHA, using the Augmented Dickey-Fuller

test. The model with a drift and trend term is

$$P_t = c_0 + c_1 t + \gamma_c P_{t-1} + \sum_{i=1}^{p} \phi_i \triangle P_{t-i} + e_t, \tag{1}$$

with the null hypothesis $\gamma_c = 1$ or

$$\triangle P_t = c_0 + c_1 t + \gamma P_{t-1} + \sum_{i=1}^{p} \phi_i \triangle P_{t-i} + e_t, \tag{2}$$

with the null hypothesis $\gamma = 0$, after Tsay (2010). If the null hypothesis holds, then the time series contains a unit root. The critical value at the 0.05 significance level is -3.4145. The test results in Tables 3 and 4 contain statistics for the Augmented Dickey-Fuller tests, and show that only stock codes 0177.HK and 600377.SS do not contain a unit root. All other stocks have unit roots. The Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) give the autoregressive order. The Breusch-Godfrey Lagrange Multiplier tests confirm the model selected.

For firms that satisfy the unit root test, we perform the Johansen (1988) cointegration test for each firm's stocks. For each firm, we consider four time series x_t, namely $(P_t^H, P_t^A, P_t^{HSI}, P_t^{SHA})$. The model is written as

$$\triangle x_t = \sum_{i=1}^{p-1} \Gamma_i \triangle x_{t-i} + \Pi x_{t-p} + \varepsilon_t, \tag{3}$$

where $\triangle$ is the first-difference lag operator, Γ_i and Π are $(n \times n)$ matrices, ε_t is an n-dimensional white noise vector with a zero mean. The null hypothesis is that the number of cointegrating vectors is at most r, which is the rank of the matrix Π, which is $H_0 : r \leq j - 1$ against $H_1 : r \geq j$ for $j = 1, 2, 3$ for trace test. For the maximal eigenvalue test, the hypothesis is $H_0 : r \leq j - 1$ against $H_1 : r = j$. The test statistics are $\lambda_{trace}(r)$ and $\lambda_{max}(r)$, which are calculated as

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i), \tag{4}$$

and

$$\lambda_{max}(r) = -T \ln(1 - \hat{\lambda}_r), \tag{5}$$

with T being the number of observations and $\hat{\lambda}_i$ being the estimated eigenvalue obtained from the Π matrix. The price series are cointegrated if the null hypothesis is rejected.

The test results for $j = 1$ and 2 are listed in Tables 5 and 6. The critical value for $\lambda_{trace}(0)$ and $\lambda_{max}(0)$ at the 10% level are 37.0354 and 21.8370. The critical value for $\lambda_{trace}(1)$ and $\lambda_{max}(1)$ at the 10% level are 21.7774 and 15.7178. The two schemes allow the northbound and southbound cross border investment. From the maximal eigenvalue/trace statistics for $r = 0$, there are 21/22 cointegrated companies in the second sample period, when the two stock connect schemes were launched, and 18 cointegrated companies over the whole sample period. This demonstrates that cointegration was a more frequent phenomenon after the two stock connection schemes were launched.

We also use Gregory and Hansen (1996)'s method to test if the break date has occurred after Shanghai-Hong Kong and Shenzhen-Hong Kong Stock Connection Schemes were launched. There are 22 companies among the total 32 companies whose break dates are after the Shanghai-Hong Kong Stock Connection Scheme launched. The detected break dates for these companies are reported in Table 7. It further supports that the two stock connection schemes promote the co-integration of the two markets.

Table 1: The A- and H- share companies examined

Code	Company name	China exchange	IPO in China	IPO in HK
323.HK	MaanshanIron	SSE	1994/1/6	1993/11/3
600808.SS				
300.HK	ShenjiGrpkunm	SSE	1994/1/3	1993/12/7
600806.SS				
1065.HK	TianjinCapEnv	SSE	1995/6/30	1994/5/17
600874.SS				
525.HK	GuangshenRailwayCo.Ltd	SSE	2006/12/22	1996/5/14
601333.SS				
995.HK	AnhuiExpressway	SSE	2003/1/7	1996/11/13
600012.SS				
670.HK	CNEasternAir	SSE	1997/11/5	1997/2/5
600115.SS				
548.HK	ShenzhenExp	SSE	2001/12/25	1997/3/12
600548.SS				
991.HK	DatangIntlPwr	SSE	2006/12/20	1997/3/21
601991.SS				
358.HK	JiangxiCopper	SSE	2002/1/11	1997/6/12
600362.SS				
177.HK	JiangsuExpress	SSE	2001/1/16	1997/6/27
600377.SS				
107.HK	SichuanExpress	SSE	2009/7/27	1997/10/7
601107.SS				
1071.HK	HuadianPower	SSE	2005/2/3	1999/6/30
600027.SS				
857.HK	Petrochina	SSE	2007/11/5	2000/4/7
601857.SS				
386.HK	CNPetroChem	SSE	2001/8/8	2000/10/19
600028.SS				
2883.HK	ChinaOilfield	SSE	2007/9/28	2002/11/20
601808.SS				
2333.HK	GrtWallMotor	SSE	2011/9/28	2003/12/15
601633.SS				
2338.HK	WeichaiPower	SZE	2007/4/30	2004/3/11
000338.SZ				
753.HK	AirChina	SSE	2006/8/18	2004/12/15
601111.SS				

Table 2: The A- and H- share companies examined

Code	Company name	China exchange	IPO in China	IPO in HK
939.HK	ChinaConstrctBk	SSE	2007/9/25	2005/10/27
601939.SS				
3968.HK	ChinaMerchtBk	SSE	2002/4/9	2006/9/22
600036.SS				
1398.HK	ICBC	SSE	2006/10/27	2006/10/27
601398.SS				
1800.HK	ChinaCommunicationsConstruction	SSE	2012/3/9	2006/12/15
601800.SS				
3993.HK	ChinaMolybdenum	SSE	2012/10/9	2007/4/26
603993.SS				
998.HK	ChinaciticBank	SSE	2007/4/27	2007/4/27
601998.SS				
2009.HK	BBMG	SSE	2011/3/1	2009/7/29
601992.SS				
1988.HK	CNMinshengBank	SSE	2000/12/19	2009/11/26
600016.SS				
2601.HK	ChinaPacific	SSE	2007/12/25	2009/12/23
601601.SS				
1288.HK	AgriculBkChina	SSE	2010/7/15	2010/7/16
601288.SS				
2208.HK	XinjiangGoldwind	SZE	2007/12/26	2010/10/8
002202.SZ				
1057.HK	ZhjShibaoCo	SZE	2012/11/2	2006/5/16
002703.SZ				
2607.HK	ShanghaiPharma	SSE	1994/3/24	2011/5/20
601607.SS				
6030.HK	CITICSecurities	SSE	2003/1/6	2011/10/6
600030.SS				
6837.HK	HAITONGSecuritiesCompany	SSE	1994/2/24	2012/4/27
600837.SS				

Table 3: Unit Root test on A- share and H- share prices

	Lag (AIC)	Lag (BIC)	Godfrey test(AIC)	Godfrey test(BIC)	ADF H_0: Unit root
0323.HK	1	1	0.0050	0.0050	-1.2295
600808.SS	10	4	0.1651	0.0087	-1.7934
1065.HK	3	2	0.2115	0.0859	-2.8060
600874.SS	9	4	0.6677	0.0690	-2.9835
0525.HK	3	1	0.0143	0.0078	-2.8345
601333.SS	9	6	0.4066	0.1226	-2.8884
0995.HK	10	1	0.5101	0.0121	-2.6914
600012.SS	8	2	0.4510	0.0197	-3.3205
0670.HK	1	1	0.0183	0.0183	-2.3586
600115.SS	9	6	0.2618	0.0736	-2.1948
0548.HK	10	1	0.6422	0.0167	-2.8516
600548.SS	10	10	0.9009	0.9009	-2.2465
0991.HK	1	1	0.0132	0.0132	-2.4731
601991.SS	9	6	0.2632	0.1085	-2.0362
0358.HK	3	3	0.5553	0.5553	-2.1726
600362.SS	9	1	0.0489	0.0092	-2.8565
0177.HK	7	2	0.1819	0.0202	-3.6329
600377.SS	9	3	0.5895	0.0277	-3.9160
0107.HK	4	2	0.0043	0.0034	-2.9026
601107.SS	5	1	0.0231	0.0052	-2.7708
1071.HK	3	3	0.0149	0.0149	-1.3380
600027.SS	8	7	0.0861	0.0529	-1.4642
0857.HK	7	1	0.2114	0.0319	-2.2862
601857.SS	8	6	0.0080	0.0074	-1.8534
0386.HK	3	1	0.0347	0.0188	-2.3401
600028.SS	8	5	0.1671	0.0323	-2.3533
2883.HK	1	1	0.0228	0.0228	-2.2615
601808.SS	6	3	0.0221	0.0358	-2.4010
2333.HK	1	1	0.0217	0.0217	-2.2941
601633.SS	3	1	0.2505	0.0426	-2.6141
2338.HK	3	1	0.0757	0.0286	-1.2210
000338.SZ	9	3	0.0179	0.0154	-1.8847
0753.HK	1	1	0.0648	0.0648	-2.3008
601111.SS	10	2	0.1264	0.0113	-1.8774
0939.HK	1	1	0.0140	0.0140	-2.1611
601939.SS	10	6	0.2207	0.0144	-1.9380
3988.HK	2	1	0.0220	0.0118	-2.0814
601988.SS	6	3	0.0608	0.0063	-1.9273

Table 4: Unit Root test on A- share and H- share prices

	Lag (AIC)	Lag (BIC)	Godfrey test(AIC)	Godfrey test(BIC)	ADF H_0: Unit root
3968.HK	7	1	0.9690	0.0525	-1.9185
600036.SS	10	1	5.8466	0.1544	-1.5205
1398.HK	3	1	0.0336	0.0151	-1.9584
601398.SS	9	8	0.5837	0.4196	-1.5909
1800.HK	2	2	0.0099	0.0099	-2.5393
601800.SS	9	1	0.2775	0.0086	-2.4038
3993.HK	7	1	7.7511	1.2613	-0.0705
603993.SS	4	1	0.0095	0.0105	-2.0951
2009.HK	2	1	0.0086	0.0041	-2.9334
601992.SS	9	2	0.1062	0.0528	-2.8993
1988.HK	1	1	0.0290	0.0290	-2.5626
600016.SS	7	1	0.6811	0.0044	-2.6017
2601.HK	5	1	0.0214	0.0089	-2.3918
601601.SS	8	3	0.0234	0.0400	-1.7028
1288.HK	2	1	0.0771	0.0408	-2.2358
601288.SS	10	6	0.2351	0.0240	-2.3018
2208.HK	3	1	0.2380	0.0429	-2.2971
002202.SZ	1	1	0.0242	0.0242	-2.4501
1057.HK	2	2	0.0508	0.0508	-2.3905
002703.SZ	2	2	0.0125	0.0125	-2.5435
2607.HK	10	1	0.3750	0.0119	-2.9647
601607.SS	9	3	0.5801	0.0240	-2.7235
6030.HK	7	1	0.0450	0.0087	-2.3580
600030.SS	10	1	0.2752	0.0073	-2.1653
6837.HK	3	2	0.0026	0.0022	-2.3427
600837.SS	3	3	0.0054	0.0054	-1.6880

Table 5: Johansen cointegration test on A- share and H- share prices

	After the two schemes launch		The whole sample period	
	Trace	Max	Tace	Max
0323.HK				
$r = 0$	29.8850	20.8034	24.8406	18.9097
$r \leq 1$	9.0816	8.0063	5.9309	4.4140
1065.HK				
$r = 0$	32.9046	23.4367	22.3148	12.2932
$r \leq 1$	9.4679	7.3239	10.0216	7.2168
0525.HK				
$r = 0$	48.0147	35.6394	49.5380	36.2452
$r \leq 1$	12.3753	8.6490	13.2928	8.1772
0995.HK				
$r = 0$	56.3753	31.2557	51.6046	36.9981
$r \leq 1$	25.1197	19.4146	14.6065	8.0091
0670.HK				
$r = 0$	71.5948	46.5826	74.5715	44.6567
$r \leq 1$	25.0123	16.0438	29.9147	23.6855
0548.HK				
$r = 0$	31.4486	17.8997	28.1973	18.6914
$r \leq 1$	13.5489	8.9555	9.5059	5.5430
0991.HK				
$r = 0$	52.5707	38.6056	33.0417	20.9578
$r \leq 1$	13.9651	9.4628	12.0838	6.7652
0358.HK				
$r = 0$	45.5209	27.0789	39.9158	27.1664
$r \leq 1$	18.4420	11.9567	12.7494	9.4662
0177.HK				
$r = 0$	65.6672	49.1912	38.0470	25.0680
$r \leq 1$	16.4760	11.3897	12.9789	5.8273
0107.HK				
$r = 0$	66.2949	44.1360	78.3331	60.2588
$r \leq 1$	22.1589	15.1293	18.0743	14.0199
1071.HK				
$r = 0$	71.7248	46.0548	69.9040	54.8499
$r \leq 1$	25.6701	21.0280	15.0540	9.7640
0857.HK				
$r = 0$	44.2773	27.6438	26.6663	15.9081
$r \leq 1$	16.6335	12.1601	10.7582	5.6396
0386.HK				
$r = 0$	26.1764	13.5061	38.6604	25.2758
$r \leq 1$	12.6704	9.0859	13.3846	9.0400
2883.HK				
$r = 0$	75.9664	47.0385	60.7261	50.6069
$r \leq 1$	28.9279	23.1609	10.1192	5.6940
2333.HK				
$r = 0$	69.3217	42.5852	49.7585	23.1709
$r \leq 1$	26.7366	17.1955	26.5876	17.8516
2338.HK				
$r = 0$	26.7096	13.2195	33.7222	20.3669
$r \leq 1$	13.4901	10.3083	13.3554	8.0287

Table 6: Johansen cointegration test on A- share and H- share prices

	After the two schemes launch		The whole sample period	
	Trace	Max	Tace	Max
0753.HK				
$r = 0$	51.0221	37.5232	46.4951	31.1418
$r \leq 1$	13.4989	8.9191	15.3533	11.1009
0939.HK				
$r = 0$	37.3502	23.5029	26.1495	14.8980
$r \leq 1$	13.8473	8.7481	11.2515	7.3160
3988.HK				
$r = 0$	37.1226	20.3860	43.6098	24.2306
$r \leq 1$	16.7366	10.9693	19.3792	15.1354
3968.HK				
$r = 0$	35.1493	23.5170	28.5174	19.3651
$r \leq 1$	11.6323	9.3708	9.1523	6.0360
1398.HK				
$r = 0$	34.3146	20.8604	25.8684	15.1802
$r \leq 1$	13.4542	8.5756	10.6882	6.6092
1800.HK				
$r = 0$	50.4456	33.0576	44.3880	32.4448
$r \leq 1$	17.3881	12.7698	11.9431	9.7293
3993.HK				
$r = 0$	29.4997	15.4186	29.9843	19.0507
$r \leq 1$	14.0811	9.9527	10.9336	8.0695
2009.HK				
$r = 0$	41.4320	24.3074	44.8903	31.2840
$r \leq 1$	17.1246	12.8105	13.6063	9.4631
1988.HK				
$r = 0$	22.9508	11.7236	28.1718	14.6423
$r \leq 1$	11.2273	8.2688	13.5295	9.8365
2601.HK				
$r = 0$	47.9049	25.7653	40.8050	26.3656
$r \leq 1$	22.1396	14.7425	14.4395	11.7419
1288.HK				
$r = 0$	54.0401	39.9302	29.8267	14.7481
$r \leq 1$	14.1099	8.3301	15.0786	10.3508
2208.HK				
$r = 0$	29.4307	13.2134	25.3973	14.3595
$r \leq 1$	16.2173	11.3097	11.0377	6.5662
1057.HK				
$r = 0$	45.0181	23.0109	38.3932	23.3970
$r \leq 1$	22.0072	15.1854	14.9963	11.4489
2607.HK				
$r = 0$	27.5665	16.3788	22.9170	12.6755
$r \leq 1$	11.1877	8.5147	10.2415	5.7526
6030.HK				
$r = 0$	50.3085	30.1783	44.4615	21.8559
$r \leq 1$	20.1302	13.8301	22.6056	15.6293
6837.HK				
$r = 0$	54.8414	26.8421	56.6407	29.6518
$r \leq 1$	27.9993	21.4790	26.9890	20.4937

Table 7: Gregory and Hansen break date test

		Pre-break period		Post-break period	
	Gregory-Hansen	Trace $\lambda_{trace}(0)$	Max $\lambda_{max}(0)$	Trace $\lambda_{trace}(0)$	Max $\lambda_{max}(0)$
Company	break date	H_0: no integration			
323.HK	2015/4/1	55.63	39.26	26.04	15.02
300.HK	2015/4/1	30.74	19.93	32.18	18.23
1065.HK	2015/4/15	46.97	25.11	40.31	28.23
525.HK	2015/4/1	32.51	17.86	48.78	27.51
670.HK	2015/4/1	44.82	30.64	23.69	12.84
991.HK	2015/4/1	47.57	30.90	42.14	22.78
177.HK	2015/4/1	72.99	51.72	61.23	36.92
107.HK	2015/4/20	45.80	26.44	70.07	44.41
1071.HK	2015/4/2	44.95	32.44	42.50	19.22
857.HK	2015/4/23	86.26	58.42	35.63	21.80
386.HK	2015/4/1	40.88	24.65	76.79	45.67
2333.HK	2015/4/13	50.10	29.56	24.70	14.14
753.HK	2015/4/9	29.12	17.41	26.75	14.01
939.HK	2015/4/9	44.87	26.50	34.92	17.13
3968.HK	2015/4/9	47.20	22.16	28.18	13.66
1398.HK	2015/4/9	39.45	26.30	27.56	13.26
3993.HK	2015/4/1	28.08	17.53	26.92	13.06
2009.HK	2014/12/1	30.21	17.23	24.13	14.10
2601.HK	2015/4/9	43.28	20.82	46.84	30.88
2208.HK	2015/4/1	29.79	17.52	39.32	20.67
2607.HK	2015/1/15	48.69	27.26	62.57	33.03
6030.HK	2014/12/4	25.36	13.44	62.05	30.25

3. Conclusion

In contrast to the strict capital controls in mainland China, schemes such as QFII in 2003 and CEPA in 2004 have gradually opened passages for capital to flow across the border. The Shanghai-Hong Kong Stock Connection Scheme, implemented on November 17, 2014, and the Shenzhen-Hong Kong Stock Connection Scheme, implemented on December 5, 2016, are two recent policies designed to facilitate capital flow. This paper has investigated the financial integration between Hong Kong and Chinese stock markets. The Johansen test results show that a large number of A-shares and H-shares have begun to cointegrate after the launch of these two schemes.

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