Multi-market Trading and Liquidity: Evidence from Cross-listed Companies [1]

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Abstract:

We examine the relationship between cross-listed stock-pair price differentials and their liquidity for a large sample of international firms whose shares are traded both in their home market and on a U.S. stock exchange through either an American Depository Receipt (ADR) or ordinary shares programs. Using a sample of 650 firms from 18 countries for the period 2 January 1997 to 29 December 2012, we find that lower U.S. and higher home market share liquidity is associated with higher ADR or ordinaries premium. Also we document a positive relationship between the price discovery and liquidity for both the US and the home market as well as a liquidity effect on the price convergence. The effect of liquidity on price discovery and stock-pair price convergence remains economically and statistically significant when we control for greater risk of information asymmetry, limits to arbitrage and other firm and country-level characteristics. Our results are robust to alternative specifications and concerns of endogeneity between the underlying ADR liquidity and its premium.

JEL Classification: G10, G12, G15

Keywords: Cross listing, liquidity, ADR premium, price discovery, price convergence

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1. Introduction

As of 2013, there are over 500 non-U.S. firms listed on the New York Stock Exchange (NYSE). When a firm's shares trade simultaneously on multiple exchanges, however, there may be more than one price for the same stock, i.e. identical financial assets trade at different prices in different markets. For example, Kaul and Mehrotra (2007) provide evidence that economically significant price disparities do exist for stocks cross listed in New York and in Toronto. These differentials are net of estimated transaction costs; and traders have opportunities to save money or make arbitrage returns by sending orders to the foreign market. Gagnon and Karolyi (2010) also report wide-ranging price differentials for cross listed pairs of international firms. This apparent departure from the law of one price has generated considerable interest in both academia and the Finance industry.

Although considerable number of studies have analyzed these deviations from price parity, the questions of how ADR (ordinaries) premium, price convergence and price discovery change over time and what affects this change remain largely unexplored. Our study leads to several interesting findings. Our first set of results examine the determinants of the cross-sectional variation in the ADR (ordinaries) premium. Similarly to Chan et al, (2008) we document a liquidity-ADR premium relationship. We show that a higher premium is associated with higher home share and lower ADR (ordinaries) liquidity. This effect remains significant even after we control for greater risk of information asymmetry, limits to arbitrage and other firm and country-level characteristics. We also address the potential endogeneity between liquidity and ADR (ordinaries) premium by using the introduction of decimal trading in 2001 as an exogenous shock to liquidity in the US market. Previous research has documented evidence that decimalization has narrowed bid-ask spreads and lowered the price impact of trades. Our instrumental variables analysis confirms our main results and shows that the liquidity impact on ADR premium is not driven by endogeneity bias.

Our second set of results examines the extent to which the U.S. stock market contributes to the price discovery of cross-listed non-U.S. shares. Previous studies find that price discovery predominantly occurs in the home market, with the prices in the foreign market adjusting to the home market. Su and Chong (2007), for example, examine Chinese firms listed on both the Hong Kong Stock Exchange (SEHK) and the NYSE and find that the average information share is 89.4% for the SEHK. We estimate an error-correction model for the stock-pair prices and analyze the factors that affect the extent of the U.S. stock market's contribution to price discovery. Our cross-sectional regression analysis shows that there is a positive effect of liquidity on price discovery, where the liquidity effect is stronger for the U.S. market than the home market. The home country stock market development and shareholder rights play an important role in explaining the cross sectional variations in the contribution to price discovery.

Our third set of results comes from a survival analysis that examines the impact of liquidity on the conditional probability that cross-listed pair prices converge. We document evidence that the duration of the deviations from price parity is shorter for more liquid stocks. Finally, our three main results remain the same when we control for the effect of the 2008 Financial Crisis and the financials short sale ban in all our regression models.

Our paper makes a contribution to the literature that examines the relationship between cross-listing and market liquidity. Cross-listing is pursued for various reasons. Previous studies have highlighted the improved access to larger capital markets and the lower cost of capital, enhanced liquidity, and better corporate transparency and governance provisions as some of the motives for cross-listing (see Gagnon and Karolyi (2010) for a surveys of this literature). As previous studies suggest, however, cross-listing does not guarantee a more liquid trading environment for the firm's shares nor does the new competition for order flow among different markets necessarily improves efficiency and price discovery. Often fragmentation between competing markets can also lead to large deviations from price parity. Recent studies have suggested that market liquidity appears to explain the observed price differentials. For example, Chan et al, (2008) investigate the liquidity-premium relationship of an American Depositary Receipt (ADR) and its underlying share. They show that a higher ADR premium is associated with higher ADR liquidity and lower home share liquidity[2]. Previous literature on the liquidity effects in asset pricing has also shed light on the size and variation of the ADR (ordinaries) premium (see Amihud, Mendelson and Pedersen (2005) for a survey).

Earlier studies also show that cross-listing decision itself has a liquidity impact. Noronha et al. (1996) examine the liquidity of NYSE/AMEX listed stocks and find that there are increases in informed trading and trading activity after the stocks are listed overseas. However, spreads do not decrease because the increase in informed trading increases the cost to the specialist of providing liquidity. In contrast, Foerster and Karolyi (1998) find that Toronto Stock Exchange listed stocks have narrower spreads in the domestic market after they are cross-listed on a U.S. exchange. They attribute the decrease in trading costs to the increased competition from the U.S. market makers. Similarly, Moulton and Wei (2010) find narrower spreads and more competitive liquidity provision for European cross-listed stocks due to availability of substitutes. In contrast, Berkman and Nguyen (2010) examine domestic liquidity after cross-listing in the U.S using a matched sample of non-cross-listed firms to control for contemporaneous changes in liquidity and find that there are no improvements in home market liquidity due to cross-listing.

We also contribute to the literature on limits to arbitrage in international equity markets. Gagnon and Karolyi (2010) empirically investigate whether the variation in the magnitude of the deviations from price parity for cross-listed stocks is related to arbitrage costs. Their findings suggest that the deviations are positively related to holding costs, especially idiosyncratic risk, which can impede arbitrage. Their study focuses on the magnitude of the deviation from parity for cross-listed price pairs. It does not identify the determinants of the variations in the persistence and duration of such price deviation.

Domowitz et al. (1998) show that the market quality of cross-listed stocks depends on the degree to which markets are linked informationally. For markets that are sufficiently

[2] There is a vast literature on the pricing of ADRs, which investigates the differences in pricing between the ADR and the underlying share, and thus indirectly seek to explain the premium in relation to macroeconomic factors and the degree of segmentation/integration between the home and ADR market. See, for example, Karolyi and Li (2003), De Jong, Rosenthal, and van Dijk (2004), Doidge, Karolyi, and Stulz (2004), Gagnon and Karolyi (2003), Suh (2003), Menkveld, Koopman, and Lucas (2003), Karolyi (2004), Bailey, Karolyi, and Salva (2005), Blouin, Hail, and Yetman (2005).

segmented, trading costs are higher for cross-listed stocks due to greater adverse selection associated with arbitrageurs who exploit pricing differences across these segmented markets at the expense of less-informed liquidity providers. In addition, different trading rules and regulations across markets may have an impact on liquidity providers trading non-U.S. stocks. For example, affirmative and negative obligations imposed upon the NYSE specialist may be particularly burdensome for specialist trading non-U.S. stocks. Also, differences exist between minimum tick sizes, priority rules, and insider trader restrictions and regulations for US and non-US stocks. Our empirical results support the liquidity hypothesis as increases in the ADR premium are associated with decreases in the liquidity in the US market.

The reminder of this paper is organized as follows. In Section 2, we describe our data sources, discuss sample details and presents summary statistics. Section 3 examines whether differences in liquidity in the home and US markets have effects on the stock-pair price differentials. Section 4 begins with preliminary data analysis, including unit root and cointegration tests and then presents the estimates from a vector error correction model (VECM). Based on these estimates, we examine the cross-sectional variation in the price discovery process. In Section 6, we carry out a duration analysis of the stock-pair price convergence and offer robustness tests to our main results. A summary of our findings and a discussion about future research opportunities concludes the paper.

2. Data and Summary Statistics

Our data sources are Datastream, CRSP, TAQ Consolidated Trades and Compustat databases; and the sample period is 2 January 1997 to 29 December 2012. We identify the stocks in our sample by searching the complete list of foreign companies listed on their home market as well as on a U.S. stock exchange as of January 2013. The foreign listings include both active and inactive issues at the time of the search, and are either in the form of American Depositary Receipts or in the form of ordinary equities. We remove all issues without home market security code and issues that are described as preferred shares, perpetual capital security, trust, unit, right, or fund. Our analysis includes only listed (Level II and Level III) ADRs and ordinaries.

We collect daily home-market closing prices from Datastream for the sample stocks[3]. We set the home-market price as missing when there is no trading or no price reported for a particular trading day, or when a series becomes inactive in Datastream due to restructuring, delisting, or other events. We match each home-market price with a U.S.-market price. For stocks for which the home market and the U.S. market close at the same time, i.e. Canadian, Mexican and Brazilian stocks, we collect daily U.S.-market closing prices from Datastream. For the majority of the firms in our sample, however, the home market closes before the U.S. markets do. To synchronize the home-market price and the U.S.-market price, we use the TAQ Consolidated Trades database to obtain intraday trading price for the foreign listings on the U.S. market. We use the intraday U.S. price with time ticker closest to and within 30 minutes after the home market closes. The synchronization is imperfect as trading hours of stock markets in Asian Pacific countries and in the U.S. do not overlap with at least 12-hour time difference between the two regions. As stock markets in the Asian Pacific region close before stock markets in the U.S. open, we use the U.S. market trading price closest to and within 30 minutes after U.S. market opens.[4] We adjust all U.S.-market prices by their ADR ratios so that they are comparable to the underlying equity's home-market prices[5]. Finally, we check the Bank of New York Mellon Corporation's DR Directory and J.P. Morgan adr.com as additional information sources to verify ADRs and fill in ADR ratios when these ratios are missing from Datastream.[6]

[3] All variables are in U.S. dollars to avoid currency conversion when comparing the domestic values with the issue's U.S. counterpart. In line with the previous literature, we treat exchange rates as exogenous.

[4] Gagnon and Karolyi (2010) use a similar methodology to synchronize home-market and U.S.-market price pairs.

[5] An ADR ratio of ten means that one ADR represents ten ordinary shares. In this case, we divide the U.S.-market price by ten before comparing it to the home-market price. If the foreign listing is in the form of ordinary equity, then the U.S.-market price is compared to the home-market price directly without this type of adjustment.

[6] See Chan et al. (2008) for details. ADR ratios are only available at the end of the sample period, although they may change over time. Similar to their study, we check the ADR premium/discount for each firm to spot abnormal patterns that indicate possible ratio changes. Then we search news announcements and/or security filings to identify the events of ratio changes and manually correct the old ADR ratios. Finally, we drop 13 firms from the sample for not being able to identify ratio changing events or for missing ADR ratios.

We remove observations from countries with less than five ADRs since we require some within-country cross-sectional variation to estimate the effect of country-level attributes. We also remove stocks with less than 30 consecutive price observations during our sample period in order to obtain a long enough time series to estimate a vector error-correction model. After removing all stocks with missing price data, our final sample consists of 650 firms from 18 countries for the time period from 2nd January 1997 to 29th December 2012. Finally, we obtain firm-level accounting data from Compustat. Table A1 in the Appendix to this paper reports the distribution of sample firms by country and presents some county-level characteristics.

Next we discuss some summary statistics for our sample of cross-listed firms. Panel A of Table 1 presents descriptive statistics for security characteristics. On average cross-listed stocks are traded on the US market at a premium relative to their home market prices. On average, there is an ADR premium for the daily prices of our sample stocks of 2.36% percent, whereas the median ARD premium is 0.09%. The average cross-listed firm in our sample has ADR shares outstanding that represent 18% of its home market equity while the median has only 4%. In terms of trading volume, the U.S. market typically trades more shares than the home market, although variations in the ratio of U.S.-market volume over home-market volume are wide ranging. The New York Stock Exchange hosts more cross-listed stocks than AMEX and Nasdaq combined.

Panel B presents firm-level characteristics. The distribution of the size of the sample cross-listed firms, as measured by both total assets and sales is highly skewed. The average firms has $12,610 million in total assets and $6,618 million in sales; the median firms has $917 million in total assets and $506 million in sales. Also on average the cross-listed firms in our sample has 15.99% leverage as measured by the long-term debt-to-assets ratio and -4.51% profitability as measure by net income-to-assets ratio.

Panel C presents descriptive for the liquidity measures of the cross-listed stocks for both the US market and the home market. We report descriptive statistics for the four most commonly used liquidity measures: (i) the ratio of the bid-ask spread over the bid-ask midpoint; (ii) the natural logarithm of daily volume over shares outstanding (log turnover);

(iii) the natural logarithm of absolute daily return over dollar volume [7] (the Amihud illiquidity measure); and (iv) the number of zero return days over the number of trading days[8]. The p values from the t test for differences in means provide a simple way to compare the US and the home market liquidity. Even though bid-ask spreads are significantly different at 5%, the difference is not large and economically significant with the average spread of 2.37% in the US market and 2.33% in the home market. The t statistic for turnover is consistent with the result on trading volume in Panel A of Table 1, i.e. on average the U.S. market has higher turnover than the home market. The Amihud's illiquidity and zero-return measures, on the other hand, suggest a (statistically and economically) higher liquidity for the home market. The home market is characterised by more consistent trading as only 9.59% percent of the trading days have no trading activity, whereas in the US market, the percentage is 15.70%. Finally, Table A2 in the Appendix to this paper contain the description of all the variables used in our empirical analysis. The rest of the paper discusses our formal tests of the effect of liquidity on multi market trading.

3. ADR liquidity

This section presents our first set of results. We examine the cross-sectional variation in ADR (ordinaries) premium and the effect of the US and home market liquidity. In the spirit of Chan et al (2008), we conjecture that the differences in liquidity in the two markets have effects on the size of the ADR (ordinaries) premium. Chan et al (2008) report a positive relationship between the premium and the ADR's liquidity, and a negative relationship between the premium and the liquidity of the underlying share in the home market. The authors argue that high liquidity in the ADR market increases the price of the ADR and its premium whereas high illiquidity in the home market depresses the price of the home share, and thus increases the ADR's premium.

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[7] If the dollar volume is missing, we use closing price multiplied by the number of shares traded to proxy for the value of the dollar volume.

[8] Lesmond, Ogden, and Trzcinka (1999) use the percentage of days with zero returns as a proxy for illiquidity.

We extend the analysis of Chan et al (2008) to address the endogeneity between stock liquidity and ADR (ordinaries) premium by using the introduction of decimal trading in 2001 as an exogenous shock to liquidity in the US market. The conversion was completed by April 9, 2001 and after that studies have documented an increase in trading volume and reduction of bid ask spreads (see Bacidore, Battalio and Jennings, 2002)[9].

In our model, we conjecture that the cross-sectional differences of the ADR premium are determined both by the liquidity effects, firm and country characteristics. Our first regression model is specified by the following equation:

$$Premium_{it} = a_i + \gamma_1 Liquidity_{it} + \gamma_2 FX\ premium_{it} + \gamma_3 \Delta Equity\ return_{it}^{Home} + \gamma_4 Firm\ factors_{it} + \gamma_5 Country\ factors_{it} + \varepsilon_{it} \quad (1)$$

where $Premium_{it}$ is i^{th}'s stock-pair premium. $Liquidity_{it}$ is a vector of liquidity measures for both the US and the home market discussed in Section 2, $FX\ premium_{it}$ is the one-month forward premium (discount) on the home foreign currency, $\Delta Equity\ return_{it}^{Home}$ is the most recent one month change in the return of the home market equity index[10], $Firm\ factors_{it}$ and $Country\ factors_{it}$ are vectors of firm-specific and country-specific characteristics discussed below[11]. We estimate equation (1) both in level and in differences in order to account for the persistence in our liquidity measures. The results are not materially different.

Investing in an ADR is effectively taking a position in foreign stock markets. Therefore, expectations of future exchange rate changes and foreign equity returns are potentially important factors in ADR (ordinaries) pricing[12]. We use the 1-month forward premium (discount) to proxy for expected future exchange rate changes. All exchange rates are defined

[9] Prior empirical work has used also decimalization as a shock to liquidity to study corporate governance (see Gerken, 2009, Bharath 2013, Fang 2009 etc.).

[10] We chose not to use the forward equity return as a possible proxy for expectations about the future stock market performance because of the relative stationarity of the interest rates. The proxy will be a scaled version of the spot return.

[11] To estimate (1) with panel data, we note that there is an important difference in the properties of the liquidity measures and firm and country factors. The variables that measure the liquidity of the stock-pairs vary from one month to the next, while the vector of firm characteristics vary annually and the vector of country characteristics do not change very much over the sample period.

[12] This argument presumes some transaction costs, currency restrictions or other frictions that make it costly or difficult to speculate directly or hedge the risk of exchange rate movements.

as the number of units of the foreign currency per U.S. dollar, i.e. a positive exchange rate change indicates a depreciation of foreign currency, while a negative change indicates appreciation. We expect that currency appreciation will have a positive effect on the ARD premium. Similarly, increases in the home market equity return will have a positive effect on the ADR premium.

Next, we account for the effect of firm-specific characteristics. All our regressions include firm fixed effects. In addition, we control for the greater risks of asymmetric information (analysis coverage and institutional holding) and limits to arbitrage (ADR idiosyncratic volatility) associated with ADR investment. We also include the log of ADR size[13], profitability and leverage as additional controls.

Finally, we use country dummy variables as a catch-all variable for all country-specific variables as well as a number of country-level characteristics to account for the home country's openness (as measured by intensity of capital controls, the transparency and credibility of its accounting standards, the efficacy of its judicial system, corporate governance variables such as anti-director rights), as well as its market restrictions (See Tables A1 and A2 for details).

Table 3 reports the results from the estimation of (1). We estimate fixed effect regressions with standard errors clustered at the firm level. The coefficients of the liquidity measures have the expected sign and are statistical significant when we control for firm and country level characteristics. A decrease in the US market liquidity result in an increase in the ADR (ordinaries) premium. The effect is large and economically significant. For example from column (e), one standard deviation increase in the US bid-ask spread results in 0.91% increase in the ADR premium, which is large compared to the mean of 2.36% and the median of 0.09%. Although, the effect is not so strong for the home market liquidity, there is some evidence that increase in the home market liquidity increases the ADR (ordinaries) premium.

[13] Size has been widely accepted as an important factor in most liquidity based asset pricing models. See Pastor and Stambaugh (2003) and Acharya and Pedersen (2005).

The effect of liquidly on the premium remains significant when we control for information asymmetry and limits to arbitrage. The signs of these controls are as expected. Increase in analyst coverage and institutional holdings (asymmetric information) decrease the ADR premium whereas increase in the idiosyncratic volatility (limits to arbitrage) increases the ADR premium. The foreign exchange premium and the stock market development of the home country, on the other hand, have a negative effect on the premium.

Table 4 reports the estimation results for equation (1) when we control for the endogeneity between the ADR premium and the ADR liquidity. We use Decimalization dummy as an instrumental variable (IV) for the US liquidity measures in a 2SLS estimation. The results remain robust as the sign and size of the coefficients remain the same. The next section investigates the effect of home and US market liquidity on the process of price discovery.

4. Price discovery and liquidity

In the second part of the study, we examine the price discovery process of a cross-listed stock's home-U.S. price pair. We test for (long-run) conversion of the pair of stock prices by estimating an error correction model to assess the impact of liquidity on the speed of conversion to the long-term co-integration relation. The estimates of the error correction coefficients show how the home market and the U.S. market contribute to price discovery. Our hypothesis is that liquidity has an important effect on price convergence that explains the cross sectional variation in the speed with which the cross-listed stock's home-market price and U.S.-market price adjust toward the long run parity.

We begin with preliminary analysis of whether or not the home and U.S. price series are cointegrated[14]. The reason we expect the home-U.S. price pair to be cointegrated is that a pair of cross-listings represents the same underlying equity and therefore the price pair may temporarily deviate from parity, but such deviations will be corrected as market participants take advantage of arbitrage opportunities. When testing for the order of

[14] Two price series are cointegrated if both are integrated of order one and there is a linear combination of the price pair that is stationary. Before testing for cointegration, we carry out unit root tests for the price series.

integration of the ADR price, home market underlying stock price, US equity index, and home market equity index series, we follow Choi (2001) and use the inverse normal Z statistic for its trade-off between size and power of the unit root test. Our p-values given by Z-test are 1 for all four price series, so the null hypothesis of unit roots cannot be rejected [15].

Panel A of Table 4 displays the mean and median values for the number of cointegration vector at 95% and 99% confidence level. As shown in the table the majority of the cross-listed stocks in the sample has one cointegration vector. At 95% confidence level, there are 76 ADRs (out of 650) that have no cointegration vector. In addition, when we sort stocks in portfolios based on their liquidity, the rank test results are the same for each portfolio sorted by each of the liquidity proxies. The median value is one for all portfolios and the means are not significantly different at conventional levels. Our result suggests that liquidity is not driving the results from our cointegration tests.

The next step is to examine the speed of price convergence using an error correction model. We estimate the following model for each firm i.

$$\Delta p_{i,t}^{H} = \alpha_i^{H}\left(\beta_i^{H} p_{i,t-1}^{H} + \beta_i^{US} p_{i,t-1}^{US} + \beta_i^{Hindex} p_{i,t-1}^{Hindex} + \beta_i^{USindex} p_{i,t-1}^{USindex}\right) + \gamma_i \Delta p_{i,t-1}^{H} + \delta_i \Delta p_{i,t-1}^{US} + \theta_i \Delta p_{i,t-1}^{Hindex} + \vartheta_i \Delta p_{i,t-1}^{USindex} + a_i^{H} \quad (2)$$

$$\Delta p_{i,t}^{US} = \alpha_i^{US}\left(\beta_i^{H} p_{i,t-1}^{H} + \beta_i^{US} p_{i,t-1}^{US} + \beta_i^{Hindex} p_{i,t-1}^{Hindex} + \beta_i^{USindex} p_{i,t-1}^{USindex}\right) + \gamma_i \Delta p_{i,t-1}^{H} + \delta_i \Delta p_{i,t-1}^{US} + \theta_i \Delta p_{i,t-1}^{Hindex} + \vartheta_i \Delta p_{i,t-1}^{USindex} + a_i^{US} \quad (3)$$

$$\Delta p_{i,t}^{Hindex} = \alpha_i^{Hindex}\left(\beta_i^{H} p_{i,t-1}^{H} + \beta_i^{US} p_{i,t-1}^{US} + \beta_i^{Hindex} p_{i,t-1}^{Hindex} + \beta_i^{USindex} p_{i,t-1}^{USindex}\right) + \gamma_i \Delta p_{i,t-1}^{H} + \delta_i \Delta p_{i,t-1}^{US} + \theta_i \Delta p_{i,t-1}^{Hindex} + \vartheta_i \Delta p_{i,t-1}^{USindex} + a_i^{Hindex} \quad (4)$$

[15] Results from the unit root tests are available upon request.

$$\Delta p_{i,t}^{USindex} = \alpha_i^{USindex}\left(\beta_i^H p_{i,t-1}^H + \beta_i^{US} p_{i,t-1}^{US} + \beta_i^{Hindex} p_{i,t-1}^{Hindex} + \beta_i^{USindex} p_{i,t-1}^{USindex}\right) + \gamma_i \Delta p_{i,t-1}^H + \delta_i \Delta p_{i,t-1}^{US} + \theta_i \Delta p_{i,t-1}^{Hindex} + \vartheta_i \Delta p_{i,t-1}^{USindex} + a_i^{USindex} \qquad (5)$$

where is this that and the other.

We expect that the home price and the U.S. price of a cross-listed stock to be very close to one another, i.e. long-run conversion. With β_i^H normalized to 1, we expect β_i^{US} to be insignificantly different from -1, β_i^{Hindex} and $\beta_i^{USindex}$ insignificantly different from 0.

The main parameters of interest are the short-run coefficients, α_i^H and α_i^{US}. These coefficients show how each price respond to a divergence of the home-market price and the U.S.-market price. α_i^H indicates how the home-market price adjusts to a previous divergence between the price pair; α_i^{US} indicates how the U.S.-market price adjusts to a previous divergence between the price pair. We expect the sign of α_i^H to be negative and the sign of α_i^{US} to be positive, given our specification of the cointegration vector $\beta_i = (\beta_i^H, \beta_i^{US}, \beta_i^{Hindex}, \beta_i^{USindex})$.[16]

Panel B of Table 4 reports the estimated coefficients from the VECM. We report only β_i^{US} since β_i^H is normalized to one. For all firms in all regions, the 25th, 50th and 75th percentiles for β_i^{US} range between -1 and -0.9. Similarly to our cointegration tests, the 25th, 50th and 75th percentiles range between -1 and -0.9 for all portfolios sorted using each of the four liquidity measures.

The estimates for the other two coefficients β_i^{Hindex} and $\beta_i^{USindex}$ are not significantly different from zero as expected[17]. Overall, the results suggest that the median of normalized

[16] This is because we expect larger price correction when the magnitude of divergence between a home-U.S. price pair is larger. Consider the case where $P_{i,t-1}^H > P_{i,t-1}^{US}$, and $\left(\beta_i^H p_{i,t-1}^H + \beta_i^{US} p_{i,t-1}^{US} + \beta_i^{Hindex} p_{i,t-1}^{Hindex} + \beta_i^{USindex} p_{i,t-1}^{USindex}\right) > 0$. We expect that (1) $P_{i,t}^H$ goes down, $\Delta p_{i,t}^H < 0$, thus $\alpha_i^H < 0$; or (2) $P_{i,t}^{US}$ goes up, $\Delta p_{i,t}^{US} > 0$, thus $\alpha_i^{US} > 0$. Similar results can be obtained by considering the case where $P_{i,t-1}^H < P_{i,t-1}^{US}$. This is also explained by Eun and Sabherwal (2003).

[17] The 25th, 50th, and 75th percentiles for β_i^{Hindex} are -0.0001, 0.0000, and 0.0001. The percentiles for $\beta_i^{USindex}$ are -0.0002, -0.0000, and 0.0001.

cointegration vector estimates is (1, -1, 0, 0), i.e. there is long-run convergence of the home-market price and the U.S.-market price for our sample of the cross-listed stocks.

In order to analyse the effect of liquidity of the speed of convergence, we examine the cross-sectional variations in the magnitudes of α_i^H and α_i^{US}. We use seemingly unrelated regressions and jointly estimate the following two equations:

$$\left|\alpha_i^H\right| = a_0 + a_1 Liquidity^{US} + a_2 FX\,vol + a_3 Equity\,vol + a_4 Firm\,factors + a_5 Country\,factors + \epsilon_1 \quad (6)$$

$$\left|\alpha_i^{US}\right| = b_0 + b_1 Liquidity^{H} + b_2 FX\,vol + b_3 Equity\,vol + b_4 Firm\,factors + b_5 Country\,factors + \epsilon_2 \quad (7)$$

The variables in (6) and (7) are the same as the variables discussed in section 3. We first estimate the model for the full sample to see how each factor impacts the speed of error correction. Our hypothesis is that liquidity is positively related to the speed of error correction. To address the endogeneity issues discussed in the previous section, we estimate the model for two subsamples split by the introduction of the decimalization.

Panel A of Table 5 reports the estimate for the speed of error correction, α_i^H and α_i^{US}. The median values for α_i^H and α_i^{US} are -0.29 and 0.25. This means that when home market price is higher than U.S. market price by one dollar, home market price subsequently decreases by 29 cents and U.S. market price increases by 25 cents. α_i^H measures the U.S. market contribution to the price discovery, because it is the extent to which home market price responds to information provided by the U.S. market price; α_i^H measures the U.S. market contribution to the price discovery, because it is the extent to which home market price responds to information (a deviation from home market price) provided by the U.S. market price; in turn, α_i^{US} measures home market contribution to the price discovery. For our sample overall, the signs of α_i^H and α_i^{US} estimates are as expected: α_i^H is negative; and α_i^{US} is positive. Our results show that, on average, the U.S. market contributes more to the price discovery than the home markets, however, for some countries, home markets are dominant. This is consistent to Eun and Sabherwal (2003) who investigate Canadian firms cross-listed in the U.S. and find that there are many firms for which the U.S. market contributes more to price discovery even though the Canadian market is the dominant market for a large portion of the firms.

Table 5 reports error correction coefficients for portfolios sorted by different liquidity measures. We use the lower of the home-market liquidity and the U.S.-market liquidity to characterize the cross-listed firms. P1 is the least liquid portfolio; P4 is the most liquid one. When spread is used as liquidity measure, the absolute value of α_i^H increases by 0.23 as firms become more liquid (from P1 to P3), but decreases by 0.1 from P3 to P4. When volume is used as liquidity proxy, the absolute value of α_i^H increases more than doubled as firms become more liquid (from P1 to P3), but again decreases from P3 to P4. When Amihud and zero are used to proxy liquidity, the magnitudes of α_i^H increase monotonically as firms become more liquid. However, α_i^{US} appears to have little correlation with stock liquidity. α_i^{US} measures home-market contribution to price discovery; it is likely to be affected by the home-market liquidity. We observed previously that for our sample of cross-listed firms, the home markets display higher liquidity than the U.S. markets. In panel B, firms are sorted by the lower of the home-market liquidity and the U.S. market liquidity, which is for the majority of our sample firms is the U.S.-market liquidity measure rather than the home-market liquidity measure. This may explain why α_i^{US} appears to have an ambiguous relationship with stock liquidity.

Table 6 presents the estimate from the cross sectional analysis of the effect of liquidity on the convergence to price parity, i.e. equations (6) and (7). The results suggest that liquidity have an important effect on price convergence that explains the cross sectional variation in the speed with which the cross-listed stock's home-market price and U.S.-market price adjust toward the long-run parity. The signs of the estimation coefficients are as expected. The more liquid the ADR (underlying stock), the faster the convergence to price parity. The rest of our control variable also have the expected signs. Profitability and leverage have a significant negative effect on price convergence whereas size has a significant positive effect. Foreign exchange rate volatility has a negative effect, whereas stock market turnover and the stock market development index have a positive and significant effect. The next section provides duration analysis of the speed of price convergence.

5. Duration analysis

In the last part of the study, we carry out duration analysis on the cross-listed price pairs. The "failure event" is the convergence of a pair of prices after deviating from parity. We use a standard Cox regression framework to estimate the coefficients in a proportional hazard function.

Another way to assess the relationship between liquidity and movement in prices of cross-listed stocks on home and the U.S. markets is to look at how liquidity affects the time spell, during which a price pair converges.

The first step is to convert the sample into time-to-event data. The event here is convergence of a cross-listed firm's pair of prices. We calculate the percentage price differential as

$$price\ diff_{i,t} = \frac{abs(p_{i,t}^{H} - p_{i,t}^{US})}{(p_{i,t}^{H} + p_{i,t}^{US})/2} \quad (8)$$

When the price disparity is small, it may not be worthwhile for investors to trade on the arbitrage premium, which can be washed off simply by transaction costs. For investors using long-short strategy, there are two times round trip transaction costs, position open and close on both long and short side. For investors taking either long or short position, there are at least one round trip transaction costs, position open and close. In order for investors to trade on the price disparities, the benefits from the trades need to exceed at least one round trip transaction costs. We consider a price pair diverges when the price differential is larger than estimated round trip trading costs. Grundy and Martin (2001) calculate the raw and risk-adjusted returns of a zero investment momentum trading strategy and estimate that a 1.5% round trip costs would make the profits insignificant. Mitchell and Pulvino (2002) assess the effect of transaction costs on risk arbitrage portfolio returns. By comparing the return series of Value Weighted Average Return portfolio and Risk Arbitrage Index Manager portfolio, they approximate a 1.5 percent reduction in annual return by direct transaction costs (commission, surcharges, taxes) and another 1.5 percent reduction by indirect transaction costs (price impact). Kaul and Mehrotra (2007) estimate trading costs of a sample of cross-listed firms using effective spreads. They estimate a median spread of 1.2 percent on NYSE and Nasdaq, and 0.8 to 1.5 percent on TSX. Do and Faff (2012) report an average one-way trading costs of 60 bps for a pairs-trading sample ranging from 1963 to 2009. Given the results of these studies, we assume a 1.5 percent roundtrip trading costs. We assign a value of 1 to the “event” dummy variable when price diff in equation (11) is smaller than 1.5 percent, and a value of 0 otherwise.

Then we estimate a Cox proportional hazard model following the specification

$$h(t) = h_0(t)e^{(A_{i,t})} \quad (9)$$

where $h(t)$ is hazard ratio, $h_0(t)$ is baseline hazard and the explanatory and control variables are in $A_{i,t}$.

Table 7 presents the estimation results from our duration analysis. Our third set of results comes from a survival analysis that examines the impact of liquidity on the conditional probability that cross-listed pair prices converge. We document evidence that the duration of the deviations from price parity is shorter for more liquid stocks. The results for our control variables are also consistent with the estimation results of equation (1) and equations (6) and (7).

Summary and Conclusions

Our paper makes a contribution to the literature that examines the relationship between cross-listing and market liquidity and the literature on limits to arbitrage in international equity markets. We examine the determinants of the cross-sectional variation in the ADR (ordinaries) premium and show that a higher premium is associated with higher home share and lower ADR (ordinaries) liquidity. The effect remains significant even after we control for greater risk of information asymmetry, limits to arbitrage and other firm and country-level characteristics. We use the introduction of decimal trading in 2001 as an exogenous shock to liquidity in the US market to control for potential endogeneity between liquidity and ADR (ordinaries) premium. Our results remain the same. The effect of liquidity on the ADR premium is large and statistically and economically significant with one standard deviation increase in the US bid-ask spread results in 0.91% increase in the ADR premium, which is large compared to the mean of 2.36% and the median of 0.09%.

We also examine the extent to which the U.S. stock market contributes to the price discovery of cross-listed non-U.S. shares. We estimate an error-correction model for the stock-pair prices and analyze the factors that affect the extent of the U.S. stock market's contribution to price discovery. We use the short-term converge coefficients in a cross-sectional regression analysis to show that there is a positive effect of liquidity on price discovery, where the liquidity effect is stronger for the U.S. market than the home market. The home country stock market development and shareholder rights play an important role in explaining the cross sectional variations in the contribution to price discovery.

Finally, our duration analysis provides evidence that the duration of the deviations from price parity is shorter for more liquid stocks. Our results remain robust when we control for the effect of the 2008 Financial Crisis and the financials short sale ban in all our regression models.

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Table A1: Cross-listed Firms and Country-level Characteristics

This table presents the distribution of sample firms by country and country-level characteristics. Legal origins and shareholder (SH) rights is from La Porta et al (1998). Stock market development index is from Mclean et al (2014). Foreign exchange (FX) volatility is the annualized volatility of daily exchange rates. Stock market turnover is from the World Bank, World Development Index 2012.

Country	# crosslisted firms	Legal origin	SH right	Stock market development index	FX Volatility	Stock market turnover
Argentina	14	French	4	0.064	0.1709	3.76
Australia	20	English	4	0.744	0.1333	84.65
Brazil	14	French	3	0.235	0.1624	67.88
Canada	334	English	5	0.778	0.0896	61.58
Chile	18	French	5	0.308	0.0950	16.01
France	14	French	3	0.581	0.1042	66.43
Germany	8	German	1	0.474	0.1027	91.77
Hong Kong	7	English	5	0.788	0.0047	123.08
Israel	37	English	3	0.632	0.0769	45.90
Japan	23	German	4	0.509	0.1124	99.85
Mexico	28	French	1	0.150	0.1040	25.31
Netherlands	13	French	2	0.769	0.1045	70.85
Norway	10	Scandinavian	4	0.598	0.1228	56.28
South Africa	14	English	5	0.598	0.1749	54.93
Spain	8	French	4	0.607	0.1041	106.32
Sweden	9	Scandinavian	3	0.692	0.1243	73.00
Switzerland	8	German	2	0.821	0.1143	63.74
United Kingdom	71	English	5	0.829	0.0891	84.04

Table A2: Variables Description

Variable	Definition
Panel A: Security characteristics	
ADR (ordinaries) premium	the US-market (intraday) price over the home-market price adjusted by the ADR ratio minus one, i.e a number greater(less) than zero represents ADR premium(discount)
Shares outstanding (U.S.)/ Shares outstanding (Home market)	Ratio of ADR (ordinaries) outstanding to shares outstanding of the underlying stock in the home market.
NYSE	Dummy variable equals one if ADR (ordinary) is traded on NYSE
AMEX	Dummy variable equals one if ADR (ordinary) is traded on AMEX
NASDAQ	Dummy variable equals one if ADR (ordinary) is traded on NASDAQ
Idiosyncratic volatility	Standard deviation of the residuals of the stock returns regressed on market index returns from the previous quarter
Analyst coverage	Number of price estimates
Institutional holdings	Shares held by institutional investors over shares outstanding
Panel B: Liquidity measures	
Spread	Bid-ask spread over the mid point of bid-ask spread
Turnover	Natural logarithm of daily volume over shares outstanding
Amihud	Natural logarithm of absolute daily return over dollar volume
Zeros	Number of zero-return days in a month over the number of trading days in that month
Panel C: Firm-level variables	
Market cap	Natural logarithm of market cap
Assets	Natural logarithm of total assets
Sales	Net sales
Debt to Asset	Book value of long term debt over book value of total assets
Profitability	Net income over book value of total assets
Return volatility	Annualized volatility of daily returns
Panel D: Country-level variables	
English	Dummy variable equals one if the country has English legal origin
French	Dummy variable equals one if the country has French legal origin
German	Dummy variable equals one if the country has German legal origin
Emerging	Dummy variable equals one if the country is an emerging market
Shareholder rights	An index constructed to capture the rights of minority shareholders
Stock market turnover	Stock market turnover index
SMI	Stock market development index
FX premium	1-month forward exchange rate over spot exchange rate minus one
FX volatility	Annualized volatility of daily exchange rates
Panel E: Time events	
Financial crisis	Dummy variable equals one for time period between September 1, 2007 and September 30, 2008
Decimalization	Dummy variable equals one for time period after January 29, 2001 until end of sample

Table 1: Descriptive Statistics

This table presents descriptive statistics for the sample of cross-listed firms. Our sample period is 2 January 1997 to 29 December 2012. The sample consists of 650 cross-listed firms from 18 countries. When the two markets do not traded synchronously, we use the U.S. market trading price closest to and within 30 minutes after U.S. market opens. Panel A presents security characteristics; Panel B presents firm-level characteristics; Panel C presents descriptives for our liquidity measures.T test is the p value from a standard test for differences in means.

	Mean	Median	Std Dev	5%	95%
Panel A: ADR (ordinaries) characteristics					
Premium/Discount (%)	2.36%	0.09%	0.1716	-4.00%	13.81%
SO(ADR)/SO(HOME)	0.5871	0.8720	0.4470	0.0030	1.0166
SO(ADR)/SO(HOME)	0.1755	0.0373	0.3945	0.0017	0.9941
Volume(ADR)/Volume(HOME)	16.6354	1.0790	70.1644	0.0088	54.4319
NYSE	0.5184	1.0000	0.5000	0.0000	1.0000
AMEX	0.1718	0.0000	0.3775	0.0000	1.0000
NASDAQ	0.3098	0.0000	0.4628	0.0000	1.0000
Panel B: Firm characteristics					
Asset ($millions)	12,610	917	41,795	28	53,732
Sales ($millions)	6,618	506	23,951	0.0000	31,531
Debt to Asset	0.1599	0.1200	0.1632	0.0000	0.4615
Profitability	-0.0451	0.0110	0.1868	-0.3614	0.1099
Panel C: Liquidity measures	US market		Home market		
	Mean	Std Dev	Mean	Std Dev	T test
Spread	0.0237	0.0364	0.0233	0.0449	(0.024)**
Turnover	-6.4421	1.6255	-6.7788	1.4744	(0.000)***
Amihud	-17.2618	2.6917	-18.2194	3.1455	(0.000)***
Zeros	0.1570	0.1509	0.0959	0.1373	(0.000)***

Table 2: ADR Premium and Liquidity Effects

This table summarizes the OLS regressions of the ADR (ordinaries) premium on the ADR and home share liquidity measures, as well as other control variables. The sample includes 650 pairs of ADR and corresponding underlying shares in the home market from 18 countries, from January 1997 to December 2012. The liquidity measures and the control variables are as defined in Table A2. The coefficient estimates are the estimates from OLS regressions of the panel data with fixed effects. The values in parenthesis are the corresponding p-values for the coefficient estimates using standard errors clustered by firm. *, **, and *** indicate 10%, 5% and 1% significance, respectively.

		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Liquidity									
Spread	Home	-0.0713				0.1435***			
		(0.445)				(0.000)			
	US	0.6792				0.2513***			
		(0.136)				(0.000)			
Turnover	Home		0.0023				0.0030***		
			(0.645)				(0.000)		
	US		-0.0105**				-0.0028***		
			(0.040)				(0.000)		
Amihud	Home			0.0092*				0.0011***	
				(0.065)				(0.010)	
	US			0.0030				0.0022***	
				(0.522)				(0.000)	
Zeros	Home				-0.0565				0.0193***
					(0.320)				(0.000)
	US				0.2023				0.0050
					(0.176)				(0.331)
Controls									
Financial crisis		-0.0026	-0.0075	-0.0019	-0.0059	0.0039***	0.0031**	0.0030**	0.0032***
		(0.654)	(0.183)	(0.649)	(0.275)	(0.005)	(0.011)	(0.012)	(0.008)
firm-level									
Profitability						0.0121***	0.0038	0.0056*	0.0049*
						(0.007)	(0.183)	(0.054)	(0.094)
Debt to Asset						-0.0250***	-0.0150***	-0.0158***	-0.0156***
						(0.001)	(0.002)	(0.001)	(0.001)
Log ADR size						0.0046***	0.0033***	0.0061***	0.0020***
						(0.000)	(0.000)	(0.000)	(0.000)
Idiosyncratic volatility	Home					0.0154	0.0167	0.0141	0.0111
						(0.321)	(0.157)	(0.233)	(0.355)
	US					-0.0118	-0.0016	-0.0074	-0.0018
						(0.337)	(0.865)	(0.443)	(0.852)
Analyst coverage						0.0007***	-0.0003**	-0.0002	-0.0003**
						(0.005)	(0.036)	(0.106)	(0.042)
Institutional holdings						-0.0039**	-0.0047***	-0.0041***	-0.0041***
						(0.015)	(0.001)	(0.003)	(0.003)
country-level									
FX premium						-1.5242***	-0.5660***	-0.5487***	-0.5796***
						(0.000)	(0.000)	(0.000)	(0.000)
ΔEquity market return	Home					0.0016	-0.0000	-0.0007	0.0010
						(0.723)	(0.996)	(0.856)	(0.792)
Stock market turnover	Home					-0.0044**	-0.0067***	-0.0062***	-0.0061***
						(0.015)	(0.000)	(0.000)	(0.000)
SH right						-0.0003	-0.0022	-0.0020	-0.0021
						(0.932)	(0.554)	(0.603)	(0.583)
SMI						0.0093	0.0107	0.0302	0.0244
						(0.761)	(0.809)	(0.319)	(0.429)
Legal origin dummy						Yes	Yes	Yes	Yes
Number of observations		35,755	58,016	57,382	58,401	18,415	26,386	26,298	26,389

Table 3: ADR Premium and Liquidity Effects: IV Estimation

This table summarizes the OLS regressions of the ADR (ordinaries) premium on ththe ADR and home share liquidity measures, as well as other control variables. The sample includes 650 pairs of ADR and corresponding underlying shares in the home market from 18 countries, from January 1997 to December 2012. The liquidity measures and the control variables are as defined in Table A2. The coefficient estimates are the OLS estimates from the 2SLS IV regressions of the panel data with fixed effects. The values in parenthesis are the corresponding p-values for the coefficient estimates using standard errors clustered by firm. *, **, and *** indicate 10%, 5% and 1% significance, respectively.

		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Liquidity									
Spread	Home	-0.4315***				-0.4000***			
		(0.000)				(0.000)			
	US	4.0907***				6.1162***			
		(0.000)				(0.000)			
Turnover	Home		0.0203***				0.0020*		
			(0.000)				(0.069)		
	US		-0.0661***				0.0008		
			(0.000)				(0.849)		
Amihud	Home			-0.0079**				0.0021**	
				(0.011)				(0.045)	
	US			0.0216***				-0.0005	
				(0.000)				(0.839)	
Zeros	Home				-0.1332***				0.0222***
					(0.000)				(0.004)
	US				0.4358***				-0.0093
					(0.000)				(0.741)
Controls									
Financial crisis		0.0014	0.0039	0.0055*	-0.0001	0.0075***	0.0030**	0.0032***	0.0033***
		(0.683)	(0.230)	(0.083)	(0.965)	(0.000)	(0.013)	(0.010)	(0.008)
firm-level									
Profitability						-0.0187***	0.0033	0.0055*	0.0048
						(0.004)	(0.262)	(0.059)	(0.103)
Debt to Asset						0.0057	-0.0152***	-0.0164***	-0.0156***
						(0.569)	(0.002)	(0.001)	(0.001)
Log ADR size						-0.0155***	0.0020	0.0031	0.0018***
						(0.000)	(0.221)	(0.319)	(0.007)
Idiosyncratic volatility	Home					0.1561***	0.0070	0.0102	0.0125
						(0.000)	(0.668)	(0.410)	(0.308)
	US					0.1002***	-0.0052	-0.0060	-0.0039
						(0.000)	(0.622)	(0.536)	(0.714)
Analyst coverage						0.0003	-0.0004**	-0.0003*	-0.0003**
						(0.312)	(0.024)	(0.066)	(0.039)
Institutional holdings						-0.0029	-0.0053***	-0.0047***	-0.0042***
						(0.173)	(0.001)	(0.002)	(0.003)
country-level									
FX premium						-1.0434***	-0.5673***	-0.5493***	-0.5838***
						(0.000)	(0.000)	(0.000)	(0.000)
ΔEquity market return	Home					0.0039	0.0010	-0.0003	0.0008
						(0.528)	(0.789)	(0.941)	(0.821)
Stock market turnover	Home					-0.0020	-0.0067***	-0.0059***	-0.0062***
						(0.416)	(0.000)	(0.000)	(0.000)
SH right						-0.0037	-0.0017	-0.0015	-0.0021
						(0.471)	(0.656)	(0.691)	(0.592)
SMI						0.0424	0.0167	0.0378	0.0252
						(0.284)	(0.599)	(0.236)	(0.420)
Legal origin dummy						Yes	Yes	Yes	Yes
Number of observations		35,755	58,016	57,382	58,401	18,415	26,386	26,298	26,389

Table 4: Cointegration and VECM

	Cointegration rank test		
Rank, 95% significance	0.9549	1	
Rank, 99% significance	0.8670	1	

	Mean	Median	T test
Panel A: Cointegration vector			
US price	-0.9689	-0.9994	(0.478)
Home price	Normalize to 1		
US index	-0.0269	-0.0000	(0.305)
Home index	3.3156	-0.0000	(0.317)
Panel B: Error correction coefficients			
US price	0.3595	0.2085	(0.000)
Home price	-0.4840	-0.4086	(0.000)
US index	25.0213	3.5726	(0.000)
Home index	-21.5030	-3.1372	(0.523)

Table 5: Price Convergence and liquidity

Panel A: Alphas (US) for sorted portfolios with T tets

	Least liquid			Most liquid	T test
	P1	P2	P3	P4	P4 = P1
Spread	0.5827	0.3267	0.2535	0.1280	(0.020)
Turnover	0.3644	0.3468	0.5027	0.2229	(0.155)
Amihud	0.4079	3811	0.4448	0.2051	(0.033)
Zeros	0.4795	0.3593	0.4944	0.1959	(0.082)

Panel B: Alphas (Home) for sorted portfolios with T tets

	Least liquid			Most liquid	T test
	P1	P2	P3	P4	P4 = P1
Spread	-0.1851	-0.4131	-0.6083	-0.7452	(0.000)
Turnover	-0.2795	-0.5442	-0.4925	-0.6230	(0.000)
Amihud	-0.1999	-0.3636	-0.6273	-0.7440	(0.000)
Zeros	-0.2053	-0.3578	-0.6738	-0.6983	(0.000)

Table 6: Cross-sectional Variation in Price Discovery

	(a)		(b)		(c)		(d)	
	αH	αUS	αH	αUS	αH	αUS	αH	αUS
Liquidity								
Spread	-9.7976***	1.1330						
	(0.000)	(0.233)						
Turnover			0.1083***	0.0484*				
			(0.000)	(0.057)				
Amihud					-0.0876***	-0.0234		
					(0.000)	(0.171)		
Zeros							-0.9884***	-0.2188
							(0.000)	(0.484)
Control: firm								
Profitability	-0.5045**	-0.7188***	-0.6493***	-0.8333***	-0.5866***	-0.8307***	-0.5718***	-0.7823***
	(0.027)	(0.002)	(0.001)	(0.000)	(0.004)	(0.000)	(0.004)	(0.000)
Debt to Asset	-0.5483*	-0.1831	-0.5140**	-0.2623	-0.5159**	-0.2702	-0.4274	-0.2668
	(0.080)	(0.559)	(0.050)	(0.327)	(0.050)	(0.315)	(0.105)	(0.321)
Log ADR size	0.0225	0.0103	0.0845***	0.0226	0.0183	0.0180	0.0460**	0.0280
	(0.372)	(0.645)	(0.000)	(0.285)	(0.489)	(0.431)	(0.039)	(0.184)
Control: country								
FX Volatility	-3.3014*	-0.8115	-2.7557	-0.9609	-2.2697	-0.6940	-1.7800	-0.7570
	(0.086)	(0.674)	(0.147)	(0.623)	(0.233)	(0.723)	(0.341)	(0.700)
Equity market volatility								
Stock market turnover	-0.0082***	-0.0064**	-0.0112***	-0.0080***	-0.0095***	-0.0088***	-0.0087***	-0.0071***
	(0.002)	(0.014)	(0.000)	(0.002)	(0.000)	(0.003)	(0.001)	(0.006)
SH right	-0.0128	0.0763	0.0400	0.0941**	0.0351	0.0893*	0.0318	0.0910**
	(0.791)	(0.117)	(0.372)	(0.041)	(0.436)	(0.053)	(0.476)	(0.049)
SMI	0.5450	0.6737	0.7922*	0.7087*	0.6719	0.8621**	0.6856*	0.7516*
	(0.184)	(0.104)	(0.058)	(0.098)	(0.108)	(0.044)	(0.098)	(0.083)
Legal origin dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	389	389	489	489	489	489	489	489
Adjusted R2, %	23.1	17.96	21.62	17.51	21.18	16.95	22.33	16.96

Table 7: Price convergence: Duration analysis

		(a)	(b)	(c)	(d)
Liquidity					
Spread	Home	-1.7921***			
		(0.000)			
	US	-11.3852***			
		(0.000)			
Turnover	Home		0.0275***		
			(0.000)		
	US		0.0183***		
			(0.009)		
Amihud	Home			-0.0149*	
				(0.084)	
	US			-0.0162***	
				(0.002)	
Zeros	Home				0.0138
					(0.649)
	US				-0.0356
					(0.267)
Controls					
Profitability		0.2357**	0.1838**	0.1491**	0.2075**
		(0.030)	(0.028)	(0.042)	(0.017)
Debt to Asset		-0.1131	-0.1036	-0.0721	-0.1131
		(0.260)	(0.192)	(0.296)	(0.179)
Log ADR size		0.0074	0.0422***	0.0085	0.0435***
		(0.586)	(0.000)	(0.558)	(0.000)
Idiosyncratic volatility	Home	-0.4272***	-0.4781***	-0.4595***	-0.4561***
		(0.010)	(0.002)	(0.000)	(0.003)
	US	0.0535	-0.1230	-0.0708	-0.0943
		(0.571)	(0.313)	(0.489)	(0.427)
Analyst coverage		-0.0033	-0.0016	-0.0018	0.0005
		(0.361)	(0.474)	(0.480)	(0.834)
Institutional holdings		0.0242	-0.0159	0.0030	0.0159
		(0.371)	(0.614)	(0.932)	(0.565)
Financial crisis		0.0214	-0.0183	-0.0150	-0.0160
		(0.640)	(0.674)	(0.747)	(0.713)
FX Volatility	Home	-2.7071	-4.5338	-6.9390*	-4.3200
		(0.531)	(0.224)	(0.081)	(0.238)
Stock market turnover	Home	-0.0171	-0.0268	-0.0208	-0.0195
		(0.699)	(0.553)	(0.655)	(0.669)
Number of observations		267,281	391,238	357,825	391,513