THE ROLE OF LIQUIDITY IN PRICE DISCOVERY OF AMERICAN DEPOSITARY RECEIPTS: EVIDENCE FROM LATIN AMERICA

Abstract

This study provides the first comprehensive examination of price discovery dynamics for American Depositary Receipts (ADRs) originating from Latin America—an ideal setting for analyzing price discovery in an environment of low domestic liquidity. We apply a vector error correction model that endogenizes the exchange rate to daily closing prices. The results indicate that unlike developed markets, exchange rates in Latin America (particularly Brazil and Mexico) are sensitive to innovations in stock market prices. Moreover, we document a mixture of price discovery locations for ADRs from Latin America: primarily via the home market in Chile, through the home and foreign markets in Brazil, and primarily via the foreign market in Argentina and Mexico. Results from a cross-sectional analysis indicate that higher levels of illiquidity at home are consistent with higher contributions to price discovery from the foreign market. This relationship holds after controlling for firm size, U.S. share of trading volume, and industry effects. Overall, the results suggest that the conventional finding that the home market is most important for price determination does not hold in an environment of low domestic liquidity like Latin America.

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This paper examines price discovery for Latin American equity internationally cross-listed in the United States via an American Depositary Receipt (ADR). ADRs are negotiable instruments issued in the U.S., in dollars, but they represent ownership of foreign equity. ADR issues from Latin America comprise a significant portion of ADRs available to U.S. investors. Specifically, by year-end 2010, ADR issues from Argentina, Brazil, Chile, and Mexico constituted 21% (86 of 399) of active ADR programs listed on U.S. exchanges. Furthermore, ADRs from Latin America are among the main beneficiaries of rising fund flows to emerging markets.[1]

The growing importance of ADR issues from Latin America in the United States raises an important question: which market determines prices? The answer to this question depends on the level of intermarket communication (Garbade and Silber (1979)). At one extreme, if no intermarket communication exists, the markets are independent and prices in the two markets are unrelated. Alternatively, with perfect intermarket communication, the two markets are perfectly integrated and the law of one price guarantees that prices are always identical across markets. The more likely scenario, however, is a hybrid between perfectly independent and perfectly integrated markets. In such a case, two possibilities emerge: (1) both markets contribute equally to price discovery or (2) one market dominates in price discovery and the other behaves as a satellite market—mainly incorporating price information generated by the dominant market.

Much of the previous work on the price discovery of internationally cross-listed firms examines stock from various developed countries. The findings indicate that price discovery occurs primarily in the home market (Eun and Sabherwal (2003);Grammig et al. (2005); Pascual et al. (2006); Korczak and Phylaktis (2010); Frijns et al. (2010)). However, some studies also examine emerging markets (Studies of emerging Asia include Chen et al. (2002); Su and Chong

[1] Based on the Bank of New York's December 2009 publication—Institutional Investment Insights: Focus on Emerging Markets Equities.

(2007); Chen et al. (2010)) and support the finding that price discovery occurs primarily at home. One notable exception is India where the domestic and foreign markets contribute equally to price discovery (Kadapakkam et al. (2003)).

This essay contributes to the existing literature on the price discovery of internationally cross-listed stocks by providing the first comprehensive analysis of ADR issuing firms from Latin America. Data on Latin America suggest that low stock market liquidity is a problem despite rising capital flows (via ADRs) to the area. Figure 1 depicts how Latin American markets are less liquid (based on the Turnover/ GDP ratio) than developed markets, but more importantly, they are also less liquid than other developing countries such as China and India. Furthermore, the illiquidity of Latin American markets is evident in Mexico where the trading infrequency (defined as the number of days the market is open but the security does not trade) is, on average, 16.9% for stocks underlying ADR issues[2]. Equivalently, no trading of these stocks occurs for approximately 4 days of one trading month. Thus, on a given day, an ADR may be trading on a U.S. exchange but no trading occurs for its underlying stock in the Mexican market. Since low liquidity can impede suitable intermarket communication, the illiquidity of Latin American markets produces the possibility that the home market may not be the source of price discovery.

To examine price discovery of ADR issues from Latin America, we apply a vector error correction model with an endogenous role for exchange rate fluctuations to daily closing prices. The results indicate a mixture of price discovery locations for Latin American internationally cross-listed stocks. Only in Chile does the evidence support the standard result that price discovery occurs primarily in the home market. In Brazil, contributions to price discovery are

[2] Author's calculations based on a sample of exchange-listed, non-financial ADRs trading for at least one year during the period 2003-2010.

made by both the home and foreign markets. Finally, in Argentina and Mexico, where underlying stock illiquidity is highest, price discovery occurs primarily in the U.S. market.

These results suggest that a relationship exists between low domestic liquidity and contributions of the foreign market to price discovery but individual firm results reveal differences in the price discovery dynamics across firms within the same country. To explain these differences, we employ a cross-sectional analysis that explores whether different characteristics, with emphasis on liquidity, help determine the contribution of the U.S. market to price discovery. The results indicate that liquidity, particularly of the underlying stock, is an important determinant of the price discovery location. Higher levels of illiquidity in the stock trading in the domestic market are consistent with higher contributions of the U.S. market to price discovery. This result holds after controlling for firm size, the U.S. share of total trading, and industry effects.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature. Section 3 presents the sample and data sources. Section 4 details the methodology and Section 5 reviews the empirical results. Section 6 concludes.

2. Relevant Literature

ADRs offer important benefits to U.S. investors who purchase them and to the foreign firms who issue them[3]. For U.S. investors, ADRs provide convenience in international investment because they offer familiar trade, clearance and settlement procedures, and they offer competitive foreign exchange rates on currency conversions for dividends and other cash

[3] Foreign firms have several options for issuing ADRs. Level I ADRs are traded in over the counter exchanges and are generally not very liquid. Private placements of ADRs to institutional investors can be issued under (RegS/Rule144A). Level II and Level III ADRs are traded on U.S. exchanges including the New York Stock Exchange and NASDAQ. As such, they have to meet disclosure requirements of the Securities and Exchange Commission and conform to generally accepted accounting principles (G.A.A.P.). Level II ADRs are designed to meet U.S. investor demand for foreign equity while level III ADRs are issued by foreign firms to raise capital in the U.S. market.

distributions[4]. More importantly, ADR investment offers U.S. investors diversification benefits (Officer and Hoffmeister (1987); Wahab and Khandwala (1993); Choi and Kim (2000); Alaganar and Bhar (2001); Arnold et al. (2004)). For foreign firms, ADR issuance offers an expanded shareholder base, higher liquidity, higher global visibility, and a lower cost of capital[5].

Early literature on ADR pricing focuses on the factors driving ADR returns. Several studies document that ADR returns are more sensitive to shocks in the home than the host market (i.e. Jiang (1998); Choi and Kim (2000); Ely and Salehizadeh (2001); Fang and Loo (2002))[6]. Others suggest that ADR returns are sensitive to changes in exchange rates (Liang and Mougoue (1996); Bin et al. (2004); Bae et al. (2008)) and to a lesser extent interest rates (Bin et al. (2003)). These studies suggest that the home market generates pricing information since it is one of the most important drivers of ADR returns. Yet they offer limited insight into the price discovery process because they do not examine the relationship between the ADR price and the price of the underlying stock trading in the home market.

Other studies examine the transmission of shocks to ADR prices. For example, Eun and Jang (1997) examines price transmission for portfolios of stocks cross-listed on the New York Stock Exchange (NYSE), London and Tokyo stock exchanges. The findings from a vector error correction model (VECM) and Granger causality tests indicate shocks in the home market price are always transmitted to overseas markets. However, innovations in the NYSE are also transmitted to the home market. Ely and Salehizadeh (2001) analyze price transmission in equally weighted portfolios of British, Japanese, and German ADRs. Their VECM findings suggest that the home markets are a more important source of information than the U.S. market.

[4] Exchange rate conversions are described as "competitive" by the depositary banks (i.e. Bank of New York) which issue the ADRs

[5] For a review of the empirical literature, see Karolyi (1998).

[6] An exception is Aquino and Poshakwale (2006) who document, using a panel data approach, that ADR returns are more sensitive to changes in U.S. than home market returns and that they are exposed to exchange rate risk.

While these studies offer some evidence that price discovery occurs primarily in the home market, the use of portfolios masks variation in the price discovery process of individual firms. Using firm level data, Kim, et al. (2000) examines this question for a sample of 21 Japanese, 21 British, 5 Dutch, 5 Swedish, and 4 Australian ADR issuing firms. Their results indicate that although the U.S. market and exchange rates play a role, the most important determinant of ADR prices is the prices of their underlying stocks. While this study documents important influences on ADR prices, it assumes that price discovery occurs in the home market and information flows to the ADR market. Therefore, the location of price discovery for ADRs remains unidentified.

However, developments in the literature for U.S. stocks cross-listed on the NYSE and regional exchanges (i.e. Harris et al (1995); Hasbrouck (1995)) foster advancements in the literature on price discovery of internationally cross-listed stocks, particularly those from developed markets that cross-list on the NYSE. For instance, using intraday price data, Eun and Sabherwal (2003) follow the approach of Harris et al. (1995)—where the speed of adjustment coefficients resulting from the estimation of a VECM yield the relative contribution of each market to price discovery. The findings are that price discovery for Canadian stocks cross-listed in the U.S. occurs in both markets (although the home market dominates) and that the U.S. contribution to price discovery is positively related to the U.S. share of trading and inversely related to the relative level of transaction costs in the U.S. market. Grammig et al. (2005) examines the issue of price discovery for three German stocks cross-listed in the United States. Their model builds on the Hasbrouck (1995) argument that cointegration implies that assets with similar cash flows trading on different markets share a common implicit efficient price[7]. In this model, a market's contribution to price discovery is defined in terms of an

[7] Hasbrouck tests this model using intraday data for Dow stocks cross-listed on the NYSE and on regional exchanges. The evidence indicates that the NYSE is the main contributor to price discovery.

information share—the proportion of the innovation variance of the efficient price that can be attributed to the respective market. Grammig et al. (2005) extends this approach by endogenizing the exchange rate. That is, instead of converting the foreign price into local currency, the model includes the exchange rate as an endogenous variable in the VECM estimation. The results indicate that the home market is the main contributor to price discovery and that exchange rate innovations are exogenous with respect to stock prices[8]. Others document that price discovery occurs mostly in the home market but depends on the information content of trades and the market maker's information environment (Pascual et al. (2006); Korczak and Phylaktis (2010)). Overall, these studies document that price discovery for stocks from developed markets cross-listed on the NYSE occurs primarily at home.

Evidence on the price discovery of cross-listed stocks from emerging markets is scant likely due to the limited availability of intraday data. However, using daily data, several studies support the findings based on developed markets. For instance, Chen et al. (2002) uses Granger causality tests on a sample of Taiwanese ADRs and finds that the home market is dominant. Furthermore, factors such as mispricing in the ADR market and net purchases of Qualified Foreign Institutional Investors influence the price transmission mechanism but the direction of this influence is ambiguous. Similarly, Su and Chong (2007) concludes that the home market is the main contributor to price discovery (over 80%) for a sample of eight Chinese firms cross-listed on the NYSE. Chen et al. (2010) examine price discovery for seven stocks from China's A market that cross-list in the United States. They report no cointegration among prices which indicates segmentation of the Chinese market. Since there is little intermarket communication, the markets are independent. Yet there is unidirectional volatility spillover from the Chinese

[8] Evidence from stocks dually listed on the Australian and New Zealand stock exchanges also support these conclusions (Frijns et al. (2010)).

market to the U.S. market. Kadapakkam et al. (2003) finds slightly different results when analyzing price discovery for twenty-three Indian Global Depositary Receipts (GDRs) cross-listed in the London Stock Exchange. They document that each market contributes equally to price discovery and that the foreign market's (London) contribution to price discovery increases with increasing foreign ownership of the firm and GDR issue size.

Overall, the literature suggests that the home market is the leader in generating prices. However, limited evidence exists on price discovery in emerging markets, particularly Latin America. For example, Von Furstenberg and Tabora (2004) examines price discovery for two highly traded Mexican cross-listed stocks—Televisa and Telmex L and finds that Mexico is the market leader in price discovery. However, this pattern is not consistent across the shares or sub periods examined. In addition, those studies that examine price discovery in emerging markets find little support for the factors influencing price discovery. Therefore, this essay examines price discovery in Latin America and questions whether and to what extent liquidity impacts the process.

3. Sample and Data Sources

Sample construction begins with the set of ADRs (active and terminated) available from the DataStream International database and verifiable via the Bank of New York, Citibank's, or Deutsche Bank's ADR websites. The sample includes only non-financial, exchange-listed ADR programs from Latin America trading for more than one year during the January 2003-December 2010 period. This time period captures growing activity in the ADR market but also a period of relative domestic stability in Latin America. According to *Latin Finance*, this time period leaves behind financial crises (Mexico 1994, Brazil 1999, and Argentina 2002) and finds Latin American countries with stronger "economic fundamentals and better prepared…for economic shocks—so the impact of the recent global crisis was…relatively mild and short lived when compared with the crushing economic problems during previous episodes of global turbulence."

Only firms with price data available for the ADR and the underlying stock are included. These filters result in the inclusion of 87 ADR programs (Argentina (10), Brazil (38), Chile (11), and Mexico (28)). A complete list of ADR programs and their industry classification is available in Table 1 of the Appendix. DataStream International provides all data--daily closing prices for each ADR, daily closing prices of underlying stocks, daily closing spot exchange rates and data necessary to calculate measures of liquidity and firm size (i.e. trading volume and market capitalization).

4. Methodology

4.1 Measuring Contributions to Price Discovery

Since an ADR represents a claim to the same cash flows as its underlying stock, its exchange rate adjusted price should equal the price of the underlying stock trading in the home market[9]. If p_t^h represents the log price of the stock in the home market, p_t^{ADR} represents the log price of the stock trading in the United States as an ADR, and e_t represents the log of the exchange rate expressed as foreign currency per U.S. dollar (an increase in e_t means depreciation of the home currency relative to the U.S. dollar), then

$$p_t^h = p_t^{ADR} + e_t \, . \qquad (1)$$

The law of one price dictates that price deviations arising between ADRs and their underlying stocks must be temporary as arbitrageurs will prevent the prices from moving too far apart. Because the prices do not diverge boundlessly from each other, there exists in the long-run a linear combination of the prices that is stationary even when the individual price series are

[9]Generally, an ADR is equivalent to more than 1 share of the underlying stock. Therefore, the ADR price is also adjusted by the conversion ratio.

nonstationary (as is the case with most stock prices). That is, e_t p_t^h and p_t^{ADR} are cointegrated and $\beta' = (1, -1, 1)$ is the cointegrating vector.[10] In turn, cointegration implies that the dynamics of price changes can be described by a vector error correction model (VECM) of the following form:

$$\Delta e = \omega_0 + \alpha^e z_{t-1} + \sum_{i=1}^{p} \omega_{1i}\, \Delta e_{t-i} + \sum_{i=1}^{p} \omega_{2i}\, \Delta p_{t-i}^h + \sum_{i=1}^{p} \omega_{3i} \Delta p_{t-i}^{ADR} + \varepsilon_{1t} \qquad (2)$$

$$\Delta p^h = \gamma_0 + \alpha^h z_{t-1} + \sum_{i=1}^{p} \gamma_{1i}\, \Delta e_{t-i} + \sum_{i=1}^{p} \gamma_{2i}\, \Delta p_{t-i}^h + \sum_{i=1}^{p} \gamma_{3i} \Delta p_{t-i}^{ADR} + \varepsilon_{2t} \qquad (3)$$

$$\Delta p^{ADR} = \delta_0 + \alpha^{ADR} z_{t-1} + \sum_{i=1}^{p} \delta_{1i}\, \Delta e_{t-i} + \sum_{i=1}^{p} \delta_{2i}\, \Delta p_{t-i}^h + \sum_{i=1}^{p} \delta_{3i} \Delta p_{t-i}^{ADR} + \varepsilon_{3t} \qquad (4)$$

where $z_{t-1} = e_t - p_{t-1}^h + p_{t-1}^{ADR}$ is the error correction term.

Grammig et al. (2005) employs a similar model and documents the importance of explicitly modeling the exchange rate. When the exchange rate is treated as an exogenous variable (prices are converted to a common currency), the converted price absorbs any exchange rate effect. Consequently, its contribution to price discovery can be overestimated. Furthermore, the degree of exchange rate risk exposure of ADRs remains unsettled in the literature with many studies indicating that ADR returns are significantly exposed to currency fluctuations (see Section 2). Including the exchange rate as an endogenous variable in the VECM ensures that exchange rate effects are captured and not erroneously attributed to the home or ADR markets.

Of particular importance to this study are the magnitudes of the α-coefficients because they measure the different markets' speeds of adjustment to deviations from long-run equilibrium. Three aspects regarding the speed of adjustment coefficients are important[11]. First, according to the Granger Representation Theorem, the sum of the absolute values of α^e, α^h, and α^{ADR} must be greater than zero; equivalently, at least one must be statistically significant. Second, for the

[10] This cointegrating vector is based on the series entering the model in this order: exchange rate, underlying stock price, ADR price.
[11] The first two are discussed by Tse and Booth (1997) for a similar model applied to international oil futures markets.

home market to move to restore long-run equilibrium α^h must be greater than zero. Since z_{t-1} is defined the same across markets, in order for the foreign exchange and ADR markets to restore long-run equilibrium, α^e and α^{ADR} should be negative. Finally, the magnitude of the speed of adjustment coefficients also plays an important role. Garbade and Silber (1979) suggest that price adjustment can be characterized in one of two ways: adjustment is symmetrical (both markets adjust towards each other at the same rate) or adjustment may be one sided (where prices in one market usually adjust to those in the other market, with some time delay). In the latter case, the market that adjusts is coined the satellite market and the other is the dominant market. For the VECM, when a market dominates in price discovery, the absolute value of its α coefficient will be small. However, when a market has a high α (in absolute value), the market has strong adjustment to errors in prices; it behaves like a satellite market.

While the speed of adjustment coefficients offer valuable insight, they do not reveal all price discovery dynamics. For instance, suppose the home market price exhibits a high α. We can safely conclude that the home market behaves like the satellite market, but we cannot tell if the home market is responding to innovations in the ADR market or the foreign exchange market. To isolate the contribution of the ADR market to price discovery, we rely on conditional information shares (CIS, proposed by Grammig et al. (2005) and coined by Frijns et al. (2010)). The idea is that observed security prices impound an efficient implicit price which is common to all markets and sources of variation in this efficient price can be attributed to different markets. Therefore the proportion of the efficient price innovation that can be attributed to each market is that market's information share (its contribution to price discovery).

Calculating the conditional information shares requires specifying the cointegrated system in a vector moving average (VMA) representation as follows:

$\Delta P_t = \Psi(L)\varepsilon_t = \varepsilon_t + \psi_1\varepsilon_{t-1} + \psi_2\varepsilon_{t-2} + \cdots.$ (5)

Cointegration of the three price series with cointegrating vector β' implies that $\beta'\Psi(1)\varepsilon_t = 0$, where $\Psi(1) = \mathrm{I} + \psi_1 + \psi_2 + \cdots$. Estimating the $\Psi(1)$ matrix is the main component of the process since it contains information about the magnitude of the permanent effect that each of the innovations exerts on the long-run dynamics of the three prices. The value of its elements can be determined by computing impulse response functions.[12]

From Stock and Watson's (1988) common trends representation, the permanent impact of innovations on the three asset prices is given by the vector $\Psi(1)\varepsilon_t$. Writing the components of this vector explicitly yields the following:

$$\Psi(1)\varepsilon_t = \begin{bmatrix} \psi_{11} & \psi_{12} & \psi_{13} \\ \psi_{21} & \psi_{22} & \psi_{23} \\ \psi_{31} & \psi_{32} & \psi_{33} \end{bmatrix} \begin{bmatrix} \varepsilon_t^e \\ \varepsilon_t^h \\ \varepsilon_t^{ADR} \end{bmatrix}. \quad (6)$$

The first row of $\Psi(1)\ \varepsilon_t, \psi_{11}\varepsilon_t^e + \psi_{12}\varepsilon_t^h + \psi_{13}\varepsilon_t^{ADR}$, gives the long-run component of the innovations that is permanently impounded in the exchange rate. To find the conditional information shares attributable to each market we decompose the variance of the long-run impacts ($\mathrm{var}(\psi_{i1}\varepsilon_t^e + \psi_{i2}\varepsilon_t^h + \psi_{i3}\varepsilon_t^{ADR})$). These variances are found on the diagonal of the matrix $\psi\Omega\psi'$, where Ω represents the estimated variance-covariance matrix from the VECM.

In the case of contemporaneous correlation, we cannot identify an independent information share for each asset. To circumvent this problem we apply the Choleski factorization to Ω which leads to a lower triangular matrix C where $\Omega = \mathrm{CC}'$. The following equation defines the conditional information share:

[12] Here we compute the impulse response functions 500 steps ahead.

$$s_{ij} = \frac{([\psi C]_{ij})^2}{(\psi\Omega\psi')_{ii}} \text{ . (7)}$$

The Choleski factorization guarantees that the information shares will sum to unity for each price series. However, the decomposition depends on the variable ordering; it provides an upper bound for the market ordered first and a lower bound for the shares of the market ordered last. Therefore, we permute across all six variable orderings and use the average as the relevant conditional information share.

4.2 Cross-sectional analysis: explaining U.S. contributions to price discovery

After measuring the contribution of the ADR market to price discovery via conditional information shares, we employ a cross-sectional analysis to examine the role that liquidity plays in the price discovery process. Eun and Sabherwal (2003) use a cross-sectional approach to examine Canadian firms internationally cross-listed in the U.S. and document that the U.S. market's contribution to price discovery is negatively related to the ratio of the bid-ask spreads in the two countries—lower spreads in the U.S. mean more competition from U.S. market makers and consequently, more response from the home market makers. Korczak and Phylaktis (2010) find similar results for a sample of British and French firms. However, the role of liquidity in price discovery remains understudied in emerging markets.[13] Since we study price discovery for a sample of Latin American firms for which illiquidity can be so severe that no trading occurs for several days (an unlikely problem for developed markets), it is critical to identify differences in the effects of liquidity on the ADR trading in the U.S. and the underlying stock trading at home. Therefore, we estimate an equation of the following form:

$$ADRContribution = \beta_0 + \beta_1 ADR_{ILLIQ} + \beta_2 UND_{ILLIQ} + \Phi X + \varepsilon_i \text{ . (8)}$$

[13]Kadapakkam et al. (2003) document weak evidence on the role of liquidity in price discovery of Indian GDRs. They use the size of a GDR issue to proxy for liquidity due to unavailable trading data in the two markets and find that larger GDR issues are associated with greater price discovery contributions from the London market.

where *ADRContribution* is the logistic transformation of the conditional information share that captures the contribution of the ADR market to price discovery. Since the variable ranges from 0% to 100%, we transform it via the logistic transformation.[14] The transformation ensures that its values range from negative to positive infinity and therefore makes it suitable for Ordinary Least Squares regression (OLS). The variables ADR_{ILLIQ} and UND_{ILLIQ} are the Amihud (2002) measures of illiquidity for the ADR and underlying stock respectively. We expect the ADR market's contribution to price discovery to be increasing in the liquidity of the ADR but decreasing in the liquidity of the underlying stock. That is, as the liquidity of the ADR trading in the U.S. increases (equivalently illiquidity decreases) and as the liquidity of the underlying stock decreases (illiquidity increases) then the ADR contribution to price discovery should increase. Finally, *X* represents a vector of control variables including the average daily share of total dollar trading volume that occurs in the U.S., firm size as measured by the natural log of daily market capitalization averaged over the sample period, and a series of binary variables to capture industry effects and whether the ADR program is active at the end of December 2010.

Measuring liquidity is a challenge as it is an elusive concept that is not observed directly; it has several dimensions not captured by a single measure. Many measures in the extant literature utilize high-frequency intra-day data but data limitations preclude the use of measures. Consequently, we select the Amihud (2002) measure of illiquidity because it can be calculated using only daily data. The measure, which is averaged over the sample period, is calculated on a daily basis as follows:

$$ADR_{ILLIQ_i} = \frac{R_{i,d}^{ADR}}{VOL_{i,d}^{adr}} \qquad (9)$$

[14] If the conditional information share is *x* then the transformed variable is *ln(x/1-x)*.

where $R_{i,d}^{ADR}$ is the daily return of the i^{th} ADR on day d and $VOL_{i,d}^{adr}$ is the dollar trading volume of the i^{th} ADR on day *d*, defined as the number of shares traded multiplied by the ADR price on day *d* (scaled by 10^9). The measure is calculated similarly for the corresponding underlying stock (UND_{ILLIQ}), but the daily trading volume is converted from the home currency into U.S. dollars at the corresponding exchange rate on day *d*. This adjustment ensures that the measure is calculated on the same basis for all countries. This illiquidity measure captures the daily price response associated with one dollar of trading volume—it roughly measures the price impact of order flow. Since liquid markets should absorb large trading quantities without a major price response, the greater the price response to changes in trading volume, the more illiquid the stock. Thus, higher values of the variable indicate lower liquidity (higher illiquidity). An advantage of the Amihud (2002) measure is that it can be calculated even for days with no price change. However, the measure is undefined on days with no trading volume. Since lack of trading is indicative of low liquidity this measure can understate the actual illiquidity of the stock in question. Consequently, we consider an alternative measure of liquidity—trading infrequency. In some cases, ADRs and/or their underlying stocks are so illiquid that there is no trading of the stock for many regular trading days. We follow Chan et al. (2008) and measure trading infrequency as the number of days that the stock is *not* traded divided by the total number of trading days.

5. Empirical Results

5.1 Price Discovery—Stationarity and Cointegration

The first step in the analysis requires examining the stationarity of the price series. We use the following unit root tests: Augmented Dickey Fuller (ADF), the MZ_α and the MZ_t tests of Ng and Perron (2001). The null hypothesis in each of these tests is that the series has a unit root.

Since stock prices generally follow a random walk, we expect the tests to fail to reject the null hypothesis when the price series are tested in levels but to reject the null of the first difference. Panel A of Table 1 displays a summary of the results for the unit root tests—individual test results are shown in Table 2 of the Appendix. As expected, the results from different unit root tests coincide and indicate that 65% (113 of 174) of the series examined are integrated of the first order. In approximately 33% of cases, the results differ across the unit root tests but at least one test indicates the series are I(1). However, in four cases, (Argentina (1), Brazil (2), and Chile (1)) neither test supports an I(1) process. Consequently, these four firms are excluded from the remainder of the analysis.

Next, we examine whether the price and exchange rate series are cointegrated. To do so, we employ Johansen's cointegration test with a trend in the data series but not in the cointegration equation. Information criteria including the Schwarz-Bayesian (SC), Hannah-Quinn (HQ) and Akaike (AIC) guide lag length determination. Using Monte Carlo simulations to examine the performance of these information criteria, Hacker and Hatemi-J (2008) rank the SC as the best performer but document that the HQ criterion provides improvements in forecasting performance when autoregressive conditional heteroskedasticity (ARCH) effects are present. Since ARCH effects are common in financial asset data, this study favors the SBC and HQ criteria for lag selection. However, for our sample, in many cases, applying these criteria leads to problems of serial correlation in the residuals. Enders (2004) suggests that one way to improve model adequacy is to increase lag lengths of the variables included in the model. Since the AIC generally selects longer lag lengths than the SBC and HQ criteria, when the model diagnostics using the latter two criteria are poor, the AIC criterion is employed[15].

[15] In cases where model diagnostics are not improved by increasing the lag length, we estimate using the lag lengths suggested by the SC or HQ criteria.

Panel B of Table 1 presents a summary of the trace and maximum eigenvalue tests (see Johansen (1991) for a detailed description of these tests and Table 3 in the Appendix for the individual firm results). The results unambiguously support the existence of one long-run equilibrium relationship between the underlying stock price, the ADR price and the exchange rate for 86% (71 of 83) of the firms tested. In 9 cases, the results from the trace and maximum eigenvalue tests offer conflicting evidence regarding the cointegrating relationship between the three variables of interest. However, in all these cases, at least one of the employed tests supports the existence of one cointegrating equation among the three price series. Three firms (2 from Mexico and 1 from Brazil) are excluded from further analysis because the test results indicate no cointegration or more than 1 cointegrating equations.

5.2 Price Discovery—VECM Results

Next, the VECM is estimated for each of the 80 firms that exhibited one cointegrating vector based on the Johansen (1991) tests. Table 3 exhibits an overview of the results (see Appendix, Table 4 for individual firm results). The results indicate that the average long run relationship between the exchange rate, the prices of the underlying stocks, and the prices of the corresponding ADRs, is close to $\beta' = (1, -1, 1)$ which is the theoretically expected relationship. Having established that a long-run equilibrium relationship exists, we now focus on the adjustments to long-run equilibrium to examine price discovery dynamics.

The magnitudes of the speed of adjustment coefficients differ substantially across firms and countries. Therefore, we follow Eun and Sabherwal (2003) and quantify the contribution of the foreign market using a ratio of the speed of adjustment coefficients[16]. The foreign market' contribution to price discovery is the proportion of adjustment that takes place in the home

[16] In Eun and Sabherwal (2003), the exchange rate is treated as an exogenous variable and U.S. prices are converted to Canadian dollars. Thus, their ADR contribution variable is constructed as $\frac{\alpha_h}{\alpha_{ADR} + |\alpha_h|}$.

market as a result of trading the security in the United States. Specifically, the variable is defined as

$$ForeignMarketContribution = \frac{\alpha_h}{\alpha_h + |\alpha_e| + |\alpha_{ADR}|}. \qquad (10)$$

When there is no feedback from the ADR or foreign exchange markets, then α_h will be zero and *ForeignMarketContribution* will be zero. That is, the home market dominates in price discovery and the foreign market is the satellite market. When *ForeignMarketContribution* equals 1 (equivalently 100%), all adjustments to restore long-run equilibrium are made by the home market. In this case, the foreign market dominates in price discovery and the home market behaves as the satellite market. Other values of *ForeignMarketContribution* indicate that both markets contribute to the price discovery function. An overview of the results is presented in Panel B of Table 2 (see Appendix, Table 5 for individual firm results).

The values of the speed of adjustment coefficients indicate that in Latin America (unlike Germany—based on Grammig et al. (2005)) the exchange rate is not exogenous with respect to stock prices. Since firms that issue exchange-listed ADRs are among the largest firms in the domestic market, our results coincide with the findings of Diamandis and Drakos (2011) who document a significant relationship between stock and foreign exchange markets in Latin American countries. While the exchange rate adjusts to eliminate deviations from long-run equilibrium in each market, the degree of adjustment varies across countries. For example, in Brazil α^e is statistically significant for 75% (see individual firm results) of the firms sampled—its average magnitude (in absolute terms) across all firms is 8.9%. In Mexico, the exchange rate corrects deviations from long-run equilibrium less frequently but corrections can reach levels of 28.4%. The exchange rate effects are less pronounced in Argentina and Chile. In Chile, 60% of firms exhibit adjustment through the exchange rate but the corrections are small (less than 7%)

while in Argentina the maximum exchange rate adjustment is 1.3%. The results, particularly for Brazil and Mexico, highlight the importance of incorporating the exchange rate as an endogenous variable.

Moreover, the speed of adjustment coefficients indicate a mixture of price discovery locations among Latin American firms. First, consistent with most literature on price discovery, the home market is the dominant market in Chile. The average correction of the ADR market to deviations from long-run equilibrium triples that of the home market. In addition, the average foreign market contribution is on average 23.85% and is at most 57.83%. In most Chilean firms (80%), the home market dominates—in 3 cases price discovery occurs exclusively in the home market. One exception is Lan Airlines. This case, however, is an anomaly because deviations from long-run equilibrium are corrected only through the foreign exchange market.

In Brazil, both the domestic and foreign markets contribute to price discovery. The average values of α^h and α^{ADR} are similar and the average foreign market contribution is 39.36%. In 55% of Brazilian firms, both the home and foreign markets contribute to price discovery. While the contribution of the home market is generally stronger, for approximately 23% of Brazilian firms, price discovery occurs exclusively in the foreign market.

The results are vastly different in Argentina and Mexico where the foreign market clearly dominates in price discovery. In Argentina, the average values of α^h and α^{ADR} are similar but the average foreign market contribution is 63.23%. Individual firm results indicate that for 67% of Argentinean firms, both the domestic and foreign markets contribute to price discovery. However, in the remaining firms, price discovery occurs exclusively in the foreign market. Interestingly, for no firm in Argentina does price discovery occur exclusively at home. In Mexico, the importance of the foreign market in price determination is unquestionable. For 40%

of Mexican firms price discovery exclusively in the foreign market. Furthermore the average value of α^h almost doubles the average value of α^{ADR} and the average foreign market contribution is 59.50%. This is in sharp contrast to the findings of von Furstenberg and Tabora (2004), who argue that in Mexico there "is little support for the argument that the demise of local markets is inevitable." Their conclusion that corrections to long-run equilibrium are made through the ADR market and not the home market is drawn from an examination of two Mexican ADRs during the period 1996-2002. However, the current results which utilize an expanded sample and a different time period indicate that while the Mexican market is not irrelevant, it is less important than the foreign market for price determination.

In addition, the foreign market contribution is not driven by exchange rate effects. The conditional information shares, summarized in Table 3 (individual firm results are displayed in the Appendix, Table 5), support the conclusions drawn from the speed of adjustment coefficients. First, the exchange rate is not exogenous with respect to stock market prices. The CIS of underlying stock prices on the exchange rate ranges from 2.38% in Argentina to 7.75% in Brazil. Surprisingly, the CIS of ADR prices on the exchange rate is even higher, reaching a maximum of 22.09% in Brazil. However, the largest CIS of the exchange rate comes from itself (over 50% in all cases). Therefore, these results indicate that the exchange rate is not determined by the stock market; yet it is sensitive to stock market innovations.

Furthermore, the remaining conditional information shares support the price discovery dynamics suggested by the speed of adjustment coefficients. In Chile, whether we decompose underlying stock prices or ADR prices, the average CIS of the home price exceeds the average CIS of the ADR price. This indicates that the home market dominates in price discovery. The opposite occurs in Argentina and Mexico. The average CIS of p^h is lower than 40% while the average CIS of p^{ADR} is approximately 60% for both p^h and p^{ADR}. Thus, on average, price discovery in these two countries occurs primarily in the ADR market. For Brazil, the average conditional information shares do not tell a clear story. For example, the average CIS of p^h for p^h and the average CIS of p^{ADR} for p^{ADR} are each approximately 50%. In Brazil, the CIS results support our previous finding that price discovery occurs in both the home and ADR markets.

Unlike the standard result in the price discovery literature, our results indicate the foreign market is an important contributor to price discovery for many Latin American firms. The VECM results indicate that the foreign market is particularly important for price discovery of Argentinean and Mexican firms. However, the results also reveal that important differences exist across firms even within the same country. Therefore, we now proceed to examine factors that may explain these differences.

5.3 Cross-sectional results

Descriptive statistics of the independent variables used in the cross-sectional analysis are displayed in Table 4. The statistics reveal cross-country differences in liquidity and within-country differences in the liquidity of the ADR relative to the underlying stock. For example, ADRs from Argentina are the least liquid based on the average ADR_{ILLIQ} measure. However, the underlying stocks trading in Mexico exhibit higher average values of illiquidity than stocks in the other Latin American countries. Looking within countries reveals illiquidity is higher in the underlying stocks than in the ADRs of Argentina and Mexico. The opposite is observed in Chile and Brazil where average liquidity is lower among the ADRs than the underlying stocks.

Regarding the average U.S. share of total trading, Argentina and Mexico differ from Chile and Brazil because most trading occurs in the ADR market (average values exceed 60%). Firm size, as measured by the average of market capitalization does not appear to vary greatly across countries. In addition to the summary statistics, we divided the sample into two groups based on whether the ADR contribution to price discovery exceeds 50% and we conducted univariate tests to assess whether the groups differ on the aforementioned set of characteristics. The results, shown in the last column of Table 4, indicate that firms with a high contribution to price discovery from the ADR market exhibit lower levels of underlying stock liquidity (higher illiquidity and higher trading infrequency) and higher shares of trading in the United States. Yet, on average, the groups do not appear to be statistically different with respect to the liquidity of ADRs or firm size.

Next, we estimate Equation (8) and present the results in Table 5, Panel A.[17] The results indicate that liquidity influences the ADR market's contribution to price discovery. First, consistent with our expectations, higher illiquidity of the ADR is associated with lower price discovery in the U.S. market. However, this relationship disappears when we control for firm size or the U.S. share of total dollar trading volume.

More importantly, the liquidity of the underlying stock exerts a statistically significant influence on the ADR market's contribution to price discovery. Specifically, more illiquidity in the underlying stock is consistent with a higher share of price discovery occurring in the U.S. market. This result is consistent across different equation specifications. It is important to note, however, that the U.S. share of total trading also plays a critical role in determining the price discovery location. This result is consistent with Eun and Sabherwal (2003) who suggest that higher shares of U.S. trading indicate a higher degree of informativeness of the U.S. market relative to the domestic market. They document evidence that higher shares of trading volume in the U.S. are consistent with higher contributions made by the U.S. market in the price discovery

[17] The results displayed include only the Amihud (2002) illiquidity variables. Regression results using the trading infrequency variable offer the same conclusions.

of Canadian cross-listed firms. However, an important problem arises here—the possibility exists that the U.S. share of total trading is not exogenous to liquidity. That is, trade migration to the U.S. may be a consequence of low liquidity in the stock market. Furthermore, continued trade migration can exacerbate problems of illiquidity at home. While our current analysis is unable to disentangle these two effects, the fact that underlying stock liquidity remains statistically significant when controlling for U.S. share of total trading confirms its importance in the price discovery process. Thus, it appears that in Latin America, low liquidity of the domestic stocks results in the decreasing importance of the home market for price discovery.

Furthermore, the multivariate results confirm that firm size does not explain differences in the contribution of the ADR market to price discovery. This result creates a third alternative to an already mixed set of results in the empirical literature. In general, previous findings suggest that firm size matters but the direction of its impact on the U.S. market's contribution to price discovery is unclear—positive for Canadian firms (Eun and Sabherwal (2003)) but negative for French and British firms (Korczak and Phylaktis (2010)). Issuing exchange listed ADRs is a costly process—firms have to comply with the Securities and Exchange Commission's disclosure requirements and with generally accepted accounting principles. Consequently, only the larger Latin American firms tend to list their ADRs on exchanges. The statistical insignificance of the size variable may reflect that the sample consists primarily of large firms such that size differences become trivial.

Finally, none of the binary variables are statistically significant. We categorize firms into industries using the Fama-French 5-industry groups based on 4-digit SIC codes. No firms are classified as health care firms, so the sample is separated into 4 industry clusters: consumer, manufacturing, hi-tech, and other. In our estimations we use the hi-tech industry as the reference category. In addition, the *active* variable captures whether the ADR program was still active at the end of the sample period. We conclude that the U.S. market's contribution to price discovery for internationally cross-listed Latin American firms does not vary by industry.

The summary statistics presented in Table 4 indicate that trading infrequency is a severe problem for some underlying stocks particularly in Argentina and Mexico. Examining individual firm data suggests that there are several firms in the sample for which trading infrequency in the home market is extreme (over 70%). As should be expected, these firms exhibit most of their trading in the U.S. with values of U.S. share of total trading approximating 100%. To ensure that the regression results are not driven by these extreme observations, we remove these observations and re-estimate Equation (8). Panel B of Table 5 displays the results.

Excluding these observations reveals that our previous results are not driven by outliers. In fact, the presence of these extreme observations masks important effects of liquidity on the contribution of the ADR market to price discovery. The results indicate that the price discovery location is sensitive to changes in the liquidity of the ADR trading in the United States—higher illiquidity in the U.S. is consistent with lower U.S. contributions to price discovery. In addition, the results for the underlying stock remain statistically significant, with the correct sign, but the magnitudes increase substantially by excluding the extreme observations. The U.S. share of total trading continues to exert an important influence on the contribution of the ADR market to price discovery. However, the results suggest that the influence of this variable is somewhat driven by the inclusion of outlier observations since the magnitudes of these coefficients is now smaller. Consistent with our previous results, the price discovery location is not a function of firm size for Latin American firms. Finally, there are still no statistically significant industry effects, although the results indicate that the contribution of the U.S. market to price discovery is higher among the ADR issues that remain active in the U.S. market than for those that were terminated during the sample period.

6. Conclusion

This paper examines price discovery for ADR issues from Latin America and contributes to the literature on price discovery in several distinct ways. To begin with, this is the first comprehensive analysis of price discovery dynamics for ADR issues from Latin America—an ideal setting for examining price discovery in an environment of low domestic liquidity. In addition, this is the first attempt among studies of price discovery in emerging markets that allows for an endogenous role of exchange rate fluctuations and that examines the link between liquidity and price discovery.

The results indicate that unlike the results from developed markets, the exchange rates in Latin America (particularly Brazil and Mexico) are sensitive to innovations in stock market prices. Moreover, we find a mixture of price discovery locations for ADRs from Latin America. Price discovery occurs primarily in the home market in Chile, in both the home and foreign markets in Brazil, and primarily in the ADR market in Argentina and Mexico. Furthermore, we undertake a cross-sectional analysis that indicates that liquidity, particularly of the underlying stock, significantly influences the price discovery location. Specifically, higher levels of illiquidity at home are consistent with higher contributions to price discovery from the foreign market. This relationship holds after controlling for firm size, U.S. share of total trading, and industry effects.

Overall, our results support the premise that an environment of low domestic liquidity increases the importance of the U.S. market in price discovery. An important implication from these findings is that if investment in ADR issues from Latin America continues increasing, but conditions, particularly liquidity, in the domestic market remains limited, the role of the domestic market in price discovery can become obsolete. A stock market incapable of providing suitable pricing information is unlikely to attract new participants—investors and issuers both. Therefore, future research should examine the dynamic relationship between rising ADR investments and stock market conditions in Latin America.

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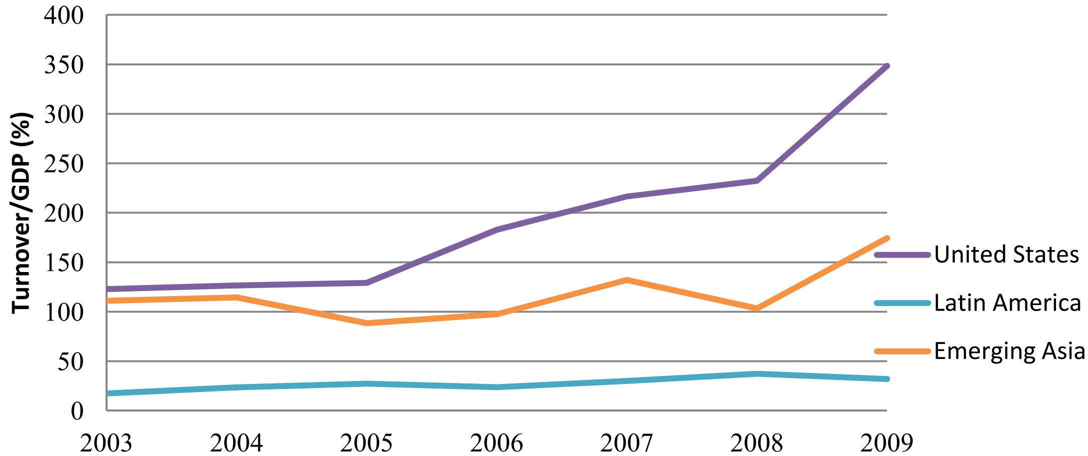

Figure 1: Ratio of Turnover to GDP
Source: World Bank

Notes: Except for the United States, the values are averaged for a set of countries in each region. Countries included are those comprising at least 5% of the ADR issues in their region, and classified as developing according to the World Bank. Latin America includes Argentina, Brazil, Chile and Mexico while Emerging Asia includes China and India.

Table 1
Preliminary Tests

Panel A: Summary of Unit Root Tests

Country	P^{ADR} are I(1) All tests	P^{ADR} are I(1) At least 1	P^{ADR} are integrated of different order	P^{h} are I(1) All tests	P^{h} are I(1) At least 1	P^{h} are integrated of different order
Argentina	4	5	1	8	2	0
Brazil	21	16	1	28	9	1
Chile	9	2	0	8	2	1
Mexico	17	11	0	18	10	0

Panel B: Summary of Cointegration Tests

	Number of Cointegrating Equations			
	1		0	>1
Country	All tests	At least 1		
Argentina	9	0	0	0
Brazil	31	4	0	1
Chile	9	1	0	0
Mexico	22	4	1	1

Notes: Tests are conducted using daily data from 1/1/2003 to 12/31/2010. Individual firm results are found in the Appendix.
The unit root tests employed include the Augmented Dickey-Fuller (ADF) t-tests for unit roots and two of the M-tests developed by Ng and Perron (2001). A deterministic trend is included only when testing the series in levels. Lag length (*k*) for the ADF tests is chosen by the Campbell-Perron data dependent procedure, whose method is usually superior to *k* chosen by the information criterion, according to Ng and Perron (1995). The Ng and Perron (2001) M-tests, MZ_α and MZ_t, can be viewed as modified versions of the Phillips and Perron (1988) Z_α and Z_t tests, which suffer from severe size distortions when the errors have a negative moving average (MA) root. The method involves construction of the DF-GLS modified ADF test proposed by Elliott et al. (1996) and computation of the MZ_α and MZ_t statistics as defined in Ng and Perron (2001). Lag lengths for the M-tests are selected using the modified Akaike information criteria.
The cointegration tests employed are the trace and maximal eigenvalue tests. Each test is allowed a deterministic trend in the series but not in the cointegrating equation. Lag selection is determined by estimating the model using each information criterion: Schwarz-Bayesian (SC), Hannah-Quinn (HQ) and Akaike (AIC). The SBC and HQ are the preferred information criteria for lag selection based on evidence in Hacker and Hatemi-J (2008). When model diagnostics using SC or HQ are poor, the AIC criterion is employed due to its selection of longer lag lengths.

Table 2
Vector Error Correction Models

Panel A: Estimated Values of β (Normalized such that β^{fx}=1

		Argentina	Brazil	Chile	Mexico
β^h	Average	-0.965	-1.012	-1.005	-0.983
	Minimum	-0.873	-0.967	-0.833	-0.705
	Maximum	-1.077	-1.281	1.270	-1.342
β^{ADR}	Average	0.912	1.006	0.994	0.986
	Minimum	0.692	0.942	0.782	0.710
	Maximum	1.042	1.224	1.271	1.312

Panel B: Estimated Values of α

		Argentina	Brazil	Chile	Mexico
α^e	Average	-0.002	-0.089	-0.029	-0.062
	Minimum	0	0	0	0
	Maximum	-0.013	-0.166	-0.122	0.284
α^h	Average	0.132	0.215	0.087	0.216
	Minimum	0.046	0	0	0
	Maximum	0.232	0.539	0.236	0.804
α^{ADR}	Average	-0.151	-0.194	-0.313	-0.118
	Minimum	0	0	0	0
	Maximum	-0.517	-0.506	0.588	0.631
Foreign Market Contribution	Average	63.23%	39.36%	23.85%	59.50%
	Minimum	20.44%	0%	0%	0%
	Maximum	100%	100%	57.83%	100%

Notes: Vector error correction models are conducted using daily data from 1/1/2003 to 12/31/2010. Foreign market contribution is defined as $\frac{\alpha^h}{\alpha^h+|\alpha^e|+|\alpha^{ADR}|}$.

Table 3
Conditional Information Shares

CIS of Exchange Rate in		Argentina	Brazil	Chile	Mexico
Exchange Rate	Average	92.96%	70.16%	83.79%	81.47%
	Minimum	79.72%	52.62%	54.84%	52.55%
	Maximum	99.13%	93.32%	96.49%	99.11%
Underlying Stock	Average	0.70%	3.82%	2.77%	3.03%
	Minimum	0.05%	0.38%	0.92%	1.02%
	Maximum	2.81%	9.51%	9.26%	8.11%
ADR	Average	1.27%	11.65%	10.37%	8.56%
	Minimum	0.09%	3.85%	0.50%	0.97%
	Maximum	3.59%	25.05%	20.61%	21.21%
CIS of Underlying Stock in					
Exchange Rate	Average	2.38%	7.75%	3.50%	5.27%
	Minimum	0.48%	1.34%	0.56%	0.06%
	Maximum	9.69%	13.12%	11.73%	14.10%
Underlying Stock	Average	39.32%	50.42%	59.62%	39.28%
	Minimum	2.25%	5.47%	35.21%	3.63%
	Maximum	71.33%	86.28%	81.60%	72.80%
ADR	Average	38.04%	40.88%	47.17%	33.42%
	Minimum	1.33%	31.43%	30.38%	4.23%
	Maximum	70.44%	67.85%	82.03%	61.74%
CIS of ADR in					
Exchange Rate	Average	4.66%	22.09%	12.71%	13.27%
	Minimum	0.16%	5.33%	2.95%	0.53%
	Maximum	10.59%	34.41%	33.43%	33.35%
Underlying Stock	Average	59.97%	44.35%	37.62%	57.69%
	Minimum	28.53%	11.94%	15.81%	19.10%
	Maximum	95.91%	54.50%	55.54%	94.10%
ADR	Average	60.70%	47.48%	42.45%	58.02%
	Minimum	27.54%	14.20%	17.46%	17.05%
	Maximum	97.73%	62.87%	59.52%	91.13%

Notes: Conditional information shares are computed using data from 1/1/2003 to 12/31/2010. The different blocks in each panel show the conditional information shares in the different markets. For example, the 92.96% in the first row, first column indicates that in Argentina the exchange rate has an average conditional information share of 92.96% in itself.

Table 4

Descriptive Statistics-Cross Sectional Regression Related Variables

	Statistic	Argentina	Brazil	Chile	Mexico	t-statistic
ADR_{ILLIQ}	Mean	2.665	0.370	0.821	0.808	0.595
	Standard deviation	4.973	0.993	1.765	1.090	
UND_{ILLIQ}	Mean	3.468	0.087	0.141	5.370	-2.218**
	Standard deviation	4.321	0.243	0.172	11.769	
ADR Infrequency	Mean	0.063	0.020	0.039	0.068	0.219
	Standard deviation	0.147	0.059	0.051	0.080	
UND Infrequency	Mean	0.134	0.012	0.018	0.169	-2.384**
	Standard deviation	0.193	0.063	0.033	0.238	
U.S. share of total trading	Mean	0.670	0.464	0.390	0.613	-4.720***
	Standard deviation	0.217	0.187	0.115	0.280	
Log (MarketCap)	Mean	6.200	7.998	7.634	6.978	-0.436
	Standard deviation	1.081	1.580	0.856	1.464	

Notes: ADR_{ILLIQ} and UND_{ILLIQ} represent the Amihud (2002) measure of illiquidity for the ADR and underlying stock respectively. The variable is calculated daily and averaged over the sample period. Calculation is as follows:

$ADR_{ILLIQ_i} = \frac{R_{i,d}^{ADR}}{VOL_{i,d}^{adr}}$ where $R_{i,d}^{ADR}$ is the daily return of the i-th ADR on day d and $VOL_{i,d}^{adr}$ is the dollar trading volume of the i-th ADR on day d, defined as the number of shares traded multiplied by the ADR price on day d, scaled by 10^9. The Amihud illiquidity measure for the corresponding underlying share (UND_{ILLIQ}) is computed similarly, but the daily trading volume is converted from the home currency into U.S. dollars at the corresponding exchange rate on day d. ADR and UND infrequency represent trading infrequency for the ADR and underlying stock respectively. Trading infrequency is calculated following Chan et al. (2008) as the number of days that the stock is *not* traded divided by the total number of trading days. The U.S. share of total trading is the share of dollar trading volume that occurs in the United States of total dollar trading volume. This variable is calculated on a daily basis and averaged over the sample period. Log (MarketCap) is the natural logarithm of the firm's daily market capitalization, averaged over the sample period. The t-statistics in the last column are derived from univariate mean comparison tests where we divide the sample into two groups based on whether the ADR contribution to price discovery exceeds 50%.

, * represent statistical significance at the 5% and 1% levels respectively.

Table 5
Cross Sectional Regression Results

Panel A: Full Sample

	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.036	-0.027	-0.702***	-0.528	-0.477	-0.426
	(0.088)	(0.485)	(0.200)	(0.460)	(0.478)	(0.495)
ADR_{ILLIQ}	-0.069*	-0.067	-0.028	-0.034	-0.031	-0.027
	(0.041)	(0.044)	(0.039)	(0.041)	(0.042)	(0.049)
UND_{ILLIQ}	0.058***	0.059***	0.037***	0.036***	0.033**	0.032**
	(0.012)	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)
Log (MarketCap)		0.008		-0.024	-0.054	-0.053
		(0.061)		(0.057)	(0.062)	(0.064)
U.S. share of total trading			1.426***	1.448***	1.439***	1.447***
			(0.354)	(0.359)	(0.375)	(0.382)
Active					0.221	0.272
					(0.193)	(0.221)
Consumer						-0.148
						(0.221)
Manufacturing						-0.162
						(0.210)
Other						-0.138
						(0.248)
F-statistic	13.00***	8.56***	15.81***	11.77***	9.42***	5.79***
Adj. R^2	23.29	22.30	35.99	35.29	35.96	33.83

Panel B: Cross Sectional Regression Results Excluding Outliers

	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-0.027	-0.232	-0.464	-0.490	-0.437	-0.328
	(0.078)	(0.423)	(0.196)	(0.425)	(0.438)	(0.452)
ADR_{ILLIQ}	-0.145***	-0.138***	-0.101**	-0.101**	-0.100**	-0.103**
	(0.040)	(0.042)	(0.043)	(0.044)	(0.045)	(0.048)
UND_{ILLIQ}	0.190***	0.192***	0.146***	0.146***	0.151***	0.150***
	(0.032)	(0.032)	(0.036)	(0.037)	(0.038)	(0.039)
Log (MarketCap)		0.026		0.004	-0.030	-0.033
		(0.053)		(0.053)	(0.057)	(0.059)
U.S. share of total trading			0.870**	0.865**	0.795**	0.778*
			(0.360)	(0.369)	(0.385)	(0.395)
Active					0.291	0.339*
					(0.179)	(0.191)
Consumer						-0.253
						(0.207)
Manufacturing						-0.149
						(0.194)
Other						-0.065
						(0.239)
F-statistic	18.12***	12.04***	14.82***	10.97***	9.16***	5.82***
Adj. R^2	31.06	30.35	35.30	34.41	36.16	34.86

Notes: ADR_{ILLIQ} and UND_{ILLIQ} represent the Amihud (2002) measure of illiquidity for the ADR and underlying stock respectively, calculated daily and averaged during the sample period. The *U.S. share of total trading* is the share of dollar trading volume that occurs in the United States of total dollar trading volume. This variable is calculated on a daily basis and averaged over the sample period. *Log (MarketCap)* is the natural logarithm of the firm's daily market capitalization, averaged over the sample period. *Active* takes on the value of 1 if the ADR issue is active at the end of the sample period and zero otherwise. *Consumer, Manufacturing* and *Other* represent dummy variables to control for industry effects. Firms are categorized into industries using French's 5-industry groups based on 4-digit SIC codes. No firms are classified as health care firms and the hi-tech industry serves as the reference category. Panel B excludes 3 outlier observations.
*,**,*** represent statistical significance at the 10%, 5%, and 1% levels respectively.

Appendix

Table 1

List of Firms By Country

	Firm Name	Industry
Argentina		
Firm 1	Alto Palermo	Real Estate
Firm 2	Cresud Sacifya	Food Producers
Firm 3	Empresa Distribuidora y Comercializadora Norte	Electricity
Firm 4	Metrogas	Gas, Water, and Multiutilities
Firm 5	Pampa Energia	Electricity
Firm 6	Petrobras Argentina	Oil & Gas Producers
Firm 7	Telecom Argentina	Mobile Telecommunications
Firm 8	Telefonica de Argentina	Fixed Line Telecommunications
Firm 9	Transportadora Gas del Sur	Oil Equipment & Services
Firm 10	YPF	Oil & Gas Producers
Brazil		
Firm 1	Aracruz	Forestry & Paper
Firm 2	Brasil Telecom PF	Fixed Line Telecommunications
Firm 3	Brasil Telecom C	Fixed Line Telecommunications
Firm 4	Brasil Telecom	Fixed Line Telecommunications
Firm 5	Braskem SA	Chemicals
Firm 6	Brasil Foods	Food Producers
Firm 7	Centrais Electricas Brasileria Eletrobras ON	Electricity
Firm 8	Centrais Electricas Brasileria Eletrobras PNB	Electricity
Firm 9	Compania Energetica de Minas Gerais	Electricity
Firm 10	Compania Saneamento Basico	Gas, Water, and Multiutilities
Firm 11	Compania Paranaense de Energia	Electricity
Firm 12	Companhia Brasileira Distribuicao PN	Food & Drug Retailers
Firm 13	Companhia de Bebidas Das Americas PN	Beverages
Firm 14	Companhia de Bebidas Das Americas ON	Beverages
Firm 15	CPFL Energy	Electricity
Firm 16	Embraer	Aerospace & Defense
Firm 17	Gafisa SA	Household Goods & Home Construction
Firm 18	Gerdau PN	Industrial Metals & Mining
Firm 19	Gol Linhas Aereas Inteligentes	Travel & Leisure
Firm 20	Net Servicos da Communicacao	Media
Firm 21	Petroleo Brasileiro	Oil & Gas Producers
Firm 22	Sadia	Food Producers
Firm 23	Siderurgica Nacional	Industrial Metals & Mining
Firm 24	Tam SA	Travel & Leisure
Firm 25	Tele Centro Oeste Celular	Mobile Telecommunications
Firm 26	Tele Lest	Mobile Telecommunications
Firm 27	Tele Nort	Mobile Telecommunications
Firm 28	Tele Norte	Fixed Line Telecommunications
Firm 29	Tele Sudeste Celular	Mobile Telecommunications
Firm 30	Telemig	Mobile Telecommunications
Firm 31	Telesp PN	Fixed Line Telecommunications
Firm 32	Tim Participacoes	Mobile Telecommunications
Firm 33	Ultrapar Participacoes	Gas, Water, & Multiutilities
Firm 34	Vale ON	Industrial Metals & Mining
Firm 35	Vale PN	Industrial Metals & Mining
Firm 36	Vivo Participacoes SA	Mobile Telecommunications
Firm 37	Petroleo Brasileiro A	Oil & Gas Producers

Firm 38	Companía Energetica de Minas Gerais	Electricity
Chile		
Firm 1	Enersis	Electricity
Firm 2	Andina B	Beverages
Firm 3	Cervecerias Unidas	Beverages
Firm 4	CTC	Fixed Line Telecommunications
Firm 5	Empresa Nacional de Electricidad	Electricity
Firm 6	Lan Airlines	Travel & Leisure
Firm 7	Masisa SA	Construction & Materials
Firm 8	Quinenco	General Industrials
Firm 9	Vina Concha y Toro	Beverages
Firm 10	Andina A	Beverages
Firm 11	SQM	Chemicals
Mexico		
Firm 1	Grupo Aeroportuario del Centro Norte	Industrial Transportation
Firm 2	Grupo Aeroportuario del Pacifico	Industrial Transportation
Firm 3	Grupo Aeroportuario del Sureste	Industrial Transportation
Firm 4	Cemex	Construction & Materials
Firm 5	Ceramic	Construction & Materials
Firm 6	Coca-Cola Femsa	Beverages
Firm 7	Controladora Comercial Mexicana	Food & Drug Retailers
Firm 8	Desc	Chemicals
Firm 9	Empresas ICA	Construction & Materials
Firm 10	Fomento Economico Mexicano	Beverages
Firm 11	Gruma	Food Producers
Firm 12	Grupo Casa Saba	Food & Drug Retailers
Firm 13	Grupo IMSA	Industrial Metals & Mining
Firm 14	Grupo Radio Centro	Media
Firm 15	Grupo Simec	Industrial Metals & Mining
Firm 16	Grupo Televisa	Media
Firm 17	Desarrolladora Homex	Household Goods & Home Construction
Firm 18	Industrias Bachoco	Food Producers
Firm 19	Maseca	Food Producers
Firm 20	Maxcom Telecomunicaciones	Fixed Line Telecommunications
Firm 21	Telefonos de Mexico L	Fixed Line Telecommunications
Firm 22	TV Azteca	Media
Firm 23	Vitro	General Industrials
Firm 24	America Movil A	Mobile Telecommunications
Firm 25	America Movil L	Mobile Telecommunications
Firm 26	Grupo TMM	Industrial Transportation
Firm 27	Telefonos de Mexico A	Fixed Line Telecommunications
Firm 28	Telmex Internacional A	Fixed Line Telecommunications

Notes: Sample includes ADRs (active and terminated) issued from Latin America available from the DataStream International database and verifiable via the Bank of New York, Citibank's, or Deutsche Bank's ADR websites. Only non-financial, exchange-listed ADR programs trading for more than one year during the period January 2003-December 2010 and with price data available for the ADR and the underlying stock in DataStream International are included.

Table 2
Unit Root Tests

		Tests in Levels			Tests in First Differences		
Firm	Series	ADF (k)	Ng-Perron MZ_{α}	Ng-Perron MZ_t	ADF (k)	Ng-Perron MZ_{α}	Ng-Perron MZ_t
Argentina							
	FX	-3.187 (12)*	-0.404	-0.290	-10.325(15)***	-7.339*	-1.876*
Firm1	P^{ADR}	-1.677 (14)	-4.408	-1.485	-14.121 (13)***	-5.039	-1.570
	P^{H}	-1.623 (8)	-3.889	-1.389	-14.997 (7)***	-0.805	-0.504
Firm 2	P^{ADR}	-2.828 (14)	-4.967	-1.575	-43.807 (0)***	-34.410***	-4.119***
	P^{H}	-2.535 (11)	-6.967	-1.864	-13.544 (0)***	-14.348***	-2.665***
Firm 3	P^{ADR}	-0.225 (5)	-0.937	-0.437	-13.992 (4)***	-21.599***	-3.284***
	P^{H}	-0.371 (15)	-1.036	-0.477	-7.139 (14)***	-66.261***	-5.756***
Firm 4	P^{ADR}	-2.599 (15)	-1.546	-0.735	-12.405 (14) ***	-5.484	-1.487
	P^{H}	-2.709 (8)	-2.121	-0.906	-14.751 (7) ***	-12.452**	-2.457**
Firm 5	P^{ADR}	-0.907 (9)	-1.049	-0.456	-19.135 (0) ***	-3.873	-1.339
	P^{H}	-1.109 (5)	-0.889	-0.386	-7.061 (4) ***	-85.686***	-6.545***
Firm 6	P^{ADR}	-2.514 (13)	-4.145	-1.440	-12.025 (12) ***	-3.379	-1.243
	P^{H}	-2.861 (2)	-11.157	-2.323	-33.755 (1) ***	-1042.70***	-22.833***
Firm 7	P^{ADR}	-2.5122 (7)	-1.72977	-0.898	-18.541 (6) ***	-2.95567	-1.1438
	P^{H}	-2.227 (9)	-2.574	-1.122	-16.420 (8) ***	-10.542***	-2.274**
Firm 8	P^{ADR}	-3.028 (3)	-2.987	-1.156	-24.809 (2) ***	-238.708***	-10.925***
	P^{H}	-2.366 (9)	-4.656	-1.487	-14.262 (8) ***	-362.661***	-13.466***
Firm 9	P^{ADR}	-2.817 (1)	-1.427	-0.839	-48.960 (0) ***	-0.126**	-0.107**
	P^{H}	-2.057 (5)	-2.353	-1.082	-21.234 (4) ***	-11.154	-2.344
Firm 10	P^{ADR}	-3.447 (13)**	-1.677	-0.874	-12.907 (12) ***	-1.929	-0.891
	P^{H}	-3.271 (12)*	-2.337	-1.062	-14.488 (11) ***	-16.720***	-2.876***
Brazil							
	FX	-2.214 (12)	-6.009	-1.699	-10.412 (15)***	-43.052***	-4.640**
Firm 1	P^{ADR}	-1.833 (14)	-4.578	-1.444	-7.732 (15) ***	-4.597	-1.471
	P^{H}	-1.943 (15)	-5.557	-1.595	-8.244 (14) ***	-18.251***	-3.017***
Firm 2	P^{ADR}	-2.403 (4)	-8.950	-2.115	-22.829(3)	-4.487	-1.486
	P^{H}	-2.428(7)	-12.041	-2.447	-18.316 (6)***	-885.260***	-21.036***
Firm 3	P^{ADR}	-1.905 (3)	-3.348	-1.168	-8.349 (2) ***	-1.725	-0.875
	P^{H}	-1.998 (0)	-2.050	-0.867	-15.897 (0) ***	0.187	0.244
Firm 4	P^{ADR}	-2.837 (0)	-11.256	-2.353	-46.335(0)***	-1042.77***	-22.834***
	P^{H}	2.354 (13)	-11.828	-2.420	-13.861(12)***	-1040.49***	-22.809***
Firm 5	P^{ADR}	-2.336 (10)	-1.345	-0.806	-13.409 (9) ***	-7.661*	-1.927*
	P^{H}	-2.491 (12)	-1.127	-0.738	-11.613 (11) ***	-1.066	-0.610
Firm 6	P^{ADR}	-1.814 (13)	-6.494	-1.798	-10.797 (12) ***	-612.648***	-17.502***
	P^{H}	-2.232 (12)	-612.648	-17.502	-12.734 (11) ***	-8.768**	-2.084**
Firm 7	P^{ADR}	-3.161 (4)*	-9.345	-2.056	-24.405 (3) ***	-5.845*	-1.688*
	P^{H}	-3.354 (0)*	-14.329*	-2.565*	-44.086 (0) ***	-14.318***	-2.665***
Firm 8	P^{ADR}	-3.276 (13)*	-9.281	-2.099	-20.271 (6) ***	-4.028	-1.384
	P^{H}	-3.572 (6)**	-16.137	-2.788	-21.328 (5) ***	-12.354**	-2.474**

Firm 9	P^{ADR}	-2.119 (10)	-2.582	-1.010	-12.538 (15) ***	-20.240***	-3.177***
	P^{H}	-2.143 (10)	-2.931	-1.065	-12.851 (15) ***	-22.338***	-3.337***
Firm 10	P^{ADR}	-1.975 (10)	-5.664	-1.662	-14.863 (9) ***	-1042.430***	-22.830***
	P^{H}	-2.060 (12)	-5.979	-1.713	-13.785 (11) ***	-16.470***	-2.864***
Firm 11	P^{ADR}	-2.099 (13)	-8.758	-2.083	-15.466 (9) ***	-5.145	-1.586
	P^{H}	-2.353 (7)	-10.246	-2.263	-20.593 (6) ***	-11.326**	-2.373**
Firm 12	P^{ADR}	-2.508 (12)	-12.595	-2.465	-16.906 (8) ***	-10.655**	-2.277**
	P^{H}	-2.343 (14)	-10.499	-2.183	-12.378 (13) ***	-193.008***	-9.824***
Firm 13	P^{ADR}	-2.106 (2)	-3.914	-1.398	-11.910 (15) ***	-1042.780***	-22.834***
	P^{H}	-1.908 (4)	-5.402	-1.625	-11.213 (15) ***	-11.217**	-2.347**
Firm 14	P^{ADR}	-1.925 (10)	-7.667	-1.933	-15.576 (9) ***	-17.133***	-2.916***
	P^{H}	-2.015 (9)	-9.493	-2.094	-17.177 (8) ***	-18.893***	-3.065***
Firm 15	P^{ADR}	-2.273 (6)	-3.948	-1.381	-19.237 (5) ***	-3.785	-1.335
	P^{H}	-2.598 (7)	-6.168	-1.729	-17.791 (6) ***	-3.363	-1.239
Firm 16	P^{ADR}	-2.022 (1)	-3.394	-1.286	-12.035 (13) ***	-11.986**	-2.438**
	P^{H}	-1.904 (14)	-5.130	-1.592	-12.519 (13) ***	-26.706***	-3.649***
Firm 17	P^{ADR}	-1.663 (2)	-5.709	-1.682	-23.289 (1) ***	-25.421***	-3.565***
	P^{H}	-1.692 (13)	-25.421	-3.565	-9.415 (12) ***	-8.559**	-2.057**
Firm 18	P^{ADR}	-2.072 (10)	-2.920	-1.073	-13.981 (9) ***	-4.422	-1.449
	P^{H}	-2.123 (12)	-2.807	-1.021	-12.546 (11) ***	-5.081	-1.547
Firm 19	P^{ADR}	-1.803 (14)	-2.585	-1.137	-9.617 (15) ***	-15.368***	-2.765***
	P^{H}	-1.712 (14)	-2.266	-1.064	-9.596 (15) ***	-88.936***	-6.668***
Firm 20	P^{ADR}	-2.282(4)	-3.006	-1.202	-21.735(3)***	-85.001***	-6.518***
	P^{H}	-2.428(14)	-1.870	-0.927	-12.597(13)***	-8.411**	-2.038**
Firm 21	P^{ADR}	-1.470 (13)	-3.934	-1.228	-11.224 (15) ***	-22.189***	-3.331***
	P^{H}	-1.204 (8)	-3.292	-1.044	-17.180 (7) ***	-51.639***	-5.080***
Firm 22	P^{ADR}	-1.848 (13)	-2.162	-0.935	-10.491 (12) ***	-8.336**	-2.033**
	P^{H}	-1.830 (11)	-1.939	-0.876	-12.096 (10) ***	-35.147***	-4.169***
Firm 23	P^{ADR}	-2.514 (13)	-3.430	-1.188	-10.649 (15) ***	-29.162***	-3.818***
	P^{H}	-2.476 (10)	-4.244	-1.320	-10.467 (15) ***	-15.184***	-2.747***
Firm 24	P^{ADR}	-1.166 (9)	-4.540	-1.452	-13.331 (8) ***	-87.894***	-6.629***
	P^{H}	-1.475 (0)	-4.194	-1.396	-34.544 (0) ***	-545.862***	-16.521***
Firm 25	P^{ADR}	-2.435 (10)	-5.283	-1.578	-8.744 (10) ***	-1.172	-0.660
	P^{H}	-2.162 (0)	-5.338	-1.588	-15.779 (3) ***	-2.498	-1.055
Firm 26	P^{ADR}	-2.010 (1)	-6.975	-1.860	-11.997 (6) ***	-4.976	-1.550
	P^{H}	-1.646 (13)	-5.068	-1.584	-7.773 (12) ***	-7.726*	-1.951*
Firm 27	P^{ADR}	-2.097 (3)	-7.514	-1.915	-22.371 (2)***	-21.654***	-3.277***
	P^{H}	-1.835 (8)	-7.166	-1.860	-14.165 (7)***	-519.892***	-16.123***
Firm 28	P^{ADR}	-2.624 (6)	-3.902	-1.277	-21.801 (5) ***	-2.541	-1.050
	P^{H}	-3.130 (9)*	-6.905	-1.737	-19.979 (6) ***	-120.481***	-7.761***
Firm 29	P^{ADR}	-2.624 (6)	-3.902	-1.277	-21.801(5)***	-2.541	-1.050
	P^{H}	-3.130(9)*	-6.905	-1.737	-19.979(6)***	-120.481***	-7.761***
Firm 30	P^{ADR}	-2.433 (13)	-6.272	-1.769	-10.757 (12) ***	-5.622	-1.677*

	P^H	-2.340 (3)	-8.149	-2.013	-27.224 (2) ***	-3.112	-1.209
Firm 31	P^{ADR}	-2.358 (5)	-3.376	-1.210	-23.402 (4) ***	-1.689	-0.827
	P^H	-2.582 (11)	-6.033	-1.684	-15.131 (10) ***	-6.217*	-1.729*
Firm 32	P^{ADR}	-1.816 (6)	-3.874	-1.373	-20.507 (5) ***	-5.130	-1.553
	P^H	-1.833 (7)	-4.932	-1.557	-19.279 (6) ***	-8.435**	-2.027**
Firm 33	P^{ADR}	-2.369 (13)	-7.601	-1.949	-12.829 (12) ***	-5.375	-1.600
	P^H	-2.258 (7)	-8.808	-2.090	-11.263 (15) ***	-9.470**	-2.163**
Firm 34	P^{ADR}	-1.803 (2)	-4.809	-1.501	-10.982 (15) ***	-1042.950***	-22.835***
	P^H	-1.820 (3)	-5.730	-1.639	-11.014 (15) ***	-18.425***	-3.032***
Firm 35	P^{ADR}	-1.734 (10)	-5.700	-1.649	-11.175 (15) ***	-1042.830***	-22.834***
	P^H	-1.798 (7)	-6.295	-1.733	-18.400 (6) ***	-25.192***	-3.547***
Firm 36	P^{ADR}	-2.403 (13)	-7.200	-1.889	-12.387 (12) ***	-1.664	-0.797
	P^H	-1.824 (10)	-7.877	-1.962	-14.702 (9) ***	-1.683	-0.820
Firm 37	P^{ADR}	-1.578 (13)	-3.840	-1.227	-11.235 (15) ***	-22.283***	-3.338***
	P^H	-1.330 (8)	-3.274	-1.056	-17.196 (7) ***	-12.530**	-2.488**
Firm 38	P^{ADR}	-1.806 (14)	-5.361	-1.588	-8.886 (13) ***	-9.936***	-2.184***
	P^H	-2.755 (14)	-455.127	-15.085	-9.129 (13) ***	-2.806	-1.128
Chile							
	FX	-2.321 (12)	-5.300	-1.627	-12.673 (11)***	-27.857***	-3.728***
Firm 1	P^{ADR}	-2.397(15)	-5.339	-1.569	-12.411(14)***	-1041.640***	-22.822***
	P^H	-2.417(12)	-7.003	-1.757	-13.855(11) ***	-1037.500***	-22.776***
Firm 2	P^{ADR}	-2.455(11)	-11.932	-2.430	-14.343(10) ***	-668.939***	-18.289***
	P^H	-2.774(15)	-11.932	-2.430	-12.796(14) ***	-668.939***	-18.289***
Firm 3	P^{ADR}	-2.588(6)	-10.790	-2.279	-20.300(5) ***	-109.441***	-7.395***
	P^H	-2.783(6)	-15.621*	-2.694*	-13.820(12) ***	-997.364***	-22.331***
Firm 4	P^{ADR}	-2.783(13)	-4.608	-1.254	-11.237(12) ***	-816.355***	-20.203***
	P^H	-3.130(0)*	-9.277	-2.128	-39.818(0) ***	-168.544***	-9.180***
Firm 5	P^{ADR}	-1.757(15)	-2.373	-0.968	-13.019(14) ***	-4.980	-1.528
	P^H	-1.648(7)	-3.596	-1.174	-18.186(6) ***	-893.687***	-21.139***
Firm 6	P^{ADR}	-2.142(15)	-1.859	-0.952	-11.688(14) ***	-176.726***	-9.399***
	P^H	-2.188(4)	-2.325	-1.066	-22.323(3) ***	-17.222***	-2.925***
Firm 7	P^{ADR}	-1.876(9)	-2.316	-1.063	-10.701(8) ***	-2.361	-1.086
	P^H	-1.696(10)	-2.909	-1.196	-8.096(9) ***	-25.287***	-3.542***
Firm 8	P^{ADR}	-2.146(0)	-3.460	-1.279	-33.315(0)***	-95.106***	-6.884***
	P^H	-1.950(7)	-3.300	-1.275	-32.836(0)***	-142.391***	-8.438***
Firm 9	P^{ADR}	-2.635(0)	-6.780	-1.802	-24.179(3) ***	-40.188***	-4.479***
	P^H	-2.742(14)	-9.297	-2.100	-12.316(13) ***	-18.934***	-3.068***
Firm 10	P^{ADR}	-2.541(14)	-7.109	-1.885	-14.743(8) ***	-60.414***	-5.496***
	P^H	-2.829(13)	-9.562	-2.181	-13.374(12) ***	-440.033***	-14.833***
Firm 11	P^{ADR}	-2.867(13)	-10.267	-2.253	-10.505(15) ***	-196.434***	-9.890***
	P^H	-3.165(15)*	-18.626**	-3.034**	-10.959(14) ***	-26.108***	-3.361***
Mexico							
	FX	-2.244 (13)	-8.950	-2.112	-12.521 (12)***	-4.712	-1.517

Firm 1	P^{ADR}	-1.166(12)	-3.631	-1.274	-7.958(15)***	-3.563	-1.239
	P^{H}	-1.038(5)	-3.077	-1.171	-15.250(4)***	-449.090***	-14.980***
Firm 2	P^{ADR}	-1.378(5)	-3.034	-1.202	-17.038(4)***	-4.912	-1.528
	P^{H}	-1.551(5)	-3.869	-1.376	-17.067(4)***	-5.373	-1.618
Firm 3	P^{ADR}	-2.299(14)	-4.351	-1.427	-12.834(13)***	-29.215***	-3.821***
	P^{H}	-2.502(14)	-3.418	-1.231	-13.075(13)***	-1042.330***	-22.828***
Firm 4	P^{ADR}	-1.621(3)	-3.191	-1.212	-27.255(2)***	-9.392**	-2.134**
	P^{H}	-1.647(3)	-2.650	-1.081	-27.256(2)***	-13.050**	-2.519**
Firm 5	P^{ADR}	-2.650(8)	-4.600	-1.512	-7.507(7)***	-81.531***	-5.717***
	P^{H}	-1.226(3)*	-4.458	-1.337	-9.786(2)***	-86.142***	-6.563**
Firm 6	P^{ADR}	-3.245(8)*	-18.111	-2.974	-11.309(7)***	-8.191**	-2.010**
	P^{H}	-3.157(3)*	-21.123	-3.206	-12.394(2)***	-10.665**	-2.307**
Firm 7	P^{ADR}	-2.214(13)	-7.459**	-1.918**	-8.919(12)***	-189.025***	-9.722***
	P^{H}	-1.934(7)	-4.303**	-1.467**	-9.079(15)***	-10.558**	-2.202**
Firm 8	P^{ADR}	-2.211(14)	-8.905	-2.107	-6.012(13)***	-28.467***	-3.772***
	P^{H}	-2.751(15)	-7.034	-1.875	-6.169(14)***	-100.474***	-7.088***
Firm 9	P^{ADR}	-1.848(13)	-5.426	-1.617	-9.914(13)***	-32.063***	-4.002***
	P^{H}	-1.758(12)	-4.721	-1.490	-10.230(12)***	-61.727***	-5.554***
Firm 10	P^{ADR}	-2.526(13)	-10.777	-2.320	-21.443(15)***	-269.991***	-11.619***
	P^{H}	-2.848(13)	-15.847	-2.812	-12.158(12)***	-1041.570***	-22.821***
Firm 11	P^{ADR}	-2.123(13)	-5.462	-1.640	-10.447(4)***	-12.763**	-2.485**
	P^{H}	-2.206(0)	-5.164*	-1.590*	-9.592(15)***	-68.275***	-5.835***
Firm 12	P^{ADR}	-1.102(11)	-2.472	-0.959	-12.670(10)***	-7.842*	-1.867*
	P^{H}	-1.020(14)	-2.167	-0.833	-16.222(13)***	-414.167***	-14.304***
Firm 13	P^{ADR}	-1.289(12)	-4.487	-1.339	-10.454(11)***	-117.036***	-7.465***
	P^{H}	-0.888(7)	-4.364	-1.288	-10.527(6)***	-204.110***	-10.101***
Firm 14	P^{ADR}	-3.522(5)**	-3.723	-1.309	-12.122(4)***	-17.691***	-2.959***
	P^{H}	-3.610(6)**	-2.181	-0.959	-12.548(5)***	-476.132***	-15.428***
Firm 15	P^{ADR}	-2.087(10)	-2.727	-1.053	-24.220(15)***	-1041.790***	-22.823***
	P^{H}	-1.674(15)	-1.728	-0.784	-18.403(14)***	-1040.270***	-22.806***
Firm 16	P^{ADR}	-1.775(0)	-2.556	-1.102	-21.247(3)***	-2.231	-0.974
	P^{H}	-2.006(8)	-2.055	-0.967	-12.872(7)***	-1.204	-0.646
Firm 17	P^{ADR}	-2.129(6)	-4.421	-1.456	-12.277(5)***	-19.411***	-3.113***
	P^{H}	-2.120(14)	-4.621	-1.481	-12.510(13)***	-30.577***	-3.909***
Firm 18	P^{ADR}	-1.768(11)	-4.014	-1.379	-14.217(10)***	-48.979***	-4.941***
	P^{H}	-1.853(11)	-4.045	-1.368	-14.758(10)***	-1042.730***	-22.830***
Firm 19	P^{ADR}	-2.727(12)	-13.550	-2.602	-21.299(11)***	-5.551	-1.649*
	P^{H}	-2.384(12)	-8.793	-2.091	-7.736(11)***	-25.061***	-3.539***
Firm 20	P^{ADR}	-1.531(2)	-1.950	-0.888	-7.097(1)***	-7.162*	-1.883*
	P^{H}	-1.736(11)	-2.225	-0.970	-9.469(10)***	-13.064**	-2.544**
Firm 21	P^{ADR}	-1.800(15)	-7.423	-1.856	-33.098(14)***	-7.442*	-1.905*
	P^{H}	-1.822(9)	-8.145	-1.915	-16.782(8)***	-10.129**	-2.230**
Firm 22	P^{ADR}	-1.597(2)	-3.336	-1.158	-9.637(1)***	-4.476	-1.484

	P^H	-1.363(12)	-2.165	-0.831	-26.065(11)***	-0.782	-0.440
Firm 23	P^{ADR}	-1.728(7)	-3.797	-1.339	-10.774(6)***	-4.164	-1.136
	P^H	-1.818(0)	-5.352	-1.601	-11.284(0)***	-41.391***	-4.474***
Firm 24	P^{ADR}	-1.510(14)	-0.910	-0.530	-12.843(13)***	-1.972	-0.928
	P^H	-1.529(11)	-0.418	-0.281	-19.569(10)***	-5.459	-1.634*
Firm 25	P^{ADR}	-1.495(13)	-0.847	-0.505	-19.355(12)***	-4.411	-1.460
	P^H	-1.415(7)	-0.378	-0.257	-12.040(6)***	-8.745**	-2.067**
Firm 26	P^{ADR}	-1.977(7)	-8.921	-2.089	-13.023(6)***	-9.659**	-2.196**
	P^H	-1.987(11)	-8.801	-2.062	-12.566(14)***	-388.741***	-13.934***
Firm 27	P^{ADR}	-1.893(9)	-8.065	-1.939	-16.698(15)***	-7.595*	-1.924*
	P^H	-1.774(15)	-7.122	-1.768	-47.067(14)***	-7.143*	-1.856*
Firm 28	P^{ADR}	-3.083(1)	-2.966	-1.204	-6.315(7)***	-41.695***	-4.566***
	P^H	-3.078(0)	-4.391	-1.481	-9.059(0)***	0.267	0.407

Notes: Daily data from 1/1/2003 to 12/31/2010. A deterministic trend is included only when testing the series in levels. ADF(*k*) refers to the Augmented Dickey-Fuller t-tests for unit roots. The lag length (*k*) for ADF tests is chosen by the Campbell-Perron data dependent procedure, whose method is usually superior to *k* chosen by the information criterion, according to Ng and Perron (1995). The method starts with an upper bound, k_{max}=15, on *k*. If the last included lag is significant, choose $k = k_{max}$. If not, reduce *k* by one until the last lag becomes significant (at the 5% level). If no lags are significant, then set $k = 0$. Lag lengths appear next to the reported calculated
t-values. Also reported are two of the M-tests developed by Ng and Perron (2001) with the modified AIC used for lag-length selection. The MZ_α and MZ_t can be viewed as modified versions of the Phillips and Perron (1988) Z_α and Z_t tests, which suffer from severe size distortions when the errors have a negative moving average (MA) root. The first step of the method is to construct the DF-GLS modified ADF test proposed by Elliott et al. (1996) and then to compute the MZ_α and MZ_t statistics as defined in Ng and Perron (2001).
*,**,*** indicate statistical significance at the 10%, 5%, and 1% levels respectively.

Table 3

Cointegration Tests

	Trace Test		Maximal Eigenvalue Test		Lags	Criterion
Firm	CE=0	CE=1	CE=0	CE=1		
Argentina						
Firm 1	94.578***	5.072	89.506***	4.266	4	HQ, AIC
Firm 2	110.422***	11.096	99.326***	10.895	6	AIC
Firm 3	135.852***	4.640	131.212***	3.195	1	SC,HQ,AIC
Firm 4	113.366***	9.831	103.535***	9.617	6	AIC
Firm 5	141.375***	5.523	135.852***	5.313	1	SC, HQ
Firm 6	57.133***	7.862	49.271***	7.658	4	HQ
Firm 7	128.657***	12.906	115.751***	12.168	4	HQ
Firm 8	182.713***	10.873	171.840***	10.821	4	SC, HQ
Firm 9	252.090***	6.504	245.586***	6.486	2	SC,HQ
Firm 10	92.780***	24.644***	68.136***	24.589***	8	AIC
Brazil						
Firm 1	331.635***	3.439	328.196***	3.419	3	HQ
Firm 2	550.245***	10.937	539.307***	8.507	1	SC, HQ
Firm 3	117.966***	10.734	107.233***	8.081	1	AIC
Firm 4	125.529***	8.004	117.525***	6.183	9	AIC
Firm 5	403.707***	10.092	393.615***	9.021	2	HQ
Firm 6	66.217***	13.523*	52.693***	11.604	9	AIC
Firm 7	84.095***	10.611	73.483***	8.984	9	AIC
Firm 8	274.353***	13.448*	260.904***	11.284	4	AIC
Firm 9	59.007***	10.095	48.912***	6.738	9	AIC
Firm 10	363.133***	12.374	350.759***	9.846	3	SC, HQ
Firm 11	82.359***	11.155	71.204***	10.514	9	AIC
Firm 12	190.275***	5.706	184.569***	4.481	6	AIC
Firm 13	38.487***	5.939	32.549***	4.579	4	AIC
Firm 14	31.193**	10.305	20.888*	10.134	6	SC
Firm 15	185.493***	15.227	170.266***	11.623	3	HQ
Firm 16	310.953***	4.156	306.797***	2.777	1	SC
Firm 17	167.083***	14.111*	152.973***	11.420	2	HQ
Firm 18	312.880***	10.730	302.149***	7.629	3	HQ
Firm 19	228.474***	7.997	220.477***	6.381	3	HQ
Firm 20	115.766***	19.123**	96.644***	11.413	8	AIC
Firm 21	117.472***	8.262	109.210***	5.371	9	AIC
Firm 22	300.153***	7.517	292.636***	5.405	3	AIC
Firm 23	415.244***	11.237	404.007***	6.776	2	HQ
Firm 24	228.283***	4.460	223.824***	2.675	2	HQ, AIC
Firm 25	203.208***	4.798	198.410***	4.583	1	SC, HQ, AIC
Firm 26	259.547***	4.872	254.676***	4.051	1	HQ, AIC
Firm 27	191.316***	5.585	185.731***	4.977	3	AIC
Firm 28	400.869***	13.603	387.267***	12.468	2	SC, HQ

Firm 29	124.284***	6.154	118.129***	4.702	1	SC, HQ, AIC
Firm 30	571.585***	10.087	561.498***	6.937	1	SC, HQ, AIC
Firm 31	230.172***	10.096	220.076***	7.807	5	AIC
Firm 32	96.867***	7.527	89.340***	5.262	9	AIC
Firm 33	337.781***	9.979	327.802***	9.106	2	SC, HQ
Firm 34	94.811***	14.920*	79.891***	12.695	9	AIC
Firm 35	111.070***	15.058	96.012***	13.103	9	AIC
Firm 36	98.041***	5.785	92.255***	3.894	9	AIC
Firm 37	102.158***	9.065	93.093***	6.416	9	AIC
Firm 38	86.471***	14.414*	72.057***	12.908*	6	AIC
Chile						
Firm 1	232.984***	6.696	226.288***	21.132	5	HQ
Firm 2	467.323***	10.506	456.818***	8.605	1	HQ
Firm 3	222.714***	6.919	215.795***	6.498	6	AIC
Firm 4	58.132***	29.797	51.659***	4.844	3	HQ
Firm 5	269.279***	9.765	259.514***	6.227	5	AIC
Firm 6	33.024**	10.749	22.275**	7.302	8	AIC
Firm 7	58.217***	3.360	54.857***	3.314	6	AIC
Firm 8	272.349***	12.093	260.256***	8.348	0	SC, HQ, AIC
Firm 9	574.791***	11.015	563.777***	7.308	1	SC, HQ, AIC
Firm 10	217.797***	14.907*	202.890***	11.687	4	AIC
Firm 11	351.450***	5.786	345.664***	4.812	4	HQ
Mexico						
Firm 1	154.332***	14.156*	140.176***	11.085	2	SC, HQ
Firm 2	163.123***	12.938	150.185***	9.272	5	AIC
Firm 3	232.303***	7.353	224.950***	4.349	4	AIC
Firm 4	211.005***	8.749	202.256***	6.590	6	AIC
Firm 5	19.022	5.457	13.566	5.456	1	AIC
Firm 6	283.400***	4.566	278.834***	4.334	5	AIC
Firm 7	129.282***	12.532	116.750***	11.627	1	SC, HQ, AIC
Firm 8	22.468	9.009	13.460	7.337	1	HQ, AIC
Firm 9	153.259***	9.313	143.946***	6.276	2	SC
Firm 10	199.484***	5.253	194.231***	4.465	7	AIC
Firm 11	177.279***	9.639	167.461***	7.499	1	AIC
Firm 12	143.670***	9.509	134.161***	7.196	7	AIC
Firm 13	103.984***	14.994*	88.990***	12.112	2	AIC
Firm 14	122.715***	17.105**	105.611***	13.902*	9	AIC
Firm 15	59.190***	9.921	49.269***	6.421	4	HQ
Firm 16	180.035***	7.714	172.321***	4.591	8	AIC
Firm 17	212.840***	7.456	205.384***	5.593	5	AIC
Firm 18	222.767***	7.269	215.498***	4.172	2	HQ
Firm 19	129.937***	8.589	121.348***	8.371	0	SC, HQ, AIC
Firm 20	43.065***	12.094	30.970***	8.697	8	AIC

Firm 21	102.600***	9.950	92.650***	7.355	7	AIC
Firm 22	384.112***	13.452*	370.660***	8.637	0	SC, HQ, AIC
Firm 23	43.396***	7.541	35.855***	4.938	5	HQ
Firm 24	176.261***	12.890	163.371***	9.616	5	HQ
Firm 25	255.932***	12.364	243.568***	9.256	7	AIC
Firm 26	73.815***	10.048	63.767***	9.343	8	AIC
Firm 27	192.165***	10.281	181.884***	7.360	9	AIC
Firm 28	31.091**	13.271	17.820	10.925	2	SC

Notes: Daily data from 1/1/2003 to 12/31/2010. Lag selection determined by estimating the model using each information criterion: Schwarz-Bayesian (SC), Hannah-Quinn (HQ) and Akaike (AIC). The SBC and HQ are the preferred information criteria for lag selection based on evidence in Hacker and Hatemi-J (2008). Enders (2004) suggests that model adequacy can be improved by increasing the lag lengths of the variables included in the model. Therefore, when model diagnostics using SC or HQ are poor, the AIC criterion is employed due to its selection of longer lag lengths.

Table 4
Vector Error Correction Estimates

	Long-Run Vector			Speed of Adjustment			Adjusted R^2			LM Test
Firm	FX	Home	ADR	FX	Home	ADR	FX	Home	ADR	(k=5)
Firm 1	1	-0.873***	0.867***	-0.003***	0.047***	-0.046***	3.04%	3.43%	7.77%	4.28
		(0.057)	(0.060)	(0.001)	(0.006)	(0.012)				
Firm 2	1	-0.947***	0.924***	-0.004	0.206***	0.014	3.78%	16.36%	0.69%	14.18
		(0.016)	(0.017)	(0.005)	(0.030)	(0.037)				
Firm 3	1	-0.925***	0.886***	-0.003	0.195***	-0.404***	-0.02%	2.05%	7.20%	7.70
		(0.059)	(0.059)	(0.003)	(0.063)	(0.070)				
Firm 4	1	-1.077***	1.039***	0.001	0.046***	-0.179***	2.93%	4.20%	11.90%	13.60
		(0.062)	(0.050)	(0.002)	(0.016)	(0.025)				
Firm 5	1	-0.911***	0.912***	-0.004	0.232***	-0.517***	-0.09%	2.39%	10.72%	6.74
		(0.046)	(0.049)	(0.005)	(0.078)	(0.083)				
Firm 6	1	-0.876***	0.692***	-0.003**	0.046***	0.005	3.59%	4.78%	0.38%	15.02*
		(0.101)	(0.055)	(0.001)	(0.007)	(0.009)				
Firm 7	1	-0.945***	0.931***	-0.013***	0.147***	-0.032	3.70%	7.57%	0.97%	18.08**
		(0.015)	(0.016)	(0.005)	(0.031)	(0.037)				
Firm 8	1	-1.061***	1.021***	0.004	0.153***	-0.050***	2.92%	14.83%	2.67%	5.88
		(0.037)	(0.037)	(0.002)	(0.014)	(0.020)				
Firm 9	1	-1.069***	1.042***	-0.004	0.112***	-0.159***	1.33%	4.65%	5.75%	26.22***
		(0.020)	(0.018)	(0.003)	(0.018)	(0.023)				
Brazil										
Firm 1	1	-0.999***	0.998***	-0.209***	0.459***	-0.123	16.66%	9.07%	3.32%	21.169**
		(0.002)	(0.002)	(0.033)	(0.095)	(0.115)				
Firm 2	1	-1.000***	1.006***	-0.134***	0.248***	-0.403***	16.41%	2.55%	1.96%	51.314***
		(0.003)	(0.002)	(0.023)	(0.065)	(0.076)				
Firm 3	1	-1.115***	1.098***	-0.008	0.179*	-0.514***	0.96%	4.37%	9.21%	9.963
		(0.044)	(0.043)	(0.031)	(0.100)	(0.109)				
Firm 4	1	-1.005***	1.003***	-0.093***	0.175*	-0.230**	15.35%	2.37%	4.48%	17.833**
		(0.005)	(0.003)	(0.033)	(0.099)	(0.114)				

Firm 5	1	-0.988***	0.988***	-0.110***	0.266***	-0.292***	17.13%	1.97%	4.17%	9.732
		(0.002)	(0.002)	(0.023)	(0.069)	(0.082)				
Firm 6	1	-1.040***	1.015***	-0.001	0.177	-0.271**	20.52%	2.92%	6.99%	27.882***
		(0.022)	(0.016)	(0.040)	(0.109)	(0.140)				
Firm 9	1	-0.971***	0.976***	-0.028	-0.052	-0.257***	17.04%	2.43%	4.60%	18.348**
		(0.017)	(0.011)	(0.025)	(0.063)	(0.079)				
Firm 10	1	-0.985***	0.989***	-0.068***	0.303***	-0.247***	15.96%	4.11%	2.40%	20.67**
		(0.008)	(0.005)	(0.022)	(0.059)	(0.069)				
Firm 11	1	-1.040***	1.026***	-0.058**	0.097	-0.164*	13.80%	2.85%	5.61%	9.174
		(0.020)	(0.014)	(0.026)	(0.069)	(0.084)				
Firm 12	1	-1.022***	1.009***	-0.105***	0.208***	-0.298***	16.01%	3.85%	3.28%	5.375
		(0.004)	(0.003)	(0.035)	(0.081)	(0.104)				
Firm 13	1	-1.157***	1.113***	0.000	-0.001	-0.029***	4.43%	0.69%	3.16%	15.536
		(0.133)	(0.093)	(0.002)	(0.005)	(0.006)				
Firm 14	1	-1.281***	1.224***	0.014	-0.011	-0.077***	19.81%	2.59%	3.20%	66.448***
		(0.081)	(0.058)	(0.010)	(0.021)	(0.027)				
Firm 15	1	-0.992***	0.985***	-0.136***	0.171***	-0.169**	15.32%	1.88%	5.13%	5.514
		(0.012)	(0.008)	(0.030)	(0.062)	(0.081)				
Firm 16	1	-0.980***	0.983***	-0.158***	0.539***	0.083	20.93%	7.88%	0.5%	11.561
		(0.005)	(0.005)	(0.026)	(0.061)	(0.073)				
Firm 17	1	-0.967***	0.969***	-0.143***	0.283***	-0.123	17.10%	3.03%	2.33%	32.552***
		(0.016)	(0.013)	(0.032)	(0.120)	(0.141)				
Firm 18	1	-0.976***	0.981***	-0.139***	0.124*	-0.384***	17.67%	3.02%	3.92%	10.191
		(0.007)	(0.006)	(0.025)	(0.075)	(0.095)				
Firm 19	1	-0.992***	0.991***	-0.089***	0.277***	-0.213**	13.25%	5.44%	1.95%	11.897
		(0.004)	(0.004)	(0.024)	(0.079)	(0.092)				
Firm 20	1	-1.007	1.007	-0.067**	0.137	-0.360***	17.94%	3.65%	9.66%	7.849
		(0.010)	(0.008)	(0.033)	(0.094)	(0.117)				
Firm 21	1	-0.990***	0.992***	-0.149***	0.260***	-0.153	18.60%	5.68%	5.37%	28.512***
		(0.008)	(0.006)	(0.042)	(0.108)	(0.141)				
Firm 22	1	-0.999***	0.998***	-0.089***	0.112	-0.506***	13.54%	2.72%	6.18%	11.741

		(0.006)	(0.005)	(0.024)	(0.071)	(0.085)				
Firm 23	1	-0.990***	0.989***	-0.144***	0.342***	-0.209**	17.42%	2.12%	2.68%	22.386***
		(0.006)	(0.005)	(0.023)	(0.074)	(0.091)				
Firm 24	1	-0.974***	0.975***	-0.119***	0.333***	-0.234**	17.25%	2.23%	2.35%	7.741
		(0.005)	(0.005)	(0.030)	(0.095)	(0.113)				
Firm 25	1	-1.019***	1.013***	-0.064***	0.338***	-0.164*	7.91%	3.26%	0.37%	9.263
		(0.008)	(0.006)	(0.023)	(0.080)	(0.086)				
Firm 26	1	-1.001***	0.999***	-0.002	0.224***	-0.477***	4.89%	1.72%	8.49%	8.592
		(0.007)	(0.007)	(0.016)	(0.078)	(0.079)				
Firm 27	1	-1.011***	1.012***	-0.038***	0.290***	-0.158***	1.40%	8.49%	6.78%	10.342
		(0.008)	(0.005)	(0.013)	(0.044)	(0.042)				
Firm 28	1	-1.016***	1.011***	-0.162***	0.098	-0.433***	17.33%	2.45%	3.91%	19.372**
		(0.003)	(0.002)	(0.027)	(0.069)	(0.087)				
Firm 29	1	-0.988***	0.942***	-0.009	0.073*	-0.262***	1.75%	3.21%	10.68%	5.279
		(0.016)	(0.018)	(0.012)	(0.038)	(0.038)				
Firm 30	1	-1.016***	1.014***	-0.166***	0.309***	-0.291***	14.53%	2.35%	1.62%	10.933
		(0.004)	(0.002)	(0.023)	(0.059)	(0.066)				
Firm 31	1	-1.010***	1.002***	-0.059***	0.232***	-0.206***	12.76%	3.50%	4.85%	10.010
		(0.005)	(0.003)	(0.022)	(0.046)	(0.056)				
Firm 32	1	-1.009***	1.008***	-0.030	0.267***	-0.127	12.26%	4.50%	3.06%	23.391***
		(0.006)	(0.004)	(0.033)	(0.097)	(0.111)				
Firm 33	1	-0.990***	0.990***	-0.123***	0.221***	-0.219***	14.18%	4.59%	4.55%	12.883
		(0.007)	(0.005)	(0.020)	(0.043)	(0.057)				
Firm 34	1	-0.992***	0.993***	-0.117***	0.415***	0.166	18.72%	5.39%	3.76%	26.191
		(0.013)	(0.009)	(0.035)	(0.097)	(0.123)				
Firm 35	1	-0.985***	0.987***	-0.110***	0.357***	-0.011	18.64%	5.11%	4.65%	20.939**
		(0.011)	(0.008)	(0.038)	(0.099)	(0.132)				
Firm 36	1	-1.018***	1.017***	-0.112***	0.397***	0.102	11.43%	3.77%	2.60%	21.637**
		(0.003)	(0.003)	(0.033)	(0.102)	(0.119)				
Firm 37	1	-0.970***	0.976***	-0.165***	0.283***	-0.018	19.97%	5.07%	5.36%	29.795***
		(0.010)	(0.007)	(0.041)	(0.102)	(0.137)				

Chile										
Firm 1	1	-1.010***	1.010***	-0.122***	-0.061	-0.512***	9.10%	3.48%	6.37%	34.371***
		(0.006)	(0.005)	(0.021)	(0.045)	(0.063)				
Firm 2	1	-0.994***	0.993***	-0.029***	0.118***	-0.409***	0.89%	2.68%	12.77%	13.993
		(0.010)	(0.007)	(0.012)	(0.025)	(0.033)				
Firm 3	1	-0.992***	0.991***	0.006	0.236***	-0.354***	3.18%	5.37%	6.68%	14.684
		(0.006)	(0.005)	(0.023)	(0.050)	(0.063)				
Firm 4	1	-0.934***	0.782	0.002	0.048***	-0.035*	1.58%	1.78%	3.59%	28.467***
		0.048)	(0.055)	(0.005)	(0.014)	(0.018)				
Firm 5	1	-1.009***	1.008***	-0.067***	0.090	-0.588***	10.24%	3.96%	8.46%	8.86
		(0.005)	(0.004)	(0.029)	(0.058)	(0.081)				
Firm 6	1	-0.833***	0.882***	-0.019***	0.030	-0.012	6.74%	7.07%	3.47%	8.415
		(0.058)	(0.053)	(0.008)	(0.020)	(0.025)				
Firm 7	1	-1.270***	1.271***	0.002	-0.003	-0.263***	3.74%	6.50%	20.29%	2.271
		(0.055)	(0.056)	(0.010)	(0.033)	(0.045)				
Firm 8	1	-1.040***	1.031***	-0.020**	0.109***	-0.286***	0.29%	1.95%	9.71%	16.124*
		(0.025)	(0.017)	(0.010)	(0.023)	(0.027)				
Firm 9	1	-0.998***	0.999***	-0.002	0.187***	-0.466***	2.01%	5.32%	10.45%	11.409
		(0.006)	(0.005)	(0.014)	(0.030)	(0.036)				
Firm 10	1	-0.970***	0.976***	-0.031***	0.169***	-0.215***	1.53%	11.25%	6.59%	12.485
		(0.016)	(0.011)	(0.012)	(0.025)	(0.035)				
Mexico										
Firm 1	1	-1.010***	1.010***	-0.103***	0.195***	-0.184**	14.05%	4.49%	3.57%	11.766
		(0.013)	(0.010)	(0.028)	(0.075)	(0.091)				
Firm 2	1	-0.993***	0.997***	-0.169***	0.804***	0.264	19.23%	5.63%	1.36%	4.204
		(0.004)	(0.003)	(0.051)	(0.156)	(0.178)				
Firm 3	1	-0.996***	0.995***	-0.055***	0.312***	-0.040	9.54%	5.93%	0.57%	21.354**
		(0.007)	(0.007)	(0.015)	(0.045)	(0.051)				
Firm 4	1	-0.995***	0.995***	-0.142***	-0.074	-0.631***	15.09%	6.70%	4.32%	14.674
		(0.004)	(0.003)	(0.037)	(0.159)	(0.179)				
Firm 6	1	-0.993***	0.992	-0.126***	0.736***	0.057	12.08%	14.19%	0.91%	8.445

		(0.003)	(0.003)	(0.031)	(0.091)	(0.097)				
Firm 7	1	-1.013***	1.012***	-0.022	0.077	-0.235***	2.24%	0.86%	6.14%	9.341
		(0.031)	(0.031)	(0.015)	(0.054)	(0.053)				
Firm 9	1	-0.955***	0.965***	-0.071***	0.115**	-0.133**	16.98%	6.47%	10.51%	10.616
		(0.012)	(0.011)	(0.013)	(0.053)	(0.063)				
Firm 10	1	-0.998***	0.998***	-0.282***	0.113	-0.462**	27.19%	5.20%	3.22%	13.021
		(0.002)	(0.002)	(0.057)	(0.177)	(0.208)				
Firm 11	1	-0.937***	0.926***	0.015***	0.212***	0.017	5.51%	4.69%	1.94%	66.990***
		(0.023)	(0.021)	(0.006)	(0.027)	(0.027)				
Firm 12	1	-0.875***	0.883***	0.004	0.117***	-0.021*	1.74%	12.36%	2.88%	10.586
		(0.030)	(0.029)	(0.004)	(0.010)	(0.012)				
Firm 13	1	-1.044***	1.047***	0.007	0.282***	-0.066	1.07%	10.83%	6.58%	14.392
		(0.053)	(0.056)	(0.015)	(0.048)	(0.054)				
Firm 14	1	-0.722***	0.710***	-0.002	0.089***	-0.052***	2.98%	7.29%	4.16%	17.809**
		(0.036)	(0.036)	(0.003)	(0.010)	(0.013)				
Firm 15	1	-0.880***	0.932***	-0.004	0.054***	-0.043***	1.88%	20.70%	1.33%	20.607**
		(0.067)	(0.071)	(0.003)	(0.014)	(0.018)				
Firm 16	1	-1.001***	1.001***	-0.284***	0.263*	-0.198	22.27%	4.11%	3.77%	4.860
		(0.002)	(0.002)	(0.051)	(0.150)	(0.180)				
Firm 17	1	-1.000***	1.001***	-0.181***	0.602***	0.039	22.83%	8.61%	3.27%	13.162
		(0.003)	(0.003)	(0.039)	(0.172)	(0.196)				
Firm 18	1	-1.006***	1.012***	-0.002	0.194***	-0.012	0.45%	20.43%	1.45%	31.703***
		(0.022)	(0.023)	(0.005)	(0.014)	(0.016)				
Firm 19	1	-1.185***	1.189***	-0.003	0.087***	-0.159***	-0.12%	3.72%	8.10%	4.591
		(0.069)	(0.071)	(0.007)	(0.016)	(0.019)				
Firm 20	1	-0.938***	0.937***	-0.024	0.195*	-0.139	4.30%	3.57%	12.04%	12.313
		(0.042)	(0.035)	(0.029)	(0.110)	(0.130)				
Firm 21	1	-1.342***	1.312***	0.002	0.097***	-0.009	10.17%	17.11%	0.59%	44.580***
		(0.058)	(0.060)	(0.003)	(0.013)	(0.010)				
Firm 22	1	-1.070***	1.087***	-0.139***	0.394***	-0.238***	8.32%	4.07%	1.28%	4.048
		(0.020)	(0.022)	(0.018)	(0.073)	(0.077)				

Firm 23	1	-0.730***	0.749***	0.003	-0.015	-0.128***	3.47%	2.93%	8.56%	24.651***
		(0.054)	(0.048)	(0.005)	(0.023)	(0.028)				
Firm 24	1	-0.998***	0.992***	-0.047*	0.070	-0.502***	7.13%	1.15%	12.68%	8.046
		(0.005)	(0.005)	(0.025)	(0.075)	(0.093)				
Firm 25	1	-1.023***	1.022***	-0.009	0.569***	-0.185**	10.12%	19.69%	2.68%	14.180
		(0.005)	(0.005)	(0.023)	(0.064)	(0.083)				
Firm 26	1	-0.705***	0.721***	-0.002	0.080***	-0.018	3.27%	10.27%	4.89%	16.690*
		(0.077)	(0.069)	(0.002)	(0.011)	(0.014)				
Firm 27	1	-1.238***	1.212***	0.004	0.134***	-0.092***	3.37%	12.53%	3.57%	26.491***
		(0.021)	(0.022)	(0.007)	(0.016)	(0.022)				
Firm 28	1	-1.003***	1.024***	0.006	0.086***	-0.034	6.88%	18.23%	4.02%	3.612
		(0.093)	(0.086)	(0.012)	(0.024)	(0.036)				

Notes: Daily data from 1/1/2003 to 12/31/2010. Standard errors are reported in parentheses. The LM t-stat. is a Lagrange Multiplier test on the residuals of the regression, calculated under the null hypothesis of no serial correlation on up to 5 lags.
*,**,*** represent statistical significance at the 10%, 5% and 1% levels respectively.

Table 5

Price Discovery Contributions

	Foreign Market Contribution	Conditional Information Shares (CIS)								
		CIS of FX in			CIS of HOME in			CIS of ADR in		
		FX	HOME	ADR	FX	HOME	ADR	FX	HOME	ADR
Argentina										
Firm 1	48.96%	87.29%	0.05%	1.50%	2.45%	24.31%	20.38%	10.26%	75.64%	78.12%
Firm 2	100%	91.97%	2.81%	0.24%	1.35%	27.16%	26.94%	6.69%	70.02%	72.83%
Firm 3	32.55%	99.13%	0.22%	0.09%	0.57%	57.68%	57.44%	0.30%	42.09%	42.47%
Firm 4	20.44%	98.33%	0.13%	2.02%	1.51%	71.33%	70.44%	0.16%	28.53%	27.54%
Firm 5	30.97%	98.65%	0.22%	0.17%	0.77%	59.30%	58.79%	0.59%	40.48%	41.04%
Firm 6	93.88%	79.72%	1.84%	0.95%	9.69%	2.25%	1.33%	10.59%	95.91%	97.73%
Firm 7	91.88%	86.73%	0.41%	0.79%	3.58%	40.92%	38.96%	9.69%	58.67%	60.24%
Firm 8	75%	98.70%	0.24%	2.04%	1.05%	19.28%	19.58%	0.25%	80.48%	78.38%
Firm 9	75.37%	96.15%	0.39%	3.59%	0.48%	51.69%	48.46%	3.37%	47.92%	47.95%
Firm 10	94.94%	52.68%	37.91%	73.24%	15.08%	16.42%	12.15%	32.24%	45.67%	14.61%
Brazil										
Firm 1	68.71%	57.34%	2.29%	7.17%	11.00%	45.37%	37.83%	31.66%	52.34%	55.00%
Firm 2	31.59%	65.63%	2.55%	10.84%	8.23%	53.14%	41.64%	26.14%	44.31%	47.52%
Firm 3	25.83%	83.87%	2.93%	11.17%	3.45%	56.84%	48.88%	12.68%	40.24%	39.95%
Firm 4	35.14%	66.21%	3.01%	11.45%	8.53%	52.17%	40.58%	25.26%	44.82%	47.98%
Firm 5	39.82%	64.14%	3.27%	9.14%	9.50%	50.54%	42.62%	26.36%	46.19%	48.23%
Firm 6	0%	84.29%	3.40%	17.49%	3.56%	50.56%	39.05%	12.14%	46.04%	43.46%
Firm 7	37.69%	77.69%	3.77%	14.70%	4.66%	51.61%	39.61%	17.65%	44.62%	45.70%
Firm 8	26.08%	76.80%	3.19%	13.91%	4.86%	60.01%	47.64%	18.34%	36.79%	38.45%
Firm 9	0%	75.64%	4.97%	25.05%	5.92%	62.13%	41.10%	18.44%	32.90%	33.85%
Firm 10	49. 03%	72.71%	3.81%	15.51%	6.18%	47.60%	35.84%	21.12%	48.59%	48.65%
Firm 11	0%	71.52%	5.06%	22.97%	7.66%	49.82%	31.43%	20.81%	45.11%	45.60%
Firm 12	34.04%	72.77%	2.57%	13.74%	7.07%	52.95%	37.78%	20.16%	44.48%	48.48%
Firm 13	0%	90.43%	1.78%	17.96%	1.39%	86.28%	67.85%	8.18%	11.94%	14.20%
Firm 14	0%	78.36%	2.12%	7.51%	9.70%	67.35%	62.35%	11.94%	30.53%	30.14%
Firm 15	35.92%	63.69%	3.40%	17.52%	9.88%	51.96%	31.50%	26.43%	44.63%	50.99%
Firm 16	77.33%	57.73%	5.93%	5.59%	9.53%	39.63%	31.54%	32.74%	54.44%	62.87%
Firm 17	66.43%	58.06%	5.24%	11.46%	13.12%	45.97%	38.91%	28.82%	48.79%	49.62%
Firm 18	19.17%	61.24%	6.08%	15.80%	10.62%	50.96%	39.83%	28.14%	42.96%	44.37%
Firm 19	47.84%	78.14%	3.60%	15.17%	7.18%	45.11%	34.59%	14.68%	51.29%	50.24%
Firm 20	0%	75.76%	4.47%	18.09%	5.92%	5.47%	39.66%	18.33%	40.82%	42.25%
Firm 21	63.57%	60.80%	4.34%	13.56%	10.33%	47.58%	35.16%	28.86%	48.08%	51.28%
Firm 22	0%	73.31%	2.90%	13.11%	6.25%	56.59%	44.73%	20.44%	40.51%	42.16%
Firm 23	49.21%	57.52%	4.07%	9.01%	11.63%	49.17%	41.30%	30.85%	46.76%	49.69%
Firm 24	48.54%	71.07%	2.95%	9.39%	8.04%	48.85%	39.97%	20.89%	48.20%	50.64%
Firm 25	59.72%	71.00%	2.67%	6.50%	6.93%	48.32%	41.09%	22.06%	49.01%	52.41%
Firm 26	31.95%	86.64%	0.76%	5.07%	4.65%	55.04%	51.27%	8.71%	44.20%	43.66%

Firm 27	59.67%	87.48%	1.43%	6.76%	2.55%	44.07%	36.00%	9.98%	54.50%	57.24%
Firm 28	0%	62.59%	2.39%	11.59%	9.37%	55.57%	42.63%	28.05%	42.04%	45.79%
Firm 29	21.79%	93.32%	0.38%	9.59%	1.34%	68.10%	58.57%	5.33%	31.52%	31.83%
Firm 30	40.34%	63.83%	2.39%	8.30%	7.99%	53.09%	40.62%	28.18%	44.51%	51.08%
Firm 31	46.68%	72.00%	4.47%	11.49%	4.19%	52.76%	36.94%	23.81%	42.77%	51.57%
Firm 32	100%	80.78%	6.24%	5.91%	4.97%	48.00%	42.97%	14.25%	45.76%	51.11%
Firm 33	39.25%	66.56%	2.96%	15.66%	6.87%	49.94%	31.86%	26.57%	47.10%	52.48%
Firm 34	78.01%	52.62%	9.51%	5.33%	12.97%	39.86%	34.85%	34.41%	50.63%	59.82%
Firm 35	76.45%	60.41%	6.14%	6.80%	9.95%	45.31%	37.60%	29.64%	48.56%	55.60%
Firm 36	78.00%	64.21%	8.97%	3.85%	11.70%	43.70%	38.77%	24.09%	47.33%	57.39%
Firm 37	63.17%	53.95%	4.77%	12.06%	13.04%	45.04%	33.38%	33.01%	50.19%	54.55%
Firm 38	0%	83.09%	6.73%	35.68%	3.08%	69.07%	37.12%	13.83%	24.20%	27.21%
Chile										
Firm 1	0%	73.47%	1.85%	11.90%	5.40%	65.29%	46.43%	21.13%	32.86%	41.67%
Firm 2	21.22%	87.88%	1.23%	14.29%	1.35%	68.15%	50.44%	10.77%	30.62%	35.27%
Firm 3	40%	91.45%	2.57%	15.13%	1.42%	53.88%	40.97%	7.13%	43.55%	43.91%
Firm 4	57.83%	96.49%	9.26%	4.04%	0.56%	35.21%	36.44%	2.95%	55.54%	59.52%
Firm 5	0%	81.34%	1.61%	17.49%	3.84%	64.65%	43.91%	14.82%	33.73%	38.60%
Firm 6	0%	54.84%	4.66%	2.79%	11.73%	52.75%	38.80%	33.43%	42.58%	58.40%
Firm 7	0%	95.43%	2.59%	0.50%	1.06%	81.60%	82.03%	3.50%	15.81%	17.46%
Firm 8	26.27%	93.67%	0.92%	10.86%	0.84%	69.25%	55.41%	5.46%	29.83%	33.73%
Firm 9	28.64%	92.82%	2.24%	10.75%	1.09%	62.92%	51.16%	6.09%	34.85%	38.09%
Firm 10	40.72%	88.39%	1.55%	20.61%	1.72%	49.14%	30.38%	9.89%	49.31%	49.01%
Firm 11	38.15%	65.92%	1.96%	5.76%	9.47%	52.93%	42.93%	24.61%	45.12%	51.30%
Mexico										
Firm 1	40.46%	65.69%	2.88%	10.20%	8.40%	50.98%	39.51%	25.90%	46.14%	50.28%
Firm 2	82.63%	68.11%	4.94%	5.46%	10.23%	41.94%	36.53%	21.66%	53.11%	58.01%
Firm 3	85.01%	80.55%	3.18%	3.85%	5.04%	41.14%	35.21%	14.41%	55.68%	60.93%
Firm 4	0%	66.44%	4.55%	11.45%	11.22%	51.11%	44.65%	22.35%	44.33%	43.90%
Firm 6	85. 38%	76.55%	2.39%	6.24%	7.73%	37.78%	29.79%	15.72%	59.83%	63.96%
Firm 7	0%	85.53%	1.12%	6.97%	2.92%	59.16%	51.75%	11.55%	39.72%	41.28%
Firm 9	36.05%	58.41%	5.89%	12.13%	12.07%	47.06%	39.40%	29.52%	47.05%	48.47%
Firm 10	0%	62.91%	3.52%	15.74%	12.95%	49.51%	36.80%	24.14%	46.97%	47.46%
Firm 11	93.39%	84.22%	1.25%	3.19%	3.67%	31.42%	27.94%	12.12%	67.33%	68.87%
Firm 12	84.78%	98.88%	2.27%	4.64%	0.42%	3.63%	4.23%	0.70%	94.10%	91.13%
Firm 13	100%	98.64%	3.18%	0.97%	0.36%	32.07%	32.09%	1.00%	64.75%	66.94%
Firm 14	63.12%	98.88%	1.31%	14.84%	0.59%	19.35%	14.88%	0.53%	79.34%	70.28%
Firm 15	55.67%	87.91%	1.31%	6.82%	1.52%	41.66%	35.94%	10.57%	57.03%	57.24%
Firm 16	48.17%	52.55%	2.19%	6.77%	14.10%	53.39%	41.91%	33.35%	44.42%	51.32%
Firm 17	76.88%	59.55%	3.90%	8.41%	13.98%	44.42%	40.15%	26.47%	51.68%	51.43%
Firm 18	100%	97.04%	1.71%	4.82%	0.32%	5.56%	4.53%	2.64%	92.74%	90.65%
Firm 19	35.37%	99.11%	1.24%	8.41%	0.06%	64.33%	57.46%	0.83%	34.44%	34.13%
Firm 20	100%	83.39%	3.92%	11.60%	4.22%	46.58%	38.52%	12.39%	49.50%	49.88%

Firm 21	100%	85.83%	3.19%	4.66%	2.45%	20.20%	19.74%	11.72%	76.61%	75.60%
Firm 22	51.10%	75.51%	1.02%	2.74%	9.42%	49.77%	43.59%	15.07%	49.21%	53.67%
Firm 23	0%	90.76%	8.11%	21.21%	5.68%	72.80%	61.74%	3.55%	19.10%	17.05%
Firm 24	0%	78.59%	2.56%	14.33%	5.00%	60.37%	47.38%	16.41%	37.07%	38.29%
Firm 25	75.46%	81.38%	2.81%	9.34%	2.75%	35.66%	29.62%	15.86%	61.53%	61.04%
Firm 26	100%	96.50%	2.44%	1.18%	0.36%	9.79%	9.20%	3.14%	87.77%	89.61%
Firm 27	59.29%	91.03%	3.55%	6.17%	0.99%	36.12%	32.99%	7.98%	60.33%	60.84%
Firm 28	100%	94.13%	4.22%	20.43%	0.44%	15.59%	13.27%	5.42%	80.20%	66.30%

Notes: Foreign market contribution is defined as $\frac{\alpha_h}{\alpha_h+|\alpha_e|+|\alpha_{ADR}|}$. The different blocks in each panel show the conditional information shares in the different markets. For example, the 87.29% in the first panel indicates that the exchange rate has an average conditional information share of 87.29% in itself.