

Market Impacts on ADR Returns – Revisited

Oi Lin Cheung
Indiana University East

The non-synchronous trading hours might cause returns of ADRs affected differently by the US market and their home markets. Using 86 ADRs maintained by companies of 16 countries, it is found that the one-day lag (same day) US market night (day) returns and the day and night returns of the home market of the same day all have a significant impact on the ADR day returns. The same day US market day and night returns, the same day (one-day lead) home market night (day) returns all bear a significant impact on the ADR night returns.

INTRODUCTION

American Depositary Receipts (ADRs) are negotiable securities that represent equity securities of foreign companies which were incorporated outside the US, usually in their home countries. ADRs are listed and traded in US dollars in the US stock market. Depending on their types, they are either traded over the counter (Level I) or through the NYSE or NASDAQ (Level II and Level III). Absent any market imperfections, such as imbalance of supply and demand, the price of an ADR is the product of the price of its underlying shares in the home market, the ADR ratio, and the currency exchange rate. Thus, ADR pricing is also subject to factors of the two related markets – the US market and its home market.

This research studies the market impacts on ADR returns. Like He & Yang (2012), the daily returns of 86 ADRs maintained by companies of 16 countries, their daily home market returns, and the daily US market returns are broken down into day and night ADR, day and night home market, and day and night US market returns respectively. The study is also controlled for foreign currency risk, trading hour overlap, and distance of the home market from the US market. The one-day lag US market night returns and the same day US market day returns, the day and night returns of the home market of the same day all are found to have a significant impact on the ADR day returns. All these market returns, except the same day home market night returns, drive the ADR day returns in the same direction. The same day US market day and night returns, the same day home market night returns, and the one-day lead home market day returns all bear a significant impact on the ADR night returns. All these market returns, except the one-day lead home market day returns, drive the ADR night returns in the same direction.

This paper is organized as follows. Section 2 provides an account of the previous research on the association among ADR returns, US market returns, and home market returns. Section 3 presents some particulars in the trading hours of the sample international stock markets and their distances from the US market. Section 4 describes the data and sample used in this study. Section 5 explains the formation of the hypotheses and the testing models. Section 6 discusses the findings, followed by the conclusions in Section 7.

LITERATURE REVIEW

Research in ADRs started with taking them and their underlying shares as perfect substitutes (Officer & Hoffmeister, 1987; Kato, Linn, & Schallheim, 1991; Wahab, Lashgari, & Cohn, 1992; and Park & Tavakkol, 1994), then onto the impacts of market sentiment and liquidity on the pricing differences between the two (Suh, 2003; Kadiyala & Subrahmanyam, 2004; Chan, Hong, & Subrahmanyam, 2008; Silva & Chavez, 2008; and Arquette, Brown, & Burdekin, 2008). These latter studies focused on investigating whether ADR prices reflect their home market risk, the US market risk, and/or both. At the same time, researchers examined the possible determinants of returns on ADRs by using multiple-factor models (Patro, 2000; Kim, Szakmary, & Mathur, 2000; Choi & Kim, 2000; Alagnar & Bhar, 2001; and Fang & Loo, 2002). As expected, these studies found that home market risk bears a significant impact on ADR returns. On the other hand, there had not been much solid conclusion that could be drawn on the impacts of the US market and currency market (exchange rate) risks on ADR returns as the results vary across samples and study methods used.

Using the US market weekly returns as a proxy for the US market sentiment, Suh (2003) demonstrated that the US market returns significantly affect the premiums on ADR returns. Based on the inter-day prices, Gagnon & Karolyi (2010) showed that the returns of their sample stocks, which are listed simultaneously in two or more markets, have greater systematic co-movements with the US market index as compared with their home market indexes. Relying on a regime switching model and the weekly ADR index returns, He & Yang (2011) provided evidence that ADRs of Chinese companies are priced with the US market risk. Other studies with similar focus include Xu & Fung (2002), Mak & Ngai (2005), Kutan & Zhou (2006), and Su & Chong (2007). In view of not having much clear conclusion as to which market risk was more significant on ADR pricing, He & Yang (2012), by separating the daily returns into the day returns and night returns and using regression and vector autoregressive (VAR) analyses, found that the US market dominates in the day returns of the Chinese ADRs. On the other hand, the Hong Kong (where the underlying stocks were listed) market factors have a greater impact on the Chinese ADR night returns than the mainland China (where the companies were incorporated) market factors.

TRADING OF MAJOR INTERNATIONAL STOCK MARKETS

The majority of international stock markets open (and close) for trading at a different time during the day according to the time zones in which they are located. And, this non-synchronization in their trading hours has been giving rise to some challenges in determining which (and exactly how) market risk (particularly those of the US market versus the underlying home market) affects the pricing of ADRs as returns in one market may be resulted from prices discovered in a later period in which more information can be impounded than the other market.

As can be seen in TABLE 1, the Indonesian market (10,063.56 air miles) is geographically the furthest away from the US market in the sample whereas the Mexican market (2,089.83 air miles) is the closest.

TABLE 1
THE LOCATION AND DISTANCE FROM THE US MARKET (NEW YORK) OF THE
SAMPLE INTERNATIONAL STOCK MARKETS

Exchange Name	Country	Location	Distance from the US Market (Air Miles)
Athens Stock Exchange	Greece	Athens	4,930.12
Australian Securities Exchange	Australia	Sydney	9,946.17
BM&FBOVESPA	Brazil	Sao Paulo	4,780.84
Bolsa Mexicana de Valores	Mexico	Mexico City	2,089.83
Borsa Italiana	Italy	Milan	4,020.95
BUENOS FLOOR	Argentina	Buenos Aires	5,303.97
Euronext – Brussels	Belgium	Brussels	3,663.05
Euronext – Paris	France	Paris	3,631.09
Hong Kong Stock Exchange	Hong Kong	Hong Kong	8,054.19
Indonesia Stock Exchange	Indonesia	Jakarta	10,063.56
Korea Exchange	Korea	Seoul	6,875.34
London Stock Exchange	UK	London	3,465.23
National Stock Exchange of India	India	Mumbai	7,799.40
Taiwan Stock Exchange	Taiwan	Taipei	7,790.19
Tokyo Stock Exchange	Japan	Tokyo	6,748.59
XETRA	Germany	Frankfurt	3,858.41
<i>New York Stock Exchange</i>	<i>US</i>	<i>New York</i>	-

Source: The air miles of the international stock markets (where the stock exchanges are located) from the US market (New York) were downloaded from DistanceFromTo (<http://www.distancefromto.net/>).

TABLE 2 and FIGURE 1 show that the sample international stock markets in this study open as early as at 8:00 (Korea Exchange of Korea and London Stock Exchange of UK) and close as late as at 18:00 (BM&FBOVESPA of Brazil) local time. Daily market opening and closing in local time were checked against the official websites of the concerned stock exchanges. When translated to the coordinated universal time (UTC), the Korean (-1:00 or 23:00 the previous calendar day) stock market leads all the other international markets in daily opening while the Mexican (14:30) and US (14:30) markets lag all the others in opening on a trading day. The time during which the market is open varies across stock markets as well.

The Italian market (Borsa Italiana) remains open for the longest hours (for 8.5 hours from 09:05 to 17:35 local time) while the Taiwanese market (Taiwan Stock Exchange) remains open for the shortest hours (for 4.5 hours from 09:00 to 13:30 local time) on a trading day. Most of the markets open for 6 or 6.5 hours on a trading day. These include the Argentine (6 hours), Australian (6 hours), Japanese (6 hours), Indian (6.5 hours), Indonesian (6.5 hours), Mexican (6.5 hours), and US (6.5 hours) markets. The Brazilian and Mexican markets have the greatest overlap in trading hours of the 6.5 hours with the US market. The Australian, Hong Kong, Indonesian, Indian, Korean, Taiwanese and Japanese markets have zero overlap in the trading hours with the US market.

TABLE 2
THE COORDINATED UNIVERSAL TIME (UTC) TRANSLATED TRADING HOURS AND
THE OVERLAPPING TIME IN HOURS WITH THE US MARKET ESTIMATED ON
STANDARD TIME OF THE SAMPLE INTERNATIONAL STOCK MARKETS.

Exchange Name	Market Session (Local time)	UTC Adjustment (Hours)	UTC Open (Standard Time)	UTC Close (Standard Time)	Overlapping Hours with New York Stock Exchange (Standard Time)
Athens Stock Exchange	10:15 - 17:20	2	8:15	15:20	0.83
Australian Securities Exchange	10:00 - 16:00	10	0:00	6:00	0
BM&FBOVESPA	11:00 - 18:00	-3	14:00	21:00	6.5
Bolsa Mexicana de Valores	08:30 - 15:00	-6	14:30	21:00	6.5
Borsa Italiana	09:05 - 17:35	1	8:05	16:35	2.08
BUENOS FLOOR	11:00 - 17:00	-3	14:00	20:00	5.5
Euronext – Brussels	09:00 - 17:30	1	8:00	16:30	2
Euronext – Paris	09:00 - 17:30	1	8:00	16:30	2
Hong Kong Stock Exchange	09:30 - 16:00	8	1:30	8:00	0
Indonesia Stock Exchange	09:30 - 16:00	7	2:30	9:00	0
Korea Exchange	08:00 - 15:00	9	-1:00 (23:00 previous calendar day)	6:00	0
London Stock Exchange	08:00 - 16:30	0	8:00	16:30	2
National Stock Exchange of India	09:00 - 15:30	5.5	3:30	10:00	0
Taiwan Stock Exchange	09:00 - 13:30	8	1:00	5:30	0
Tokyo Stock Exchange	09:00 - 15:00	9	0:00	6:00	0
XETRA	09:00 – 17:30	1	8:00	16:30	2
<i>New York Stock Exchange</i>	<i>09:30 - 16:00</i>	<i>-5</i>	<i>14:30</i>	<i>21:00</i>	<i>-</i>

Sources: Schedules of the market sessions in local time were obtained from the official websites of the individual stock exchanges. UTC adjustments in hours were downloaded from timeanddate.com (<http://www.timeanddate.com/worldclock/city.html?n=179>). UTC open and UTC close as well as overlapping hours with the New York Stock Exchange of the individual stock exchanges were estimated from their market sessions and UTC adjustments, and then compared with those of the New York Stock Exchange.

One way to overcome this non-synchronous trading problem in comparing the returns among international stock markets with the ADR returns is to use the ADR intraday prices, such as the midpoint between the bid and ask prices, to match the closing prices of the underlying home markets (Gagnon & Karolyi, 2009). Another way is to separate the day returns from the night returns in the daily returns of

ADRs, the US market, and the home markets (He & Yang, 2012). Since intraday prices are subject to daily trading noises, this paper extends He & Yang (2012) by including 86 ADRs of 16 countries and, as in He & Yang (2012), distinguish the night returns from the day returns in the ADR, US, and home market daily returns. The home market overlapping trading hours with the US market and home geographical distance from the US market as well as the currency market risk are also considered.

As can be seen from FIGURE 1, due to the non-synchronous trading in the various international stock markets, the day and night ADR returns could be affected by the US market, the home market, or both. During the non-overlapping trading hours of the home markets, favorable home market impact will be transferred to the night ADR returns. Likewise, during the non-overlapping trading hours of the US market, unfavorable market conditions in the US will have a negative impact on the day ADR returns. On the other hand, during the overlapping US trading hours, day ADR returns could be affected by both markets, although may not be to the same extent. The daily ADR returns (the day and night returns combine) will have been smoothed to reflect the actual impacts of the US and the home market on ADR pricing (US market risk versus home market risk). Day and night ADR returns are expected to be most significantly affected individually by the market that stays open for trading during the non-overlapping trading periods and jointly by both markets during the overlapping trading periods.

FIGURE 1
ILLUSTRATION OF THE OVERLAPPING AND NON-OVERLAPPING TRADING HOURS
AMONG THE SAMPLE INTERNATIONAL STOCK MARKETS

Day	D _{t-1}	D _t																								
UTC Whole Hour	24	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Athens Stock Exchange (Greece)																										
Australian Securities Exchange (Australia)																										
BM&FBOVESPA (Brazil)																										
Borsa Italiana (Italy)																										
BUENOS FLOOR (Argentina)																										
Euronext - Brussels (Belgium)																										
Euronext - Paris (France)																										
Hong Kong Stock Exchange (Hong Kong)																										
Indonesia Stock Exchange (Indonesia)																										
Korea Exchange (Korea)																										
London Stock Exchange (UK)																										
National Stock Exchange of India (India)																										
Taiwan Stock Exchange (Taiwan)																										
Tokyo Stock Exchange (Japan)																										
XETRA (Germany)																										
Bolsa Mexicana de Valores (Mexico)																										
New York Stock Exchange (US)																										

DATA AND SAMPLE

ADRs of Level-II and Level-III with daily prices between January, 1, 2008 and December, 31, 2012 and listing of the underlying shares in the home market only are included. The ADRs were initially identified from the DR Universe included in the adr.com website (<https://www.adr.com/>) maintained by JP Morgan and checked against the official websites of their companies. Following He & Yang (2012), daily return is defined as the log-difference of the adjusted closing prices, day return as the log-difference between adjusted closing price and the same day opening price, and night return as the log-difference between the opening price and the previous closing price. These definitions apply to the ADRs, US market, and home markets. The opening prices, closing prices, and adjusted closing prices were downloaded from Yahoo finance (<http://finance.yahoo.com/>). The resulting sample includes 86 ADRs maintained by companies of 16 countries with daily price data from the first trading day of 2008 to the last trading day of 2012 of the ADRs, the US market index, and the underlying home market indexes. The

differences in the national holidays for the turn of years may render slight differences in the first and last trading days of the years across different markets. The US market returns were determined from those of S&P 500 index whereas the underlying home market returns from those of their key representative indexes.

TABLE 3 shows that all the sample international stock markets, except the Argentine, Indonesian, Korean and Mexican markets, have a negative average daily return over the sample period. The highest average daily gain is 0.037% (Indonesia) while the highest average daily loss is 0.135% (Greece).

From TABLE 4, it can be seen that UK (14) and Mexico (11) have the most number of ADRs in the sample whereas Belgium, Greece, Indonesia, and Italy have the least number (all with 1 only). TABLE 5 illustrates that the sample includes the highest number of ADRs in the technology sector (26, almost one-third of the sample ADRs), followed by the financial and services sectors (both with 11 ADRs in the sample).

TABLE 3
SAMPLE INTERNATIONAL STOCK MARKETS AND
THEIR REPRESENTATIVE MARKET INDEXES

Exchange Name	Country	Representative Index	Trading Currency	Average Daily Returns During the Sample Period (%)
Athens Stock Exchange	Greece	ATHEN INDEX COMPOS	EUR	-.135
Australian Securities Exchange	Australia	All Ordinaries	AUD	-.025
BM&FBOVESPA	Brazil	IBOVESPA	BRL	-.004
Bolsa Mexicana de Valores	Mexico	IPC	MXN	.031
Borsa Italiana	Italy	FTSE MIB	EUR	-.067
BUENOS FLOOR	Argentina	MERVAL BUENOS AIRES	ARS	.023
Euronext – Brussels	Belgium	BEL-20	EUR	-.040
Euronext – Paris	France	CAC 40	EUR	-.034
Hong Kong Stock Exchange	Hong Kong	Hang Seng	HKD	-.016
Indonesia Stock Exchange	Indonesia	Jakarta Composite	IDR	.037
Korea Exchange	Korea	Seoul Composite	KRW	.004
London Stock Exchange	UK	FTSE 100	GBP	-.007
National Stock Exchange of India	India	BSE 30	INR	-.004
New York Stock Exchange	US	S&P 500	USD	-.002
Taiwan Stock Exchange	Taiwan	Taiwan Weighted	TWD	-.008
Tokyo Stock Exchange	Japan	Nikkei 225	JPY	-.032
XETRA	Germany	DAX	EUR	-.005

Source: Average daily returns were calculated from the daily close levels of the representative indexes downloaded from Yahoo Finance (<http://finance.yahoo.com/>).

TABLE 4
COUNTRY DISTRIBUTION OF THE SAMPLE ADRS.

Country	Number of ADRs	Percent
Argentina	10	11.63
Australia	6	6.98
Belgium	1	1.16
Brazil	9	10.47
France	3	3.49
Germany	2	2.33
Greece	1	1.16
Hong Kong	5	5.81
India	2	2.33
Indonesia	1	1.16
Italy	1	1.16
Japan	7	8.14
Korea	7	8.11
Mexico	11	12.79
Taiwan	6	6.98
UK	14	16.28
Total	86	100.00

TABLE 5
INDUSTRY DISTRIBUTION OF THE SAMPLE ADRS.

Industry Sector	Number of ADRs	Percent
Basic Materials	6	6.98
Consumer Goods	10	11.63
Financial	11	12.79
Healthcare	6	6.98
Industrial Goods	7	8.14
Services	11	12.79
Technology	26	30.23
Utilities	6	6.98
N/A*	3	3.49
Total	86	100.00

*N/A means information/classification not available on Yahoo finance.

HYPOTHESES AND EMPIRICAL MODELS

Three hypotheses are tested in this paper.

1. It is expected that the ADR daily returns are affected by factors in both the US market and home market – the US market day and night returns and the home market day and night returns. (Model 1)

2. All the home markets, except the Mexican market, open for trading before the US market during a day in the UTC time. The Mexican market opens at the same time as the US market on a trading day. Thus, both the day and night returns of the same day of the home market but only the day returns of the same day and the night returns of the previous day of the US market are expected to have a significant impact on the ADR day returns. (Model 3)
3. By the same token, the day and night returns of the same day of the US market and the night return of the same day and the day return of the following day of the home market are expected to have significant impacts on the ADR night returns. (Model 5)

Theoretically, ADR price is equal to the product of the price of its underlying share(s), ADR ratio, and exchange rate. Thus, it is expected that ADR returns are subject to foreign currency risk as well. In view of this, the empirical models (1, 3 and 5) are controlled for foreign currency returns. Since the US market and the home market for an ADR may be located in different time zones, the trading hours between the US market and the home market may not be overlapped at all or fully overlapped. Therefore, for the hypotheses and the associated models above, the trading hour overlap is built into them as a control variable. Due to the different locations and time zones between the US market and home market, thus affecting the timing of trading activities (and the resulting information reflected in the prices) between the two markets, the models are also controlled for the distance of the home market from the US market. All these controls can be seen in Models 2, 4 and 6 respectively.

Model 1:

$$R_{i,t}^{ADR-daily} = \alpha_i^1 + \beta_{i,1}^1 R_t^{US-day} + \beta_{i,2}^1 R_t^{US-night} + \beta_{i,3}^1 R_{i,t}^{Home-day} + \beta_{i,4}^1 R_{i,t}^{Home-night} + e_{i,t}^1 \quad (1)$$

Model 2:

$$R_{i,t}^{ADR-daily} = \alpha_i^2 + \beta_{i,1}^2 R_t^{US-day} + \beta_{i,2}^2 R_t^{US-night} + \beta_{i,3}^2 R_{i,t}^{Home-day} + \beta_{i,4}^2 R_{i,t}^{Home-night} + \beta_{i,5}^2 R_{i,t}^{FX-daily} + \beta_{i,6}^2 trdhoverlap_i + \beta_{i,7}^2 distance_i + e_{i,t}^2 \quad (2)$$

Model 3:

$$R_{i,t}^{ADR-day} = \alpha_i^3 + \beta_{i,1}^3 R_t^{US-day} + \beta_{i,2}^3 R_{t-1}^{US-night} + \beta_{i,3}^3 R_{i,t}^{Home-day} + \beta_{i,4}^3 R_{i,t}^{Home-night} + e_{i,t}^3 \quad (3)$$

Model 4:

$$R_{i,t}^{ADR-day} = \alpha_i^4 + \beta_{i,1}^4 R_t^{US-day} + \beta_{i,2}^4 R_{t-1}^{US-night} + \beta_{i,3}^4 R_{i,t}^{Home-day} + \beta_{i,4}^4 R_{i,t}^{Home-night} + \beta_{i,5}^4 R_{i,t}^{FX-daily} + \beta_{i,6}^4 trdhoverlap_i + \beta_{i,7}^4 distance_i + e_{i,t}^4 \quad (4)$$

Model 5:

$$R_{i,t}^{ADR-night} = \alpha_i^5 + \beta_{i,1}^5 R_t^{US-day} + \beta_{i,2}^5 R_t^{US-night} + \beta_{i,3}^5 R_{i,t}^{Home-night} + \beta_{i,4}^5 R_{i,t+1}^{Home-day} + e_{i,t}^5 \quad (5)$$

Model 6:

$$R_{i,t}^{ADR-night} = \alpha_i^6 + \beta_{i,1}^6 R_t^{US-day} + \beta_{i,2}^6 R_t^{US-night} + \beta_{i,3}^6 R_{i,t}^{Home-night} + \beta_{i,4}^6 R_{i,t+1}^{Home-day} + \beta_{i,5}^6 R_{i,t}^{FX-daily} + \beta_{i,6}^6 trdhoverlap_i + \beta_{i,7}^6 distance_i + e_{i,t}^6 \quad (6)$$

where $R_{i,t}^{ADR-daily}$ is the daily return of ADR i on Day t ,
 $R_{i,t}^{ADR-day}$ is the day return of ADR i on Day t
 $R_{i,t}^{ADR-night}$ is the night return of ADR i on Day t
 R_t^{US-day} is the day return of the US market on Day t
 $R_t^{US-night}$ is the night return of the US market on Day t
 $R_{t-1}^{US-night}$ is the one-day lag night return of the US market on Day t
(i.e. night return on Day $t - 1$)
 $R_{i,t}^{home-day}$ is the day return of ADR i 's home market on Day t
 $R_{i,t}^{home-night}$ is the night return of ADR i 's home market on Day t
 $R_{i,t+1}^{home-day}$ is the one-day lead day return of ADR i 's home market on Day t
(i.e. day return on Day $t + 1$)
 $R_{i,t}^{FX-daily}$ is the daily return of ADR i 's currency market on Day t
 $trdhroverlap_i$ is the overlapping trading hours between the US market and ADR i 's home market
 $distance_i$ is the physical distance in air miles between the US market and ADR i ' home market

$R_{i,t}^{FX-daily}$ is the log-difference between the daily mid-point of the bid and ask prices of the exchange rate defined as USD/foreign currency. The data on the currency exchange rates were downloaded from OANDA.com (www.oanda.com/currency/historical-rates/). $trdhroverlap_i$ was estimated from comparing the UTC open and UTC close time of the stock exchange on which the underlying stock of ADR i is listed with those of the New York Stock Exchange. TABLE 2 provides the complete list on the estimates. $distance_i$ is a measure of the approximate physical distance from New York, in terms of air miles, of the city where the stock exchange on which the underlying stock of ADR i is listed. The complete list can be found in TABLE 1.

RESULTS AND DISCUSSION

TABLE 6 shows the results of panel data random effect regression analyses of the ADR returns on the various US and home market returns and the control variables.

As expected, the US and home market day and night returns all have a significant impact on the ADR daily returns. All of them drive the ADR daily returns in the same direction as well. On the other hand, the currency daily returns have a significantly negative impact on the ADR daily returns. The higher the currency daily returns, the lower the ADR daily returns. Since the currency returns are derived from the exchange rates defined as USD/foreign currencies, a positive return of a foreign currency implies a decline in value of the currency. As a result, the ADR price should go down. Distance between the home market and the US market as well as the overlapping trading hours do not seem to have any significant impact on the ADR daily returns.

When breaking the daily returns down into the day and night returns, the one-day lag US market night returns, and the same day US market day returns, the day and night returns of the home market of the same day all have a significant impact on the ADR day returns. All these market returns, except the same day home market night returns, drive the ADR day returns in the same direction. The overlap trading hours have a significantly negative impact on the ADR day returns too. The greater the overlap of the trading hours between the home market and the US market, the lower the ADR day returns.

The same day US market day and night returns, the same day home market night returns, and the one-day lead home market day returns all bear a significant impact on the ADR night returns. All these market returns, except the one-day lead home market day returns, drive the ADR night returns in the same

direction. The ADR night returns are also significantly negatively affected by the currency daily returns as well as significantly positively by the distance and the overlap trading hours between the US and home stock market.

Since the same day home market night returns (the one-day lead home market day returns) have a significantly negative association with the ADR day (night) returns, these seem to suggest that the ADR returns adjust for any over-reactions in the home markets when the US market opens (closes) for trading.

TABLE 6
RESULTS OF RANDOM EFFECT PANEL DATA REGRESSION ANALYSIS

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Dependent Variable	ADR Daily Return	ADR Daily Return	ADR Day Return	ADR Day Return	ADR Night Return	ADR Night Return
Independent Variables						
One-day lag US market night return			.811 (3.59)***	.826 (3.64)***		
US market day return	.831 (128.22)***	.831 (128.20)***	.711 (14.37)***	.711 (14.38)***	.316 (62.80)***	.315 (62.64)***
US market night return	1.085 (35.83)***	1.089 (35.94)***			2.030 (77.54)***	2.033 (77.66)***
Home market day return	.442 (65.44)***	.442 (65.23)***	.136 (2.68)***	.137 (2.70)***		
Home market night return	.277 (25.25)***	.276 (25.20)***	-.239 (-2.85)***	-.238 (-2.84)***	.260 (27.10)***	.260 (27.03)***
One-day lead home market day return					-.032 (-6.38)***	-.033 (-6.39)***
Currency daily return		-.049 (-3.75)***		.064 (0.64)		-.061 (-5.36)***
Distance from the US market (air miles)		-8.53e-08 (-1.57)		-.00002 (-0.96)		1.87e-07 (2.52)***
Overlap trading hours with US market		-.00005 (-0.98)		-.063 (-2.30)**		.0001 (2.23)***
Constant	-.0001 (-1.21)	.0005 (1.20)	-.087 (-1.77)*	.232 (1.02)	-.00003 (-0.32)	-.001 (-2.60)***
Number of Obs	111,873	111,873	111,873	111,873	111,873	111,873
Number of groups	86	86	86	86	86	86
Wald chi ²	43,479.40 ***	43,501.17 ***	343.13 ***	349.72 ***	12,625.42 ***	12,663.58 ***

z-scores are shown in parentheses beneath random effect panel data regression coefficients. Asterisks *, ** and *** indicate significance at 10%, 5% and 1% respectively.

During the overlapping trading hours, arbitrage is made more possible for a security that is traded in two simultaneous markets (either in the same form or in an equivalent form). This will eliminate the premium on pricing, if any, occurs in either market. The above result seems to provide some evidence for the extensive arbitrage activities taking place between the US market and the home markets of ADRs.

The longer the overlapping trading hours during the day in US, the shorter the time the home market stays open during the night in US, thus, less news from the open home market can be impounded into the price of ADR while the US market is closed. That the distance of the home market from the US market has a significantly positive association with the ADR night returns also confirms this.

CONCLUSION

This research studies the market impacts on ADR returns. Like He & Yang (2012), the daily returns of 86 ADRs maintained by companies of 16 countries, the daily US market returns and their daily home market returns are broken down into the day and night ADR, US market, and home market returns. The study is also controlled for foreign currency risk, trading hour overlap, and distance of the home market from the US market. The one-day lag US market night returns and the same day US market day returns, the day and night returns of the home market of the same day are all found to have a significant impact on the ADR day returns. All these market returns, except the same day home market night returns, drive the ADR day returns in the same direction. The same day US market day and night returns, the same day home market night returns, and the one-day lead home market day returns all bear a significant impact on the ADR night returns. All these market returns, except the one-day lead home market day returns, drive the ADR night returns in the same direction.

REFERENCES

- Alagnar, V., & Bhar, R. (2001). Diversification gains from American depository receipts and foreign equities: Evidence from Australian stocks. *Journal of International Financial Markets, Institutions and Money*, 11, 97–113.
- Arquette, G., Brown, W., & Burdekin, R. (2008). US ADR and Hong Kong H-share discounts of Shanghai-listed firms. *Journal of Banking and Finance*, 32, 1916–1927.
- Chan, J., Hong, D., & Subrahmanyam, M. (2008). A tale of two prices: liquidity and asset prices in multiple markets. *Journal of Banking and Finance*, 32, 947–960.
- Choi, Y., & Kim, D. (2000). Determinants of American depository receipts and their underlying stock returns: Implications for international diversification. *International Review of Financial Analysis*, 9, 351–368.
- Fang, H., & Loo, J. (2002). Pricing of American depository receipts under market segmentation. *Global Finance Journal*, 13, 237–252.
- Gagnon, L., & Karolyi, G. (2009). Information, trading volume, and international stock return comovement: Evidence from cross-listed stocks. *Journal of Financial and Quantitative Analysis*, 44, 953–986.
- Gagnon, L., & Karolyi, G. (2010). Multi-market trading and arbitrage. *Journal of Financial Economics*, 97, 53–80.
- He, H., & Yang, J. (2011). Regime switching analysis of ADR home market pass-through. *Journal of Banking and Finance*, 35, 204–214.
- He, H., & Yang, J. (2012). Day and night returns of Chinese ADRs. *Journal of Banking and Finance*, 36, 2795–2803.
- Kadiyala, P., & Subrahmanyam, A. (2004). Divergence of US and local returns in the after-market for equity issuing ADRs. *European Financial Management*, 10, 389–412.
- Kato, K., Linn, S., & Schallheim, J. (1991). Are there arbitrage opportunities in the market for American depository receipts? *Journal of International Financial Markets, Institutions and Money*, 1, 73–89.

- Kim, M., Szakmary, A., & Mathur, I. (2000). Price transmission dynamics between ADRs and their underlying foreign securities. *Journal of Banking and Finance*, 24, 1359–1382.
- Kutan, A., & Zhou, H. (2006). Determinants of returns and volatility of Chinese ADRs at NYSE. *Journal of Multinational Financial Management*, 16, 1–15.
- Mak, B., & Ngai, A. (2005). Market linkage for dual-listed Chinese stocks. *The Chinese Economy*, 38, 88–107.
- Officer, D., & Hoffmeister, R. (1987). ADRs: A substitute for the real thing? *Journal of Portfolio Management*, 13, 61–65.
- Park, J., & Tavakkol, A. (1994). Are ADRs a dollar translation of their underlying securities? The case of Japanese ADRs. *Journal of International Financial Markets, Institutions and Money*, 4, 77–87.
- Patro, D. (2000). Return behavior and pricing of American depositary receipts. *Journal of International Financial Markets, Institutions and Money*, 9, 43–68.
- Silva, A., & Chavez, G. (2008). Cross-listing and liquidity in emerging market stocks. *Journal of Banking and Finance*, 32, 420–433.
- Su, Q., & Chong, T. (2007). Determining the contributions of price discovery for Chinese cross-listed stocks. *Pacific-Basic Finance Journal*, 15, 140–153.
- Suh, T. (2003). ADRs and U.S. market sentiment. *Journal of Investing*, 12, 87–95.
- Wahab, M., Lashgari, M., & Cohn, R. (1992). Arbitrage opportunities in the American Depositary Receipts market revisited. *Journal of International Financial Markets, Institutions and Money*, 2, 97–130.
- Xu, X., & Fung, H. (2002). Information flows across markets: Evidence from China backed stocks dual-listed in HK and New York. *The Financial Review*, 37, 563–588.