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Stock market integration in the Asia-Pacific region: Evidence from cointegration of liquidity risk

Wahyoe Soedarmono
Sampoerna University, Faculty of Business, Department of Management, Jakarta, Indonesia

Abstract

This paper investigates the progress of financial integration in the Asia-Pacific region. Using a stock market liquidity measure and cointegration technique, we show that Asia-Pacific stock markets are not fully segmented in terms of liquidity risk and hence, stock market integration is feasible. Moreover, we find that the number of cointegrating vectors for different types of samples declines during the global financial crisis. This may indicate that the global financial crisis tempers the extent to which Asia-Pacific stock markets are integrated. Hence, the influence of financial crises should be considered by policy makers in designing stock market integration, while global investors can still benefit from diversifying portfolio investments in the Asia-Pacific region.

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Contact: Wahyoe Soedarmono - wahyoe.soedarmono@sampoernauniversity.ac.id.
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1. Introduction

In the aftermath of the 1997 Asian financial crisis, intraregional equity investments emerged in the Asia-Pacific region, although such trends are tempered during the global financial crisis (Kim et al., 2015). Yet, the Eurozone debt crisis, which is partly driven by the global financial crisis, has also cast doubts on the development of financial regionalism in East Asia (Volz, 2012). This paper revisits prior literature on the feasibility of stock market integration in the Asia-Pacific region by considering the influence of the global financial crisis. Unlike prior literature that assess the degree of stock market integration using comovement in stock returns, we assess the progress of integration among Asia-Pacific stock markets using comovement in stock market liquidity. Stock market liquidity has been a major concern in developed countries following the global financial crisis, because stock market liquidity evaporation contributes to prolonged financial markets turmoil due to increased investors' panic selling and liquidity constraints of financial intermediaries (e.g. Hameed et al., 2010; Brunnermeier and Pedersen, 2009).

With regards to the importance of financial integration, previous studies report that higher financial integration reduces financial shocks and foster economic development through various channels, such as efficient capital allocation, better risk management, and more transparent market frameworks (Yu et al., 2010, Umutlu et al., 2010). Higher stock market integration also decreases the cost of capital (Bekaert and Harvey, 2000; Henry, 2000), enlarges investment opportunities for global investors, and increases welfare gains from higher savings and growth (Errunza, 2001; Bekaert and Harvey, 2003). Stock market integration also invigorates real sector investments (Chari and Henry, 2008; Bekaert et al., 2001, 2005, and 2011). However, stronger financial linkages may potentially increase the probability of cross-border contagion risk transmission (Beine et al., 2010). Against this backdrop, measuring the progress of stock market integration is of particular importance for financial stability as a whole.

In principle, stock market integration is affected by structural changes. Phylaktis and Ravazzolo (2002) and Carrieri et al. (2007) document that relaxation of foreign capital controls, reduction in foreign investment barriers, and emergence of country funds have contributed to the development of financially integrated markets, particularly in the US equity market. In the Asian context, several regional initiatives, including Chiang Mai Initiatives and Asian Bond Markets Initiative, have indeed strengthened economic integration within the region (Institute of International Monetary Affairs, 2006; Yu et al., 2010).

Another strand of literature supports the view that there is a substantial integration between domestic and international financial markets in Asia-Pacific equity markets. For instance, Yang et al. (2003) show the existence of long-run and short-run relationships among stock markets in several Asian economies between 1995 and 2001. Several studies also highlight the feasibility of stock market integration in Asia (e.g. DeFusco et al., 1996; Masih and Masih, 1999; Manning, 2002; Arsyad, 2015). A similar study by Chiang et al. (2007) finds dynamic conditional correlations among Asian stock markets data between 1990 and 2003 and indicate the presence of contagion effects. Kim et al. (2006) report that capital markets in East Asia are relatively less integrated among themselves than with the global capital markets. Lee (2008) also highlights that there is only limited degree of financial market integration in Asia.

In this study, we use a novel approach to gauge the progress of integration in Asia Pacific markets using a stock market liquidity measure instead of stock market returns. Concomitantly, we build on the work of Click and Plummer (2005) and investigate the comovement of aggregate stock market liquidity in a multivariate VAR (*vector auto regression*) framework.

The remainder of this paper is organized as the following. Section 2 documents prior literature on stock market integration and liquidity. Section 3 describes our data and methodology, while the empirical results are reported and discussed in Section 4. Section 5 concludes this paper.

2. Related literature review

Because of its implication to financial stability, stock market integration is subject to considerable debate amongst policy makers, investment practitioners, and academics. Prior literature examines the feasibility of stock market integration using various methods and sample coverage. For instance, Brooks and Del Negro (2004) and Lin et al., (1994) use correlation coefficients to measure stock market comovement as a proxy of stock market integration. Rua and Nunes (2009) measure integration among developed stock markets using wavelet analysis. Other studies measure stock market integration using multivariate cointegration of stock market returns (e.g. Kasa, 1992; Richards, 1995; Click and Plummer; 2005; Corhay et al., 1993; Chung and Liu, 1994).

While considering stock market returns comovement is relevant to assess the degree of financial integration, the importance of stock market liquidity in financial markets has also received wide attention since the late 1980s, when literature on market microstructure started to emerge. Prior literature documents that illiquid stocks have a higher risk premium than liquid stocks and hence, liquidity can largely affect investments decision and asset prices (e.g. Amihud and Mendelson, 1980, 1986a, 1986b; Amihud, 2002). In addition, stock market liquidity may have a direct effect on firm performance (Edmans, 2009; Admati and Pfleiderer, 2009; Subrahmanyam and Titman, 2001, Khanna and Sonti, 2004). Recent changes that affect stock market development, such as online trading, high frequency trading, globalization and integration of equity markets, and exchange-traded funds, suggest that studies on stock market liquidity are relevant and essential for well-functioning financial markets.

Likewise, the global financial crisis has also marked that stock market liquidity is an important dimension of financial system stability. Brunnermeier (2009) shows that a decline in stock market liquidity may trigger large fall of asset prices that cannot be explained by the stocks' fundamental value. The downward spiral of asset prices during financial crisis can further be aggravated by fire sales, deleveraging to conform to margin calls and greater haircuts (Gorton and Metrick, 2009). In turn, such feedback mechanisms due to stock market liquidity evaporation may adversely affect financial system stability (Pedersen, 2009). However, stock market liquidity comovement has not been considered yet in prior literature on stock market integration. This present paper attempts to fill this gap.

3. Data and methodology

We use daily stock market data obtained from Thomson-Reuters Datastream International to measure stock market liquidity. We include data from nine Asia-Pacific countries, including Hong Kong, Japan, South Korea, China, and ASEAN-5 countries (Indonesia, Malaysia, Singapore, Thailand, Philippines). Moreover, we also include the United States, to take into account the influence of global environments on Asia Pacific equity markets.

For all countries, our sample ranges from January 3, 2000 to December 31, 2012. We measure stock market liquidity using the price impact proxy of Amihud (2002), as follows:

$$AMI \equiv -\log\left(\frac{|R_{i,d}|}{P_{i,d}VO_{i,d}}\right) \quad (1)$$

$R_{i,d}$ is firm i's stock return on day d, $P_{i,d}$ is firm i's stock price on day d, and $VO_{i,d}$ is the trading volume of stock i on day d. All data are measured in US dollars. In order to obtain the degree of stock market liquidity at the country level on day d, we compute the average value of AMI of all stocks within each country. Table 1 provides the list of countries used in this study and the number of stocks included for each country.

Table 1. Sample

No	Country	Number of stocks
1	Malaysia	818
2	The Philippines	252
3	Singapore	594
4	Indonesia	466
5	Thailand	610
6	Hong Kong	406
7	South Korea	763
8	China	928
9	Japan	406
10	United States	500

In terms of econometric methodology, this study uses a cointegration analysis to test whether Asia-Pacific equity markets have the characteristics of an integrated market in the long run. A cointegration analysis derived from VAR (*vector auto regression*) analysis is suitable to gauge dynamic linkages among various markets and hence, long-run equilibrium among stock markets can be identified (Huyghebaert, 2010; Click and Plummer, 2005).

We conduct a cointegration analysis in several stages. Specifically, we consider various types of samples (e.g. all countries; the sample excluding the US and Japan; and ASEAN-5 countries, such as Indonesia, Malaysia, Singapore, the Philippines and Thailand). In the next turn, we conduct a cointegration analysis for the whole period (2000-2012), as well as during the global financial crisis from 2007 through 2009.

4. Empirical results

Initially, the equally-weighted average of AMI for each country needs to be verified to see whether the ten series are nonstationary, or contain a unit root, before performing cointegration tests. Because all series of AMI at the country level are already stationary as in Table 2, we can proceed with cointegration tests without performing the first-order difference transformation on our data series when we conduct VAR estimation.

Table 2. Unit root tests. *** indicates significance at the 1% level, while ** and * indicate significance at the 5% and 10% levels, respectively. The null hypothesis describes that data has a unit root, suggesting that data is non-stationary.

No	Amihud Liquidity Measure (AMI)	Augmented Dicky-Fuller test statistic
1	Malaysia	-1.718*
2	The Philippines	-2.941***
3	Singapore	-1.896*
4	Indonesia	-2.570***
5	Thailand	-2.501**
6	Hong Kong	-3.799***
7	South Korea	-4.318***
8	China	-12.005***
9	Japan	-5.541***
10	United States	-1.983**

Table 3 shows cointegration results for all countries in the sample (Panel A), the sample without the US and Japan (Panel B), and ASEAN-5 sample (Panel C). In order to identify the number of cointegrating vectors, we use the Trace and Max-Eigen statistics. The Trace statistics tests the null hypothesis stating that the number of cointegrating vectors does not exceed *r*, while the Max-Eigen statistic tests the null hypothesis whether the number of cointegrating vectors equals to *r*.

In Table 3 (Panel A), several statistical criteria are used to select the optimum lag length of the VAR model and suggest that using five lags is appropriate for the sample consisting of all countries considered in this study. Meanwhile, the Trace and Max-Eigen statistics reveal that Asia-Pacific stock markets are cointegrated in terms of liquidity risk, and there are four cointegrating vectors. Moreover, Panel B (Table 3) indicates that using five lags is also appropriate in the VAR model excluding US and Japan stock markets. The Trace statistic and Max-Eigen statistics further report that Asia-Pacific stock markets, excluding US and Japan, are also cointegrated with six cointegrating vectors. Finally, Panel C (Table 3) reports that that using eight lags is appropriate in the VAR model for ASEAN-5. The Trace and Max-Eigen statistics suggest that ASEAN-5 stock markets are also cointegrated in terms of liquidity risk with three cointegrating vectors.

In parallel, Table 4 shows cointegration resuts during the global financial crisis from 2007 through 2009 for all countries in the sample (Panel A), the sample excluding the US and Japan (Panel B), and the sample consisting of ASEAN-5 countries (Panel C). Panel A (Table 4) suggests that choosing five lags is appropriate in the VAR model during the global financial crisis. The Trace and Max-Eigen statistics reveal that Asia-Pacific stock market liquidity risks are cointegrated with three cointegrating relationships. Yet, Panel B in Table 4 suggests that choosing five lags is appropriate in the VAR model without US and Japan stock markets. Meanwhile, the Trace and Max-eigen statistics highlight that Asia-Pacific stock markets are cointegrated with four cointegrating vectors, although US and Japan are excluded from the sample. Eventually, Panel C (Table 4) documents that selecting nine lags is appropriate in the VAR model for ASEAN-5 stock markets. The Trace statistic and Max-eigen statitistic reveal that ASEAN-5 stock markets are also cointegrated in terms of liquidity risk with one cointegrating vector.

Overall, we can compare the empirical results presented in Table 3 and Table 4. Specifically, during the global financial crisis, it is clearly shown that the number of cointegrating vectors for different types of samples declines. This suggests that the global financial crisis tempers the extent to which Asia-Pacific stock markets are integrated. One of the possible reasons is that during the global financial crisis, there is a substantial decline in the intraregional share in equity investments in the Asia-Pacific region as described in Kim et al. (2015).

Table 3. Cointegration results during the 2000-2012 period. *** indicates significance at the 1% level, while ** and * indicate significance at the 5% and 10% levels, respectively.

Model	Optimum lag length of VAR	Deterministic trend assumption			Null hypothesis	Trace Stat.	Max-Eigen Stat.	Number of cointegrating vectors
		Data trend	Intercept	Trend				
Panel A. All samples	5	No	Yes	No	r=0	428.1423***	118.2190***	4
					r ≤ 1	309.9234***	106.3690***	
					r ≤ 2	203.5543***	68.24659***	
					r ≤ 3	135.3077**	49.63729**	
					r ≤ 4	85.67043	36.06002	
					r ≤ 5	49.61042	22.65748	
					r ≤ 6	26.95294	13.22995	
					r ≤ 7	13.72299	7.308259	
					r ≤ 8	6.414733	6.380213	
					r ≤ 9	0.034520	0.034520	
Panel B. Excluding US and Japan's stock markets	5	No	No	No	r=0	456.5617***	137.1331***	6
					r ≤ 1	319.4286***	116.7569***	
					r ≤ 2	202.6717***	76.98022***	
					r ≤ 3	125.6915***	54.86332***	
					r ≤ 4	70.82813***	39.43139***	
					r ≤ 5	31.39674***	23.90453***	
					r ≤ 6	7.492206	6.035630	
					r ≤ 7	1.456576	1.456576	
Panel C. ASEAN-5 stock markets	8	No	No	No	r=0	129.9461***	67.60264***	3
					r ≤ 1	62.34343***	37.44003***	
					r ≤ 2	24.90341**	17.37199*	
					r ≤ 3	7.531418	7.140413	
					r ≤ 4	0.391006	0.391006	

Table 4. Cointegration results during the 2007-2009 period. *** indicates significance at the 1% level, while ** and * indicate significance at the 5% and 10% levels, respectively.

Model	Optimum lag length of VAR	Deterministic trend assumption			Null hypothesis	Trace Stat.	Max-Eigen Stat.	Number of cointegrating vectors
		Data trend	Intercept	Trend				
Panel A. All country sample	5	No	No	No	r=0	434.2949***	167.3300***	3
					r ≤ 1	266.9649***	99.17769***	
					r ≤ 2	167.7872***	56.85812***	
					r ≤ 3	110.9290*	48.29019**	
					r ≤ 4	62.63886	35.91377	
					r ≤ 5	26.72508	15.10017	
					r ≤ 6	11.62491	7.097989	
					r ≤ 7	4.526921	3.285260	
					r ≤ 8	1.241661	1.200536	
					r ≤ 9	0.041125	0.041125	
Panel B. Excluding US and Japan's stock markets	5	No	No	No	r=0	259.0341***	88.84352***	4
					r ≤ 1	170.1905***	66.24848***	
					r ≤ 2	103.9421***	46.26817***	
					r ≤ 3	57.67389*	29.58834*	
					r ≤ 4	28.08555	17.96730	
					r ≤ 5	10.11825	7.360081	
					r ≤ 6	2.758170	2.756967	
					r ≤ 7	0.001203	0.001203	
Panel C. ASEAN-5 stock markets	9	No	Yes	No	r=0	104.0611***	68.91719***	1
					r ≤ 1	35.14391	24.63596	
					r ≤ 2	10.50795	5.882094	
					r ≤ 3	4.625859	3.723292	
					r ≤ 4	0.902567	0.902567	

5. Conclusion

This study is the first to assess the progress of financial integration in the Asia-Pacific region using a cointegration analysis of stock market liquidity risk. The empirical results document that Asia-Pacific stock markets are cointegrated over the 2002-2012 period, although several common trends remain. Such results are robust when we consider different types of samples. Hence, we may conclude that Asia Pacific stock markets are partially integrated. A closer investigation however suggests that during the global financial crisis, the number of cointegrating vectors declines for all types of samples. The global financial crisis therefore tempers the degree of stock market integration in the Asia-Pacific region.

These findings have implications for policy makers and investors. Although there are rooms for improvement to achieve the full integration of Asia-Pacific stock markets, the influence of financial crisis should be taken into account by policy makers in designing initiatives to enhance stock market integration, so as to avoid uncoordinated responses across Asia-Pacific countries during financial crisis. Our findings also suggest that global investors can still benefit from portfolio diversification within the Asia-Pacific region due to the fact that Asia-Pacific stock markets are not fully integrated. Such diversification benefits are more pronounced during crisis periods.

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