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Here and There: Cross-border Evidence of Commonality in Liquidity of ADR in Asia Pacific

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ABSTRACT

This study examines the evidence for commonality in liquidity of the American Depository Receipts (ADR) in the context of Asia Pacific countries which are classified into developed markets (Australia, Hong Kong, Japan, New Zealand and Singapore) and emerging markets (China, India, Indonesia, South Korea, Malaysia, Philippines, Thailand and Taiwan). In order to understand the impact of cross listing towards co-movement in liquidity of stocks across border, liquidity features of each market are first evaluated. The ADRs from developed markets tend to be more liquid. In terms of commonality, this study shows (i) commonality in liquidity is evident at the firm level in which the emerging market displayed more co-movement in contrast with developed market; (ii) at the country level, commonality only indicated by weak sign in which the developed market tends to be higher than emerging market; (iii) at the regional level, the commonality of the ADR is also evident in which there is an influence of the ADRs from developed market on the emerging market, and (iv) commonality in liquidity of ADR still holds during the crisis period (based on robustness test).

Keywords: American Depository Receipts (ADR), liquidity, commonality in liquidity, cross-listing

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INTRODUCTION

Liquidity and price discovery are two important aspects of stock markets, and the two are linked indistinguishably. Securities markets that can provide price discovery tend to be liquid and vice versa. Liquidity is very important as it is related to returns

that the investor expects from the market (Amihud, 2002; Amihud & Mendelson, 1986; Brennan & Subrahmanyan, 1996). Research on liquidity has shifted from individual securities attributes to market liquidity features. Chordia, Roll and Subrahmanyam (2000) are the first to point out the missing link in liquidity assessment by proposing the possibility of an individual asset 'co-move' with overall market wide liquidity. This feature is now referred to *commonality in liquidity* or common cross-sectional variations in returns, liquidity, and trading activity that appear within or across stocks.

Studies on commonality in liquidity show co-movement in liquidity is global phenomenon (Brockman & Chung, 2002; Fabre & Frino, 2004; Pukthuanthong-Le & Visaltanachoti, 2009) and evident at various levels including for individual stocks and both intra-market and inter-market (Brockman, Chung, & Perignon, 2009; Dang et al., 2015; Karolyi, Lee, & Van Dijk, 2012). The importance of market liquidity co-movement among stocks is amplified by the growing interest in cross-listings, in particular in emerging countries. According to the Bank of New York report in January 2016, the total value traded for the Asia Pacific firms in 2015 was $1,373 billion or 44 billion in volume, with China as the highest country traded (about $1,016.8 billion). As a consequence, the cross-border investment flows raise the question whether the home market (*'here'*) or the host market (*'there'*) that determines the liquidity co-movement across markets.

To advance the importance of cross-listing towards liquidity commonality, we notice an important gap in the literature regarding the impact of cross-listing towards commonality in liquidity in which American Depository Receipts (ADR) could stand as an intermediary to evaluate the link between liquidity, commonality in liquidity and asset pricing. The ADR are claims against home-market common shares issued by a US depository bank which trades, quotes and settles in US dollars. For practical purposes, ADR is equivalent to common stock and close enough substitute to provide an arbitrage relationship between the US market and the corresponding home shares market where the stock originates.

An ample understanding of liquidity and its dynamic within and across the market is important not only for domestic but also international investors as well as regulators. Emerging markets such as the Asia Pacific provides an ideal setting to explain the link between commonality patterns and the pricing mechanism in stock liquidity. In addition, liquidity problem in emerging markets is more severe than in developed market since their market structure is also different (Bekaert, Harvey, & Lundblad, 2007). Thus, this study contributes to the discussion on asset pricing and emerging market issues.

The rest of this paper is organised as follows. Section 2 reviews related

studies while Section 3 discusses research methodology and data selection. Section 4 present empirical findings followed by a discussion of the results in Section 5. The paper is summarised and concluded in Section 6.

LITERATURE REVIEW

The American Depository Receipts (ADR) is believed to be an important element to detect commonality in liquidity, particularly for emerging markets. In this section, we first review some theories on liquidity and commonality in liquidity.

Liquidity

The term liquidity is used to describe (i) *funding liquidity*, (ii) *market liquidity*, and (iii) *global liquidity* (Jorion, 2007). In this paper, the term liquidity is related to liquidity of an asset. According to Kyle (1985), the liquidity of an asset is defined as the ability to trade a large amount of asset quickly, and at a low cost when one wants to trade. Kyle also explains the dimensions of liquidity such as *tightness, depth, breadth, immediacy* and *resiliency*. However, it is generally accepted there is no clearly accepted definition of liquidity among scholars. Consequently, there is also no single measurement that can represent all of the dimensions above.

Various proxies have been introduced as measures of liquidity including measurement for high and low frequency data. Since this study is interested in ADR liquidity features, low frequency proxies are more applicable. Amihud's *Illiquidity* (2002) is among the most applied measure in recent studies (Dang et al., 2015; Karolyi, Lee, & Van Dijk, 2012). Amihud's Illiquidity is a price impact measure based on daily price response related to the trading volume of one dollar of stock's trading volume. This ratio is selected as the main measurement of liquidity in this study as it covers the five dimensions of liquidity and is also a robust measurement for the ADR (Chan, Hong, & Subrahmanyam, 2008).

Commonality in Liquidity

Commonality in liquidity refers to the extent of market-wide (or industry-wide) liquidity that affects the liquidity of individual securities (Chordia, Roll, & Subrahmanyam, 2000). In other words, commonality in liquidity refers to the common underlying determinants of liquidity across securities. Empirically, it can be observed as the *co-movement* between the variations in individual stock liquidity and variations in market-wide liquidity as discussed by Chordia, Roll and Subrahmanyam (2000) as "*liquidity commonality*" or "*systematic liquidity*" as discussed by (Huberman & Halka, 2001).

There has been many empirical studies on commonality in liquidity in various markets such as Hong Kong, Australia, the U.K. and Thailand (Brockman & Chung, 2002; Fabre & Frino, 2004; Galariotis & Giouvris, 2007; Pukthuanthong-Le & Visaltanachoti, 2009). A comprehensive approach on liquidity commonality based on massive data from markets around the

world has become a trend in recent research. Karolyi, Lee and Van Dijk (2012) report within-country commonality in return, liquidity, and turnover for 40 countries including emerging and developed countries from 1995 to 2004. They show the extent of commonality in one country is inversely related to its economic and institutional development. More recently, Dang et al. (2015) examined commonality in liquidity based on 39 stock markets between 1995 and 2007. The authors focused on the impact of cross-listing in each country selected yet they did not assess directly the object of cross-listing or the ADR.

This study proposes that liquidity commonality can be observed in the ADR of Asia Pacific stock markets. While past research has focused on the property of stocks, this study argues that commonality can be detected in the new channel (the ADR), at levels of measurement level (firm, country, and regional levels), and in multi-market settings. Therefore, the following hypothesis is proposed.

H1. There exists commonality in liquidity in the ADR of the Asia Pacific stock market

Commonality in liquidity of ADR is expected to be higher in the emerging markets in Asia Pacific compared with developed markets. It is expected the developed markets would contribute to the commonality in liquidity of the emerging markets.

METHODS

The unit analysis investigated in this study is firms in Asia Pacific countries that are cross listed in the US by issuing an ADR. Based on the MSCI Index classification, countries in the Asia Pacific region are grouped into developed markets (Australia, Hong Kong, Japan, New Zealand, and Singapore) and emerging markets (China, India, Indonesia, South Korea, Malaysia, Philippines, Thailand and Taiwan). Samples are collected from Bloomberg (Level I, II and III ADRs that traded in the NYSE and the OTC) between 1 January 2000 and 29 January 2015. In total, there are 1375 ADR, which include 802 firms from developed countries and 573 firms form emerging countries. Daily variables collected include date, last sale prices, volume, ADR ratio and the Book to Market Ratio. Screening procedures are then applied to the entire datasets. First, all available ADR data is matched with their corresponding home market's stock prices and volumes, as well as their corresponding ADR. The collection of the same set of data for the corresponding shares in the home market must also occur. This eliminates incomplete data from period of observations. Second, the US daily market returns are also examined for the same period. Third, the daily foreign exchange rates are collected for the purpose of converting the home market currency into US dollars as well as the corresponding home market stock daily returns. A total of 235 and 134 ADR was collected for developed markets and emerging markets respectively.

Variables and Liquidity Measurements

At the first stage of analysis, the liquidity profile of the individual ADR using selected measures of liquidity is assessed. As proxies of liquidity, *Amihud's Illiquidity (L)* and *Difference in Illiquidity (DL)* is used. Amihud's (2002) Illiquidity is defined as the ratio of the daily absolute return to the stock's dollar trading volume in millions. This ratio represents the price impact which closely follows Kyle (1985). This measure is calculated on daily basis, and averaged into monthly frequency. On each day *d*, for each ADR *i* (and its corresponding home shares) from country *c*, Amihud's Illiquidity (L) is calculated as a daily absolute return divided by daily volumes. The monthly market illiquidity ratio is the equally weighted average of individual ADR and home share illiquidity ratios which are calculated as follows:

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

where D_i is number of trading days in month t, $R_{i,d}$ is the daily return of ADR i on day d (within month t), and $Vol_{i,d}$ is the dollar trading volume of ADR i on day d, which is defined as the number of shares traded times the ADR price on day d. In order to compare this ratio across markets, adjustments are made by constructing the dollar denominated Amihud's Illiquidity ratio so that the return comes not only from the changes in stock prices but also from the increase or decrease in the exchange rate.

The second proxy is generated from the first measurement called Difference in Illiquidity (DL). This ratio basically measures the monthly difference of illiquidity of ADR *i* (and its corresponding home shares) from country *c* which is calculated as follows:

$$DL_{i,c,t} = \frac{1}{D_t} \sum_{d=1}^{Dt} \left(\frac{L_{i,c,t} - L_{i,c,t-1}}{L_{i,c,t-1}} \right) \qquad (2)$$

where D_i is number of trading days in month t, $L_{i,c,t}$ is the liquidity of ADR i of country c in month t and $L_{i,c,t-1}$ is the previous period liquidity of ADR i of country c in month t.

In the next stage, in each month, the aggregate market liquidity of both ADR and the home shares is calculated as the equally weighted average of all individual ADR and its home shares Amihud's Illiquidity (L) ratio. We follow the similar procedures as per Chordia, Roll, and Subrahmanyam (2000) in calculating average market liquidity, for all ADR as well as their corresponding home shares. This method requires inclusion of all ADR or all home shares instead of *firm j* being analysed while calculating the average market liquidity. By conducting these measurements repeatedly, the overall individual and market variables for ADR and their corresponding home shares can be obtained.

Estimation of Commonality in Liquidity

Estimations of commonality are performed by developing the standard market model regression as per Chordia, Roll and Subrahmanyam (2000). Our models are developed for each level of analysis including the firm-by-firm level, the country-

by-country level, and the region-by-region level.

In the first stage of analysis, firm-by-firm commonality of ADR is detected by regressing the monthly percentage changes in liquidity ($DL^{adr}_{i,c,t}$) on the monthly percentage changes in the concurrent market liquidity ($DL^{adr}_{m,c,t}$), lead market liquidity ($DL^{adr}_{m,c,t+1}$) and lagged market liquidity ($DL^{adr}_{m,c,t-1}$) for ADR_i in country c. The complete model is as follows:

$$DL^{adr}_{i,c,t} = \alpha_{i,c,t} + \beta_1 DL^{adr}_{m,c,t} + \beta_2 DL^{adr}_{m,c,t+1} + \beta_3 DL^{adr}_{m,c,t-1} + \varepsilon_{i,c,t} \quad (3)$$

The main purpose of this model is to evaluate whether the individual ADR's liquidity co-moves with its market liquidity in the host market.

The second model tested for the firm-by-firm level extends Equation (3) by including the concurrent ADR_j corresponding home market liquidity of country c, ($DL^{hs}_{m,c,t}$), along with its lead ($DL^{hs}_{m,c,t+1}$) and lagged ($DL^{hs}_{m,c,t-1}$) for ADR i in country c. The complete model is as follows:

$$DL^{adr}_{i,c,t} = \alpha_{i,c,t} + \beta_1 DL^{adr}_{m,c,t} + \beta_2 DL^{adr}_{m,c,t+1} + \beta_3 DL^{adr}_{m,c,t-1} + \beta_4 DL^{hs}_{m,c,t} + \beta_5 DL^{hs}_{m,c,t+1} + \beta_6 DL^{hs}_{m,c,t-1} + \varepsilon_{i,c,t} \quad (4)$$

The main purpose of this model is to evaluate whether individual ADR's liquidity co-moves with its market liquidity (*there*) of the host market (the US) as well as its market liquidity of the corresponding home shares (*here*).

In the second stage of analysis, we expand the analysis to the country level. The first model we test is as follows:

$$DL^{adr}_{c,t} = \alpha_{f,t} + \beta_1 DL^{adr}_{m,t} + \beta_2 DL^{adr}_{m,t+1} + \beta_3 DL^{adr}_{m,t-1} + \varepsilon_{c,t} \quad (5)$$

where the weighted average of monthly percentage changes in liquidity ($DL^{adr}_{c,t}$) from all ADR in country c in month t is regressed on the monthly percentage changes in the equally weighted average of all countries' concurrent market liquidity ($DL^{adr}_{m,t}$), lead market liquidity ($DL^{adr}_{m,t+1}$), and lagged market liquidity ($DL^{adr}_{m,t-1}$). The second model isolates the impact of ADR's corresponding home shares market liquidity as follows:

$$DL^{adr}_{c,t} = \alpha_{c,t} + \beta_1 DL^{adr}_{m,t} + \beta_2 DL^{adr}_{m,t+1} + \beta_3 DL^{adr}_{m,t-1} + \beta_4 DL^{hs}_{m,t} + \beta_5 DL^{hs}_{m,t+1} + \beta_6 DL^{hs}_{m,t-1} + \varepsilon_{c,t} \quad (6)$$

where the weighted average monthly percentage changes in liquidity ($DL^{adr}_{c,t}$) from all ADR in country c on month t is regressed on the monthly percentage changes in

equally weighted average of developed market concurrent liquidity ($DL^{adr}_{dm,t}$), lead developed market liquidity ($DL^{adr}_{m,t+1}$) and lagged developed market liquidity ($DL^{adr}_{m,t-1}$).

Lastly, the models are modified in order to evaluate the commonality at the regional level. The first model tested is as follows:

$$DL^{adr}_{em,t} = \alpha_{em,t} + \beta_1 DL^{adr}_{dm,t} + \beta_2 DL^{adr}_{dm,t+1} + \beta_3 DL^{adr}_{dm,t-1} + \varepsilon_{em,t} \quad (7)$$

where the weighted average monthly percentage changes in liquidity ($DL^{adr}_{em,t}$) from all ADR in emerging market (*em*) in month *t* is regressed on the monthly percentage changes in the equally weighted average of the developed market (*dm*) concurrent liquidity ($DL^{adr}_{dm,t}$), lead developed market liquidity ($DL^{adr}_{m,t+1}$) and lagged developed market liquidity ($DL^{adr}_{m,t-1}$).

In the next model, the influence of the home shares liquidity of developed markets (*dm*) on the emerging markets (*em*) liquidity by extending the previous first model with the concurrent home share developed market liquidity ($DL^{hs}_{dm,t}$), lead market liquidity ($DL^{hs}_{dm,t+1}$), and lagged home share market liquidity ($DL^{hs}_{dm,t-1}$) is considered. The complete model is as follows:

$$DL^{adr}_{em,t} = \alpha_{em,t} + \beta_1 DL^{adr}_{dm,t} + \beta_2 DL^{adr}_{dm,t+1} + \beta_3 DL^{adr}_{dm,t-1} + \beta_4 DL^{hs}_{dm,t} + \beta_5 DL^{hs}_{dm,t+1} + \beta_6 DL^{hs}_{dm,t-1} + \varepsilon_{em,t} \quad (8)$$

A robustness test is conducted to validate the analysis of liquidity commonality, based on the sub-period estimations and to examine how the crisis period affects liquidity commonality. Firm level analysis for 4 sub-periods is performed which is constructed based on the global economic and financial crisis timeline reported by several sources such as the US Federal Reserve Board (FRB) Report, Business Report from the Guardian, Wharton, The Lauder Institute Wharton Arts and Science, and Federal Reserve Bank of St. Louis. These four periods are: (i) January 2000 to July 2003, (ii) August 2003 to January 2007, (iii) February 2007 to March 2011, and (iv) April 2011 to January 2015. The main intention is to show whether commonality in liquidity of ADR is greater or less during the period of financial crisis.

RESULTS AND DISCUSSIONS

This section discusses the empirical results regarding commonality in liquidity of Asia Pacific ADR.

Liquidity Features of ADR

In Table 1, the ADR's average monthly illiquidity (L) is presented while in Table 2 the monthly Difference in Illiquidity (DL) measure is described.

The average illiquidity ADR of the emerging market is higher than that of the developed market which means that emerging market is still less attractive. The illiquidity of Malaysia's ADR is the highest among the countries while Taiwan's is the lowest. Meanwhile, for the home shares, a lower illiquidity ratio in contrast to ADR is seen. On average, the emerging markets have the lowest illiquidity than the developed ones. However, this study shows Amihud's Illiquidity measure in certain countries (Hong Kong, Japan, China, Korea, and Taiwan) is not free from the unit root problem and the first order autocorrelation or ρ(-1) is significant. Thus, stationarity issue becomes a major consideration for using the illiquidity ratio as the main measurement in investigating the commonality.

Table 1
Summary statistics of Amihud's Illiquidity (l) measures

Market	ADR					Home Shares				
	Mean	Med	Std. Dev	ADF	ρ(-1)	Mean	Med	Std. Dev	ADF	ρ(-1)
Developed markets										
Australia	0.004	0.002	0.011	-6.172	-0.531	0.000	0.000	0.000	-4.684	-0.313
Hong Kong	0.003	0.001	0.005	0.930	0.260*	0.000	0.000	0.000	-11.133	-0.821
Japan	0.003	0.002	0.003	-0.893	-0.070	0.000	0.000	0.000	-4.228	-0.286
New Zealand	0.005	0.000	0.028	3.519	1.184	0.000	0.000	0.000	-13.651	-1.023
Singapore	0.004	0.002	0.010	-5.442	-0.320*	0.000	0.000	0.000	-5.500	-0.430
Mean	0.003	0.001	0.012	-1.612	0.105	0.000	0.000	0.000	-7.840	-0.575
Emerging markets										
China	0.003	0.000	0.007	1.216	0.091*	0.000	0.000	0.000	-5.304	-0.336
India	0.000	0.000	0.000	-4.952	-0.359	0.000	0.000	0.000	-13.199	-0.989
Indonesia	0.003	0.000	0.005	4.571	0.269	0.000	0.000	0.000	-3.748	-0.476
South Korea	0.000	0.000	0.002	-0.777	-0.242*	0.000	0.000	0.000	-6.299	-0.364
Malaysia	0.011	0.001	0.072	2.160	1.708	0.000	0.000	0.000	-6.930	-0.425
Philippines	0.005	0.000	0.015	3.210	0.517	0.000	0.000	0.000	-6.650	-0.399
Thailand	0.009	0.002	0.037	3.736	3.413	0.000	0.000	0.000	-9.141	-0.637
Taiwan	0.000	0.000	0.000	-2.325	-0.193*	0.000	0.000	0.000	-7.630	-0.392
Mean	0.004	0.000	0.017	0.855	0.651	0.000	0.000	0.000	-7.363	-0.502

Note: (*) on ρ(-1) indicates significant at the 5% level

In Table 2, on average the emerging market ADR has a higher value than the developed markets' ADR as shown in Table 1. Taiwan's ADR is reported to show the highest value of DL, while Philippines's ADR is the lowest. Regarding the stationarity issue, it is evident that in all series, both ADR and its corresponding home shares are free from unit roots. Therefore, we use the DL measure result to perform the commonality test in the next stage.

Table 2
Summary statistics of Difference in Illiquidity (dl) measures

Market	ADR					Home Shares				
	Mean	Med	Std. Dev	ADF	ρ(-1)	Mean	Med	Std. Dev	ADF	ρ(-1)
Developed markets										
Australia	2.238	0.137	2.677	-3.583	-0.376	1.921	1.528	1.569	-11.616	-0.860
Hong Kong	2.977	0.115	6.048	7.745	0.435	1.219	0.915	2.282	-13.421	-1.006
Japan	3.426	-0.370	11.142	-12.662	-0.948	0.923	0.903	0.288	-5.731	-0.496
New Zealand	2.180	0.033	14.324	4.732	2.707	2.316	1.570	3.047	-12.514	-0.496
Singapore	2.605	-0.078	6.509	-11.427	-0.886	0.630	0.542	0.401	-10.640	-0.778
Mean	2.685	-0.033	8.140	-13.066	0.186	1.402	1.093	1.516	-10.784	-0.727
Emerging markets										
China	3.595	0.100	13.391	-13.066	-0.980	0.712	0.769	0.444	-12.013	-0.0903
India	3.471	0.063	3.962	-8.578	-0.583	2.953	2.236	2.891	-12.791	-0.958
Indonesia	2.732	0.031	7.789	7.776	0.532	0.854	0.576	1.047	-12.965	-0.971
South Korea	2.999	0.310	9.992	-11.403	-0.844	0.785	0.715	0.376	-7.8024	-0.729
Malaysia	3.287	-0.092	13.842	-10.617	-0.960	0.729	0.296	2.181	-8.292	-0.557
Philippines	1.458	0.019	6.911	-11.835	-0.883	1.982	1.014	3.668	-12.523	-0.937
Thailand	2.933	-0.024	18.753	4.590	3.103	3.340	2.318	4.156	-11.131	-0.820
Taiwan	4.247	0.065	16.146	-13.379	-1.002	1.003	0.725	1.607	-9.266	-0.913
Mean	3.090	0.059	11.348	-7.0637	-0.202	1.545	1.081	2.046	-10.848	-0.747

Note: (*) on ρ(-1) indicates significant at the 5% level

Firm-by-Firm Commonality in Liquidity

In order to test the commonality in liquidity at the firm level, a regression test based on the market model as described in Equations (3) and (4) are run. The complete results are shown in Table 3 Panel A (Equation (3)) and Panel B (Equation (4)).

Table 3
Firm-by-Firm commonality results

	Panel A: Concurrent ADR Liquidity							Panel B: Concurrent Home Shares Liquidity						
Market	Mean	t-stats	R^2 (%)	% (+)	% (+) Sig.	SUM	p-value SUM-Med Sign Test	Mean	t-stats	R^2 (%)	% (+)	% (+) Sig.	SUM	p-value SUM-Med Sign Tes
Developed markets														
Australia	0.323	3.328*	7.35	82.86	40.00	0.606	0.000	0.173	0.962	9.05	57.14	8.57	0.559	0.000
Hong Kong	0.382	2.952*	13.65	87.67	41.10	0.094	0.000	0.000	-0.0124	16.38	69.86	6.85	0.297	0.000
Japan	0.273	2.519*	8.52	90.72	26.80	0.0909	0.000	0.000	0.033	10.17	48.45	3.09	0.093	0.000
New Zealand	0.353	1.984	24.14	100.00	11.11	-0.015	0.019	-0.024	-2.441*	24.98	22.22	0.00	0.072	0.016
Singapore	0.286	7.326*	11.27	100.00	80.95	0.095	0.000	0.000	-0.165	12.23	47.62	0.00	0.286	0.000
Mean	0.323	3.622	12.98	92.25	39.99	0.174	-	0.030	0.204	14.56	49.06	3.70	0.261	0.003
Emerging markets														
China	0.080	2.999*	3.48	88.00	40.00	0.380	0.000	0.000	0.059	7.79	78.00	6.00	0.060	0.000
India	0.444	4.151*	18.56	100.00	66.67	0.259	0.090	0.000	0.185	19.14	22.00	0.00	0.222	0.254
Indonesia	0.271	2.863*	20.51	100.00	50.00	-0.062	0.000	0.120	1.079	21.75	55.00	10.00	0.203	0.000
South Korea	0.500	1.972*	35.14	90.00	40.00	0.167	0.055	0.000	0.150	36.66	50.00	0.00	0.067	0.172
Malaysia	0.333	1.414	36.08	100.00	66.67	0.111	0.016	0.000	-1.335	36.61	50.00	0.00	0.110	0.015
Philippines	0.214	1.584	17.95	92.86	78.57	0.071	0.000	0.000	0.033	18.35	7.14	0.00	0.071	0.001
Thailand	0.054	1.264	16.79	89.47	10.53	0.638	0.000	-0.010	-1.677	24.60	15.79	0.00	0.631	0.000
Taiwan	0.167	1.784	21.83	83.33	33.33	0.056	0.109	0.000	-3.027*	23.78	16.67	0.00	0.056	0.109
Mean	0.288	2.254	21.29	92.86	48.22	0.203	-	0.014	-0.215	23.59	36.83	2.00	0.178	0.069

Note: Firm-by-firm (371) time series regressions of DL measure are estimated using Equation (3) & (4) with the 5% level of significance. (*) indicates that the t-stat is significant at the 5% level of significance

It is evident that commonality in liquidity of ADR exists for both developed and emerging markets in the Asia Pacific as indicated by the extremely high positive and significant coefficient of concurrent ADR market liquidity (β_1) in Panel A (see Table 3). Singapore, the Philippines, Malaysia, and India have the highest coefficients. Further results on SUM (the sum of coefficients β_1, β_2, and β_3), suggest strong evidence of liquidity in commonality in ADR with the exception of India, South Korea, and Taiwan. However, the *one sample t-test* of β_1 shows significant results mostly for ADR from developed markets including Australia, Hong Kong, Japan, and Singapore, while for emerging market only for China, India, Indonesia and South Korea. In terms of magnitude of commonality, on average, R^2 of the emerging market ADR is almost two times greater than the R^2 of developed markets which confirms the findings of Karolyi, Lee and Van Dijk (2012). China has the lowest R^2 value which is in contrast to the findings of Karolyi, Lee and Van Dijk (2012). The reason could be the use of normal individual stocks in their study.

In addition to the concurrent ADR market liquidity, it is interesting to note the impact of concurrent market liquidity of home shares on the co-movement of ADR, as indicated by coefficient β_4 in Panel B (see Table 3). However, the concurrent market liquidity of the corresponding home shares does not contribute a substantial impact on the co-movement of ADR. The number of positive and significant coefficients of β_4 are very small, both for developed and emerging markets. In terms of magnitude, China has the lowest contribution. Overall, it can be seen the commonality of emerging market's ADR exceeds that of the developed market as described earlier. However, these results suggest that the home shares market liquidity, or '*here*', is not an important factor affecting the co-movement in ADR liquidity.

Country-by-Country Commonality in Liquidity

In the next analysis, the country level is examined and for this purpose, two main groups of variables are proposed as explained in Equation (5) and (6); they are labelled as *Country ADR Liquidity Variables*, and *Country Home Shares Liquidity Variables*. In Panel A in Table 4, only a weak sign of commonality in liquidity is observed since none of the β1 coefficient is significant at the 5% level. Similar to the firm level, on average, the developed markets' coefficients are higher than the emerging market. However, the countries that have positive and significant coeffcients is only 7.69% for both groups. In terms of magnitude, the average R^2 of the developed market is also higher than that of the emerging market, and the *SUM-Med Sign Test* is also rejected for each market confirming the existence of liquidity co-movement, although at a weak level.

Table 4
Country-by-country commonality results

Market		Average	t-stats	R^2 (%)	% (+)	% (+) Sig.	SUM	p-value SUM-Med Sign Test
Panel A	Country ADR Liquidity Variables							
Developed markets	β_1	0.346	0.885	24.72	23.08	7.69	1.010	0.000
Emerging markets	β_1	0.086	0.398	12.65	23.08	7.69	0.886	0.000
Mean		0.216	0.642	18.69	23.08	7.69	0.890	-
Panel B	Country ADR and Country Home Shares Liquidity Variables							
Developed markets	β_1	0.346	0.890	26.24	38.46	7.69	1.260	0.000
	β_4	0.283	1.147		38.46	0.00		
Emerging markets	β_1	0.083	0.386	13.54	61.54	7.69	0.737	0.000
	β_4	0.103	0.273		61.54	0.00		
Mean	β_1	0.215	0.638	19.89	50.00	7.69	0.898	-
	β_4	0.193	0.710		50.00	0.00		

Note: Country-by-country (13) time series regressions of average DL measure of one country's ADR is estimated using Equation (5) and (6) with a 5% level of significance. (*) indicates that the t-stat is significant at the 5% level of significance

Panels A and B have similar patterns, which indicate the co-movement of the ADR' liquidity across countries is evident although at a weak level. None of the coefficients from the market liquidity of the country's corresponding home shares is significant at the 5% level although it has a positive sign. In line with these findings, the number of positive and significant β_4 is also equal to zero for both the developed and emerging markets. This result suggests that the co-movement of ADR liquidity in one country is not induced by the market liquidity of another country's ADR. In other words, the liquidity performance of other countries' ADR may not be considered important for investors to invest in one specific country's ADR.

Region-by-Region Commonality in Liquidity

Expanding the investigation of commonality in liquidity to regional level has been discussed by Brockman, Chung and Perignon (2009). The focus of the present study is to test whether the liquidity changes of ADR in one region has a substantial impact on the ADR in other regions. In this study, it is assumed the emerging market would follow the developed market's liquidity movement.

Table 5
Region-by-Region commonality in liquidity results

Variable	Eq.	β_1	β_2	β_3	β_4	β_5	β_6	R^2
ADR of developed market	(7)	1.023	-0.001	-0.038	-	-	-	39.18
		[7.835] **	[-0.114]	[-4.545] **	-	-	-	
Home shares of the developed market	(8)	1.023	0.000	-0.039	-0.016	-0.030	-0.057	39.19
		[6.966] **	[0.020]	[-4.559] **	[-0.370]	[-0.692]	[-1.303]	

Note: Region-by-region time series regressions of DL measure are estimated using Equation (7) and (8). (*) indicates that the t-stat is significant at the 5% level of significance, an (**) indicates that the t-stat is significant at 1% level of significance

The results in Table 5 show that for both equations, the coefficient of β_1 or the concurrent variable is positive and significant at the 1% level. Those results confirm earlier prediction that ADR's developed market influences that of the emerging market. In other words, there is liquidity co-movement among regions. Beyond the firm level and the country level, commonality in liquidity of ADR also exists at the regional level. Interestingly, it is also an indication that not only does the concurrent coefficient of ADR liquidity from the developed market affects the liquidity of ADR emerging market, but also the coefficients of β_3, or the lead variable, that have a significant negative impact on emerging market ADR liquidity.

The Impact of Crisis on Commonality of ADR

The robustness of this study's analysis is shown in Table 6.

The results indicate that the magnitude of liquidity in commonality of ADR, R^2, varies along the upward and downward trend in the market movement. In Sub-Period 1, on average the magnitude of co-movement in the ADR's liquidity is higher for the emerging market than for the developed market. During this period, South Korea, Thailand, India and Indonesia show the highest liquidity commonality. In Sub-Period 2, the highest level of commonality remains the same for these five countries. However, in Sub-Period 3, or during the Global and Financial Crisis period, Thailand indicates the weakest level of commonality compared with all other countries. In the Sub-Period 4, or the last period of observations, Japan shows the smallest magnitude of commonality among all other countries' ADR. Although commonality in liquidity of ADR is persistent across all samples in all sub-periods, the global and financial crisis responded differently among the emerging and developed markets. The emerging markets are more vulnerable to crisis but developed markets seems to be more prepared to respond the crisis. Despite the high level of co-movement, the emerging markets' R^2 tend to decrease in all periods of estimations. In contrast, the commonality of the developed markets' ADR tends to be more stable and increased for the overall period.

Table 6
Commonality in liquidity during the crisis and non-crisis sub-period estimations

Periods	Sub-Period 1	Sub-Period 2	Sub-Period 3	Sub-Period 4
	The Dot.com Bubble (Jan 2000 –July 2003)	Bull Market 1 (Aug 2003 –Jan 2007)	Global Financial Crisis (Feb 2007 – March 2011)	Post Crisis Recovery (April 2011 –Jan 2015)
	43 observations R^2 (%)	42 observations R^2 (%)	50 observations R^2 (%)	46 observations R^2 (%)
Developed markets				
Australia	14.41	8.45	15.43	7.75
Hong Kong	7.54	7.72	8.04	13.20
Japan	19.35	17.59	15.51	9.00
New Zealand	-	-	-	23.78
Singapore	8.27	16.66	10.25	13.76
Mean	12.39	12.60	12.31	13.50
Emerging markets				
China	20.56	9.68	25.52	14.34
India	35.40	28.05	31.60	14.59
Indonesia	35.38	38.97	31.60	14.98
South Korea	61.81	50.07	43.82	35.14
Malaysia	-	-	-	33.59
Philippines	-	-	-	12.06
Thailand	36.85	24.80	1.89	15.93
Taiwan	27.69	17.58	17.56	21.47
Mean	36.28	28.19	25.33	20.26

Note: Firm by firm time series regressions of DL measure are estimated using Equation (3) with a 5% level of significance

DISCUSSION

This study shows commonality in liquidity for ADR in the Asia Pacific region, hence, the hypothesis is supported. At the firm level, individual ADR liquidity is affected by the market liquidity of all other ADR that is issued from the same country. In particular, liquidity co-movement across individual ADR is higher for the emerging market issuer compared with the developed market. This suggests that if the liquidity of ADR is treated as a risk factor, then liquidity of ADR from the emerging market is more difficult to diversify, which in turn results in higher compensation for investors to accept this risk. This also highlights the important implications for investors in constructing their portfolio choice. They may need to consider choosing ADR from developed markets to be within their portfolio if they want to hedge from higher risks. In addition, we highlight that '*there*' is more important than '*here*,' or that investors should pay

attention to the host market's or the US market's liquidity impact rather than the home shares' market liquidity.

Thus, investors should construct their portfolio choice as suggested by the result from the country level commonality. Since the liquidity ADR of one country in the Asia Pacific is not affected by market liquidity co-movement of other Asia-Pacific countries, they may choose to construct their portfolio by including ADR from all market in their portfolio. In addition, the developed market ADR is preferable due to their liquidity risk.

At the regional level, the lead coefficients of the ADR's developed market have a negative impact on the emerging market's ADR liquidity. One plausible explanation is that it might be a sign of investors' response to shocks while investing in ADR. It is suggested that investors who decided to invest in the emerging market ADR are influenced by the decision to invest in the developed market ADR or the contemporaneous coefficients (t). This decision is further influenced by the lead coefficients ($t+1$), which induce a negative impact on the liquidity of ADR in the emerging market. The negative and significant price impact would influence investors' decision to hold their assets (emerging markets' ADR) and reconsider their position to migrate into the ADR of the developed market. For investors, this may be a leverage factor when considering ADR of emerging markets as part of their portfolios. Information on the home country performance would be an important factor for investors. Other explanation is the type of investors in the US market (Kamara, Lou, & Sadka, 2008) or the existence of institutional or foreign investors (Karolyi, Lee, & Van Dijk, 2012). Future research should look into what causes this phenomenon as well as other impacts of ADR's liquidity. This study has also highlighted the impact of crisis on commonality in liquidity of ADR for both emerging and developed markets. While previous studies (Hameed, Kang, & Viswanathan, 2010; Karolyi, Lee, & Van Dijk, 2012; Naes, Skjeltorp, & Odegaard, 2011) found that commonality in liquidity increases in periods of high market volatility and during times of large market declines, this study showed for the developed market's ADR, commonality in liquidity tended to be stable, while for emerging markets, it tended to decrease during crisis. This difference may be attributed to the behaviour of institutional investors and shifts in investor sentiment. High investor sentiment in the US market will result in lower commonality in liquidity of ADR listed there (Karolyi, Lee, & Van Dijk, 2012). However, has to be evaluated further as it is beyond the scope of this research.

CONCLUSION

This study has looked at the extent to which the liquidity of Asia Pacific's ADR co-moves with other ADRs in the same market. It showed a significantly higher commonality in liquidity of emerging markets' ADR. Thus, individual ADR liquidity is affected by the liquidity of the host market (the US market) rather than by the liquidity of the home shares market. The finding was

consistent with those of earlier in which liquidity commonality at the firm level is positively related to the level of market development and affected by the crisis period, although at the country level the evidence is slightly weaker. These findings boost the idea that ADR could serve as an important channel through which liquidity is transmitted across border. International cross-listing was proven to affect the liquidity co-movement between ADR and the home markets as well as between ADR and their host market. These results are of interest to both investors and regulators of Asia-Pacific countries. For investors, understanding how ADR reacts to market liquidity will help them to make decisions regarding liquidity exposure and improve trading strategies. For regulators, prevention of crisis due to liquidity shocks is also important. However, this study only focused on the liquidity property at the mean level, while future study is encouraged to elaborate further on the liquidity measurement at various levels. In addition, results of the commonality in liquidity at the regional level was supported by previous studies (Karolyi, Lee, & Van Dijk, 2012; Min & Qin, 2015) which assumed that emerging markets will be affected by developed markets. The complete profile of directions of commonality can be assessed by testing the reverse relationship, which is strongly suggested for future study. The pricing mechanism of ADR liquidity should also be investigated further by developing the liquidity asset pricing model (LCAPM) as proposed in Acharya and Pedersen (2005); Lee (2011).

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