**Day and Night Returns of Chinese ADRs**

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**Abstract:** Are the returns of Chinese American Depositary Receipts (ADR) more affected by the U.S. stock market or their underlying home market? Since there is non-synchronous trading between U.S. and the Chinese stock markets, we decompose the Chinese ADR daily returns into day and night returns to investigate the different market factors in Chinese ADR pricing. This paper also attempts to separate "homeless" ADRs from home-based ADRs to see if they are affected differently by market factors. We include a sample of 76 Chinese ADRs with the daily data from January 2000 to July 2010. Through regression and Vector Autoregressive analyses, we find that the U.S. market dominates the day returns of Chinese ADRs. We also find the Hong Kong market factor dominates the ADR night returns over the mainland China market for the whole sample. These results are particularly strong for “homeless” ADRs.

**Key words: Chinese ADRs, International cross-listing, Factor pricing models, Day and night returns.**
**JEL code: G12, G14**

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American deposit receipts (ADRs) normally involve two stock markets – their home market and the U.S. market. The market risk in ADR pricing has attracted attention in recent research: Do ADR prices reflect their home market risk or the U.S. market risk? This question has significant implications on managing international investments. However, because markets trade at different times, we will need to control such non-synchronous trading when measuring market risks. With a sample of Chinese ADRs, we propose to separate the daily returns to day and night returns and distinguish US and Chinese market effects on ADR returns at different times of a day.

Early studies view ADRs and their underlying shares as perfect substitutes (for example, Officer and Hoffmeister [1987], Kato et al. [1991], Wahab et al. [1992], Park and Tavakkol [1994]). Only recently have researchers recognized that the different market sentiments and liquidity effects may lead to the price differences between ADRs and their underlying shares (Kadiyala and Subrahmanyam [2004], Chan et al. [2008], Silva and Chavez [2008], Arquette et al. [2008]). A number of empirical studies employ multiple-factor models (home market, U.S. market, exchange rate, and others) to investigate the determinants of ADR returns (Patro [2000], Kim et al. [2000], Choi and Kim [2000], Alaganar and Bhar [2001], Fang and Loo [2002]). They find that home markets significantly influence ADR returns. However, the results on the U.S. market and exchange rate risks vary depending on the samples selected and the methods used.

Chan et al. [2008] finds that U.S. market returns (as a proxy for U.S. market sentiment) have a positive impact on the ADR premium (the additional returns over their underlying shares). With inter-day prices, Gagnon and Karolyi [2010] find that the returns on cross-listed stocks, compared with their underlying shares, have significantly higher systematic co-movements with the U.S. market indexes and significantly lower systematic co-movements with their corresponding home market indexes. He and Yang [2011] apply a regime switching model to weekly ADR index returns, and find that Chinese ADRs are priced to the U.S. market. There is a burgeoning literature on how Chinese ADRs relate to their home markets and the U.S. market (Xu and Fung [2002], Mak and Ngai [2005], Kutan and Zhou [2006], Su and Chong [2007]). However, we still lack consensus on these market risks on ADRs. Furthermore, some researchers have used daily data and they face the issue of non-synchronous trading between the U.S. and the home markets when using ADR daily returns (For example, Kim et al. [2000], Alaganar and Bhar [2001], Kutan and Zhou[ 2006]).

Non-synchronization in trading hours among different national stock markets poses challenges to comparing the market effects on ADRs. Problems arise when we compare returns for the same calendar period because returns in one market may happen in a later period and thus contain more information than returns from another market. To cope with the non-synchronous trading problem, Gagnon and Karolyi [2009] used the ADR intraday price data (midpoint between the bid/ask price) in the U.S. which matched the closing price in the originating home market. However, intraday bid/ask quotes are subject to daily trading noise, such as the intraday bid/ask bounce caused by order processing and inventory costs.

We propose separating daily returns into day and night returns to examine different market effects. Given non-overlapping trading hours in the Chinese market and the U.S. market, the ADR day returns and the night returns each coincide with only one trading market (see Exhibit 1). Therefore, the market effects on the daily returns of ADRs may be isolated to either on the day returns, night returns, or both. For example, when the Chinese markets are in session, positive market shocks will quickly be absorbed by ADR night returns. However, when the U.S. market opens and the Chinese markets have been closed, negative shocks in the U.S. demand may adversely affect ADR returns, which may outweigh the positive overnight returns.

Therefore, if we only look at the effects of Chinese markets on the total ADR daily returns, we might not be able to find the positive home market effect; instead, the home market risk may become less significant. Such separation is particularly useful when two markets follow very different trends, as is the case of Chinese and U.S. markets in the period of 2006-2008 (See Exhibit 2). We expect that ADR day returns and night returns are most significantly affected by the concurrent trading market.

Our results contribute to current empirical literature on factor pricing models of ADRs with new evidence on day and night returns. We also explore a special feature of Chinese ADRs that previous literature does not include. That is, a large proportion of Chinese ADRs do not have underlying exchanges, which we call "homeless". We take a special interest in whether or not the home market is still a significant pricing factor to these "homeless" ADRs. The exchange rate factor is not included in the model because the Hong Kong dollar is fixed to the U.S. dollar and the daily variability of the Chinese *yuan* is also very small.[1]

**Data**

We define ADR daily returns as the log-difference of the adjusted closing prices as illustrated by Exhibit 1. The night return for a particular Chinese ADR is defined as the log-difference between the ADR market opening price and the previous closing price, while the day return is the log-difference between the ADR adjusted closing price and the same day opening price. We obtain daily opening prices and closing prices of Chinese ADRs from Datastream. Our sample contains 76 Chinese ADRs with the daily price data from January 1, 2000 to July 31, 2010, totaling 88,407 firm-day observations.

[1] A robustness check is performed by including the changes of exchange rates in the regression analysis, however, the exchange rate factor turns out to be insignificant for most of the ADRs. The results are available upon request.

U.S. day and night returns are calculated in the same manner as ADR day and night returns using S&P 500 opening prices and adjusted closing prices. The Hang Seng index (the index for the Hong Kong stock market) and the Shanghai Stock Exchange Composite index (SH) are used to proxy the Hong Kong market (HK) and the mainland China market. The daily index price data is retrieved from DataStream. We report Pearson Correlation coefficients of market returns in Exhibit 3. Daily returns of the HK market are significantly correlated with the U.S. market and the mainland China market, whereas the mainland China market and the U.S. market are not significantly correlated. U.S. day returns are not significantly correlated with U.S. night returns.

Exhibit 4 reports the descriptive statistics for the sample. The mean of ADR day returns (-.19%) and night returns (.16%) have similar magnitude but opposite signs. It leads to a rather smaller mean of ADR daily returns in magnitude (-0.03%). The standard deviations of ADR day returns and night returns (4.02% and 2.97%) are much higher than those of market factors, the highest of which is only 1.91% for the mainland China market.

In our sample, 58 out of 76 Chinese ADRs are homeless in that they have no underlying shares in the home market (mainland or HK). Without underlying shares as price references, it is difficult for investors to price those ADRs relative to "dual-listed" ADRs. How these "homeless" ADRs are priced and whether they are priced differently from dual-listed ADRs are important questions for both academic research and portfolio management.

**Methodology**

We have three basic hypotheses based on Chinese ADR daily, day, and night returns. Firstly, we would expect that the Chinese ADR daily returns are affected by all market factors, i.e., U.S. market day returns and night returns, the mainland China market returns and HK market returns. Since these companies are located in China, their current and future cash flows, hence their market values, are influenced by China's overall market conditions. After depository receipts are created in the U.S. markets, they are traded just like other common stocks in the U.S. market and are influenced by the liquidity and sentiment in this market (Arquette et al. [2008], Chan et al. [2008]). For those Chinese ADRs which are also traded on Hong Kong markets, they are also influenced by the Hong Kong market risk (Xu and Fung [2002], Mak and Ngai [2005], Kutan and Zhou [2006], Su and Chong [2007]).

We specify the following empirical model (Model 1) to test this hypothesis:

$$R_{i,t}^{adr\_daily} = \alpha_i^1 + \beta_{i,1}^1 R_t^{US\_day} + \beta_{i,2}^1 R_t^{US\_night} + \beta_{i,3}^1 R_t^{China} + \beta_{i,4}^1 R_t^{HK} + e_{i,t} \tag{1}$$

where $R_{i,t}^{adr\_daily}$ represents the daily returns of ADR $i$ at time $t$. Betas measure the sensitivity of daily returns of ADR $i$ to the U.S. day returns, U.S. night returns, the mainland China market daily returns and the HK market daily returns, with the superscript indicating Model 1.

Secondly, if we assume the market is weak-form efficient, any shock from the home market trading day should be reflected in the ADR opening price. Thus, we would expect that during the trading hours in the U.S. market, ADR day returns (open to close on day t) should be affected by the U.S. market day returns only. With a capital asset pricing model framework, we specify the second hypothesis as follows (Model 2).

$$\mathrm{R}_{\mathrm{i,t}}^{\mathrm{adr\_day}} = \alpha_{\mathrm{i}}^2 + \beta_{\mathrm{i,1}}^2 \mathrm{R}_{\mathrm{t}}^{\mathrm{US\_day}} + \mathrm{v}_{\mathrm{i,t}} \tag{2}$$

where $\beta_{i,1}^2$ is the sensitivity of day returns of ADR $i$ to U.S. day returns for Model 2.

Thirdly, the shocks to ADR night returns (closing price on day t-1 to the opening price on day t) may come from three sources - any overnight market news in the U.S. and the new information from the mainland China market and the HK market. Therefore, we would expect that the ADR night premium should compensate these three market risk factors, i.e., the U.S. market night returns, HK and mainland China market daily returns of the same calendar day.

$$R_{i,t}^{adr\_night} = \alpha_i^3 + \beta_{i,2}^3 R_t^{US\_night} + \beta_{i,3}^3 R_t^{China} + \beta_{i,4}^{31} R_t^{HK} + u_{i,t} \tag{3}$$

Because the Hang Seng index is significantly correlated with U.S. market returns and the mainland China market returns, we replace $R_t^{HK}$ with $R_t^{HK*}$ where $R_t^{HK*}$ is the residual from orthogonalizing the Hang Seng index return against the S&P500 day returns, night returns and Shanghai SE Composite returns. Thus, models 1 and 3 are changed into:

$$R_{i,t}^{adr\_daily} = \alpha_i^1 + \beta_{i,1}^1 R_t^{US\_day} + \beta_{i,2}^1 R_t^{US\_night} + \beta_{i,3}^1 R_t^{China} + \beta_{i,4}^1 R_t^{HK*} + e_{i,t} \tag{4}$$

$$R_{i,t}^{adr\_night} = \alpha_i^3 + \beta_{i,2}^3 R_t^{US\_night} + \beta_{i,3}^3 R_t^{China} + \beta_{i,4}^{31} R_t^{HK*} + u_{i,t} \tag{5}$$

For each ADR, we run the regression models for the unrestricted models, i.e., we include all related market factors and test for the restriction. We control the time variation of betas by using rolling beta estimation for each firm over our sample period. We choose the rolling windows of 60 days, 180 days and 300 days and obtain beta estimates for each ADR each day. For example, with a 60-day rolling window, the first beta estimates starts from the 61st day for each ADR. We follow the Newey-west [1987] method to get beta estimates and t-statistics for each Chinese ADR over our sample period, and then get cross-sectional attributes.

Non-synchronous trading induces spurious autocorrelation.[2] To model such autocorrelations, we apply a vector autoregressive model (VAR) for day returns and night returns. In order to capture the pricing characteristics of ADRs as a whole, we look at the ADR day returns and night returns at the portfolio level. We use R to represent a return vector. The VAR system with order p can be written as

$$R_t = \sum_{j=1}^{p} \varphi_j R_{t-j} + \varepsilon_t \tag{6}$$

[2] See the literature survey in Campbell, Lo and MacKinlay (1997).

where $R_t$ is a vector of returns which equals to $(R_t^{adr_{day}}, R_t^{US_{day}})'$ for day returns, and $(R_t^{adr_{night}}, R_t^{US_{night}}, R_t^{China}, R_t^{HK})'$ for night returns; $\varepsilon_t$ is a vector of white noise processes with properties that $E(\varepsilon_t) = 0, E(\varepsilon_t \varepsilon_t') = \Sigma$, and $E(\varepsilon_t \varepsilon_s') = 0$ for $t \neq s$. For each VAR system, we only focus on the return equation for ADRs, which correspond to our previous regression analysis.

Under each VAR system, the impulse response function (IRF) is applied and the orthogonal impulse responses are calculated for each portfolio. The responses to impulses help to measure the impacts of a shock in market return factors on the ADR returns over a selected lag period and the changes of each impulse response over time.

**Results and Discussion**

We first estimate betas at the firm level regressions and report their descriptive statistics among the whole sample in Exhibit 5. Three panels in Exhibit 5 list results from 60-day, 180-day and 300-day rolling windows. The last column gives the percentage of ADRs which have a significant exposure to the corresponding market factor at the 5% level. For Model 2 on ADR day returns, the beta to the U.S. day returns has the highest percentage of ADRs – 91%, 88%, and 92% for Panel A, B and C. This is what we have expected because ADR day returns overlap with the trading hours in the U.S. market. Model 3 looks at the factors that might affect ADR night returns. The U.S. day factor, different from previous models, is the lagged variable. We found that among all these market factors, the beta to the previous U.S. day return has the smallest percentage of ADRs. It is also consistent across all three panels. This result shows that ADR night returns are rather more affected by the trading markets in mainland China and Hong Kong than by the previous U.S. day return. We also observe from Model 3 that the percentage of ADRs with night returns that are significantly exposed to the HK market factor and the mainland

China market factor are about the same for all three panels. However, in terms of the mean of the betas, the HK factor ranges .24 to .25, while the mainland China factor ranges .10 to .12. By separating ADR day returns and night returns, Model 2 and Model 3 show the varying effects of market factors at different times of day, which Model 1 fails to capture.

Given that over 70% of Chinese ADRs do not have an underlying exchange, we suspect that for the “homeless” ADRs, the effect of home market factors might be different from those cross-listed shares. Therefore, we created three equal-weighted portfolios - a portfolio using the whole sample, a “listed” ADR portfolio with ADRs that have the underlying exchange in HK or mainland China, and a “homeless” ADR portfolio with no underlying exchange.

We present the regression results using the whole sample period for all three models in Exhibit 6. ADR daily returns are significantly affected by all market factors for all three portfolios as we expect in Model 1. It is also consistent with the results from previous studies that use daily data (Mak and Ngai [2005], Kutan and Zhou [2006]). For the Model 2 estimates of the “homeless” ADR portfolio, the only significant factor is the U.S. day return with the estimated sensitivity of .84. We test on null hypothesis that all the other betas of the market factors (U.S. night returns, the mainland China and HK market factors) equal to zero. We get the Wald statistics of 1.84, which is insignificant at the 5 percent level. It indicates that “homeless” ADR day returns are only significantly affected by U.S. day returns as we expected in Model 2. It is plausible because they are not traded at home at all. The Wald statistics for the whole sample portfolio and the “listed” portfolio are statistically significant.

For Model 3 on ADR night returns, all market factors hypothesized in Model 3 are found to be statistically significant for all three portfolios. But the "homeless" portfolio's sensitivities to the mainland Chinese market and HK market daily returns are much less compared to the "listed" portfolio with much smaller estimated coefficients. The U.S. day factor (the lagged U.S. day) is insignificant for the whole sample, but significant for both the "homeless" and the "listed" portfolios. However, the coefficients are opposites for the "homeless" portfolio (.10) and the "listed" portfolio (-.007). The results imply that ADRs' sensitivities to the concurrent trading market factors are all significant but may also be affected the lagged market factors, such as the previous U.S. day return in Model 3 for both subsample portfolios. The following VAR analysis captures such cross correlations.

In estimating VAR coefficients, we start with a parsimonious specification of order one – “the short VAR”. We apply the short VAR to the day returns and night returns of ADR portfolios we created previously – the whole-sample ADR portfolio, and the “homeless” and the “listed”. The first two rows of Exhibit 7 Panel A report the estimates for ADR day return equation. The ADR day returns are positively affected by the one-day lagged U.S. day returns for the "homeless" portfolio but negatively affected by it for the "listed" portfolio. This is consistent with our previous regression results in Table 4 where the U.S. lagged day return factor is incorporated in Model 3. The results also show the one-day lagged U.S. day returns are not a significant factor to the whole sample portfolio.

We report the short VAR for ADR night returns in Panel B of Exhibit 7. Both the whole-sample portfolio night returns and the “listed” portfolio are negatively affected by the lagged U.S. night returns and lagged SH daily returns at 5% significance, but the “homeless” portfolio is not. The night returns of the “homeless” ADRs are only significantly affected by lagged ADR night returns with a rather small coefficient of -.06.

The coefficients of the short VAR indicate mixed results on the significance of one-day lagged market factors and the ADR autocorrelations. We confirm these basic results by estimating a "long" VAR with an order of three or above based on AIC and partial autoregressions of each portfolio. The first order coefficients resemble those of the short VAR, and move closer to zero and statistically insignificant as the lag increases. The cross-correlations of VAR systems indicate the strongest positive cross-correlations are at lag 0, i.e., the contemporaneous relationships, and it confirms our previous regression setup.

We graph the orthogonalized responses to impulses with two standard errors in Exhibit 8. If the market is efficient, the impulse responses will be expected to happen immediately (time 0) and die out within a few lags. All the responses drop after one period and die out at lag 2. Panel A of Exhibit 3 shows that the time 0 response to the shocks in U.S. day returns is positive but after one period the response becomes very small and below zero. It is consistent with what we found on the positive sensitivities to U.S. day returns in the regression analysis and the negative but economically small sensitivities to the lagged U.S. day returns in the VAR analysis. The same applies to the "listed" and the "homeless" ADR portfolios.

Panel B shows that ADR night return responses to the shocks in HK market is the largest at time 0 among all the market factors. We also find that the "homeless" ADRs' response to the mainland Chinese market shocks and HK market shocks are much smaller compared to the "listed" ADRs, which is consistent with the portfolio regression results in Exhibit 6.[3]

**Conclusion**

This paper directly addresses the issue of non-synchronous cross-market trading problems for Chinese ADRs by separating daily returns to day returns and night returns and examining how market factors affect Chinese ADR returns at different times of one day. We look at ADRs both at the firm level and at the portfolio level. Our regression results indicate that

[3] We omit the impulse response graphs for the "homeless" and "listed" portfolios for brevity. They are available upon request.

the U.S. day returns appear to be the most significant pricing factor for ADR day returns, especially for the "homeless" ADRs. U.S. night returns, HK and the mainland China market returns all have the higher percentage of firms that are significantly sensitive to these pricing factors relative to the lagged U.S. day return factor. We also find that the HK market returns affect ADR night returns more significantly in terms of cross-sectional averages of beta coefficients than the mainland China market returns. This is consistent with our expectation that the corresponding trading market has the most effect on ADR day returns and night returns. Our VAR analysis explores the effects of lagged market factors on ADR returns, and finds these coefficients to be relatively small and insignificant. The impulse responses also show that major responses happen at time 0 and die out at the second day. Time 0 responses of ADR day returns and night returns to the shocks in the market factors are consistent with regression results as well.

The results of the paper are important to our understanding of cross-listed shares. Different from previous literature, we find that the U.S. market dominates the home market in affecting Chinese ADR day returns while the night returns of Chinese ADRs are most significantly affected by the home market returns and U.S. night returns. We also find that "homeless" ADRs are less sensitive to the home market returns than the cross-listed shares.

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Exhibit 1: Illustration of day, night, and daily returns of a Chinese ADR

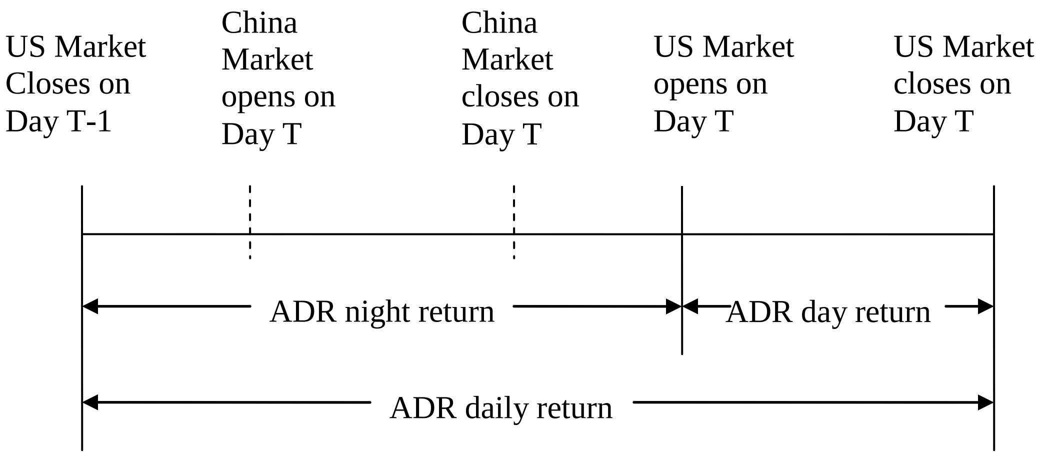
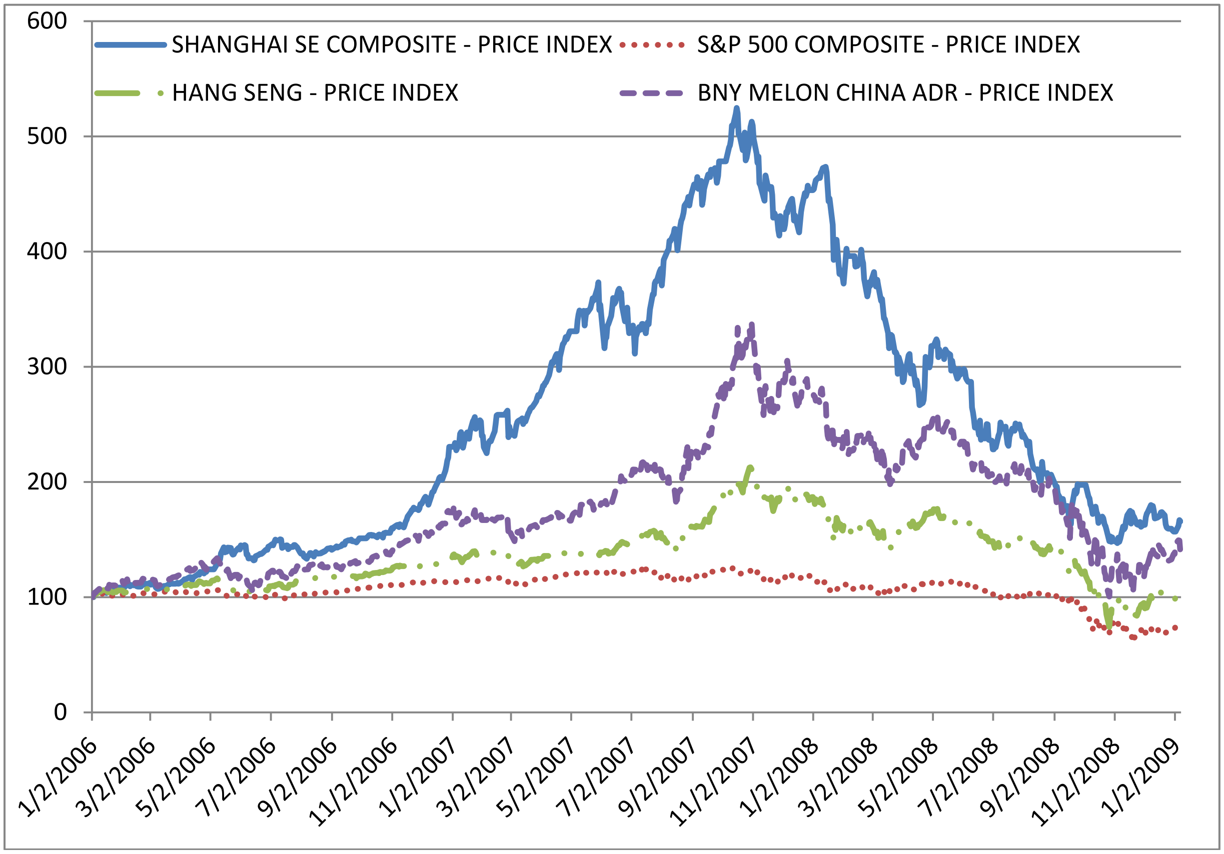


Exhibit 2: Comparison of market price indices




Note: S&P 500, Shanghai Stock Exchange Composite, Hang Seng index are used to proxy the market portfolios for US, mainland China and Hong Kong respectively. China ADR index built by Bank of New York Mellon is to proxy the Chinese ADR performance. All price indices are re-indexed on January 2, 2006. Source: Datastream.

Exhibit 3: Pearson Correlation Coefficients for market index returns

This table reports the Pearson correlation coefficients for the market returns, and China ADR index returns for the period of January 1, 2000 to July 31, 2010. U.S. day returns (USday) equal the logarithm of daily adjusted closing price minus the logarithm of same-day opening price for S&P500; U.S. night returns (USnight) equal the logarithm of daily opening price minus the logarithm of previous day closing price for S&P500; U.S. day returns (USdaily) equal the logarithm of daily adjusted closing price minus the logarithm of previous closing price for S&P500. We use Shanghai Stock Exchange Composite index returns (SH) to proxy the mainland Chinese market daily returns. We use the Hang Seng index return (HK) to proxy Hong Kong market daily return. ADR daily returns are the ADR China index returns from Bank of New York Mellon. All data are available through Datastream. * represents 5% significance level.

| | USdaily | SH | HK | USday | USnight | ADR |
|---|---|---|---|---|---|---|
| USdaily | 1 | 0.00456 | 0.17* | 0.97* | 0.33* | 0.61* |
| SH | | 1 | 0.16* | -0.00014 | 0.02 | 0.14* |
| HK | | | 1 | 0.13* | 0.19* | 0.48* |
| USday | | | | 1 | 0.09* | 0.58* |
| USnight | | | | | 1 | 0.28 |
| ADR | | | | | | 1 |

Exhibit 4: Summary Statistics

The table reports descriptive statistics for the Chinese ADR daily returns, day returns, night returns from the pooled sample from Jan 2000 to July 2010. It also reports the summary statistics for U.S. market day returns (USday), night returns (USnight), and Shanghai daily returns (SH) and orthogonalized Hang Seng index return (HK*). Day returns are calculated using the logarithm of daily adjusted closing price minus the logarithm of same-day opening price; night returns equals the logarithm of daily opening price minus the logarithm of previous day closing price; daily price return equals the logarithm of daily adjusted closing price minus the logarithm of previous day closing price.

| Variable | Mean | Std Dev | Minimum | Q1 | Median | Q3 | Maximum | Skewness |
|---|---|---|---|---|---|---|---|---|
| ADRday | -0.19% | 4.02% | -56.64% | -1.40% | 0.00% | 0.92% | 69.31% | 0.11 |
| ADRnight | 0.16% | 2.97% | -69.31% | 0.00% | 0.00% | 0.67% | 49.09% | -0.42 |
| ADRdaily | -0.03% | 4.62% | -59.78% | -1.80% | 0.00% | 1.60% | 69.31% | 0.05 |
| USday | -0.01% | 1.51% | -9.13% | -0.60% | 0.08% | 0.64% | 10.25% | -0.24 |
| USnight | -0.01% | 0.29% | -2.60% | -0.08% | 0.00% | 0.08% | 3.50% | 0.20 |
| SH | 0.01% | 1.91% | -9.26% | -0.79% | 0.01% | 1.00% | 9.40% | -0.24 |
| HK* | 0.02% | 1.62% | -10.71% | -0.78% | 0.01% | 0.77% | 14.14% | 0.87 |

Exhibit 5: Descriptive statistics on firm-level regression betas

This table presents the regression results for individual firms as in eq. (4), (2) and (5). For each model, we first get beta estimates for each ADR each day using the rolling windows of 60 days, 180 days and 300 days. The first beta estimates starts from the 61st day for each ADR. We follow the Newey-west (1987) method to get estimates and t-statistics on the sensitivities to different market variables for each Chinese ADR over our sample period, and then get cross-sectional attributes. The market variables include the U.S. market day returns (USday, USday** for one-day lagged), night returns (USnight), and Shanghai daily returns (SH) and orthogonalized Hang Seng index return (HK*). %firms represent the proportion of ADRs that are sensitive to the corresponding market factor at the 5% significance level.

| **Panel A: 60-day rolling window** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Variable | Mean | Std Dev | Min | Q1 | Median | Q3 | Max | % Firms |
| Model 1 | USday | 1.10 | 1.69 | -2.39 | 0.73 | 1.01 | 1.25 | 14.31 | 91% |
| | USnight | 2.66 | 16.10 | -27.30 | -1.46 | 0.82 | 3.53 | 109.50 | 45% |
| | SH | 0.20 | 0.22 | -1.26 | 0.13 | 0.22 | 0.33 | 0.56 | 84% |
| | HK* | 0.31 | 0.25 | -0.25 | 0.16 | 0.25 | 0.46 | 1.09 | 95% |
| Model 2 | USday | 0.97 | 1.54 | -3.24 | 0.66 | 0.94 | 1.13 | 12.69 | **91%** |
| | USnight | -0.67 | 14.28 | -35.78 | -4.07 | -1.27 | 0.04 | 84.62 | 50% |
| | SH | 0.09 | 0.20 | -1.38 | 0.04 | 0.09 | 0.18 | 0.34 | 72% |
| | HK* | 0.08 | 0.14 | -0.27 | 0.01 | 0.08 | 0.17 | 0.39 | 66% |
| Model 3 | USday** | 0.04 | 0.10 | -0.19 | 0.00 | 0.04 | 0.10 | 0.40 | *57%* |
| | USnight | 2.68 | 5.87 | -27.53 | 0.99 | 2.12 | 5.28 | 18.92 | 74% |
| | SH | 0.10 | 0.10 | -0.26 | 0.05 | 0.09 | 0.15 | 0.35 | **89%** |
| | HK* | 0.25 | 0.23 | -0.17 | 0.09 | 0.18 | 0.36 | 1.05 | **84%** |
| **Panel B: 180-day rolling window** | | | | | | | | | |
| MODEL1 | USday | 1.13 | 2.37 | -6.55 | 0.77 | 1.01 | 1.26 | 18.50 | 91% |
| | USnight | 2.87 | 18.35 | -30.27 | -2.29 | 0.71 | 4.32 | 121.50 | 49% |
| | SH | 0.19 | 0.24 | -1.33 | 0.13 | 0.21 | 0.33 | 0.61 | 87% |
| | HK* | 0.32 | 0.30 | -0.39 | 0.15 | 0.24 | 0.43 | 1.54 | 86% |
| MODEL2 | USday | 0.98 | 2.22 | -6.49 | 0.68 | 0.94 | 1.12 | 16.34 | **88%** |
| | USnight | -0.50 | 16.51 | -39.30 | -4.70 | -1.21 | 0.25 | 94.41 | 46% |
| | SH | 0.08 | 0.22 | -1.46 | 0.03 | 0.09 | 0.16 | 0.44 | 67% |
| | HK* | 0.10 | 0.21 | -0.54 | 0.01 | 0.08 | 0.17 | 1.27 | 67% |
| MODEL3 | USday** | 0.04 | 0.14 | -0.45 | -0.03 | 0.04 | 0.11 | 0.48 | *55%* |
| | USnight | 2.65 | 6.83 | -32.98 | 0.71 | 2.42 | 5.19 | 21.49 | 68% |
| | SH | 0.11 | 0.11 | -0.30 | 0.05 | 0.10 | 0.16 | 0.37 | **86%** |
| | HK* | 0.24 | 0.25 | -0.34 | 0.08 | 0.17 | 0.38 | 1.09 | **83%** |

(Continued)

**Panel C: 300-day rolling window**

| | Variable | Mean | Std Dev | Min | Q1 | Median | Q3 | Max | % Firms |
|---|---|---|---|---|---|---|---|---|---|
| MODEL1 | USday | 1.08 | 1.67 | -2.31 | 0.78 | 0.99 | 1.22 | 14.23 | 92% |
| | USnight | 2.97 | 15.95 | -28.00 | -0.44 | 1.34 | 2.38 | 112.04 | 70% |
| | SH | 0.23 | 0.15 | -0.15 | 0.14 | 0.23 | 0.34 | 0.63 | 88% |
| | HK* | 0.29 | 0.28 | -0.40 | 0.09 | 0.28 | 0.49 | 1.08 | 88% |
| MODEL2 | USday | 0.93 | 1.52 | -3.17 | 0.61 | 0.90 | 1.08 | 12.59 | **92%** |
| | USnight | 0.37 | 14.23 | -35.78 | -2.76 | -0.73 | 0.09 | 90.01 | 64% |
| | SH | 0.10 | 0.12 | -0.22 | 0.04 | 0.10 | 0.17 | 0.41 | 84% |
| | HK* | 0.07 | 0.17 | -0.41 | -0.03 | 0.08 | 0.17 | 0.43 | 79% |
| MODEL3 | USday** | 0.05 | 0.11 | -0.21 | 0.00 | 0.06 | 0.11 | 0.51 | *68%* |
| | USnight | 2.29 | 5.56 | -27.89 | 1.35 | 2.16 | 3.73 | 20.52 | 86% |
| | SH | 0.12 | 0.11 | -0.25 | 0.06 | 0.11 | 0.18 | 0.35 | **88%** |
| | HK* | 0.25 | 0.24 | -0.15 | 0.09 | 0.19 | 0.39 | 1.04 | **93%** |

Exhibit 6: Portfolio regression results for the whole sample period (Jan 2001- July 2010)
This table reports the preliminary regression results for China ADR equal-weighted portfolios for the three models (eq. 4, 2, 5). The "listed" ADR portfolio is created with ADRs that have the underlying exchange in HK or Mainland China, and the "homeless" ADR portfolio with no underlying exchange. The market variables include the U.S. market day returns (USday), night returns (USnight), and Shanghai daily returns (SH) and orthogonalized Hang Seng index return (HK*). USday for Model 3 is one-day lagged. Numbers with superscript * represent significance at 5% level. The Wald statistics for Model 2 is to test the null hypothesis that betas for USnight, SH and HK* are all zeros. The Wald statistics for Model 3 is to test the null hypothesis that the sensitivity to the U.S. day factor is zero.

| | Whole sample | | | Homeless | | | Listed | | |
|---|---|---|---|---|---|---|---|---|---|
| | ADR daily Model 1 | ADR day Model 2 | ADR night Model 3 | ADR daily Model 1 | ADR day Model 2 | ADR night Model 3 | ADR daily Model 1 | ADR day Model 2 | ADR night Model 3 |
| constant | 0.00 | 0.00* | 0.00* | 0.00 | 0.00* | 0.00* | 0.00 | 0.00* | 0.00* |
| | (-0.01) | (-4.49) | (5.02) | (-0.13) | (-2.96) | (4.75) | (0.65) | (-1.38) | (1.99) |
| USday | 0.83* | 0.69* | 0.03 | 1.01* | 0.84* | 0.10* | 0.93* | 0.75* | -0.07* |
| | (23.58) | (26.24) | (1.38) | (12.41) | (11.65) | (2.47) | (22.22) | (24.67) | (-2.88) |
| USnight | 0.96* | 0.16* | 0.82* | 1.24* | -0.01 | 1.28* | 0.93* | 0.19* | 0.75* |
| | (10.08) | (2.14) | (10.38) | (3.79) | (-0.02) | (5.58) | (8.88) | (2.56) | (9.33) |
| SH | 0.19* | 0.05* | 0.15* | 0.15* | 0.04 | 0.11* | 0.24* | 0.03 | 0.22* |
| | (9.78) | (3.13) | (9.27) | (4.2) | (1.19) | (5.02) | (11.28) | (1.87) | (12.52) |
| HK* | 0.40* | 0.04 | 0.38* | 0.20* | 0.04 | 0.19* | 0.54* | 0.02 | 0.55* |
| | (8.80) | (1.30) | (16.73) | (2.51) | (0.54) | (5.14) | (13.77) | (0.92) | (21.93) |
| Adj R-square | 0.52 | 0.44 | 0.39 | 0.12 | 0.08 | 0.07 | 0.58 | 0.52 | 0.46 |
| Wald statistics | | 17.76* | 1.9 | | 1.84 | 6.09* | | 10.47* | 8.29* |

Exhibit 7: Short VAR for ADR portfolio day returns and night returns

This table reports the parameter estimates for the two VAR(1) systems. The first short VAR includes two variables – ADR day returns (ADRday) and U.S. day returns (USday). The second VAR includes ADR night returns (ADRnight), U.S. night returns (USnight), mainland Chinese market daily returns (SH) and HK market daily returns (HK). The coefficient estimates correspond to eq.6. For each parameter estimate, we also report the t statistics in the parenthesis. The sample period is from Jan 2000 to July 2010.

**Panel A: VAR(1) for ADR day returns**

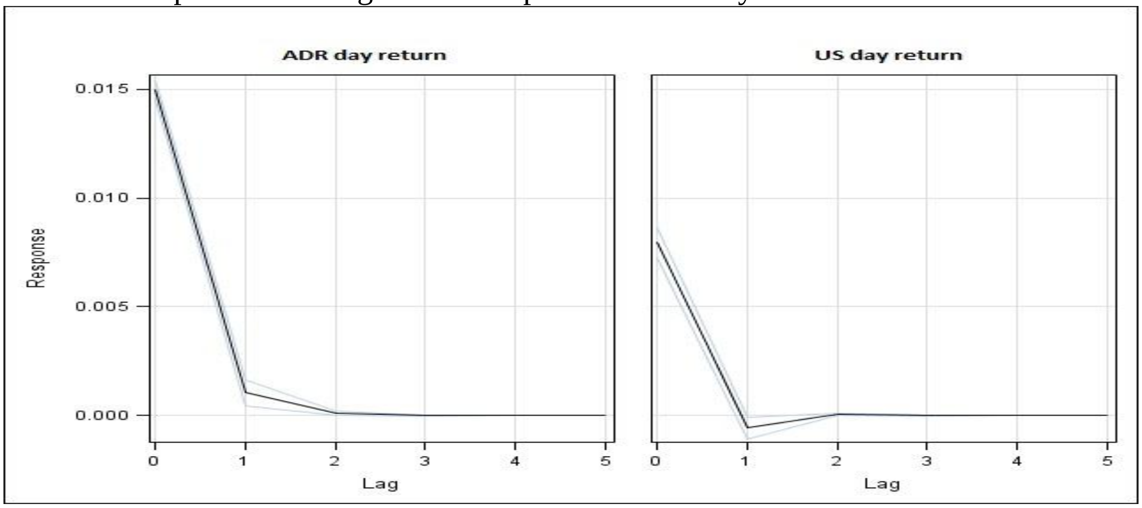
| | ***Whole sample*** | | ***Homeless*** | | ***Listed*** | |
|---|---|---|---|---|---|---|
| | ADRday(t-1) | USday(t-1) | ADRday(t-1) | USday(t-1) | ADRday(t-1) | USday(t-1) |
| ADRday | **0.09** | -0.01 | 0.00 | **0.19** | 0.02 | **-0.08** |
| | (3.62) | (-0.38) | (0.06) | (3.09) | (0.83) | (-2.60) |
| USday | 0.03 | -0.10 | 0.00 | -0.10 | 0.04 | -0.11 |
| | (1.17) | (-3.90) | (0.76) | (-4.68) | (1.39) | (-3.90) |

**Panel B: VAR(1) for ADR night returns**

| ***Whole sample*** | ADR night(t-1) | US night(t-1) | SH(t-1) | HK(t-1) |
|---|---|---|---|---|
| ADRnight | **0.09** | **-0.28** | **-0.04** | -0.03 |
| | (3.81) | (-4.04) | (-2.42) | (-1.57) |
| USnight | 0.01 | -0.13 | 0.00 | 0.00 |
| | (0.69) | (-6.44) | (-0.61) | (-0.46) |
| SH | 0.07 | 0.05 | -0.02 | -0.01 |
| | (2.08) | (0.58) | (-0.89) | (-0.39) |
| HK | 0.13 | 0.16 | -0.10 | -0.07 |
| | (4.16) | (1.8) | (-5.06) | (-2.89) |
| ***Homeless*** | | | | |
| ADRnight | **-0.06** | -0.15 | -0.03 | 0.02 |
| | (-2.82) | (-1.08) | (-1.07) | (0.65) |
| USnight | 0.00 | -0.14 | 0.00 | 0.00 |
| | (-0.65) | (-6.41) | (0.2) | (-0.05) |
| SH | 0.04 | 0.09 | -0.02 | 0.00 |
| | (2.59) | (0.94) | (-0.92) | (0.03) |
| HK | 0.01 | 0.30 | -0.09 | -0.04 |
| | (0.57) | (3.33) | (-4.16) | (-1.71) |
| ***Listed*** | | | | |
| ADRnight | **0.05** | **-0.26** | **-0.04** | -0.03 |
| | (2) | (-3.19) | (-2.39) | (-1.39) |
| USnight | 0.00 | -0.13 | 0.00 | 0.00 |
| | (0.57) | (-6.46) | (-0.62) | (-0.42) |
| SH | 0.06 | 0.06 | -0.02 | -0.01 |
| | (2.23) | (0.63) | (-0.98) | (-0.54) |
| HK | 0.10 | 0.19 | -0.11 | -0.07 |
| | (3.76) | (2.11) | (-5.14) | (-2.81) |

Exhibit 8. Response to orthogonalized impulse for the Short VAR on ADR whole sample portfolio

Panel A. Response to orthogonalized impulse in ADR day returns.




Panel B. Response to orthogonalized impulse in ADR night returns.