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

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I. Introduction

Similar or even identical financial assets are known to trade at different prices in different markets. This apparent departure from the law of one price has captured academic attention for decades. The observed price differential is often cited as evidence of market imperfections, limits to arbitrage, and investor irrationality.

Recent studies suggest that *differences in liquidity* appear to explain part of this phenomenon. For example, 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. 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.

Empirical studies generally show that illiquidity depresses asset prices, and leads to higher expected returns.[1,2] Amihud and Mendelson (1986), Brennan and Subrahmanyam

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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.

(1996), Brennan, Chordia, and Subrahmanyam (1998), and Datar, Naik, and Radcliffe (1998) show how the expected return for common stocks is related to illiquidity. Other features of liquidity have also shown a noticeable impact on stock returns.[3] The pattern is not limited to the stock market. For example, in the bond market, on-the-run Treasury bonds are more liquid and have higher prices than their off-the-run counterparts, even though they have similar cash flows and characteristics, as argued by Amihud and Mendelson (1991) and Boudoukh and Whitelaw (1993).

The ADR market provides an ideal laboratory to test whether liquidity is a significant factor in asset pricing. In cross-sectional studies of the asset liquidity-price relationship in the stock markets, factor models are often used to control for common risk factors across different stocks. The question that usually arises in these types of tests is the validity of the particular asset pricing model used, and the extent to which one can empirically separate the impact of the asset-pricing model from the liquidity effects being studied. The advantage of studying the ADR market is that investors in the U.S. markets receive *exactly* the same cash flows (on a foreign-exchange-adjusted basis) as shareholders in the home market do.[4] By comparing the differences in the prices and liquidity for the ADRs

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

[3] For instance, Chordia, Subrahmanyam, and Anshuman (2001) find that stock return is related to the *variability* of 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.

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

and their corresponding home shares, we are able to test the liquidity effect without the conflation arising out of the potential mis-specification of the asset pricing models.

There is indirect evidence from the existing literature that links asset prices with liquidity in cross-listings. 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

[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).

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 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.

There are two important advantages of examining the *changes* in the ADR premium and the liquidity measures (change variables, hereafter). First, using the change variables 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 less of a 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.

Second, the level variables are highly persistent. If we use the level variables in a panel regression, statistical inference would be problematic due to the biased standard error estimates caused by the persistence in the dependent and independent variables. On the other hand, the change variables are persistent to a much lesser extent. We can obtain correct statistical inference with proper econometric procedures. Hence, we believe that the regressions using change variables represent a better econometric specification to test our hypothesis.

In a separate robustness test, we address the impact of market structures and segmentation. We do so by carrying out regressions using the *level* variables with controls for country variables that have been shown to affect financial markets. Motivated by the research of La Porta *et al* (1998), we test whether the liquidity explanation of the ADR premium is valid when the estimation is controlled for variables such as the transparency and credibility of accounting standards, the efficacy of judicial system, and corporate governance variables such as anti-director rights.[6] Moreover, we also include variables that proxy for market restrictions in different countries (measured by restrictions on short-sales constraints and stock ownership concentration).[7] Last, but not least, we use the country's openness measure developed by Edison and Warnock (2003) to control for levels of market segmentation in our tests.[8] We show that the liquidity effects remain robust in the level regressions, even after controlling for the long list of market structural and segmentation variables mentioned above.

[6] Most of these characteristics are suggested by the recent work of La Porta *et al* (1998).

[7] Bris, Goetzmann, and Zhu (2004).

[8] Jain, Wu, and Xia (2004) use the same openness measures to show that the liquidity-premium relationship is stronger for closed-end country funds that correspond to economies that are less integrated with the world markets.

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.[9] 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

[9] 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.

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.

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 encocuntered 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.[10] 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.[11] 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 is to ensure that the measure is calculated on the same basis for all stocks from different countries.

[10] 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.

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

In our cross-sectional analysis, we employ both the Amihud measure of the ADR, $Liq^{adr}_{i,c,t}$, and of its home market counterpart, $Liq^{hs}_{i,c,t}$. Since the daily return of the ADR, $R^{adr}_{i,d}$, and that of its corresponding home share, $R^{hs}_{i,d}$, are approximately equal on any given day, the difference between $Liq^{adr}_{i,c,t}$ and $Liq^{hs}_{i,c,t}$ 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:

$$TO^{adr}_{i,c,t} = \frac{1}{D_t}\sum_{d=1}^{D_t}\frac{Vol^{adr}_{i,d}}{SO^{adr}_{i,d}}; \qquad TO^{hs}_{i,c,t} = \frac{1}{D_t}\sum_{d=1}^{D_t}\frac{Vol^{hs}_{i,d}}{SO^{hs}_{i,d}} \tag{4}$$

where $Vol^{adr}_{i,d}$ is the number of ADR shares traded and $SO^{adr}_{i,d}$ is the total ADR shares outstanding on day *d* in the U.S. market. $Vol^{hs}_{i,d}$ and $SO^{hs}_{i,d}$ 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 and size

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.[12]

[12] 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.

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:

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

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.[13] 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).[14]

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.

[13] 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.

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

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. Since the change variables are still serially auto-correlated to some extent, the OLS standard errors are biased due to the existence of firm fixed effect. To address this problem, we calculate the corresponding t-statistics using Rogers’ estimate of standard errors, clustered by firm, as suggested by Petersen (2005).[15]

IV.B. Liquidity Effects

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

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

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

[15] Petersen (2005) examines different approaches used in the finance literature that address the firm fixed effect in panel regressions. He finds that OLS, Fama-MacBeth and Newey-West standard errors are all biased, while Rogers’ standard errors, clustered by firm, are unbiased.

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 I 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.[16] The results in regression II 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 (in regression I and II) are opposite to the signs of b_3, b_4, since the Amihud measure could be thought of as a *scaled* reciprocal of the volume measures. In regression III, 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.

[16] 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.

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

IV.C. Expectations about the future 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 expectations regarding future exchange rate movements and future foreign stock market performance are potentially important factors in ADR pricing.

If an investor owns an ADR of a firm from country A, she would get an additional benefit if A's currency appreciates against the U.S. dollar, 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 A's exchange rate, since the ADR is an indirect and somewhat risky bet on the exchange rate.) We use the most recent 1-month or 6-month exchange rate change as a proxy for such expectations. 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, if the investor expects the stock market of country A to perform better in the future than the U.S. market, 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.) We also use the most recent 1-month (or 6-month) stock market performance as a proxy for such expectations, and include it in the regressions.[18] 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 US stock market performance.

Regressions V and VI in table 3 report the results for the three expectation variables. The 1-month exchange rate change variable appears to have some explanatory power (with a t-value of -1.704) on the change in the ADR's premium. The 6-month exchange rate change has much lower explanatory power, with a t-value of -0.553. Similarly, the 1-

[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. If market participants use any type of extrapolation of past exchange rate changes in their forecast of the future exchange rate, our variable should be a reasonable proxy of such a forecast.

[18] A possible proxy for expectations about the future stock market performance would be the respective forward rates/prices. However, given the relative stationarity of the interest rates, this would effectively be a scaled version of the spot rate/price. A better alternative would be to assume that investors form their expectations about changes in the future performance of the home stock market based on its past performance.

month stock market return variable has a marginally stronger explanatory power than the 6-month variable. The 1-month home market return has a t-value of 5.25. On the other hand, the 1-month US market return has a t-value of 3.84, but surprisingly with a sign contradictory with our expectation. 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.

More importantly, the qualitative results about the liquidity effects should not alter significantly after the inclusion of these expectation variables. According to the results in table 3, the coefficients $\hat{b}_1, \hat{b}_2, \hat{b}_3, \hat{b}_4, \hat{b}_5$, remain as significant as before. This robustness check is important because it shows that the liquidity effects remain strong after the inclusion of the control variables.

From regressions IV, V and VI, 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 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. 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.

IV.D. Robustness Checks: Level Regressions

Using the change variables, our main conclusion of the results so far is that the liquidity metrics, especially those of the ADR (the ADR's Amihud measure, its turnover, and trading infrequency), appear to have the strongest effects on the ADR's premium. The liquidity measures in the home market also have an impact on the premium, but only to a less statistically significant extent, as measured by the respective *t* statistics. We argue in subsection IV.A that estimating the ADR premium – liquidity relationship using change variables is a better econometric model. In this subsection, we nevertheless carry out the regressions of equation (5) using level variables, but along with the control variables as a robustness check. Namely, we include $Z_{i,t}$, with elements such as firm size and a number of country characteristics variables, which are relevant in determining the level of the ADR premium. However, these variables are, to some extent, time invariant, and thus, do not appear in the change regressions.

We report the results of level regressions in table 4. Regression I – IV involves only the liquidity measures and the results are largely consistent with those in the change regressions. All the liquidity measures, except for the ADR turnover ratio, have significant coefficients with the right sign. The ADR turnover ratio is not significant, although it also has the right sign.

Regression V and VI include the controls for expectations of exchange rate changes, and the home and US market return. Again, we use the recent return as proxies for such expectations. We use 1-month variables in regression V, and 6-month variables in regression VI. In contrast to the change regressions, the 6-month variables seem to have stronger explanatory power. In the change regressions, we show that the 1-month variables help explain the monthly change in the ADR premium. It is probably not surprising that the 6-month variables have stronger effects in the level regression since the level of the ADR premium include the cumulative changes from previous months, and thus the longer-period variables have stronger effects. In regressions VII and VIII, we also use the 6-month variables as proxies.

We include the ADR size in regression VII. Size has been widely accepted as an important factor in most asset pricing models.[19] Previous studies (e.g., Pastor and Stambaugh (2003) and Acharya and Pedersen (2005)) also document a high correlation between firm size and liquidity, which is also the case in our sample as reported in table 2. To test whether our results in the previous sub-section are merely manifestations of the size effect, we add the ADR size (market capitalization of the shares in ADR form) as an additional independent variable and run the regressions once again. The results reported in regression VII of table 4 shows that the liquidity effects do not disappear after the ADR size is added to the regressions. Indeed, the coefficient estimates and t-values are virtually unchanged from regression VI to VII.

IV.E. Robustness Checks: Country Characteristics

In this subsection, we control for a number of country-level characteristics to account for the home country's openness (as measured by intensity of capital controls, the transparency and credibility of its accounting standards, the efficacy of its judicial system, corporate governance variables such as anti-director rights), as well as its market restrictions (measured by restrictions on short-sales constraints and stock ownership concentration). On the one hand, firms from the emerging economies may have a larger

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[19] Indeed, many asset pricing models, such as that of Fama and French (1992), use size as a factor in explaining cross-sectional returns.

ADR premium, since they often present high barriers for arbitrage trading between the share and the ADR. On the other hand, these economies are also likely to have weaker corporate governance and less efficient investor protection; therefore, international investors might demand a discount on ADRs from these countries. Thus, the overall effects of some of these country characteristics may not be clear.

First, the presence of short-sales restrictions in a country might explain the deviation of ADR price from home share price. Bris *et al.* (2002) provides information on short-sales restrictions (represented as 0 or 1) on most of the ADR-issuing countries in our dataset. La Porta *et al.* (1998) shows that investors investing in a foreign country are usually entitled a very different set of rights from those in their own markets. These rights determine the level of investor protections and might therefore explain part of the ADR premium. Among these variables, anti-director rights (AD) indicate how much a country's legal system favors minority shareholders, and takes a value between 0 and 5. The quality of accounting standards (AS) is another variable, based on a proprietary index published by the Centre for International Financial Analysis and Research. It rates the countries' disclosure coverage, by counting how many accounting items firms are required to disclose, among 90 selected items. In addition to these variables, a more comprehensive account of a country's overall legal environment has been studied by Berkowitz *et al.* (2000). They computed a legality index for most world economies by incorporating the efficiency of their judiciary system, rule of law, corruption index, risk of expropriation, and risk of contract repudiation. Overall, we consider these variables, jointly, to provide an objective measure of a foreign market's development.

Besides issues relating to market development, the ADR premium could be associated with the corporate governance concerns of international investors. Foreign investors may be concerned if the market is characterized by highly concentrated ownership, particularly by domestic business groups with economic and political clout in the home country. Again, La Porta *et al* (1998) provides a measure of the presence of such large shareholders. It is the defined as the average percentage of common shares owned by the three largest shareholders in the ten largest non-financial, privately-owned-domestic firms in a given country. It is reasonable to expect a high ownership concentration could be related positively to the ADR premium. We have included this variable in our cross-sectional studies.

Even if a foreign market is highly developed and open, the securities market itself might exhibit a high degree of firm-level informational asymmetry. Morck *et al.* (2000) computed, for most countries under our studies, a synchronicity measure, which corresponds to the adjusted R^2 of regressing each stock's return on its home market index and U.S. market index. The higher is this measure, the lower is the extent that firm-specific information contributes to stock price movements. Foreigners might refrain from investing directly in a certain country's shares, because the market is characterized by a high degree of informational asymmetry. Therefore, we expect this measure to be negatively related to ADR premium.

Finally, we use a simple measure of the intensity of capital controls, the Edison-Warnock Restriction (EWR) measure, in our regression model. 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.[20] 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.[21]

Regression VIII in table 4 reports the regression result with the country variables. Since most of the country variables are correlated with the level of development of the country's economy and its capital market, these variables (except for the short-sales constraint variable) are highly correlated among each other. Including them together in the same regression potentially creates a serious problem of multi-collinearity. To avoid this problem, in regression VIII, the values of these variables are actually the residuals of each variable regressed on the other country variables. The regression is also carried out without the constant term as it appears that the country variable residuals are still highly

[20] The market's openness is based on the ability of foreigners to buy and sell shares and repatriate capital. The stock- and industry-level openness measures are based on the industry and corporate by-laws, and corporate charter limitations on foreign ownership. See Edison and Warnock (2003) for details about the construction of this measure.

[21] 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.

correlated with the constant term. With the inclusion of these variables, the liquidity effects do not seem to disappear. The ADR Amihud measure, the ADR turnover ratio and the home share turnover ratio still have significant explanatory power. However, the sign of the trading infrequency, whose strength was weak even early, is reversed and inconsistent with our hypothesis.[22]

In regression IX, we use country dummy variables as a catch-all variable for all country-specific variables. In this regression, all liquidity measures have the right signs with the home share turnover ratio and trading infrequency being significant at the 5% confidence interval. The other liquidity measures are marginally significant. Essentially, this "reduced form" representation of the country-specific openness and transparency variables, through a dummy variable, reduces the problem of multi-collinearity leading to a cleaner relationship between the premium and the liquidity variables.

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

[22] This may be due to the fact that in several emerging economies, which are not fully open or transparent, the stocks of the major firms (that are usually the ones that are listed as ADRs) are actively traded, with low levels of trading infrequency. Also, since they represent the larger firms in these countries, the frequency of trading in the ADR market is usually high.

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 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 4th (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 change in the ADR premium on the change in the ADR and home share liquidity measures, the change in the ADR trading infrequency, as well as other control variables, which include 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 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. Individual ADR and home shares Amihud (2002) liquidity 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 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). 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	V	VI
Intercept	0.000	0.000	0.000	0.000	0.000	0.000
	0.449	***0.630***	***0.703***	***0.464***	***-0.480***	***-0.311***
Change in ADR Illiquidity (Amihud)	-0.004			-0.004	-0.004	-0.004
	-2.509			***-2.426***	***-2.377***	***-2.400***
Change in Home Share Illiquidity (Amihud)	0.002			0.002	0.002	0.001
	0.605			***0.618***	***0.600***	***0.459***
Change in ADR Liquidity (Turnover)		0.010		0.020	0.034	0.040
		1.083		***2.036***	***3.559***	***3.594***
Change in Home Share Liquidity (Turnover)		-0.009		-0.009	-0.009	-0.009
		-1.567		***-1.602***	***-1.464***	***-1.423***
Change in ADR Illiquidity (Trading Infrequency)			-0.004	-0.005	-0.003	-0.006
			-1.286	***-1.236***	***-0.783***	***-1.386***
1-Month Exchange Rate Return					-0.014	
					-1.704	
1-Month US Stock Market Return					0.043	
					5.251	
1-Month Home Stock Market Return					0.100	
					3.841	
6-Month Exchange Rate Return						-0.001
						-0.553
6-Month US Stock Market Return						0.005
						1.924
6-Month Home Stock Market Return						0.007
						1.138

Table 4: Robustness Check: Regressions Using Level Variables

This table summarizes the pooled regressions of the ADR premium on the liquidity measures of ADR, home share and the home market. The liquidity measures include the Amihud (2002) liquidity measure, the turnover ratio and the ADR trading infrequency. The regressions include other control variables, such as ADR size, the exchange-rate proportionate changes in the past 1 (6) months, and home and US stock market return in the past 1 (6) months. The control variables also include country characteristics variables such as short-sales constraints, the legality index, accounting standards, anti-director rights, ownership concentration, synchronicity with the US market and the EWR measure of capital control intensity. The data are obtained from multiple sources: ADR data are obtained from CRSP; home share data are obtained from Datastream. Short-sales constraint variables are presented as 0 or 1 for each country, taken from Bris, Goetzmann, and Zhu (2004). The legality index is obtained from Berkowitz et al (2000). Accounting standard, anti-director rights, and ownership concentration data are collected from La Porta et al (1998). Synchronicity with US market is adopted from Morck *et al* (2000). The EWR variable is a country's openness measure developed by Edison and Warnock (2003). The sample includes 401 pairs of ADR and corresponding underlying shares in the home market from 23 countries, from January 1981 to December 2003. Individual ADR and home shares' Amihud (2002) liquidity measures are defined as the ratio of absolute daily return and dollar volume, and are scaled by 1000. Individual ADR and home share turnover ratios are defined as the ratio of dollar trading volume to the dollar amount outstanding in each market. 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 home stock market return is defined as the current month's average daily index level relative to the average daily index level in the previous month (or 6 months ago). The values in italics are the corresponding t-statistics for the coefficient estimates. Regression V uses the 1-month exchange rate return and stock market return. Regressions VI, VII and VIII use the 6-month exchange rate return and stock market return.

	I	II	III	IV	V	VI	VII	VIII	IX
Intercept	0.003	0.002	0.001	0.004	0.002	0.001	0.015		0.002
	5.239	***3.961***	***1.779***	***6.613***	***3.461***	***1.974***	***3.181***		***3.085***
ADR	-0.006			-0.004	-0.003	-0.003	-0.003	-0.004	-0.003
Illiquidity (Amihud)	***-2.948***			***-2.142***	***-1.993***	***-1.672***	***-2.098***	***-2.270***	***-1.862***
Home Share	0.007			0.008	0.008	0.006	0.006	0.003	0.003
Illiquidity (Amihud)	***2.679***			***2.991***	***2.857***	***2.316***	***2.203***	***0.822***	***1.357***
ADR		0.050		0.051	0.151	0.190	0.188	0.045	0.051
Liquidity (Turnover)		***1.533***		***1.528***	***4.952***	***6.398***	***6.370***	***4.346***	***1.558***
Home Share		-0.045		-0.046	-0.047	-0.037	-0.037	-0.037	-0.023
Liquidity (Turnover)		***-2.729***		***-2.747***	***-2.713***	***-2.327***	***-2.326***	***-2.275***	***-2.190***
ADR Illiquidity			-0.012	-0.012	-0.005	-0.007	-0.011	0.001	-0.011
(Trading Infrequency)			***-6.364***	***-5.112***	***-2.637***	***-3.243***	***-5.314***	***0.796***	***-4.288***
1- (or 6-) Month					-0.017	-0.009	-0.009	-0.007	
Exchange Rate Return					***-0.913***	***-1.686***	***-1.604***	***-0.402***	
1- (or 6-) Month US					0.033	0.025	0.025	0.048	
Stock Market Return					**2.848**	***4.899***	***4.856***	***1.504***	
1- (or 6-) Month Home					-0.017	-0.014	***-0.014***	0.023	
Stock Market Return					**-0.323**	***-1.102***	***-1.107***	***0.631***	
Log(ADR size)							-0.001	0.002	0.000
							-2.719	***6.287***	***7.287***
Short-sell Constraint								-0.039	
								-7.372	
Legality Index								0.015	
								4.067	
Accounting Standard								0.003	
								2.085	
Anti-director Rights								-0.006	
								-1.005	
Ownership								-0.180	
Concentration								***-3.427***	
Synchronicity with								0.112	
US Market								***0.639***	
EWR								0.100	
								0.931	