A Tale of Two Prices: Liquidity and Asset Prices in Multiple Markets*†

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Abstract

This paper investigates the liquidity effect in asset pricing by studying the liquidity-premium relationship of an American Depositary Receipt (ADR) and its underlying share. Using the Amihud (2002) measure, the turnover ratio and trading infrequency as proxies for liquidity, we show that a higher ADR premium is associated with higher ADR liquidity and lower home share liquidity, in terms of changes in these variables. We find that the liquidity effects remain strong after we control for firm size and a number of country characteristics, such as the expected change in the foreign exchange rate, the stock market performance, as well as several variables measuring the openness and transparency of the home market.

JEL Classification: G10, G12, G15

Keywords: American Depositary Receipts (ADRs), dual listing, liquidity, turnover, premium

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I. Introduction

Financial assets with claims on similar (or identical) cash flow streams are known to trade at different prices in different markets. Several theories and many empirical studies have been built around this anomaly, with specific emphasis on market imperfections, limits to arbitrage, investor irrationality, or a combination of these arguments. Not until recently did researchers begin a rigorous study of whether a *difference in liquidity* (DIL) between markets explains part of this phenomenon.

In the case of closed-end funds, Jain, Xia, and Wu (2004) find that the premia on closed-end country funds correspond to differences in liquidity between the funds' host and home markets (i.e. the U.S. and the country where the funds invest, respectively). Other studies relate liquidity to price differences between pairs of securities that have almost identical future cash flows. Examples of such studies are papers by Silber (1991), for restricted stock compared with freely traded stock of the same company, Amihud and Mendelson (1991), for U.S. Treasury notes and bills of identical maturities, and Boudoukh and Whitelaw (1993), for Japanese government bonds with a similar maturity and coupon.

The DIL hypothesis mentioned above is also consistent with a long list of empirical studies that show a positive illiquidity-return relationship.[1,2] Amihud and Mendelson (1986), Brennan and Subrahmanyam (1996), Brennan, Chordia, and Subrahmanyam (1998), and Datar, Naik, and Radcliffe (1998) show how the expected return for common stocks is related to illiquidity.[3] These studies support the DIL hypothesis in the sense that

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[1] Theoretical models of liquidity effects, however, yield mixed results. Kyle (1985) and Allen and Gale (1994) show an important effect of illiquidity on asset prices, while Constantinides (1986) and Vayanos (1998) show that illiquidity has a large effect on asset turnover, but only a relatively small effect on asset prices.

[2] See Amihud, Mendelson and Pedersen (2005) for a survey of the literature on liquidity effects in asset pricing.

[3] Other characteristics of liquidity have also shown a noticeable impact on stock returns. For instance, Chordia, Subrahmanyam, and Anshuman (2001) find that stock return is related to the *variability* of

when *similar* securities are traded at different prices at different markets, the liquidity in these markets also differ in the direction that is consistent with the positive illiquidity-return relationship. The high degree of consistency shared among these studies makes the DIL hypothesis a plausible explanation of why assets with similar cash flow claims trade at different prices.

On closer examination of these studies, however, questions arise as to whether the assets are “close” enough in terms of the characteristics of their cash flow streams. For example, there may be an issue regarding how similar closed-end funds (CEFs) are to their underlying shares (listed in another country). The complexity arising from sorting out the relationship between the liquidity of the CEFs and that of their underlying stocks would preclude a true test of the DIL hypothesis. In the case of CEFs, the liquidity of underlying assets cannot be directly measured, since the components of the underlying portfolio are unknown on each date. Furthermore, the CEF premium might reflect the U.S. investors’ confidence in the fund managers’ ability, which could cause the CEF price to deviate from its NAV.

This problem would be solved with the right choice of markets to test. Of all the traded equity markets, the American-Depositary-Receipt (ADR) market provides an ideal setting to test the DIL hypothesis. First, the liquidity of the ADR and its underlying asset can be directly measured without difficulty. Second, there is no issue about the fund manager’s ability in the case of ADRs, since the cash flows of the assets are defined to be identical.

Our paper resolves the above measurement issues and provides the needed support for the DIL hypothesis by testing it on the ADR market. The advantage of studying the ADR market is that investors in the U.S. markets receive *exactly* the same cash flows (on a

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liquidity. Pastor and Stambaugh (2003) find that stock returns are also related to the stocks’ sensitivities to innovations in market liquidity, also known as “liquidity beta”. At the market level, Amihud (2002) shows that the aggregate stock returns are higher when the market is less liquid. Acharya and Pedersen (2005) investigate the various channels for the liquidity effect on stock returns in a unified liquidity-adjusted capital asset pricing model.

foreign-exchange-adjusted basis) as shareholders in the home market do.[4] By comparing the differences in the prices and liquidity of the ADRs and their corresponding home shares, we are able to test the difference-in-liquidity hypothesis in a straightforward manner without the ambiguities embedded in earlier studies.

A few previous studies also provide indirect evidence that links asset prices cross-listed across markets, such as ADRs, with liquidity. For instance, Alexander, Eun and Janakiraman (1988) document a reduction in a security's expected return after its international listing. Kadlec and McConnell (1994) and Foerster and Karolyi (1999) show that the reduction in expected return is associated with an increase in the share price around the listing date. They also attribute the increase in the share price to the superior liquidity associated with the international listing.[5]

In this paper, we directly investigate the cross-sectional relationship between the ADR premium and the liquidity of the ADR and that of its underlying share, in the presence of several other controls. Our sample consists of 401 ADRs from 23 countries over the period between January 1981 and December 2003. We use the Amihud (2002) measure of liquidity, the turnover ratio and trading infrequency as proxies for liquidity. We primarily examine the relationship between the monthly *change* in the ADR premium and the monthly *change* in the liquidity measures. We find that the change in the ADR premium is positively correlated with the change in the ADR's liquidity, and negatively

[4] See Foerster and Karolyi (1999) for a primer on ADRs.

[5] There is a vast literature on the pricing of ADRs, which is *indirectly* connected with the issue analyzed in this paper. Many of the papers in this literature investigate the differences in pricing between the ADR and the underlying share, and thus indirectly seek to explain the premium in relation to macroeconomic factors and the degree of segmentation/integration between the home and ADR market. See, for example, Rosenthal and Young (1990), Kato, Lin, and Schallheim (1991), Wahab, Lashgari, and Cohn (1992), Park and Tavokkol (1994), Miller and Morey (1996), Chakravarty, Sarkar, and Wu (1998), Foerster and Karolyi (1999), Dabora and Froot (1999), Grammig, Melvin, and Schlag (2001, 2005), Eun and Sabherwal (2002), Karolyi and Li (2003), De Jong, Rosenthal, and van Dijk (2004), Doidge, Karolyi, and Stulz (2004), Gagnon and Karolyi (2003), Suh (2003), Menkveld, Koopman, and Lucas (2003), Karolyi (2004), Bailey, Karolyi, and Salva (2005), Blouin, Hail, and Yetman (2005).

correlated with the change in the home share liquidity. The liquidity effects do not disappear, even after we control for expectations about the future exchange rate change, the foreign stock market return and the US stock market return.

The important advantage of examining the *changes* in the ADR premium and the liquidity measures (change variables, hereafter) is that it indirectly controls for other firm and country characteristics. Intuitively, institutional factors such as restrictions on foreign ownership, short sale constraints, and opaque accounting standards can potentially hinder the arbitrage activities between the two markets, thus potentially determine the cross-sectional variation of the *level* of ADR premium. However, it is likely that these factors would play little role in the *change* in the ADR premium since the factors are quite stable from one month to the next. On the other hand, the liquidity measures themselves vary substantially from one month to the next. If liquidity is truly an important factor in the pricing of the ADR and its underlying asset, we would expect the change in liquidity to be related to the change in the ADR's premium.

As a result, the *change* variable regressions should show the isolated impact of liquidity on the ADR premium, which is the focus of the study. Although our purpose is not to explain the level of the ADR premium using an exhaustive list of variables, we address the impact of market structures and segmentation in a separate robustness test. We show that the liquidity effects remain robust by carrying out regressions using the *level* variables with controls for country characteristics that have been shown to affect financial markets.

More importantly, the findings are also economically significant. We find that the average premium of the most liquid ADRs (the top decile in terms of the Amihud measure) is 1.53 percent higher than the average premium of the most illiquid ones (bottom decile). If the turnover ratio is used as the liquidity measure, the average premium of the most liquid ADRs is 1.76 percent higher than the average premium of the most illiquid ones.

The rest of the paper is organized as follows. In section II, we discuss our ADR dataset and report summary statistics. Section III covers the construction of liquidity measures for the individual ADRs, the shares in the home market and the home markets as a whole. Section IV presents our empirical findings. Section V concludes the paper.

II. Data

We begin our sample construction with the universe of all ADRs in the Center for Research in Securities Prices (CRSP) datasets as of December 31, 2003. Depending on the registration and reporting requirements, and trading conditions, there are four types of ADRs: Level I, Level II, Level III and Rule 144A. Only Level II and level III ADRs are listed on American Stock Exchange/New York Stock Exchange/National Association of Securities Dealers Automated Quotation System.[6] Our analysis includes only these listed (Level II and Level III) ADRs, as CRSP only covers those from AMEX, NYSE or NASDAQ. Based on these criteria, there are 809 ADRs in the entire CRSP dataset, of which 437 were still actively traded at the end of 2003.

Out of the 809 ADRs, we are able to match 470 with their respective home market stock prices and volumes, which are available on Datastream, and the corresponding ADR ratios (1 share of ADR = # of shares of home stock). We also exclude countries with fewer than 5 ADRs, since otherwise the number of firms may be too few to account for cross-sectional differences in the country characteristics we seek to use as explanatory variables. This eliminates 30 ADRs, which represent 16 countries, and 440 ADRs remain in our database for our empirical tests.

[6] Level I ADRs trade over the counter (OTC) on “pink sheets”, require minimal SEC disclosure and do not require compliance with US GAAP financial reporting obligations. Rule 144A ADRs are privately placed to Qualified Institutional Buyers and also do not require SEC disclosures or US GAAP compliance. We exclude these from our study, due to the opacity of their price formation as well as the lack of reliable data for our analysis.

After these initial screens, we obtain daily prices, trading volume and shares outstanding of the ADRs and U.S. daily market returns from CRSP. We then collect the same set of data for the corresponding shares in the home market from Datastream. The daily foreign exchange rates for conversion from the home market currency into U.S. dollars and the daily returns of the respective home markets are also obtained from Datastream. The sample period covers daily data for the period from January 1981 to December 2003.

One issue with our datasets is that the ADR ratios are only available at the end of our sample period. As this ratio is crucial for calculating the ADR premium, we need to make appropriate adjustments in our analysis, if the ratio changes over time. Typically, custodian banks advise firms to change the ratio to maintain a “proper” price range in the US, especially when the home share price changes significantly. In order to correct for these ratio changes, we first manually check the ADR premium pattern of each stock to identify such ratio changes. Out of the 440 ADRs we checked, 275 do not appear to have such a ratio change during the period under investigation. The ratios of 126 ADRs apparently changed and the old ratios are easily identifiable (e.g. the ratio changed from 1:5 to 1:1). We manually correct the old ADR ratios for these ADRs in our database on these dates. We are unable to explain the premium pattern for the other 39 ADRs, which might be due to data errors or mismatching of data from CRSP and Datastream in the first step of our sample construction. We, therefore, eliminate these 39 ADRs from our sample.

In our final sample, there are 401 ADRs from 23 countries from January 1981 to December 2003. During this period, with the increasing trend towards globalization of financial markets, the ADR, as a financial instrument, has been growing in popularity. As a result, there are more ADRs towards the end of our sample period, particularly in the last 5 years. On average, there are 183 ADRs that were traded each month during our whole sample period.

Table 1 reports the summary statistics of the final sample. Not surprisingly, there are more ADRs of firms from the developed markets, since these markets had fewer trading restrictions, particularly in the earlier years, compared to the emerging markets. In our sample, therefore, the UK has the most firms, with 92 ADRs traded in the U.S. Other countries with more than 20 ADRs include France (29), Germany (24), Japan (32), Hong Kong (23), and Australia (24). In recent years, there is an increasing tendency for companies from emerging economies, especially from Asia and Latin America, to raise capital in the form of ADRs. Hence, there are also significant numbers of ADRs included in our sample from emerging market countries, such as Korea (9), India (10), Taiwan (10), Mexico (18), Chile (17), Brazil (12), Argentina (10) and South Africa (14).

Columns 4 and 5 report the statistics on market capitalization (MV) of the ADRs in our sample. The MV is calculated using data on the home share price and the exchange rate from Datastream, as the data for shares outstanding on CRSP refer only to those in ADR form and not to the total number of shares. The numbers reported are the time series averages of the monthly median (mean) market capitalization of the ADRs for each country. According to the averages of the monthly median market capitalization, companies from Spain have the highest MV (US$38.6 billion), while those from Israel have the lowest (US$396.75 million). For all companies from all countries, the average of the monthly MV medians is US$3.17 billion and the average of the monthly MV means is US$8.51 billion.

The statistics on the ADR premium are reported in column 6 and 7. We first compute the daily ADR premium as defined below:

$$Prem_{i,d} = \frac{P_{i,d}^{adr} * ER_d}{P_{i,d}^{hs} * AR_{i,d}} - 1 \qquad (1)$$

where $Prem_{i,d}$ is the premium (discount) for ADR *i*, if it is positive (negative) on day *d*, $P_{i,d}^{adr}$ is the ADR price from CRSP, $P_{i,d}^{hs}$ is the home share price from Datastream, ER_d is the currency exchange rate, and $AR_{i,d}$ is the ADR ratio, i.e. the number of home shares equivalent to 1 share of ADR. After we compute the daily premium for each ADR, we compute the average for each month to get its monthly premium. We again report the time series average of the monthly median (mean) premium of the ADRs for each country. According to the average of the monthly medians, the country ADR premium ranges from -10.54% (Netherlands) to 21.53% (India). The average premium for all ADRs from all countries, however, is close to zero (0.01%).

III. Liquidity Measures

III.A. The Amihud measure, the turnover ratio, and trading infrequency

In simple terms, illiquidity can be thought of as the sensitivity of asset returns (or prices) to order flow. The larger the illiquidity, the greater is the impact of a particular level of order flow on the asset price. Unfortunately, illiquidity is not an observable variable and is somewhat difficult to quantify, sometimes even with actual market microstructure data. In practice, several illiquidity proxies are used and their impact on stock returns has been well documented in the existing academic literature. The simplest and the most traditional measure of illiquidity is the quoted bid-ask spread employed in Amihud and Mendelson (1986). Chalmers and Kadlec (1998) use the effective spread obtained from quotes as well as from subsequent transactions. Brennan and Subrahmanyam (1996) measure illiquidity based on the price response to signed order flow (i.e. using opposite signs for buy and sell orders) using intra-day data on transactions and quotes. Easley, Hvidkjaer and O'Hara (2002) introduce a measure of the probability of information-based trading (PIN), which captures the information asymmetry aspect of illiquidity, i.e., the likelihood that the next trade comes from an informed agent. They show that PIN has a direct impact on expected stock returns, independent of the stocks' illiquidity and return characteristics.

Unfortunately, it is difficult to apply these microstructure-based measures in the ADR setting due to constraints on data availability. Although intra-day data on transactions and quotes are available for the ADR market in the U.S. (e.g. the Trades and Quotes (TAQ) database of the New York Stock Exchange), these are often not available for individual foreign stock markets. As a result, we are constrained to obtain alternative liquidity measures that use only daily return and volume data as inputs. Indeed, the developments of these measures were partly motivated by the constraints on data availability encountered in market microstructure research in general.

Among the first measures using only daily return and price data is the "Amivest" liquidity ratio, which is defined as the average of daily ratio of volume to absolute return. This measure has been used in the studies of Cooper, Groth and Avera (1985), and Amihud, Mendelson, and Lauterbach (1997), among others. Another measure closely related to the Amivest ratio is the Amihud (2002) illiquidity measure, which is based on Kyle's (1985) *lambda* and calculated as the average of daily ratio of absolute return to volume (the reciprocal of the Amivest liquidity ratio). This measure is intuitively appealing in the sense that it measures the daily price impact of the order flow, which is exactly the concept of illiquidity, since it quantifies the price/return response to a given size of trade. Finally, Pastor and Stambaugh's (2003) liquidity beta estimates the liquidity cost from signed volume-related return reversals using daily return and volume data.

Clearly, any candidate metric for liquidity, using only daily price and volume data, needs to be positively correlated to the finer measures using microstructure data. This would justify its use, especially when the latter high frequency data are unavailable. Hasbrouck (2005) addresses this issue by evaluating the various alternative liquidity measures using daily data and estimates their correlations with the microstructure-based measures. He finds that the correlations between the Amihud (2002) measure and various microstructure-based measures are higher compared with those involving the Amivest measure. He also finds that the Pastor and Stambaugh (2003) measure is weakly correlated to microstructure-based measures, and sometimes with the wrong sign and should be used with caution.

In our analysis, we use the Amihud (2002) measure of liquidity, which is founded on the basic intuition about a security's price impact (i.e. Kyle's λ), and can be easily computed from the foreign and U.S. market daily price and volume data. Intuitively, liquidity includes two dimensions: the *liquidity level* and the *liquidity risk*. The level of liquidity is the predictable part of the tradability of the security without suffering the adverse consequences of market impact. Liquidity risk, on the other hand, arises from the unpredictable changes in liquidity over time. In this paper, we focus on the effect of liquidity level, since we need to first establish whether this matters for the pricing of ADRs, before examining the effect of liquidity risk. Also, the existing literature appears to indicate that *liquidity level* is an important determinant of an asset's price.[7] Thus, our procedure begins with calculating the liquidity measure for each ADR and its home market counterpart. We first obtain the daily measure, when it is well defined.[8] We then average it across all trading days of a specific month to obtain the monthly measure. The monthly Amihud measure $Liq_{i,c,t}^{adr}$ for ADR *i* of country *c*, in month *t* is defined as:

$$Liq_{i,c,t}^{adr} = \frac{1}{D_t} \sum_{d=1}^{D_t} \frac{\left| R_{i,d}^{adr} \right|}{Vol_{i,d}^{adr}} \qquad (2)$$

where D_t is the number of trading days in month *t*, $R_{i,d}^{adr}$ is the daily return of ADR *i* on day *d* (within month *t*), and $Vol_{i,d}^{adr}$ is the dollar trading volume of ADR *i* on day *d*, defined as number of shares traded times the ADR price on day *d*.

The monthly Amihud measure for the ADR's home market counterpart, $Liq_{i,c,t}^{hs}$, is defined similarly, except that the daily money trading volume in that market is converted into U.S. dollars at the corresponding spot exchange rate on day *d*. The purpose of this adjustment

[7] Acharya and Pedersen (2005) estimate that, in the US markets, the return premium due to liquidity level is 3.5%, while the return premium due to commonality in liquidity with market liquidity, cov($Liquidity_i$,$Liquidity_M$) is only 0.08%. They also estimate the premium due to the other cross liquidity-market risk factors, cov($Return_i$, $Liquidity_M$) and cov($Liquidity_i$, $Return_M$) to be 0.16% and 0.82%, respectively.

[8] The measure is not defined if there is no trading on a particular trading day.

is to ensure that the measure is calculated on the same basis for all stocks from different countries.

In our cross-sectional analysis, we employ both the Amihud measure of the ADR, $Liq_{i,c,t}^{adr}$, and of its home market counterpart, $Liq_{i,c,t}^{hs}$. Since the daily return of the ADR, $R_{i,d}^{adr}$, and that of its corresponding home share, $R_{i,d}^{hs}$, are approximately equal on any given day, the difference between $Liq_{i,c,t}^{adr}$ and $Liq_{i,c,t}^{hs}$ is largely determined by the respective dollar trading volumes in the U.S. and in the home market. This, potentially, creates a measurement discrepancy between these two variables, since the numbers of floating shares are very different in the two markets. To address this issue, we use turnover ratio as an alternative liquidity measure and carry out the same analysis. The turnover ratio measures how actively the stock is being traded, adjusted by the number of shares outstanding, and thus, available for trading. Chordia, Roll, and Subrahmanyam (2000) also document high correlations between the quoted bid-ask spread and various volume measures, which include share volume, dollar trading volume, and turnover. The monthly turnover ratio $TO_{i,c,t}$ is simply defined as the average of daily turnover ratios in each month:

$$TO_{i,c,t}^{adr} = \frac{1}{D_t}\sum_{d=1}^{D_t}\frac{Vol_{i,d}^{adr}}{SO_{i,d}^{adr}}; \quad TO_{i,c,t}^{hs} = \frac{1}{D_t}\sum_{d=1}^{D_t}\frac{Vol_{i,d}^{hs}}{SO_{i,d}^{hs}} \tag{4}$$

where $Vol_{i,d}^{adr}$ is the number of ADR shares traded and $SO_{i,d}^{adr}$ is the total ADR shares outstanding on day *d* in the U.S. market. $Vol_{i,d}^{hs}$ and $SO_{i,d}^{hs}$ correspond to the number of home shares traded and total shares outstanding in the home market, respectively.

In extreme cases, some ADRs are so illiquid that there is virtually no trading at all during many regular trading days in the U.S. markets. We believe that this type of trading infrequency captures another aspect of illiquidity. So we construct another variable, the monthly trading "infrequency," defined as number of days that the ADR is *not* traded divided by the total number of trading days in the month. This trading infrequency is typically an issue only for the ADRs, but not for their home market counterparts, since the underlying shares in the home markets are generally those of the larger companies, and hence more actively traded in those markets. Hence, in virtually all cases, we observe that the home shares are traded on almost every trading day, and trading infrequency has no cross-sectional variation.

III.B. Summary statistics and correlations between the alternative liquidity measures

Panel A in table 2 provides a brief overview of the statistical characteristics of the Amihud measure and the turnover ratios of ADRs and the underlying securities in their home markets. Notably, all variables, except trading infrequency, span wide ranges, cross-sectionally in our dataset. Take the home share Amihud measure as an example: the time series average of the monthly cross-sectional mean is 0.0332, while it has a (cross-sectional) standard deviation of 0.1730. It is interesting to note that a significant number of ADRs are not traded every day, since the average of the cross-sectional mean trading infrequency is 0.1147, which means that, on average, the typical ADR has zero trading volume on about 2 trading days per month. Investors who hold (or plan to buy) ADRs that have a lower frequency of trading certainly face some liquidity risk if they were to sell (or add to) their holdings.

Panel B in table 2 provides the correlation coefficients among the liquidity measures, the size of the ADR and its home counterpart. The size of the ADR and the size of the home market counterpart are typically quite different, since we only calculate them by multiplying the price and the outstanding shares in the U.S. market and the home market, respectively. (A typical firm in our sample has 5%-10% of its total outstanding shares traded in the U.S. in ADR form.) There are two sets of correlations between the variables – in the home markets and in the U.S. market, respectively. However, a striking similarity is observed in the correlation pattern between the two sets. Surprisingly, the Amihud measure has low correlation with the turnover ratio in both markets. This may suggest that the two measures capture different aspects of the stock's illiquidity that are somewhat orthogonal to each other. Since the Amihud measure is negatively correlated with firm size, a given amount of trading volume could lead to a large price movement for a smaller firm, and hence, a greater Amihud measure. The turnover ratio is also negatively correlated with size, which might be consistent with the fact that smaller stocks tend to be held by retail investors, and thus have a higher turnover ratio. Interestingly, trading infrequency is positively correlated with the Amihud measure. This is consistent with our intuition that if a stock trades less often, it is likely to lead to large price movement *once* it is traded. Finally, trading infrequency has a negative correlation with size, as expected.

IV. Methodology and Empirical Results

IV.A. The Model

As discussed in the introduction, holders of ADRs and the underlying shares in the home market have identical claims to the firm's future cash flows. However, this does not guarantee that the ADR and its underlying share trade at the same price, when there is a certain level of market segmentation between the two markets, even apart from differences between the time zones of the two markets. Our focus in this paper is to study whether the differences in liquidity in the two markets have effects on the price of the ADR in relation to the home share, apart from these other effects. If liquidity is an important factor in pricing the asset, different levels of liquidity in the host (ADR) market and home market can potentially cause the ADR price to deviate from the price of its underlying asset, thus creating a premium (or a discount). High liquidity in the ADR market increases the price of the ADR and its premium. On the other hand, high illiquidity in the home market depresses the price of the home share, and thus increases the ADR's premium. Therefore, we expect a positive relationship between the premium and the ADR's liquidity, and a negative relationship between the premium and the liquidity of the underlying share in the home market.

In addition to the liquidity differences, investors in the two markets face many institutional and informational differences. In a prior study, Gagnon and Karolyi (2003) use daily data to document that the ADR premium has a higher systematic co-movement with the U.S. market index and a lower systematic co-movement with the corresponding home market index. They also show that the "excessive co-movements" are influenced by factors that impede arbitrage activities. The factors they study include three major categories: first, market-based ones such as investment barriers, short-sales restrictions, accounting standards, legal protection, etc., which are regulatory in nature; second, information-based factors such as the degree of synchronization of the common movement between the stock and the home market, the existence of asymmetry of information between insiders and other shareholders; and third, trading-based factors such as whether the cross-listed stocks have a "preferred" trading location, which we believe is indirectly related to our concepts of liquidity. Since all these country factors affect arbitrage activities between the home and ADR markets, they could potentially explain the variations in the ADR premium.

Time zone differences may also contribute to the differences between the daily closing prices of the ADR and their respective underlying assets. Since we construct monthly measures for all variables by averaging their daily measures within each month, and our regressions are all based on monthly observations, we believe that the possible time-zone effects will have little impact on our empirical analysis.[9]

In our model, we conjecture that the cross-sectional differences of the ADR premium are determined both by the liquidity effects and country factors. The relationship can be described by the following equation:

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[9] To check this conjecture, we test the sensitivity of our results to time-zone differences, by computing the daily premium differently: by comparing the U.S. price on day d-1 and the home market price on day d, or alternatively, by comparing the U.S. price on day d+1 and the home market price on day d. The empirical results are essentially the same as those when the premium is computed as in equation (1) and are not presented here in the interests of brevity.

$$Prem_{i,t} = X_{i,t} * b_x + Z_{i,t} * b_z + \varepsilon_{i,t} \qquad (5)$$

where $Prem_{i,t}$ is ADR *i*'s premium in month *t*, defined as the average of the daily premium in equation (1). $X_{i,t}$ is a vector of the liquidity measures discussed in section III, and $Z_{i,t}$ is a vector of country factors discussed above. To estimate (5) with panel data, one should note that there is an important difference in the properties of $X_{i,t}$ and $Z_{i,t}$: The vector $X_{i,t}$ measures the liquidity of the ADR and its home counterpart, and varies from one month to the next, while the vector $Z_{i,t}$ measures country characteristics, which usually do not change much from month *t-1* to month *t*. Since the liquidity effects are the focus of this study and we are interested primarily in the coefficients b_x, we instead estimate the model in first differences:

$$\Delta Prem_{i,t} = \Delta X_{i,t} * b_x + \Delta \varepsilon_{i,t} \qquad (5')$$

which is the difference of equation (5) in *t-1* and *t.* Note that $Z_{i,t}$ and b_z drop out because $Z_{i,t}$ does not change from *t-1* to *t*. Intuitively, the country factors can potentially determine the *level* of ADR premium cross-sectionally.[10] However, as mentioned above, it is unlikely that there is such a relationship between the *changes* in these factors and the *change* in the ADR premium. On the other hand, our liquidity measures vary substantially from month to month. If liquidity is truly an important factor in the pricing of the ADR and its underlying asset, we expect the *change* in liquidity to be related to the *change* in the ADR's premium. Estimating equation (5') allows us to obtain unbiased estimates of the liquidity effects, without the complication of the time-invariant components $Z_{i,t}$ in equation (5).[11]

[10] In addition, $Z_{i,t}$ may also include firm characteristics that do not change much from month to month, such as beta, firm size, value/growth characteristics, or analyst following, although their effects on the ADR premium are unclear intuitively.

[11] As a robustness test, we estimate equation (5) and report the results in a later subsection.

Another advantage of using equation (5') is due to an important statistical property of the liquidity measures $X_{i,t}$ and the ADR premium $Prem_{i,t}$. Although $X_{i,t}$ and $Prem_{i,t}$ do vary from month to month, these variables are highly persistent in nature. The average first-order auto-correlation of $Prem_{i,t}$ is about 45%, and that of the elements of $X_{i,t}$ falls in the range of 40%-65%. With such a high degree of persistence in the dependent and independent variables, we are likely to obtain biased standard errors of the coefficient estimates in panel regressions, even if we apply some econometric correction to address the problem. On the other hand, although there is still some degree of persistence in the change variables, $\Delta X_{i,t}$ and $\Delta Prem_{i,t}$, the average first-order auto-correlation coefficients are much lower, and fall in the range of -10% to -25%. With proper econometric controls, we are likely to obtain unbiased estimates from our regressions.

Given the advantages of using the change variables discussed above, we estimate equation (5') with panel data. The estimates for b_x are the OLS estimates. The OLS standard errors are biased due to the existence of a firm effect (time series dependence for a given firm) since the change variables are still serially auto-correlated to some extent. To address this problem, we calculate the corresponding t-statistics using Rogers' estimate of standard errors, clustered by firm, as suggested by Petersen (2005).[12] In a robustness test, we also estimate equation (5') using the Fama-MacBeth (1973) procedure. In doing this, we actually find much stronger results using time-series adjusted (or unadjusted) Fama-MacBeth standard errors[13]. To be conservative, we only report the results using the methodology that indicates weaker liquidity effects.

IV.B. Liquidity Effects

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[12] Petersen (2005) examines different approaches used in the finance literature that address the firm fixed effect in panel regressions. He finds that Rogers' standard errors, clustered by firm, are unbiased.

[13] Since the Fama-MacBeth procedure is designed to address a time effect (cross-sectional dependence for a given year), the fact that we obtain stronger results using the Fama-MacBeth procedure indicates that the time effect is insignificant in our data.

By expanding equation (5'), we have the following equation:

$$\begin{aligned}\Delta Prem_{i,t} &= b_{0,t} + b_1 * \Delta Liq^{adr}_{i,c,t} + b_2 * \Delta Liq^{hs}_{i,c,t} \\ &+ b_3 * \Delta TO^{adr}_{i,c,t} + b_4 * \Delta TO^{hs}_{i,c,t} + b_5 * \Delta Infreq_{i,c,t} + \varepsilon_{i,c,t}\end{aligned} \qquad (6)$$

In the above regression, the right hand side includes the various liquidity measures discussed in section III. $\Delta Liq^{adr}_{i,c,t}$ and $\Delta Liq^{hs}_{i,c,t}$ represent the *change* in the ADR and home share Amihud liquidity measures, respectively. $\Delta TO^{adr}_{i,c,t}$ and $\Delta TO^{hs}_{i,c,t}$ denote the *change* in the ADR and home share turnover ratios, respectively. $\Delta Infreq_{i,c,t}$ is the *change* in the monthly trading infrequency of the ADR. The trading infrequency of the home shares is not included in the model specification because the home shares are traded on almost every day in virtually all cases, as discussed in subsection III.A.

Since we are examining the effect of liquidity on the price difference between the ADR and its corresponding home share, one might be tempted to use the *difference* in liquidity between the two markets as an explanatory variable. However, in a typical case, 95% of the shares are traded in the home market and only 5% are traded as ADR, the home share liquidity and the ADR liquidity have different scales. Thus, measuring the difference between the two liquidity metrics might be problematic. In addition, using the liquidity difference as an explanatory variable also assumes that the ADR liquidity and the home market liquidity have the same magnitude and sign for the effect on the ADR premium, which may be too restrictive. Indeed, our results show that the liquidity effect of the ADR is much stronger than that of the home share.

Our intuition suggests that the signs of the estimates of the coefficients in regression (6) should be $b_2>0$, $b_3>0$, and $b_1<0$, $b_4<0$, $b_5<0$. Table 3 summarizes the main results. We estimate equation (6) using different sets of independent variables, which allow us to gauge the relative impact on the change in the ADR premium on the change in the ADR liquidity and the home share liquidity. Regression I estimates the relationship between the ADR premium and the illiquidity of the underlying assets, when the Amihud measures are used. Regressions II and III estimates the same relationship when turnover ratios and trading infrequency are used, respectively. In regression IV, we include the Amihud measures, the turnover ratios, and trading infrequency to see if the estimates differ significantly from the previous setups.

The results in table 3 are both intuitive and consistent with our expectations regarding how illiquidities in the home and host markets are related to the ADR premium. Regression Ia shows that the change in the ADR premium is negatively related to the change in its Amihud measure, suggesting that the increase of the ADR's illiquidity in the U.S. market has an impact on reducing the ADR premium (i.e., reducing the ADR price in relation to its home market counterpart). On the other hand, the relationship between the ADR premium and the home share Amihud measure is not significant, although it has the correct sign.[14] The results in regression IIa are also consistent with our main hypothesis, but the significance is somewhat marginal for the home share turnover. Higher ADR turnover corresponds to higher liquidity, and thus a higher ADR premium. In contrast, higher home share turnover corresponds to a lower ADR premium. As expected, the signs of b_1, b_2 are opposite to the signs of b_3, b_4 (in regression I and II), since the Amihud measure could be thought of as a *scaled* reciprocal of the volume measures. In regression IIIa, the inverse relationship between the ADR premium and the trading infrequency is anticipated, since the latter is *partially* related to illiquidity. We expect infrequently traded securities to be a subset of illiquid assets, although the two dimensions are likely to offer different perspectives regarding the liquidity and informational content of an asset.

Regression IVa illustrates the full regression result of equation (6), with the Amihud measures, the turnover ratios and the trading infrequency being used as explanatory

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[14] Following the suggestion of Hasbrouck (2005), we also use the square root of the Amihud measures in our regressions as a robustness check. The results are qualitatively the same as those when the simple Amihud measure is used; therefore, we do not report those results in this paper.

variables. Even though all three liquidity measures contain liquidity information, using all of them in the same regression does not appear to diminish their respective individual explanatory powers. This can be clearly seen from the similar levels of significance of the estimates b_1, b_2, b_3, b_4, and b_5 in regressions Ia - IVa, respectively.

In regressions Ib – IVb, we use a simple AR(1) model to decompose the monthly changes in the liquidity measures into expected and unexpected components, and then carry out the same analysis as in regressions Ia – IVa. As mentioned earlier, there is still certain level of auto-correlation in the monthly changes of the liquidity measures. So, to some extent, part of the change in liquidity is expected. It would seem that, in a rational expectations model, the predominant relation would be between *changes* in the premium and the *unexpected* changes in liquidity. For example, when there is a surprise increase (decrease) in the liquidity of the ADR, the ADR premium increases (decreases). On the other hand, if the ADR liquidity increase (decrease) is expected *ex ante,* it should not cause the ADR premium to increase (decrease). Indeed, we find in regressions Ib – IVb that the expected components of the liquidity changes have little explanatory power on the change in the ADR premium, while the coefficients and the significance level of the unexpected components are similar to what we obtained in regressions Ia – IVa[15]. Since the expected components of the liquidity changes do not seem to be important, we only use the unexpected components in the rest of our regressions.

From the regressions, it appears that liquidity in the host (i.e. ADR) market is more important than liquidity in the home market. We suspect that the asymmetry of the liquidity effects in both the host and home markets has to do with the fact that the premium is largely determined by the investors in the U.S. market, rather than those in the home market. Under normal conditions, investors in the U.S. market observe the price of the underlying asset, and collectively determine the level of the premium according to various factors they are faced with. It is also possible that home market investors observe the ADR's price in the U.S. market and then determine their demand

[15] We thank an anonymous referee for the suggestion to decompose total liquidity changes into expected and unexpected components.

for the underlying asset, but we believe that it is to a lesser degree compared to investors in the U.S. market doing the reverse. This argument is based on the presumption that the bulk of the shares are typically held by investors in the home market, and most information is revealed there, as well. Based on our analysis, liquidity is an important factor in the pricing difference between the ADR and its home share. It is not surprising that the ADR's liquidity has stronger effects on its premium, since the latter is largely determined by ADR investors, who care much more about the liquidity in the ADR market rather than in the home market.

The findings are also economically significant. We find that the average premium of the most liquid ADRs (the top decile in terms of the Amihud measure) is 1.53 percent higher than the average premium of the most illiquid ones (bottom decile), with a *t*-statistic of 4.60[16]. If the turnover ratio is used as the liquidity measure, the average premium of the most liquid ADRs is 1.76 percent higher than the average premium of the most illiquid ones, with a *t*-statistic of 5.45. Also, according to table 2 and the estimated coefficients in table 3, a one standard deviation change in the ADR Amihud measure, turnover, or trading infrequency translates into a change of 10, 12, or 10 basis points in the ADR premium, respectively.

IV.C. Exchange rate and stock market movement

Since ADR investors are, in essence, U.S. (or more generally, global) investors interested in taking a position in foreign stock markets, their views regarding future exchange rate movements and future foreign stock markets performance are potentially important factors in ADR pricing.

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[16] Each month, we sort ADRs into deciles according to their Amihud measure. We then compute the average ADR premium for each decile and find the difference between the top decile and bottom decile. After we construct the time-series of such monthly differences, we then compute its mean and corresponding *t*-statistics. We use the same procedure for computing the economic significance of the liquidity effect based on ADR turnover.

If an investor owns two ADRs, one from country A and the other one from country B, she would get an additional benefit if A's currency appreciates against B's currency, everything else being equal. Thus, she would be willing to pay a higher premium if she expects A's currency to appreciate in the future. (This argument presumes some transaction costs, currency restrictions or other frictions that make it costly or difficult for the investor to speculate directly on the exchange rates, since the ADR is an indirect and somewhat risky bet on the exchange rates.) Similarly, if the investor expects the stock market of country A to perform better in the future than that of country B, she might be willing to pay a higher premium for an ADR from country A. (Again, this presumes that other ways of placing this bet are costly or have significant constraints attached to them.)

Bhojraj and Swaminathan (2006) document momentum effects in both international stock market indices and currencies. Following their findings, we use the most recent 1-month or 6-month exchange rate change and stock markets performance as proxies for expectations about the relative future performance of stock markets and currencies, and include them in the regressions. Note that the additional variables serve as controls for relative expectations in the cross-section, but not for the autocorrelations in a given stock market index or currency. Since our exchange rate is defined as the number of units of the foreign currency per U.S. dollar, a positive exchange rate change indicates a depreciation of foreign currency, while a negative change indicates appreciation.[17] Based on this intuition, we should expect the coefficient of this variable to be negative. Similarly, we expect the estimated coefficient to be positive for the variable representing recent foreign stock market performance, and to be negative for that of the recent U.S. stock market performance. However, there could be an additional counteracting effect on the ADR premium from the U.S. market performance. Bodurtha, Kim and Lee (1995) show that closed-end country fund premiums move together, primarily because of the comovements of their stock prices with the U.S. market, which may be interpreted as a

[17] We considered using the forward exchange rate, but decided not to, since by covered interest rate parity, the forward exchange rate is the spot exchange rate adjusted by the interest rate differential. Hence, it is *not* a market expectation variable, but simply an *adjusted* version of the spot exchange rate, given the relative stability of the interest rate differential, from one month to the next.

U.S. market sentiment effect. Since an ADR is essentially a closed-end country fund holding a single stock, the U.S. market return as a proxy for market sentiment could have a positive impact on the ADR premium, based on the same argument. Coupled with the negative effect from our earlier analysis, the total effect of the U.S. market return on the ADR premium is, therefore, ambiguous.

Regressions I and II in table 4 report the results for the three control variables. The 1-month exchange rate change variable appears to have some explanatory power (with a t-value of -1.22) on the change in the ADR's premium. The 6-month exchange rate change has much lower explanatory power, with a t-value of -0.61. Similarly, the 1-month stock market return variable has stronger explanatory power than the 6-month variable. The 1-month home market return has a t-value of 4.89. On the other hand, the 1-month US market return has a t-value of 3.40, with a sign in support of the U.S. market sentiment hypothesis. Since the dependent variable is the change in the ADR premium from one month to the next, we suspect that the contemporaneous change in the exchange rate and the stock market return provide more relevant information. Thus, we observe a much stronger effect for the 1-month variables compared to the 6-month variables. Overall, the returns of the stock markets and currencies appear to be important in determining the ADR premium, which can also be seen from the substantial increase in R-squared compared to table 3.

More importantly, the qualitative results about the liquidity effects should not alter significantly after the inclusion of these control variables. According to the results in table 4, the coefficients $\hat{b}_1, \hat{b}_2, \hat{b}_3, \hat{b}_4, \hat{b}_5$, remain as significant as before[18]. This robustness check is important because it shows that the liquidity effects remain strong after the inclusion of the control variables.

[18] The coefficient of ADR turnover and its corresponding *t*-statistics increase substantially compared to table 3. This is mainly due to the change in sample size as we have missing values in stock market returns and exchange rates for some countries in certain periods. After including market returns and exchange rates, our sample size reduces by about 10%, which may eliminate some extreme values in the ADR turnover observations. We did not find high correlation between ADR turnover and the additional control variables.

IV.D. Robustness Checks

IV.D.1. Country Effect

Our analysis thus far imposes equal coefficients across all countries, which may be too strict. In this subsection, we allow for country-specific coefficients in our regression model by introducing interaction terms between the liquidity measures and a simple measure of the intensity of capital controls, EWR[19]. The measure, constructed by Edison and Warnock (2003) is essentially the portion of the domestic shares that foreigners may own, and is computed based on the market's openness and the stock- and industry-specific limitations. A value of 0 represents a completely open market and a value of 1 means a completely closed market. Their study only covers emerging markets from January 1989 to December 2000, but not the developed markets. Based on our judgment, we assume a value of 0 for all the developed markets in our sample, since they are likely to be all highly liberalized markets.[20] We choose EWR because it has the least data non-availability problem among all the country characteristics variables, and we find it to be highly correlated to most of the country variables.

Regression III in table 4 reports the result of the regression including the interaction terms between the five liquidity measures and the EWR measure. The ADR liquidity effects do not disappear. The ADR turnover and trading infrequency are significant at the

[19] An ideal way to allow for country-specific coefficients is to introduce interaction terms between all the liquidity measures and country dummies. However, this approach is not practical since we have 5 liquidity measures and 23 countries, which means we would have to introduce 115 variables in the regression. This does not work because the sample size for some countries is too small. Using the EWR variable is a compromise, but it has its own drawback because of non-availability of data for some countries. We lost about 40% of observations because of EWR's non-availability.

[20] See Edison and Warnock (2003) for details about the construction of this measure. Given the value of the EWR measure is around 0.10 for some of the emerging markets, we believe that the value should fall in between 0 and 0.10 for developed markets. Assuming a value of 0 for all developed markets might introduce some bias. However, the bias appears to be minor since in a robustness test, we also assume a EWR value of 0.05 or 0.10 for all developed markets and get similar results.

5% confidence level. The ADR Amihud measure is only marginally significant, although it still has the correct sign. The 1-month returns of the home stock markets and currencies also continue to have strong explanatory power. For brevity, the coefficients on the interaction terms are not reported since they are insignificant. In regression IV, we just include 23 dummy variables for each country and run the regression without a constant term. We find the coefficients and their significance level are almost identical to regression I where no dummy variables are included. Again for brevity reason, the coefficients on the dummy variables are not reported.

IV.D.2. Level Regressions

We argue in subsection IV.A that estimating the ADR premium – liquidity relationship using change variables is a better econometric model. In a separate robustness test, we nevertheless carry out the regressions of equation (5) using level variables, along with control variables. Namely, we include $Z_{i,t}$, with elements such as firm size and a number of country characteristics variables. With the inclusion of these variables, the liquidity effects do not disappear. The ADR Amihud measure, the ADR turnover ratio and the home share turnover ratio still have significant explanatory power.[21]

V. Conclusion

Liquidity is generally viewed as a positive characteristic of a traded asset in positive net supply. In this paper, we investigate the liquidity effect in asset pricing using a large sample of ADRs. The ADR market is ideal for testing the liquidity effect, since it consists of securities with cash flow rights that are identical to that of their counterparts in the home market. The other aspect of the ADR market that makes it interesting for such empirical testing is its size and growing importance in the context of global equity

[21] The country characteristics variables include: short-sales restrictions (Bris *et al.* (2002)), anti-director rights, quality of accounting standards, ownership concentration (La Porta *et al.* (1998)), legal environment (Berkowitz *et al.* (2000)), firm-level informational asymmetry (Morck *et al.* (2000)), the Edison-Warnock Restriction (EWR) measure, and finally, country dummies. For brevity, we do not report the results of level regressions but they are available upon request.

markets, contributing in mid-2004 to about 5% of all trading value in the U.S. equity markets.

In an integrated market without frictions and time zone differences, there should be no premium or discount for the ADRs. In reality, financial markets are, to some extent, segmented, and are affected by many market frictions such as international capital controls, differences in taxes, security laws, and trading regimes, between the host and home markets. In this paper, we focus mainly on the liquidity differences between the two markets, and their effects on the pricing of an ADR in relation to its underlying share. Consistent with the liquidity hypothesis, we find that an increase in the ADR premium is associated with an increase in the liquidity in the ADR market. An increase in the premium is also associated with a decrease in home share liquidity, albeit to a lesser degree, compared to ADR liquidity. In the robustness check with level regressions, the liquidity effects remain strong, even after we control for ADR market size, and investors' expectations regarding future exchange rate movements, home stock market performance, and various measures of country characteristics.

Our study has several implications for firms, regulators and investors. As firms from more and more countries expand their investor base by listing in overseas markets, particularly in New York, London and Singapore, the role of liquidity in the pricing of their securities is bound to command attention. Our study has implications for the design of depositary receipt programs, both American (ADR) and Global (GDR), since it provides indirect clues regarding the optimal size of these offerings. A small size for an ADR program in relation to its total amount outstanding may have large illiquidity effects. By the same token, a large ADR program may cause the liquidity in the home market to dry up. Caution must be exercised in ensuring that the amounts outstanding in the two markets are well balanced.

An interesting question arises in the context of liquidity effects in dually listed securities, in particular with regard to how liquidity is transferred from one market to another. This also raises the possibility of arbitrage by forecasting movements in one market, based on the price changes in the other, especially when there are differences in the time zones where the two markets are situated. These effects are likely to be more significant for firms from the emerging markets. We leave these questions to future research.

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Table 1: Summary Statistics: January 1981 - December 2003

This table reports the number, the average market capitalization and the premium statistics for the ADRs of each country included in the study. The data are obtained from two sources: the ADR data are obtained from CRSP; the home share data are obtained from Datastream. The sample includes 401 pairs of ADR and corresponding underlying shares in the home market from 23 countries, from January 1981 to December 2003. Column 1 reports the total number of ADRs included in the study for each country. Column 2 reports the average number of ADRs in each month. The next four columns refer to the central tendencies of the monthly market capitalization (MV) and the premium, for each country, using the average of daily observations. The 4rd (5th) column of the table represents the average of each country's monthly median (mean) MV in millions of US dollar throughout the sample period. The 6th (7th) column is the average of each country's monthly median (mean) premium in percentage throughout the sample period.

	# of ADRs		Average MV (Million)		Average Premium (%)	
Country	Total	Average	Median	Mean	Median	Mean
UK	92	35	3410	8743	0.36	-0.76
France	29	12	6772	12488	-0.02	-0.12
Germany	24	6	8465	12798	0.04	-0.44
Netherlands	13	5	7843	9251	-10.54	-11.81
Italy	11	5	6995	11371	0.06	5.40
Sweden	8	4	3210	5970	0.04	0.13
Switzerland	11	5	4954	11298	-0.18	-0.26
Ireland	10	5	1968	2673	0.51	0.89
Spain	6	4	38603	41312	-0.26	-0.02
Israel	6	5	397	570	7.10	7.09
Norway	7	3	3610	4701	-0.26	-0.79
Finland	5	2	2734	11268	0.14	0.17
Japan	32	24	9047	14925	-0.04	4.07
HK	23	8	4609	7479	-0.15	-0.37
Korea	9	3	11164	10644	6.72	4.54
India	10	6	5014	6541	21.53	25.48
Taiwan	10	3	7286	10364	6.93	11.14
Australia	24	11	2479	4397	-0.13	-6.45
Mexico	18	7	1223	3026	-0.15	0.25
Chile	17	10	853	1428	2.03	2.03
Brazil	12	5	840	1523	-2.44	-17.90
Argentina	10	7	2482	3558	-0.73	-0.14
South Africa	14	6	1007	1674	0.24	1.40
All	**401**	**183**	**3173**	**8512**	**-0.01**	**1.13**

Table 2: Liquidity and Turnover Characcteristics of ADRs and their Underlying Securities

This table provides the basic statistics of the liquidity and turnover characteristics of ADRs' and their underlying securities. The data are obtained from two sources: ADR data are obtained from CRSP; home share data are obtained from Datastream. The sample includes 401 pairs of ADR and corresponding underlying shares in the home market from 23 countries. Individual ADRs and home shares' Amihud (2002) liquidity measures are defined as the ratio of absolute daily return and dollar volume, and are scaled by 1000. Daily measures are then averaged to provide monthly series of the ADRs in our study. Turnover is defined to be number of shares traded divided by the total number of shares outstanding. Trading infrequency is obtained by dividing the number of days that the ADR is not traded by the number of trading days in a given month. Panel A provides the time series averages of the monthly cross-sectional mean, median, standard deviation, maximum and minimum values. Panel B provides the time series averages of the monthly correlations among the liquidity measures and size.

Panel A

	Mean	Median	Std	Max	Min
Home Share Amihud Measure	0.0332	0.0002	0.1730	1.9724	0.0000
Home Share Turnover	0.0093	0.0022	0.0772	1.0311	0.0001
ADR Amihud Measure	0.0719	0.0052	0.2617	2.4288	0.0000
ADR Turnover	0.0137	0.0052	0.0510	0.6280	0.0003
ADR Trading Infrequency	0.1147	0.0336	0.1724	0.8202	0.0180

Panel B: Correlations

	HS Amihud	HS Turnover	HS Size
Home Share Amihud Measure	1	-0.0081	-0.4139
Home Share Turnover	-	1	-0.2776
Home Share Size	-	-	1

	ADR Amihud	ADR Turnover	ADR Size	ADR TI
ADR Amihud Measure	1	-0.0344	-0.4662	0.4688
ADR Turnover	-	1	-0.1869	0.0077
ADR Size	-	-	1	-0.5614
ADR Trading Infrequency	-	-	-	1

Table 3: Liquidity Effects: Regressions Using Change Variables

This table summarizes the pooled regressions of the monthly change in the ADR premium on the monthly change (total, expected and unexpected changes) in the ADR and home share liquidity measures. The data are obtained from two sources: ADR data are obtained from CRSP; home share data are obtained from Datastream. The sample includes 401 pairs of ADR and corresponding underlying shares in the home market from 23 countries, from January 1981 to December 2003. The liquidity measures include the Amihud measure, turnover ratio and trading infrequency. Individual ADR and home shares Amihud measures are defined as the ratio of absolute daily return and dollar volume, scaled by 1000. Individual ADRs and home turnover ratios are defined as the ratio of dollar trading volume to the dollar amount outstanding in each market. The monthly trading infrequency (TI) is defined as number of days that the ADR is *not* traded divided by the total number of trading days in the month. Regressions Ia, IIa, IIIa, IVa employ the monthly changes in the liquidity measures. Regressions Ib, IIb, IIIb, IVb employ the expected and unexpected monthly changes in the liquidity measures. We use a simple AR(1) model to decompose monthly changes in the liquidity measures into expected and unexpected components. The coefficient estimates are the OLS estimates from the pooled regressions of the panel data. The values in italics are the corresponding t-statistics for the coefficient estimates using Rogers' standard errors clustered by firm.

		Ia	**Ib**	**IIa**	**IIb**	**IIIa**	**IIIb**	**IVa**	**IVb**
Intercept		0.000 ***(0.45)***	0.000 ***(0.45)***	0.000 ***(0.63)***	0.000 ***(0.44)***	0.000 ***(0.70)***	0.000 ***(0.44)***	0.000 ***(0.46)***	0.000 ***(0.41)***
ADR Amihud	**Monthly change**	-0.004 ***(2.51)***						-0.004 ***-(2.43)***	
	Expected change		-0.003 ***-(0.94)***						-0.003 ***-(0.92)***
	Unexpected change		-0.004 ***-(2.33)***						-0.004 ***-(2.23)***
Home Share Amihud	**Monthly change**	0.002 ***(0.61)***						0.002 ***(0.62)***	
	Expected change		0.001 ***(0.32)***						0.001 ***(0.33)***
	Unexpected change		0.003 ***(0.57)***						0.003 ***(0.59)***
ADR Turnover	**Monthly change**			0.022 ***(2.00)***				0.020 ***(2.04)***	
	Expected change				-0.010 ***-(0.66)***				-0.010 ***-(0.66)***
	Unexpected change				0.024 ***(2.06)***				0.024 ***(2.05)***
Home Share Turnover	**Monthly change**			-0.008 ***-(1.41)***				-0.009 ***-(1.60)***	
	Expected change				0.005 ***(0.55)***				0.005 ***(0.55)***
	Unexpected change				-0.010 ***-(1.63)***				-0.010 ***-(1.63)***
ADR Trading Infrequency	**Monthly change**					-0.004 ***-(1.29)***		-0.005 ***-(1.24)***	
	Expected change						0.003 ***(0.35)***		0.001 ***(0.11)***
	Unexpected change						-0.008 ***-(1.75)***		-0.006 ***-(1.30)***
# of observations		29779	29306	29779	29306	29779	29306	29779	29306
R-squared		1%	1%	6%	7%	1%	1%	7%	8%

Table 4: Robustness Tests

This table summarizes the pooled regressions of the change in the ADR premium on the unexpected change in the ADR and home share liquidity measures, along with control variables. The data are obtained from two sources: ADR data are obtained from CRSP; home share data are obtained from Datastream. The sample includes 401 pairs of ADR and corresponding underlying shares in the home market from 23 countries, from January 1981 to December 2003. The liquidity measures include the Amihud measure, turnover ratio and trading infrequency. Individual ADR and home shares Amihud measures are defined as the ratio of absolute daily return and dollar volume, scaled by 1000. Individual ADRs and home turnover ratios are defined as the ratio of dollar trading volume to the dollar amount outstanding in each market. The monthly trading infrequency (TI) is defined as number of days that the ADR is *not* traded divided by the total number of trading days in the month. Regressions I and II include the unexpected change in the ADR and home share liquidity measures, as well as the exchange-rate proportionate change in the past 1 (6) months, and home and US stock market return in the past 1 (6) months. The exchange-rate return is defined as the percentage return of the current month's average daily exchange rate relative to average daily exchange rate in previous month (or 6 months ago), where the exchange rate is defined as the number of units of foreign currency per unit of U.S. dollar. The stock market return is defined as the current month's average daily index level relative to the average daily index level in previous month (or 6 months ago). Regression III also includes interaction terms between the five liquidity measures and the EWR measure. The EWR variable is a country's openness measure developed by Edison and Warnock (2003). Regression IV includes dummy variables for the 23 countries in our sample. For brevity reason, in table 3 and 4, the coefficients on the interaction terms and dummies are not reported. The coefficient estimates are the OLS estimates from the pooled regressions of the panel data. The values in italics are the corresponding t-statistics for the coefficient estimates using Rogers' standard errors clustered by firm.

	I		**II**		**III**		**IV**	
Intercept	0.000	***-(0.53)***	0.000	***-(0.21)***	0.000	***-(0.27)***		
Unexpected Change in ADR Amihud	-0.005	***-(2.22)***	-0.005	***-(2.18)***	-0.002	***-(1.43)***	-0.005	***-(2.22)***
Unexpected Change in HS Amihud	0.003	***(0.43)***	0.003	***(0.46)***	0.002	***(0.71)***	0.003	***(0.43)***
Unexpected Change in ADR Turnover	0.041	***(3.91)***	0.041	***(3.92)***	0.021	***(2.70)***	0.041	***(3.91)***
Unexpected Change in HS Turnover	-0.010	***-(1.50)***	-0.010	***-(1.55)***	0.001	***(0.79)***	-0.010	***-(1.51)***
Unexpected Change in ADR Trading Infrequency	-0.005	***-(1.03)***	-0.007	***-(1.49)***	-0.009	***-(2.64)***	-0.005	***-(1.04)***
1-Month Exchange Rate Return	-0.010	***-(1.22)***			-0.006	***-(0.69)***	-0.010	***-(1.22)***
1-Month US Stock Market Return	0.040	***(4.89)***			0.031	***(4.65)***	0.040	***(4.92)***
1-Month Home Stock Market Return	0.091	***(3.40)***			0.091	***(2.87)***	0.092	***(3.42)***
6-Month Exchange Rate Return			-0.002	***-(0.61)***				
6-Month US Stock Market Return			0.005	***(1.81)***				
6-Month Home Stock Market Return			0.007	***(1.15)***				
# of observations	26883		26883		16023		26883	
R-squared	14%		11%		13%		14%	