DO FIRM CHARACTERISTICS AFFECT PRICE DISCOVERY? EVIDENCE FROM CHINESE CROSS-LISTED STOCKS

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Abstract

This study examines the price movement relationship for Chinese firms that cross-list their shares on the Hong Kong Stock Exchange and the Shanghai Stock Exchange or Shenzhen Stock Exchange in mainland China. We estimate the coefficients of adjustment speed between the two markets by conducting a unit root test and apply a vector error correction model for the price series of our 55 sample firms. The majority of the adjustment speeds of the sample firms are statistically significant, implying that the stock prices of companies cross-listed in both markets respond to each other. Our results are in line with the literature on price discovery that the Hong Kong and mainland China financial markets are informationally linked. We regress the coefficients of adjustment speed on a spectrum of firm-specific variables. The cross-sectional regression results indicate that the effective spread that proxies for the liquidity factor partially accounts for the speed of price adjustment. Our study adds to the existing literature on the price discovery process within Chinese stock markets.

Keywords: cross-listed stocks, price discovery, vector error correction model

JEL: G12, G15

1. Introduction

The Chinese economy is the second-largest economy worldwide and is connected to international stock markets through the trend of economic globalization. This study investigates whether the mainland China stock markets command the price movement of the Hong Kong Stock Exchange (HKG) or vice versa. In other words, we aim to determine whether the price discovery process concerning the fundamental value of a firm occurs in the Chinese or Hong Kong stock markets. The efficient market hypothesis asserts that the equilibrium price quickly and accurately incorporates new information. While the literature demonstrates that developed financial markets are mostly efficient, it is vital to examine whether the Chinese stock markets allow the information flow to affect asset prices efficiently.

The fragmentation in China's financial markets offers an excellent platform to test the price discovery process. Investors can purchase shares of a Chinese company traded on the mainland China stock exchanges or the HKG. Under the law of one price, the trading price on the mainland China stock exchanges should be equal to that of the HKG because each share claims the same equity ownership of a Chinese firm. Otherwise, price misalignment between the two markets creates an arbitrage opportunity that cannot persist in the long run.

In theory, the price movement of the mainland China stock exchanges should contribute to that of the HKG and vice versa. Each price series in the two markets should be cointegrated because there should be no large deviation from the equality of the two-price series according to the efficient market hypothesis. To an extreme extent, the price response in one market should occur in the other market instantaneously. We take a further step to investigate whether firm-specific characteristics explain how fast the trading price converges to the equilibrium price, measured by the speed of price adjustment for a Chinese cross-listed stock in the two exchanges.

We perform a unit root test of the price series of Chinese companies that list in both mainland China and Hong Kong and confirm that both the Chinese and Hong Kong price series are stationary. We utilize a vector error correction

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model (VECM) to evaluate the long-run equilibrium relationship and calculate the coefficients of the adjustment speed in each pair of the price series. The VECM results indicate a long-term co-movement between the Chinese and Hong Kong stock markets. The statistical significance of adjustment speed suggests that one market responds to the other and vice versa. That is, the price series in mainland China adapts to those in Hong Kong and vice versa. In short, there is an informational connection between the two equity markets that engage in price discovery process, so the information flow across the two markets contributes to the long-term equilibrium price.

We examine the determinants of adjustment speed by regressing the coefficients of adjustment speed on a variety of firm-related factors, including liquidity, information asymmetry, and riskiness. Our cross-sectional regression results demonstrate that the liquidity of a firm is statistically significant in explaining the variation of adjustment speed. As most prior studies do not explore how firm characteristics affect price discovery for Chinese cross-listed stocks, our analysis sheds light on the adjustment speed of the Chinese stock markets. Given that only elite Chinese firms can cross-list on the HKG, our findings have practical implications for foreign investment companies that need to understand the dual market functioning in China.

The rest of this paper is organized as follows. The next section summarizes the related literature. Section 3 describes the hypotheses and sample data. Section 4 presents methodology and results. Finally, Section 5 concludes.

2. Literature review

In this section, we summarize the literature on the price discovery process, cross-border listings, and China's financial environment.

2.1 Price discovery process

A key function of a stock exchange is to provide price discovery, described by Schreiber and Schwartz (1986) as a process in which markets incorporate new information into and find an equilibrium price. A great deal of literature on the price discovery process demonstrates that the price movement of a cross-listed security in one market generally reacts to the price movement of its counterpart in the other market. Harris *et al*. (1995) study the price discovery process of IBM stock traded on the New York, Pacific, and Midwest Stock Exchanges. They conclude that the response of the New York Stock Exchange (NYSE) to the two regional exchanges is less than that of the two regional exchanges to the NYSE. Their findings suggest that the two regional exchanges become satellite exchanges around the NYSE. Hasbrouck (1995) indicates that the preponderance of price discovery occurs at the NYSE for homogeneous or closely linked securities that trade in multiple stock markets. Using data from the American depository receipts (ADRs), Eun and Sabherwal (2003) examine the contribution of the U.S. stock exchanges to the price discovery of Canadian stocks cross-listed in the U.S. They find that U.S. prices generally adjust more to the Canadian prices than vice versa. The sensitivity of Canadian prices to U.S. prices is positively related to the U.S. share of total trading and negatively related to the bid-ask spreads in both markets. Booth *et al*. (2002) study the price movement between the upstairs and downstairs markets on the Helsinki Stock Exchange and conclude that most of the price discovery process occurs in the downstairs market. The upstairs market tends to be a satellite exchange of the downstairs market because the latter is more favorable for informed traders to obscure their trades.

Several studies aim to determine the factors associated with the price discovery process. Sabherwal (2007) analyze firm-specific determinants of the U.S. share of trading for Canadian firms. Consistent with market liquidity arguments, his evidence shows that markets with lower bid-ask spreads have greater trading volume. Venkataraman (2001) compares the execution costs for the common stock of similar firms in an automated limit order market (the Paris Bourse) and a floor-based exchange (NYSE). The matched samples analysis shows that the effective spreads are significantly lower for firms listed on the NYSE than its counterparts on the Paris Bourse and imply that the difference in trading mechanisms between two exchanges partly explains the variation in transaction costs. Baruch *et al*. (2007) theorize multimarket trading in a model predicting that the greater the sensitivity of a stock value to information in the U.S. relative to information in the home market, the greater the U.S. share of the overall trading volume. In short, market liquidity and the trading mechanism are vital in the price discovery for informationally linked security markets.

2.2 Cross-border listings

One stream of literature investigates cross-border competition for order flow, which tends to enhance the liquidity of a stock. An alternative trading venue in global stock markets encourages involvement abroad by foreign investors who would otherwise not trade. Assuming that intermarket price information is freely available, some markets may generate more trading activities for international dual listings than others because of superior microstructure or transparency (Noronha *et al*., 1996).

Another area of empirical research examines why a dual listing may not always improve liquidity because of market fragmentation. If intermarket information linkages are inferior, then the offsetting impact of market fragmentation may outweigh the benefit of cross-border competition, and order flow may suffer in the domestic or foreign market. Domowitz *et al*. (1998) examine the effects of cross-listing on trading volume and support the view of market fragmentation with evidence of Mexican companies issuing ADRs. They conclude that the introduction of ADRs is negatively related to liquidity as a result of order flow migration. International cross-listing triggers a migration of investors' orders from the Mexican to the U.S. market, which is believed to be more liquid and transparent. Werner and Kleidon (1996) analyze the U.K. and U.S. trading of British cross-listed stocks and reveal that order flow in both markets is segmented.

2.3 The Chinese financial environment

China's stock markets are young relative to the U.S. markets because the Shanghai Stock Exchange (SSE) and Shenzhen Stock Exchange (SZSE) were established in December 1990 and July 1991, respectively. The third official stock market in China is the HKG, which began listing Chinese state-owned enterprises in the mid-1990s. China's stock shares fall into three categories: A-shares, B-shares, and H-shares. The Chinese government allows domestic investors to purchase only A-shares of mainland Chinese companies traded on the SSE and SZSE. The B shares in both exchanges are denominated in foreign currencies and primarily traded among foreign investors but are open to Chinese traders with foreign currency accounts. The H-shares are the shares of mainland Chinese corporations that cross-list on the HKG and can be traded by Chinese and foreign investors alike.

The vast empirical research on China's financial environment provides inconclusive evidence of financial integrity and corporate governance. In their survey, Shleifer and Vishny (1997) indicate that an effective corporate governance system combined with legal protection of investors distinguishes the U.S. from less-developed countries. Stocks in emerging markets are less intensively analyzed and less subject to accounting disclosure and corporate governance than those in U.S. markets.[1] With their lack of corporate governance and shareholder rights protection, Chinese financial markets are more likely subject to insider trading than their counterparts in developed countries. Nonetheless, the Hong Kong market is considered more liberal and open than the SSE and SZSE. The HKG attracts foreign investment because of its low trading cost and high transparency in terms of the standard of financial reporting and information disclosure imposed on the listed securities.

As the Chinese regulatory authority restricts, to some extent, free capital flow and investment, the literature in the past decades reports little significant long-term relationships between the mainland China and world stock markets (see Huang *et al*. 2000; Chen *et al*. 2003; Cheng & Glascock 2005). Nevertheless, Fan *et al*. (2009) apply a Markov-Switching VECM (MS-VECM) to examine the dynamic linkages between the mainland China and main international stock markets. They find a significant trend of long-term co-movement between the Chinese and international stock markets since 1999. In addition, several empirical studies demonstrate that the mainland China stock market is linked to the Hong Kong stock market (e.g., Zhu *et al*. 2004; Mak & Ngai 2005). In general, the mainland China stock market appears to correlate with global stock markets, though Chinese financial markets are less transparent than those of developed financial markets.

3. Hypotheses and sample data

Drawing on the literature on price discovery and cross-border listings, we propose two hypotheses. First, the cointegration hypothesis asserts that the price movements of stocks cross-listed on the mainland China and Hong Kong markets are cointegrated in the long run.

Second, the firm characteristics hypothesis acknowledges that firm-specific factors affect the cointegration process: explicitly, the speed of achieving a long-term equilibrium price between the two markets. We classify the attributes of a Chinese company into three broad types: liquidity, information asymmetry, and risk. Because a liquid market allows market participants to trade securities with low transaction cost and at a fair market price, a liquid stock is more likely to approach the long-term price equilibrium than an illiquid one. The more liquid a cross-listed stock, the faster the short-term disequilibrium is eliminated and the higher the speed of price adjustment. Effective spread is a common liquidity measure, defined as the difference between the ask and bid prices divided by the midpoint of the ask and bid prices.

We account for whether information asymmetry impacts the price discovery process. The more intermarket information available to market participants to make sound investment decisions, the more likely price discovery occurs and the higher the speed of price adjustment. We follow Chordia *et al*. (2007), who proxy information asymmetry by growth opportunity and firm size. We estimate the former by the market-to-book (M/B) ratio, computed as the market value of equity divided by the book value of shareholders' equity. We calculate the latter as the log of either stock price or total assets. A large firm is less subject to information asymmetry than a small firm in part because a large firm may take advantage of economies of scale in disseminating information. Both the M/B ratio and firm size proxies, which reduce information asymmetry and enhance order flow, are positively associated with the speed of adjustment.

Apart from the liquidity and information asymmetry factors, the third factor is the riskiness of a company. Investors who perceive different levels of risk have different opinions regarding the fundamental value, thereby becoming more aggressive in trading activity and increasing the speed of price adjustment. Both the financial leverage of a firm and the volatility of stock return proxy for the risk level of a company. A firm with excessive debt is riskier than an equity-financed firm because of a high probability of financial distress and bankruptcy. We define the financial leverage of a firm as the ratio of total debt to market equity or total assets. We calculate the volatility of stock returns as the standard deviation of stock returns. The higher the financial leverage or the more volatile the stock return, the higher the speed of adjustment.

The sources for our data are *Datastream* and the *Taiwan Economic Journal*. Based on Table 2 of Pan *et al*. (2012), who excerpted the names and share codes of 56 cross-listed Chinese companies, we identify 55 Chinese firms, where each sample Chinese firm must trade on either the SSE or SZSE and be cross-listed on the HKG.[2] The daily data of stock price series are denominated in Chinese yuan. We derive the Chinese yuan value of the Hong Kong-based securities by multiplying the closing price on the HKG by the exchange rate of the Chinese yuan per Hong Kong dollar.[3] Table 1 shows the summary statistics of our sample firms. The transaction cost of our sample firms is lower in mainland China than in Hong Kong because the average effective spread of the mainland China markets, 0.002, is lower than the average effective spread of the Hong Kong stock market, 0.011. The M/B ratio is, on average, higher in mainland China than in Hong Kong. The results in Table 1 are consistent with those of Lee (2009), who document that Chinese A-shares provide better liquidity and command a higher price premium than their Hong Kong H-share counterparts.

Table 1. *Summary Statistics of Sample Firms*

Variable		Mean	Std. dev.	Minimum	Maximum
Effective Spread	*CH*	0.002	0.001	0.000	0.004
	HK	0.011	0.014	0.002	0.103
Market-to-book	*CH*	3.393	1.356	0.254	6.554
	HK	1.798	1.484	0.385	10.724
Firm Size	*Total Asset*	17.271	2.153	13.734	22.669
	Stock Price	2.212	0.603	1.348	4.095
Leverage	*L1*	0.464	0.563	0.009	2.933
	L2	0.243	0.161	0.008	0.657
Standard Deviation	*CH*	0.030	0.005	0.021	0.041
	HK	0.037	0.007	0.025	0.068

Source: Authors' calculation

The sample comprises 55 Chinese firms, each of which are traded on the SSE or SZSE and cross-listed on the HKG. Effective spread is the difference between the ask and bid prices divided by the midpoint of the ask and bid prices. CH and HK indicate a mainland China stock market or the Hong Kong stock market, respectively.

The M/B ratio is the market value of equity divided by the book value of shareholders' equity. Firm size is the log of either total assets or the stock price. Leverage is the ratio of total debt to market equity (L1) or total assets (L2). The volatility of stock returns is the standard deviation of stock returns.

4. Methodology and results

Our method consists of three parts. First, we conduct a unit root test to verify a unit root process in the stock price series. Second, we construct a VECM to estimate the speed of price adjustment.

Finally, we determine the firm characteristics that contribute to the responsiveness of the Chinese markets by regressing the speed of adjustment on the firm-related variables.

4.1 Unit root test

We apply the augmented Dickey-Fuller (1981) (ADF) test to check for the presence of a unit root in the stock price series.

The generalized regression equation of the ADF test is

$$\Delta y_t=\alpha + \beta\cdot y_{t-1}+ \delta\cdot t + \zeta_1\cdot\Delta y_{t-1} + \zeta_2\cdot\Delta y_{t-2} +\dots\dots\dots+ \zeta_k\cdot\Delta y_{t-k} + \varepsilon_t, \quad (1)$$

where y_t is the price at time t, and k is the number of lags. "Δ" denotes the difference in prices. For example, Δy_t is equal to y_t-y_{t-1}. However, we consider three models for the ADF test. The major differences among the three models are the existence of a drift or linear deterministic time trend in Equation (1). First, if both the drift and linear deterministic time trend are absent in the regression equation, then we let the two parameters α and δ together be zero (model 1, M1). Second, if only the deterministic time trend is absent in the regression equation, then we limit the parameter δ to zero (model 2, M2). Third, if both the drift and linear deterministic time trend exist, then we do not restrict the α and δ parameters (model 3, M3).

The null hypothesis in Equation (1) is H_0: $\beta=0$ and indicates that the price series y_t has a unit root. The alternative hypothesis is H_0: $\beta<0$. For the ADF test, we determine the lag (denoted as k) in the model using the Schwarz Bayesian criterion (Schwarz 1978). We check the presence of a unit root[4] in the stock prices of the 55 sample firms (denoted as $P_{CH,t}$), the corresponding stock prices on the HKG (denoted as $P_{HK,t}$), and the price ratio of both stock exchanges for the same company (denoted as $P_{CH,t}$ / $P_{HK,t}$). Most of the ADF tests (unreported) do not reject the null hypothesis at the 5% significance level. Our ADF results indicate that almost all the stock price series have a unit root and exhibit a non-stationary property. If taking a non-stationary series as if it were stationary, traditional time series regression models with this assumption will yield spurious estimations. We avoid such spurious regression results in the conventional time series analysis by adopting the cointegration method to determine whether some linear combinations of two non-stationary time series could achieve a stationary sequence (Granger 1981; Engle & Granger 1987). Specifically, a cointegration relationship exists among two non-stationary variables (i.e., x_t and y_t) if one of the linear combinations, $z_t = x_t - \beta y_t$, represents a stationary variable. Given that a long-run equilibrium relation ($z_t = x_t - \beta y_t$) exists between x_t and y_t, the expected value of z_t is zero in the long term. If a disequilibrium or external shock occurs in the short run, then both x_t and y_t should experience short-run dynamic adjustments that correct the short-lived disequilibrium into a long-lasting equilibrium state. The VECM is appropriate for non-stationary series that contain cointegration relations. The specification of the VECM limits the long-term behavior of the endogenous variables (e.g., the share prices of cross-listed Chinese firms) in their convergence to their cointegrating relationships while permitting short-term adjustment dynamics, where the deviation from the long-term equilibrium is corrected steadily through a string of partial short-run adjustments. As most stock price series pass the unit root test, we estimate the coefficients of the VECM (such as the speed of price adjustment) in the following section.

4.2 VECMs

Without the design of linear time trend and constant terms in the cointegration equation (CE), a simple VECM to study the dynamic time paths of two price variables, $P_{\text{i,t}}^{\text{CH}}$ and $P_{\text{i,t}}^{\text{HK}}$, is

$$\Delta P_{\text{i,t}}^{\text{CH}} = \alpha_i^{\text{CH}} \times \left(P_{\text{i,t-1}}^{\text{CH}} + \beta_i \times P_{\text{i,t-1}}^{\text{HK}}\right) + \sum_{j=1}^{p} \delta_{\text{i,j}}^{\text{CH}} \times \Delta P_{\text{i,t-j}}^{\text{CH}} + \sum_{j=1}^{p} \gamma_{\text{i,j}}^{\text{CH}} \times \Delta P_{\text{i,t-j}}^{\text{HK}} + \varepsilon_{\text{i,t}}^{\text{CH}} \quad (2)$$

$$\Delta P_{\text{i,t}}^{\text{HK}} = \alpha_i^{\text{HK}} \times \left(P_{\text{i,t-1}}^{\text{CH}} + \beta_i \times P_{\text{i,t-1}}^{\text{HK}}\right) + \sum_{j=1}^{p} \delta_{\text{i,j}}^{\text{HK}} \times \Delta P_{\text{i,t-j}}^{\text{CH}} + \sum_{j=1}^{p} \gamma_{\text{i,j}}^{\text{HK}} \times \Delta P_{\text{i,t-j}}^{\text{HK}} + \varepsilon_{\text{i,t}}^{\text{HK}} \quad (3)$$

Here, the subscript i denotes the sample firm (i=1, 2,...,55), t is the period of time, and ε is the white-noise disturbance term. Superscripts *CH* and *HK* indicate the mainland China exchanges and the HKG, respectively. Therefore, the price series at time $t-1$ ($P_{\text{i,t-1}}^{\text{CH}}$ and $P_{\text{i,t-1}}^{\text{HK}}$) and the price difference at time t ($\Delta P_{\text{i,t}}^{\text{CH}}$ and $\Delta P_{\text{i,t}}^{\text{HK}}$) are

- ✓ $P_{\text{i,t-1}}^{\text{CH}}$= price in the mainland China market (either A share or B share) at time $t-1$
- ✓ $P_{\text{i,t-1}}^{\text{HK}}$ = price on the HKG calculated in units of Chinese yuan at time $t-1$
- ✓ $\Delta P_{\text{i,t}}^{\text{CH}}$= the price difference in the mainland China market (either A-share or B-share) at time t
- ✓ $\Delta P_{\text{i,t}}^{\text{HK}}$= the price difference on the HKG (H-share) at time t

The coefficients of the CE term in Equations (2) and (3), α_i^{CH} and α_i^{HK}, are the speeds of price adjustment in the mainland China market and HKG, respectively. Concretely, $\alpha_i^{\text{CH}}(\alpha_i^{\text{HK}})$ reflects the extent to which the price in mainland China (HKG) reacts to deviations from the long-term equilibrium attained by $P_{\text{i,t-1}}^{\text{CH}} = -\beta_i \times P_{\text{i,t-1}}^{\text{HK}}$, where β_i is the coefficient of the long-run equilibrium price.

Furthermore, when estimating the VECM regression equations, we set the number of lags (denoted by j) uniformly across the two equations and determine them according to the multivariate version of the Schwarz Bayesian criterion (Schwarz 1978). Our empirical results reveal that most of the optimal lags are less than 3. We report the estimation results of the VECM regression equations by summarizing the percentiles for the three key parameters, namely β_i, α_i^{CH}, and α_i^{HK}, in Table 2. Two thirds of the α_i^{CH} and α_i^{HK} values are statistically significant at below the 10% level (unreported), suggesting an informational link between the two markets in which Chinese cross-listed stocks engage in price discovery.

The VECM results in Table 2 confirm our hypothesis of a long-run cointegration relationship between the mainland China and Hong Kong exchanges.

The absolute value of most estimated β_i values is greater than unity and statistically significant at the 1% level, consistent with prior findings that Chinese cross-listed stocks trade at a premium over their counterparts in Hong Kong.

Table 2. *VECM Percentiles*

	Estimated value of β_i, α_i^{CH}, and α_i^{HK}		
	β_i	α_i^{CH}	α_i^{HK}
5th percentile	-10.9479	-0.0298	-0.0070
25th percentile	-2.9096	-0.0108	0.0003
Median	-1.8048	-0.0058	0.0011
75th percentile	-1.3839	-0.0022	0.0065
95th percentile	-1.0245	0.0017	0.0341

Source: Authors' calculation

This table summarizes the 5th, 25th, 50th (median), 75th, and 95th percentiles for the three key parameters (β_i, α_i^{CH}, and α_i^{HK}) in the VECM regression equations:

$$\Delta P_{\text{i,t}}^{\text{CH}} = \alpha_i^{\text{CH}} \times \left(P_{\text{i,t-1}}^{\text{CH}} + \beta_i \times P_{\text{i,t-1}}^{\text{HK}}\right) + \sum_{j=1}^{p} \delta_{\text{i,j}}^{\text{CH}} \times \Delta P_{\text{i,t-j}}^{\text{CH}} + \sum_{j=1}^{p} \gamma_{\text{i,j}}^{\text{CH}} \times \Delta P_{\text{i,t-j}}^{\text{HK}} + \varepsilon_{\text{i,t}}^{\text{CH}} \qquad (2)$$

$$\Delta P_{\text{i,t}}^{\text{HK}} = \alpha_i^{\text{HK}} \times \left(P_{\text{i,t-1}}^{\text{CH}} + \beta_i \times P_{\text{i,t-1}}^{\text{HK}}\right) + \sum_{j=1}^{p} \delta_{\text{i,j}}^{\text{HK}} \times \Delta P_{\text{i,t-j}}^{\text{CH}} + \sum_{j=1}^{p} \gamma_{\text{i,j}}^{\text{HK}} \times \Delta P_{\text{i,t-j}}^{\text{HK}} + \varepsilon_{\text{i,t}}^{\text{HK}}, \qquad (3)$$

where *i* denotes the sample firm (*i*=1, 2,…,55), *t* represents the period of time, and ε is the error term. *CH* and *HK* indicate a mainland China stock market or the Hong Kong stock market, respectively.

The two price variables are $P_{\text{i,t}}^{\text{CH}}$ and $P_{\text{i,t}}^{\text{HK}}$, the speeds of price adjustment are α_i^{CH} and α_i^{HK}, and β_i is the coefficient of long-run equilibrium price.

4.3 Regression results

We test whether firm-specific factors contribute to the speed of price adjustment, α_{CH} and α_{HK}, with the following regression models

$$\alpha_{\text{CH}} = a_{0,\text{CH}} + a_{1,\text{CH}} \times ES_{CH} + a_{2,\text{CH}} \times MB_{CH} + a_{3,\text{CH}} \times FS_{CH} + a_{4,\text{CH}} \times LE_{CH} + a_{5,\text{CH}} \times SD_{CH} + \text{D} + u \qquad (4)$$

$$\alpha_{\text{HK}} = a_{0,\text{HK}} + a_{1,\text{HK}} \times ES_{HK} + a_{2,\text{HK}} \times MB_{HK} + a_{3,\text{HK}} \times FS_{HK} + a_{4,\text{HK}} \times LE_{HK} + a_{5,\text{HK}} \times SD_{HK} + \text{D} + u, \qquad (5)$$

where *ES* is the effective spread, *MB* is the M/B ratio, *FS* is the firm size, *LE* is the leverage, *SD* is the standard deviation of stock returns, and *u* is the error term. We added an exchange dummy (*D*) that controls the possible effects of institutional trading mechanisms on α_{CH} and α_{HK}. *D* takes on the value of one if the firm is traded on the SSE and zero if the firm is traded on the SZSE.

Table 3 shows the regression results for the four models. Model I regresses the speed adjustment on *ES*, *MB*, *FS*, and *D*; model II on *ES*, *MB*, *FS*, *SD*, and *D*; model III on *ES*, *MB*, *FS*, *LE*, and *D*; and model IV on all the independent variables. We find that liquidity, measured by the effective spread, significantly explains the variation in α_{CH} and α_{HK}.[5]

Put differently, the higher the effective spread, the higher the speed of price adjustment. On the other hand, neither information asymmetry nor firm riskiness is statistically significant in relation to the speed of price adjustment. Regardless of the specification, our results are quantitatively similar and somewhat in support of our firm characteristic hypothesis because liquidity plays a more important role in influencing the speed of price adjustment than information asymmetry and firm riskiness do.

Table 3. *Regression results*

Explanatory Variable		(1-1) α^{CH}	(1-2) α^{CH}	(1-3) α^{HK}	(1-4) α^{HK}	(2-1) α^{CH}	(2-2) α^{CH}	(2-3) α^{HK}	(2-4) α^{HK}
			Model I				Model II		
Intercept		0.009 (0.924)	-0.015 (-1.542)	0.019 (1.518)	0.012* (1.889)	0.020* (1.848)	-0.012 (-1.099)	-0.003 (-0.236)	-0.005 (-0.497)
Effective Spread (*ES*)	*CH*	2.532* (1.690)	4.300* (1.950)			2.249* (1.565)	4.488** (2.147)		
	HK			-0.374* (-1.802)	-0.331** (-1.976)			-0.491** (-2.332)	-0.506*** (-2.758)
Market-to-book (*MB*)	*CH*	0.000 (0.037)	0.000 (0.177)			0.000 (0.601)	0.000 (0.381)		
	HK			0.003 (1.484)	0.003* (1.651)			0.003 (1.420)	0.003* (1.805)
Firm Size (*FS*)	*Total Asset*	-0.001** (-2.149)		-0.001 (-1.089)		-0.001*** (-2.707)		-0.000 (-0.642)	
	Stock Price		0.001 (0.399)		-0.003 (-1.151)		0.002 (0.539)		-0.003 (-1.188)
Leverage (*LE*)	*L1*								
	L2								
Standard Deviation (*SD*)	*CH*					-0.307 (-1.449)	-0.152 (-0.656)		
	HK							0.451** (2.170)	0.475** (2.398)
Dummy (*D*)		-0.003* (-1.755)	-0.004** (2.364)	-0.000 (-0.169)	-0.001 (-0.868)	-0.002 (-1.447)	-0.004** (-2.232)	0.000 (0.174)	-0.001 (-0.250)

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.
Source: Authors' calculation

Table 3. *Regression results* (Continued)

Explanatory Variable		(3-1) α^{CH}	(3-2) α^{CH}	(3-3) α^{CH}	(3-4) α^{CH}	(3-5) α^{HK}	(3-6) α^{HK}	(3-7) α^{HK}	(3-8) α^{HK}
					Model III				
Intercept		0.007 (0.770)	0.011 (1.199)	-0.014 (-1.395)	-0.014 (-1.347)	0.016 (1.259)	0.019 (1.365)	0.010 (1.210)	0.012 (1.442)
Effective Spread (*ES*)	*CH*	3.212** (2.020)	2.986* (1.953)	4.628** (2.008)	4.593** (2.006)				
	HK					-0.367* (-1.771)	-0.374* (-1.772)	-0.323* (-1.823)	-0.331** -2.028()
Market-to-book (*MB*)	*CH*	0.000 (0.253)	0.000 (0.338)	0.000 (0.500)	0.000 (0.429)				
	HK					0.003 (1.491)	0.003 (1.463)	0.003 (1.548)	0.003* (1.616)
Firm Size (*FS*)	*Total Asset*	-0.001** (-2.114)	-0.001** (-2.482)			-0.001 (-0.962)	-0.001 (-1.034)		
	Stock Price			0.001 (0.172)	0.001 (0.311)			-0.003 (-0.797)	-0.003 (-1.043)
Leverage (*LE*)	*L1*	-0.002 (-1.094)		-0.002 (-1.111)		0.002 (0.960)		0.001 (0.469)	
	L2		-0.009 (-1.484)		-0.007 (-1.071)		0.000 (0.002)		0.000 (0.008)
Standard Deviation (*SD*)	*CH*								
	HK								
Dummy (*D*)		-0.003* (-1.703)	-0.003 (-1.625)	-0.005** (-2.363)	-0.005** (-2.353)	-0.000 (-0.165)	0.000 (-0.166)	-0.001 (-0.791)	-0.001 (-0.867)

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.
Source: Authors' calculation

Table 3. *Regression results* (Continued)

Explanatory Variable		Model IV							
		(4-1) α^{CH}	(4-2) α^{CH}	(4-3) α^{CH}	(4-4) α^{CH}	(4-5) α^{HK}	(4-6) α^{HK}	(4-7) α^{HK}	(4-8) α^{HK}
Intercept		0.019* (1.680)	0.020* (1.876)	-0.011 (-1.026)	-0.012 (-1.076)	-0.003 (-0.203)	-0.003 (-0.165)	-0.005 (-0.493)	-0.005 (-0.526)
Effective Spread (*ES*)	*CH*	2.887* (1.904)	2.687* (1.792)	4.770** (2.162)	4.686** (2.121)				
	HK					-0.478** (-2.153)	-0.506** (-2.301)	-0.515** (-2.370)	-0.520*** (-2.662)
Market-to-book (*MB*)	*CH*	0.001 (0.732)	0.001 (0.724)	0.001 (0.629)	0.000 (0.515)				
	HK					0.003 (1.436)	0.003 (1.416)	0.003* (1.701)	0.003* (1.765)
Firm Size (*FS*)	*Total Asset*	-0.001*** (-2.649)	-0.001*** (-2.954)			-0.000 (-0.625)	-0.001 (-0.696)		
	Stock Price			0.001 (0.297)	0.001 (0.397)			-0.003 (-1.004)	-0.003 (-1.126)
Leverage (*LE*)	*L1*	-0.002 (-1.094)		-0.002 (-1.077)		0.001 (0.456)		0.000 (-0.159)	
	L2		-0.008 (-1.272)		-0.006 (-0.950)		-0.004 (-0.484)		-0.005 (-0.577)
Standard Deviation (*SD*)	*CH*	-0.293 (-1.371)	-0.254 (-1.146)	-0.130 (-0.560)	-0.099 (-0.408)				
	HK					0.415** (2.106)	0.486** (2.523)	0.492** (2.372)	0.526*** (2.820)
Dummy (*D*)		-0.002 (-1.422)	-0.002 (-1.392)	-0.004** (-2.236)	-0.004** (-2.226)	0.000 (0.153)	0.001 (0.234)	-0.001 (-0.256)	0.000 (-0.193)

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.
Source: Authors' calculation

5. Conclusions

This study examines whether the mainland China markets dominate the price discovery process of cross-listings on the HKG and investigates the cross-sectional determinants of the speed of price adjustment. Applying a VECM for the sample of Hong Kong-listed Chinese securities, we find that most of the price discovery takes place in both financial markets and that significant mutual feedback of information exists between the two markets. In agreement with the recent literature, the price movement in one market responds to the other and is cointegrated.

The results of cross-sectional regression suggest that the liquidity of a firm's stock explains the speed of price adjustment in Chinese markets and that information asymmetry and firm riskiness are not relative to the speed of the price response.

Understanding the determinants of the speed of price adjustment is crucial for managers, investors, and policymakers. For cross-border issuers, the economic benefits of international cross-listings include overcoming investment barriers, growing the shareholder base, improving visibility among analysts and the media, and reducing the cost of capital. Executives of cross-listed companies have an incentive to identify the factors that govern the price movement to maximize shareholder wealth.

From the investors' perspective, the speed of price adjustment affects asset pricing and return and thus plays a role in portfolio formation. One practical application of cross-border listings is to develop profitable trading strategies in asset markets.

Specifically, we may relate the price discovery of these cross-listed Chinese stocks to potential arbitrage profits. Considering the commission and other transaction costs, arbitrage opportunities can be tested by utilizing the values of $\Delta P_{i,t}^{CH}$ and $\Delta P_{i,t}^{HK}$, where changes in predicted stock prices in the respective markets are calculated based on the VECM, whose coefficients are estimated in Equations (2) and (3). A simple arbitrage decision is made as follows. If the predicted stock prices are trending up (down), we buy (sell) the stock and hedge our long (short) position by borrowing (lending) funds at the risk-free rate.

Though the simple arbitrage scheme above is no guarantee of investment outcomes, it is interesting to devise sophisticated trading algorithms that could take advantage of the riskless profits, if any, as a result of the price discovery process that gradually drives cross-listed Chinese share prices to a long-run equilibrium state.

Chinese securities regulators are concerned about the consequences of cross-listings between the mainland China and Hong Kong markets, which are vital to facilitating intermarket competition, disintegrating segmented markets, and enhancing market liquidity. Not only does our study highlight the importance of intermarket informational linkages, but it contributes to the understanding of price discovery of Chinese cross-listed shares.

Enlarging the dataset of Chinese stocks that also list on the HKG is one area of future work in this regard. Changes in the international environment of overseas listings can influence the listing decisions of Chinese firms. For example, many U.S.-listed Chinese companies will likely seek to raise funds from and list in the Hong Kong equity market shortly because U.S. securities authorities impose more restrictive business policies on Chinese companies that float their shares on major U.S. stock exchanges.

Over time, Chinese firms that pursue international cross-listing may choose to list in two geographically similar markets (i.e., mainland China and Hong Kong). If a larger sample of dual-class Chinese shares becomes available, the additional data may yield definitive results, which may in turn support or limit our concluding remarks.

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[1] Gibson (2003) finds that corporate governance is ineffective in emerging markets, as there is no link between CEO turnover and firm performance. La Porta *et al*. (1998) argue that the U.S. has the world's strongest shareholder rights protection. Reese and Weisbach (2002) suggest shareholder rights protection is one of the reasons foreign firms cross-list in the U.S.

[2] Our sample consists of only 55 Chinese firms because our databases do not contain sufficient transaction data for one of the Chinese companies in Table 2 of Pan *et al*. (2012).

[3] *Datastream* encompasses a broad range of financial entities and instruments in nearly 200 countries. We also extract exchange rate data for the Chinese yuan and Hong Kong dollar from *Datastream*.

[4] In addition to the ADF test, we apply the Phillips Perron (PP) test (Phillips and Perron 1988) to check for a unit root using three models.

[5] Our results are consistent with Eun and Sabherwal (2003), who report the adjustment speed of U.S.-listed Canadian stocks is associated with bid-ask spreads.