

**GLOBAL AND REGIONAL FINANCIAL INTEGRATION
IN EMERGING ASIA:
EVIDENCE FROM STOCK MARKETS**

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Revised, February 2021

Abstract

This paper investigates whether financial markets in emerging Asia have become more globally or regionally integrated since the Asian financial crisis in the late 1990s. It employs a price-based measure of integration, namely stock return differentials between ten emerging Asian economies and the US (as an indicator of global integration), as well as Japan and the Asian region (as two alternative indicators of regional integration), to test for mean reversion and draw inference on financial integration. It makes a three-fold contribution: it uses not only aggregate but also industry level data on stock returns; it examines the impact of the 2008 crisis; it adopts a more general fractional integration approach. The evidence suggests that in emerging Asia, at both the aggregate and industry (especially for the financial sector) level, there is more regional than global integration, and that the former has become even stronger in the post-2008 crisis period. Further, Japan's influence has been declining and the Chinese stock market has become more integrated, both regionally and globally.

Keywords: Global and regional integration, Asian stock markets, fractional integration, Global financial crisis

JEL classification: F31, C22

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1. Introduction

Since the 1997 Asian financial crisis and the information technology bubble at the turn of the century, Asian stock markets have rebounded strongly, peaked in November 2007, and then plunged by 41.9% (in US dollars) a year later at the onset of the 2008 global financial crisis (Figure 1). They again recovered at an astonishing speed and by 2016 accounted for nearly a quarter (23.2% in US dollars) of the capitalisation of global stock markets (World Federation of Exchange, 2016). The greater impact on the Asian stock markets of the 2008 global financial crisis originating from the US compared to the Asian 1997 (both in terms of the speed and the size of the decline in daily stock prices - see Hinojales and Park, 2011) raises the question whether Asian financial markets have become more globally than regionally integrated in the past two decades. Whilst financial integration generally has positive implications for the efficient allocation of capital (Pauer, 2005), promotes financial development and enhances economic growth (Fung et al., 2008), stronger financial linkages may also imply a higher risk of cross-border financial contagion with adverse consequences for financial stability and economic growth. For developing Asia, assessing and monitoring financial integration is of particular importance not only because of its great potential benefits given the fact that the outstanding stock to credit remains low compared with developed economies (Almekinders et al., 2015), but also because developing Asia is characterised by poor risk management and overexposure to cyclical economic activities (Almekinders et al., 2015; Schipke, 2015).

This paper aims to assess the extent of financial integration in developing Asia and to investigate whether it is of the global or of the regional type. It employs a price-based measure of integration, namely stock return differentials between ten emerging Asian economies and the US (as an indicator of global integration), as well as Japan and the Asian region (as two alternative indicators of regional integration), to test for mean reversion and draw inference on the extent of both global and regional financial integration. It makes a three-fold contribution

to the literature on stock market integration in emerging Asia. First, it uses not only aggregate but also industry level data on stock returns, hence providing information on the role of specific sectors in the process of financial integration (very few previous studies have analysed Asian stock market integration using industry level data - see Hinojales and Park, 2011).

Second, it examines the impact of the 2008 crisis on regional and global integration in Asian stock markets (both at the aggregate and industry level). Again, only a few other studies have addressed this issue. Wu et al. (2015) and Wang (2014) both use daily data at the aggregate level. The former focus on the transmission of shocks (contagion) from the US, Japan, and Hong Kong to other Asian countries and hence regional integration in East Asia stock markets is not considered, and neither is the evidence at the industry level.

Third, unlike previous studies using either correlation tests or vector autoregression (VAR) techniques,¹ it employs a fractional integration approach as in Gil-Alana (2000) and Caporale and Gil-Alana (2017). A fractional differencing parameter d below one in the return differentials does not necessarily imply mean reversion, which would indicate stock market integration: only values below zero represent evidence of integration, whilst values above zero imply long memory in the return differentials, i.e., no stock market integration. To our knowledge, fractional integration tests have not been carried out before in the case of the emerging Asian stock market returns, despite their advantages over conventional methods based on the classical $I(0) / I(1)$ dichotomy².

The layout of the paper is as follows. Section 2 briefly reviews the relevant literature. Section 3 outlines the methodology. Section 4 describes the data. Section 5 presents the empirical results. Section 6 offers some concluding remarks.

¹ Another strand of the literature on stock market integration examines volatility spillovers - see Sharma and Seth (2012) for an extensive review.

² Some recent examples of mean-reverting analysis on Asian stock prices using techniques other than conventional ADF unit root tests include Chen and Kim (2011), who employ nonlinear mean reversion tests, and Wang et al. (2015), who carry out a Lagrange Multiplier Fourier unit root test and a stationary test with a Fourier function.

2. Literature Review

Various indices have been employed in the existing literature to measure financial integration. Broadly speaking there are three types of measures: (1) price-based measures that are largely embodied in interest parity conditions in the money markets as well as in co-movements in assets returns in stock and bond markets; (2) volume-based measures that include the saving-investment correlations pioneered by Feldstein and Horioka (1980), consumption correlations (e.g., Bayoumi, 1997; de Brower, 1999) and capital flows (cross-border financial transactions) (Cavoli et. al., 2006); (3) measures based on regulatory or institutional factors, capital controls and legal restrictions such as those on foreign equity holdings (e.g., Grilli and Milesi-Ferretti, 1995; Magud and Reinhart, 2006).

In addition to those, Kearney and Lucey (2004) put forward a measure based on the concept of international capital market completeness (Stockman, 1988), and Baele et al. (2004) consider news-based measures that test whether returns on assets across countries are influenced by local or world-wide news as an indication of financial integration (see Baltzer et al., 2008) for a similar approach). More recently, within the price-based measures, Volosovych (2011, 2013) have suggested a price-based measure that is an integration index in the context of capital market integration obtained from a dynamic principal component analysis (see also Donadelli and Paradiso, 2014).

Our focus is on studies using price-based measures for the Asian stock markets, since these are most widely used for financial integration (Kearney and Lucey, 2004; Sharma and Seth, 2012). Typically, (time-varying) correlation analysis and VAR estimation (including Granger causality tests, variance decompositions, impulse responses and cointegration tests) are carried out on stock market returns. More recently, (time-varying) correlation analysis has been applied. For instance, Loh (2013) investigates co-movement between 13 Asia-Pacific

stock market returns using the wavelet coherence method for the period 2001M1-2012M3 and finds evidence of long-term co-movement between most of the Asia-Pacific stock markets as well as between them and both Europe and the US. Abid et al. (2014) test a conditional version of the International Capital Asset Pricing Model (ICAPM) using pre-2008 data for five major Asian countries and estimating a multivariate General Dynamic Covariance-GARCH model; their results support the validity of the ICAPM and indicate that risk is priced at the regional level. Again testing the ICAPM, Boubakri and Guillaumin (2015) find segmented stock markets until 2008 and an upward trend in regional integration between the East Asian stock markets using GARCH-dynamic conditional correlations (DCCs) and data from 1990M1 to 2012M8. Narayahet et al. (2014) also estimate a GARCH-DCC model to investigate the patterns of stock market integration of four emerging Asian nations vis-à-vis the US, Australia, China and India over the period 2001M1-2012M3; they find stronger correlations during the 2007-2009 crisis period. Cao et al. (2017) carry out a volatility constrained multifractal detrended cross-correlation analysis and highlight the key role of the Hong Kong stock market. Wang et al. (2017) apply a coupling de-trended fluctuation analysis method to four Asian stock markets and find evidence of financial integration.

Some recent VAR studies on the Asian stock markets include Huyghebaert and Wang (2010) and Wang (2014), both examining long- and short-term linkages using cointegration tests and impulse response analysis respectively. Studies focusing on individual Asian countries include Gupta and Guidi (2012) on India and Chien et al. (2015) on China, both using cointegration techniques (DCC analysis is also carried out in the former).

The overall conclusion of the above mentioned papers is that financial integration between the Asian stock markets has increased and linkages between them have become stronger as a result of shocks. Some recent studies investigate the issue of whether the higher degree of financial integration observed in Asian stock markets is of the global or regional type

(e.g., Hinojales and Park, 2011; Park and Lee, 2011; Kim et al., 2011; Kim and Lee, 2012; Park, 2013). They generally use correlation analysis, and conclude almost integration is predominantly global, although regional integration has also increased.³

In contrast to the aforementioned studies, the present one measures integration as the stock return differentials between Asian economies and the US (as an indicator of global integration), Japan or a regional index (as two alternative indicators of regional integration). We then carry out fractional integration tests (Gil-Alana, 2000, 2004) on the return differentials to examine their mean-reversion properties and obtain evidence on global and/or regional integration.⁴ Further, we assess the impact of 2008 global financial crisis, much less studied compared to the 1997 Asian crisis, and perform both aggregate and sectoral analysis.⁵

3. Methodology

The fractional integration framework adopted here allows the differencing parameter required to make a time series stationary or $I(0)$ to be any real number (as opposed to an integer): a series x_t , $t = 1, 2, \dots$ is said to be integrated of order d , and is denoted as $I(d)$ if it can be represented as

$$(1 - L)^d x_t = u_t, \quad t = 1, 2, \dots, \quad (1)$$

where x_t is the observed series, L the lag operator (i.e., $Lx_t = x_{t-1}$) and u_t is $I(0)$ and assumed to be a covariance stationary process with a finite sum of the autocovariances. In this context, a

³ In addition to correlation analysis, other techniques such as factor analysis (e.g., Hinojales and Park, 2011) and convergence tests (e.g., Park, 2013) have also been employed in studies comparing global and regional integration of Asian stock markets.

⁴ In terms of Asia, some recent examples of mean-reverting analysis on stock prices using techniques alternative to conventional ADF unit root tests include Chen and Kim (2011) employing nonlinear mean reversion tests and Wang et al. (2015) employing a Lagrange Multiplier Fourier unit root test and a stationary test with a Fourier function.

⁵ Wu et al. (2015) and Wang (2014) examine the role of the recent financial crisis in Asia stock markets integration. Both use daily data at aggregate level. The former focuses on the transmission of shocks (contagion) from the US, Japan, and Hong Kong to other Asian countries and hence regional integration in East Asia stock markets is not explained. The latter employs cointegration test and impulse response analysis. Compared with latter and other studies mentioned above that also cover post 2008 crisis period, our study adopts alternative measures of financial integration and empirical method, and we also provide further evidence at industry level.

process is defined to be mean reverting if d is smaller than 1; this framework is more general than the standard approaches that only consider mean reversion in the case of $d = 0$. In addition, the lower the value of d in the interval $[0, 1)$ is, the faster the convergence process is. Also, if d is higher than 0, the process is said to exhibit long memory because of the strong degree of association between observations that are far away in time, and covariance stationarity holds if d is smaller than 0.5. Therefore, if d belongs to the interval $[0.5, 1)$ the process is non-stationary but mean-reverting.⁵

From the above outline of the fractional integration approach it is clear that this method outperforms other classical ones which are based exclusively on integer degrees of differentiation such as in the stationary $I(0)$ and the nonstationary $I(1)$ cases, since it allows for a wider range of alternatives and a much richer degree of flexibility in the specification of the series. The $I(d)$ approach also differs from other methods such as wavelets since it focuses only on the long-run or zero frequency - that is, the spectral density function of x_t in (1) tends to infinity as the frequency approaches zero for $d < 0$. This is, in fact, the original finding by Granger (1980) and others who showed that many aggregate economic series exhibit a spectrum with very large values at the smallest frequency, which suggests that first differences should be taken; however, first differencing produced spectrums with values close to zero at the zero frequency, which was an indication of overdifferentiation.⁶ Specifically, we consider the following regression model,

$$y_t = \beta_0 + \beta_1 t + x_t, \quad t = 1, 2, \dots, \quad (2)$$

where y_t is the series of interest, β_0 and β_1 are unknown coefficients on an intercept and a linear time trend, and the regression errors, x_t , are specified as in equation (1), that is, as integrated

⁵ Note that the nonstationarity refers to the variance. In the $I(d)$ context, the variance of the partial sums increases with d .

⁶ See Robinson (1978), Granger (1980), Granger and Joyeux (1980) and Hosking (1981) among many others for the seminal studies on fractional integration.

of order d , where d is also an unknown parameter to be estimated. The estimation method for all parameters is the Whittle function in the frequency domain as in Dahlhaus (1989). Other approaches produce very similar results.

4. Data Description

The emerging Asian stock markets examined are those of China (PRC), Hong Kong, India, Indonesia, Malaysia, Philippines, Singapore, South Korea, Taiwan, and Thailand. We calculate the stock market return differentials between each of the ten emerging Asian economies and the following three benchmarks:

- a) The US to examine global financial integration;
- b) Japan to examine regional financial integration since this country has long been regarded as the regional leader in terms of financial market development;
- c) Morgan Stanley Capital International (MSCI) Asia (excluding Japan) as an alternative benchmark to examine regional financial integration.

Stock market returns are calculated as monthly log first differences of stock indices. The stock indices are collected from Datastream at the monthly frequency and cover the period 2000M1-2016M8.

As mentioned before, in addition to aggregate data, we also analyse industry level data. Owing to data unavailability, we are not able to include all ten industry stock indices⁷ for our group of emerging Asian economies. Therefore, using the same data sources and methods as for the aggregate stock indices, we calculate three sets of differentials for the following industries: 1) industrials; 2) consumer goods; and 3) financials, which are most developed in developing Asia.

⁷ According to MSCI, the ten industry indices are for 1) Basic Materials, 2) Consumer Goods, 3) Consumer Services, 4) Financials, 5) Healthcare, 6) Industrials, 7) Oil & Gas, 8) Technology, 9) Telecommunications, and 10) Utilities.

Further, in order to examine the impact of the 2008 financial crisis on the process of both global and regional integration, we divide the sample into two sub-periods: 1) 2000M1-2007M12; and 2) 2009M1-2016M8, excluding 2008 when markets were most volatile. Therefore, for each emerging Asian economies, we obtain 24 stock return differentials (three benchmarks; four stock indices, one at aggregate and three at the industry level; two sub-periods).

5. Empirical Results

The results are presented in Tables 1 - 4, with the aggregate ones in Table 1, and the disaggregated ones in Tables 2-4. As expected, most of the return differentials are $I(0)$ processes, which implies a unit root in the original series. We focus in particular on cases of long memory ($d > 0$) in the return differentials, which indicates high persistence ($d > 1$) in the original series, and on cases of anti-persistence ($d < 0$), which implies mean reversion ($d < 1$) in the original series and therefore integrated markets.

5.1 Asian Stock Markets: Full Sample and Pre- and Post-Crisis Results

Table 1 presents estimates of d for three sets of return differentials at the aggregate level. For the whole sample period 2001M1-2016M8 (columns (1), (4) and (7)), long memory in return differentials ($d > 0$) or high persistence in the original series ($d > 1$) is only found for Indonesia vis-à-vis the US. By contrast, there is evidence of anti-persistence ($d < 0$) or mean reversion ($d < 1$) in the original series in a few cases, namely Hong Kong vis-à-vis the US and Asia, as well as India, Taiwan and Thailand vis-à-vis Asia.

The sub-sample results are presented in the rest of the columns in Table 1. In the pre-crisis period (2001M1-2007M12), long memory ($d > 0$) or high persistence in the original series ($d > 1$) is only found for China vis-à-vis Japan (as indicated in column (5)), whilst there is evidence of anti-persistence ($d < 0$) or mean reversion ($d < 1$) in various cases, specifically Hong Kong, India and the Philippines vis-à-vis the US, and Hong Kong and India vis-à-vis Asia (as indicated in column (2) and (8), respectively).

In the post-crisis period (2009M1-2016M12), anti-persistence is not found in any case vis-a-vis the US and Japan. The only evidence of mean reversion is obtained for Singapore, Taiwan, and Thailand vis-à-vis Asia (see column (9)). Further, it appears that there is long memory or high persistence in the original series in the case of Malaysia vis-à-vis Asia.

Two points are noteworthy. First, there is no evidence of integration between the emerging Asian economies considered and Japan, either in the whole sample period or the sub-periods. This probably reflects the power shift witnessed in East Asia in the past two decades, with the rise of China and the relative decline of Japan (Yang, 2017), which was hit by the 2008 global financial crisis whilst still in the midst of a slow recovery from economic stagnation (Grimes, 2009).

Second, regional rather than global integration appears to be predominant over the full sample when the regional index (excluding Japan) is used as the benchmark. In the pre-crisis period, global integration is stronger than the regional one but the opposite is true in the post-crisis period when no cases of global integration are found but there is stronger regional integration. Since the Asian financial crisis, Asian policymakers have encouraged greater financial cooperation and integration within the region introducing a range of initiatives (e.g., Chiang Mai Initiative Multilateralisation, Asian Bond Market Initiative) and promoting financial forums (e.g, Association of Southeast Asian Nations Plus Three, the Executives' Meeting of East Asia–Pacific Central Banks) (Ananchotikul et al., 2015). The Association of

Southeast Asian Nations (ASEAN) has also outlined plans to foster capital market integration by building capital market infrastructure and harmonising regulations (Almekinders et al., 2015). The uncertainty and volatility transmitted from the US to the rest of the world during the 2008 financial crisis have pushed investors towards a more inward-looking view (Rughoo and You, 2016) and Asian countries towards even closer regional cooperation and integration (Asian Development Bank, 2013).

We also compare the values of d in the pre- and post- crisis periods in Table 1. An increase in d (i.e., a move away from stock market integration) is found in the case of Hong Kong, India and the Philippines vis-à-vis the US; there is instead a decrease in d (a move towards stock market integration) in the case of China vis-a-vis Japan but these two stock markets are still not integrated; finally, there is an increase in d for Hong Kong, India and Malaysia, and a decrease for Singapore, Taiwan and Thailand vis-à-vis the Asian regional index. It confirms the relative decline of Japan and the stronger regional integration after the crisis. It is also interesting to notice that Hong Kong and India appear to be integrated with both the US and regional (excluding Japan) stock markets before but not after the crisis. In the case of Hong Kong, this probably reflects the greater influence of mainland China since the 2008 financial crisis, although it is still less important than that of the US (He, et al., 2009), despite the lower impact of US equity returns (see Glick and Hutchison, 2013). As for India, this country has been less involved in the various initiatives mentioned before aimed at increasing regional integration.

5.2 Industry Level Results

Industrial Sector

For the industrial sector (Table 2), focusing on the whole period results (columns (1), (4) and (7)), there is evidence of long memory only for South Korea vis-à-vis Asia, and of anti-

persistence (or mean reversion in the original series) only for Hong Kong and Thailand vis-à-vis the US and Asia, Thailand vis-à-vis Japan and Taiwan vis-a-vis Asia. Regional integration appears to be stronger than the global one when the regional index (excluding Japan) is employed for the analysis.

In the pre-crisis period (columns (2), (5) and (8)), there is no evidence of long memory, whilst anti-persistence is found for Thailand vis-à-vis the US, Japan and Asia, Hong Kong and Malaysia vis-à-vis the US. In the post-crisis period (columns (3), (6) and (9)), there is no evidence of integration with the US, whilst there appears to be integration for Hong Kong and Malaysia vis-à-vis Japan and China and Taiwan vis-à-vis Asia. Evidence of long memory is found only for Indonesia vis-à-vis the US. Global integration seems to be stronger than the regional one prior to the 2008 crisis and the opposite is true in the following period.

A comparison of the pre- and post-crisis results shows an increase in d for Hong Kong, Indonesia, the Philippines and Thailand vis-à-vis the US. d also increases in the case of Thailand while it decreases in the case of China and Malaysia vis-à-vis Japan; it increases for Hong Kong and Thailand as well and decreases for China and Taiwan when the regional index is used for the analysis. Therefore, Thailand seems to move away from both regional and global integration whilst China appears to have become integrated regionally in the post-crisis period.

Consumer Goods Sector

For this sector (Table 3) during the whole sample period (columns (1), (4) and (7)), most estimated values of d imply $I(0)$ stationarity, although there are also some cases of long memory ($d > 0$) or high persistence: Indonesia vis-à-vis the US and Japan, the Philippines vis-à-vis

Japan and Asia, Thailand vis-à-vis Japan. No evidence of anti-persistence or mean reversion is found in any case.

The sub-sample results in the rest of the columns of Table 3 provide evidence of regional integration only for Taiwan vis-à-vis Asia in the post-crisis period (in column (9)), whilst there is no evidence of global integration. There are various cases of long memory in the post-crisis period, i.e., Indonesia vis-à-vis the US, the Philippines, South Korea and Thailand vis-à-vis Japan and India and Malaysia vis-à-vis Asia, but only two in the pre-crisis period, namely India vis-à-vis Japan and China vis-à-vis Asia. Overall there is limited evidence of integration, and only at the regional level, with long memory being found in more cases after the crisis.

Comparing the pre- with post-crisis period, the estimated value of d increases only for Indonesia vis-à-vis the US, and for the Philippines, South Korea and Thailand vis-à-vis Japan. Finally, d increases in the case of India and Malaysia and decreases in the case of China and Taiwan when the regional index is used as a benchmark. Hence, several emerging countries appear to be moving away from integration, either globally or regionally, China and Taiwan being the exceptions.

Financial Sector

For the financial sector (Table 4) full-sample evidence of long memory is found for Indonesia vis-à-vis the US (in column (1)) and Japan (in column (4)), and of mean reversion for Thailand vis-a-vis Asia (in column (7)). In the pre-crisis period, there is only one case of mean reversion, namely Thailand vis-à-vis Asia (see column (8)), whilst in the post-crisis period six economies (i.e., China, the Philippines, Singapore, South Korea, Taiwan, and Thailand) exhibit mean

reversion vis-à-vis Asia (see column (9)). After the crisis, there is only one case of mean reversion vis-à-vis the US, namely that of China, and none vis-à-vis Japan. The only post-crisis case of long memory is that of India vis-à-vis Japan. The sub-sample analysis provides strong evidence of integration at the regional level after the 2008 crisis when using the regional index rather than the Japanese one.

Looking across the pre- and post-crisis period, the estimated value of d decreases only in the case of China vis-à-vis the US and it increases in the case of India vis-à-vis Japan. When the regional index is used, it declines in various cases, namely those of China, the Philippines, Singapore, South Korea, Taiwan and Thailand, which implies stronger regional integration in the post-crisis period.

Overall, in all three sectors examined regional integration appears to be growing stronger despite some degree of heterogeneity. This is particularly apparent in the case of the financial sector: there is only one case of regional integration in the full sample and the pre-crisis period (Thailand vis-à-vis the Asian (excluding Japan) index), but in the post-crisis period six of the ten economies examined exhibit regional integration (again vis-à-vis the Asian index excluding Japan), whilst there is only one case of global integration, namely China (which is also regionally integrated). The Asian financial sector is dominated by banks that often focus on the traditional bank business of deposit taking and consumer lending to households and companies; they rely less on lending to other banks and on selling financial derivatives, which was an advantage during the global financial crisis, when dependence on borrowing from other banks became a major problem in the US and Europe as markets seized up (Bhattacharya, et al., 2015). The growing integration at regional level could be a reflection of an even stronger reliance of the developing Asian economies on traditional banking, which after the crisis is perceived to be safer and less risky.

For the industrial sector, there is slightly stronger regional than global integration for the whole sample period, with much weaker global integration and slightly stronger regional integration in the second sub-sample (mainly reflecting stronger integration of China). While trade linkages within region have continued to strengthen, foreign direct investments (FDI) within Asia has also been increasing as the development of technology, human resources, and accumulation of capital have enabled many economies in the region to invest and set up production in neighbouring countries (Asian Development Bank, 2016). Strengthened trade and investment linkages may have contributed to stronger regional integration in the industrial sector, especially after the crisis, when demand and FDI from the developed world slowed down. As for the consumer goods sector, there is no evidence of global integration and very limited evidence of regional integration. This is not surprising, since in this case domestic factors tend to play a bigger role.

On the whole the sectoral analysis suggests that while some sectors (e.g., the financial sector) contributed to integration at aggregate level, some others (e.g., the consumer goods sector) held it back. Further, Japan does not appear to be a regional leader, since regional integration is only found when using the regional price index (excluding Japan) rather than the Japanese price index (with only a few exceptions), whilst China is become increasingly integrated, especially after the 2008 crisis (at the regional level for the industrial sector and both regionally and globally for the financial sector). Hong Kong, Taiwan and Thailand are among the most regionally integrated economies.

6. Conclusions

This paper investigates the issue of global and regional financial integration of ten emerging Asian economies at both the aggregate and industry level analysing the stochastic behaviour of

stock return differentials by means of fractional integration techniques. Our main findings are as follows. First, there is overwhelming evidence of stronger regional than global integration at the aggregate level. The sub-period analysis shows that in the pre-2008 crisis period global integration was stronger than the regional one, whilst the opposite is true of the post-crisis period. Second, stronger evidence of regional integration is also found at industry level, especially in the post-crisis period and for the financial sector. Our industry level analysis also highlights that integration is heterogeneous across industries. Third, regional integration in emerging Asia is mainly within economies other than Japan; China appear to be more integrated both globally and regionally after the 2008 crisis, and Hong Kong, Taiwan and Thailand are the countries that are most regionally integrated.

Our first finding of stronger regional integration is in contrast to the conclusions of numerous other studies finding more evidence of global integration (e.g., Hinojales and Park, 2011; Park and Lee, 2011; Kim et al., 2011; Kim and Lee, 2012; Park, 2013), but consistent with the results of Wang (2014) for the post-2008 crisis period. This could reflect the various regional agreements signed in recent years (e.g., Chiang Mai Initiative in 2000, Asian Bond Market Initiative (ABMI) in 2003, new ABMI roadmap in 2008, Chiang Mai Initiative Multilateralization in 2012) to promote financial cooperation in the region. The 2008 financial crisis provided further incentives for greater regional integration to deal with external common shocks (Asian Development Bank, 2013). Hence an important policy implication of our findings is that regional cooperation should be continued and intensified if possible.

The immediate and sizeable adverse effects of the 2008 global financial crisis on the Asian stock markets also highlight the crucial role played by shifts in investors' risk profile. Whilst the developed economies were mainly hit by a liquidity shock, emerging equity markets were primarily affected by a decline in risk appetite (Chudik and Fratzscher, 2011), regardless of their level of financial integration with the developed economies (Wang, 2014). Therefore,

despite the declining level of global integration after the 2008 crisis, policy makers in the emerging Asian economies should have a framework in place to assess and monitor this type of transmission mechanism of financial crisis (e.g., the daily measures of risk appetite proposed by Kumar and Persaud (2002)) to be able to react quickly and effectively.

Our industry level analysis suggests that the financial sector is highly regionally integrated while its integration with the US or other countries in the region such as Japan has been declining, especially after the 2008 crisis, which is consistent with the findings of Hinojales and Park (2011). Therefore, the Asian stock markets could be an attractive option for investors seeking global portfolio diversification. By contrast, regional diversification does not seem to be achievable given the evidence of strong regional integration in the case of China, Hong Kong, Taiwan and Thailand.

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Table 1: Estimates of d for the whole period (2000M1-2016M8) and two subsamples (2000M1-2007M12, 2009M1-2016M12): Aggregate data

Aggregate Data									
	Against US			Against Japan			Against Asia regional index		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Whole Period	1 st subs.	2 nd subs.	Whole Period	1 st subs.	2 nd subs.	Whole Period	1 st subs.	2 nd subs.
CHINA	0.02 (0.061)	0.07 (0.079)	-0.04 (0.097)	-0.01 (0.061)	0.11 (0.081)	-0.14 (0.087)	0.02 (0.061)	0.10 (0.096)	-0.06 (0.091)
HONG KONG	-0.09*** (0.048)	-0.26*** (0.146)	-0.12 (0.128)	-0.04 (0.067)	0.03 (0.152)	-0.06 (0.114)	-0.15** (0.060)	-0.16*** (0.089)	-0.10 (0.091)
INDIA	-0.07 (0.012)	-0.20*** (0.104)	0.02 (0.115)	-0.04 (0.073)	-0.15 (0.127)	0.10 (0.110)	-0.21* (0.067)	-0.33* (0.114)	-0.06 (0.085)
INDONESIA	0.09 (0.073)	-0.02 (0.109)	0.13 (0.128)	0.07 (0.079)	0.00 (0.129)	0.10 (0.090)	-0.06 (0.080)	-0.09 (0.154)	-0.17 (0.146)
MALAYSIA	-0.03 (0.079)	-0.03 (0.133)	-0.13 (0.127)	0.00 (0.068)	0.01 (0.110)	-0.03 (0.019)	0.02 (0.068)	-0.09 (0.152)	0.10 (0.091)
PHILIPPINES	-0.07 (0.067)	-0.22** (0.112)	-0.06 (0.109)	-0.02 (0.060)	-0.19 (0.109)	0.05 (0.099)	-0.01 (0.085)	-0.09 (0.157)	-0.11 (0.109)
SINGAPORE	0.02 (0.061)	-0.11 (0.111)	0.06 (0.098)	0.02 (0.067)	-0.03 (0.145)	0.05 (0.096)	-0.07 (0.085)	-0.09 (0.140)	-0.23*** (0.134)
SOUTH KOREA	0.03 (0.061)	0.03 (0.103)	-0.07 (0.097)	0.00 (0.061)	-0.02 (0.133)	0.05 (0.085)	0.03 (0.080)	0.07 (0.120)	-0.17 (0.119)
TAIWAN	-0.09 (0.085)	-0.11 (0.122)	-0.05 (0.084)	-0.09 (0.072)	-0.14 (0.121)	-0.01 (0.090)	-0.15*** (0.086)	-0.14 (0.133)	-0.55* (0.136)
THAILAND	-0.05 (0.067)	-0.07 (0.097)	-0.05 (0.085)	0.01 (0.067)	-0.07 (0.104)	0.02 (0.130)	-0.11*** (0.057)	-0.14 (0.098)	-0.23** (0.121)

Note: In parentheses the standard errors. Three models are employed in the estimations of d: a) no deterministic items, b) intercept, and c) a linear trend. Values included in this table are based on the most significant model out of the three for each series according to the deterministic terms and the type of I(0) disturbance. The results with *, ** and *** correspond to cases of anti-persistence ($d < 0$) at the 95% level, which implies integrated markets respectively for $p < 0.1$, $p < 0.05$ and $p < 0.01$.

Table 2: Estimates of d for the whole period (2000M1-2016M8) and two subsamples (2000M1-2007M12, 2009M1-2016M12): Industrials sector data

Industrials sector									
	Against US			Against Japan			Against Asia regional index		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Whole Period	1 st subs.	2 nd subs.	Whole Period	1 st subs.	2 nd subs.	Whole Period	1 st subs.	2 nd subs.
CHINA	-0.06 (0.061)	-0.02 (0.083)	-0.14 (0.103)	-0.02 (0.058)	0.07 (0.071)	-0.24* (0.105)	0.05 (0.068)	0.12 (0.082)	-0.25* (0.118)
HONG KONG	-0.15** (0.067)	-0.36** (0.151)	-0.10 (0.120)	-0.09 (0.076)	-0.08 (0.160)	-0.10 (0.109)	-0.11** (0.054)	-0.21** (0.095)	-0.11 (0.088)
INDIA	0.04 (0.060)	-0.07 (0.090)	0.08 (0.112)	0.03 (0.071)	-0.07 (0.109)	0.07 (0.133)	0.02 (0.072)	-0.01 (0.100)	-0.04 (0.105)
INDONESIA	0.06 (0.061)	-0.13 (0.098)	0.13 (0.122)	0.07 (0.066)	0.01 (0.122)	0.04 (0.103)	-0.04 (0.071)	-0.06 (0.097)	-0.09 (0.120)
MALAYSIA	-0.06 (0.070)	-0.05 (0.104)	-0.16 (0.127)	-0.05 (0.079)	0.07 (0.122)	-0.16* (0.091)	0.00 (0.062)	-0.08 (0.107)	0.04 (0.094)
PHILIPPINES	-0.09 (0.071)	-0.26** (0.121)	0.05 (0.101)	-0.03 (0.072)	-0.13 (0.114)	0.04 (0.119)	-0.04 (0.068)	-0.09 (0.122)	-0.05 (0.092)
SINGAPORE	-0.04 (0.055)	-0.13 (0.091)	-0.05 (0.163)	-0.02 (0.068)	-0.05 (0.122)	-0.01 (0.104)	-0.10 (0.081)	-0.18 (0.133)	-0.07 (0.062)
SOUTH KOREA	0.02 (0.075)	0.05 (0.079)	0.03 (0.083)	-0.02 (0.066)	0.01 (0.115)	-0.03 (0.092)	0.10 (0.0090)	0.15 (0.050)	-0.04 (0.129)
TAIWAN	-0.02 (0.078)	0.00 (0.110)	-0.03 (-0.14, 0.11)	-0.08 (0.065)	-0.09 (0.137)	-0.08 (0.077)	-0.13*** (0.072)	-0.12 (-0.31, 0.10)	-0.30* (0.080)
THAILAND	-0.17** (0.071)	-0.24** (0.114)	-0.04 (0.135)	-0.19** (0.087)	-0.27** (0.124)	-0.05 (0.136)	-0.13** (0.059)	0.33* (0.134)	-0.16 (0.121)

Note: The same as for Table 1.

Table 3: Estimates of d for the whole period (2000M1-2016M8) and two subsamples (2000M1-2007M12, 2009M1-2016M12): Consumer Goods sector data

Consumer Goods sector									
	Against US			Against Japan			Against Asia regional index		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Whole Period	1 st subs.	2 nd subs.	Whole Period	1 st subs.	2 nd subs.	Whole Period	1 st subs.	2 nd subs.
CHINA	0.04 (0.081)	0.05 (0.121)	0.07 (0.139)	0.01 (0.059)	0.03 (0.094)	0.02 (0.134)	0.11 (0.069)	0.15 (0.073)	0.01 (0.132)
HONG KONG	0.03 (0.079)	-0.07 (0.105)	0.10 (0.128)	0.04 (0.062)	0.01 (0.105)	-0.01 (0.122)	-0.09 (0.068)	-0.11 (0.085)	0.01 (0.114)
INDIA	0.04 (0.058)	0.05 (0.090)	-0.09 (0.122)	0.06 (0.074)	0.06 (0.099)	0.06 (0.141)	0.03 (0.073)	0.00 (0.091)	0.07 (0.149)
INDONESIA	0.14 (0.090)	0.12 (0.119)	0.17 (0.107)	0.14 (0.085)	0.21 (0.154)	0.08 (0.109)	0.04 (0.105)	0.08 (0.097)	-0.13 (0.145)
MALAYSIA	-0.02 (0.066)	-0.06 (0.091)	0.01 (0.122)	0.05 (0.057)	0.04 (0.095)	0.06 (0.091)	0.05 (0.061)	-0.03 (0.109)	0.17 (0.098)
PHILIPPINES	0.05 (0.121)	0.01 (0.095)	0.08 (0.103)	0.08 (0.064)	-0.02 (0.095)	0.14 (0.091)	0.14 (0.086)	0.01 (0.138)	0.09 (0.146)
SINGAPORE	0.00 (0.083)	-0.10 (0.126)	0.04 (0.085)	0.03 (0.088)	0.03 (0.139)	0.07 (0.090)	-0.03 (0.079)	-0.09 (0.152)	-0.14 (0.103)
SOUTH KOREA	0.00 (0.073)	-0.04 (0.137)	0.01 (0.091)	0.03 (0.073)	-0.03 (0.137)	0.11 (0.087)	-0.02 (0.085)	-0.02 (0.109)	-0.13 (0.103)
TAIWAN	0.04 (0.0074)	0.03 (0.090)	0.12 (0.085)	-0.01 (0.120)	0.00 (0.100)	0.01 (0.109)	-0.06 (0.080)	-0.01 (0.110)	-0.23** (0.109)
THAILAND	0.08 (0.076)	0.02 (0.096)	0.05 (0.106)	0.13 (0.066)	0.05 (0.075)	0.24 (0.128)	0.07 (0.072)	-0.03 (0.134)	0.01 (0.128)

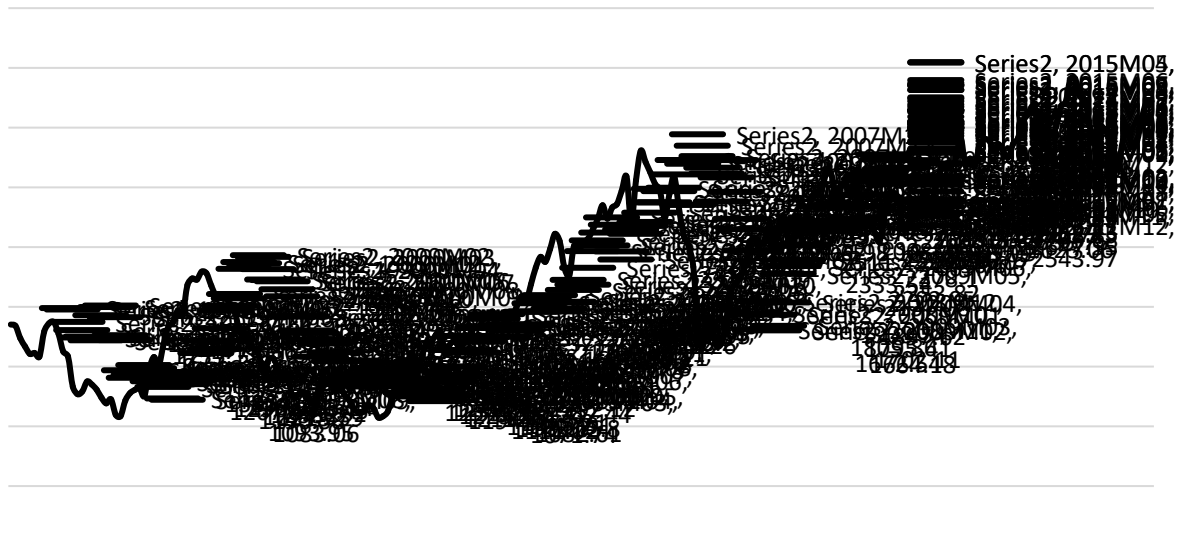
Note: The same as for Table 1.

Table 4: Estimates of d for the whole period (2000M1-2016M8) and two subsamples (2000M1-2007M12, 2009M1-2016M12): Financial sector data

Financial sector									
	Against US			Against Japan			Against Asia regional index		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Whole Period	1 st subs.	2 nd subs.	Whole Period	1 st subs.	2 nd subs.	Whole Period	1 st subs.	2 nd subs.
CHINA	-0.05 (0.060)	0.02 (0.090)	-0.20** (0.098)	0.01 (0.063)	0.10 (0.099)	-0.09 (0.098)	0.05 (0.059)	0.08 (0.082)	-0.28** (0.114)
HONG KONG	-0.07 (0.049)	-0.12 (0.087)	-0.19 (0.138)	0.00 (0.079)	0.07 (0.154)	0.03 (0.104)	-0.06 (0.060)	-0.12 (0.103)	-0.12 (0.107)
INDIA	0.02 (0.079)	0.00 (0.126)	0.01 (0.121)	0.09 (0.073)	0.06 (0.123)	0.17 (0.126)	-0.06 (0.079)	-0.03 (0.130)	-0.10 (0.108)
INDONESIA	0.13 (0.061)	0.03 (0.128)	0.11 (0.147)	0.09 (0.071)	0.06 (0.091)	0.05 (0.097)	0.06 (0.090)	0.06 (0.153)	-0.10 (0.091)
MALAYSIA	0.07 (0.080)	0.11 (0.127)	-0.11 (0.129)	0.05 (0.068)	0.05 (0.092)	0.01 (0.091)	0.04 (0.073)	0.08 (0.152)	0.07 (0.099)
PHILIPPINES	0.01 (0.067)	-0.16 (0.128)	-0.06 (0.122)	0.05 (0.050)	-0.02 (0.108)	0.03 (0.093)	-0.09 (0.078)	-0.07 (0.134)	-0.15** (0.063)
SINGAPORE	-0.02 (0.052)	-0.17 (0.110)	-0.14 (0.097)	0.03 (0.074)	0.03 (0.146)	0.07 (0.086)	-0.08 (0.106)	-0.03 (0.145)	-0.31*** (0.146)
SOUTH KOREA	0.01 (0.067)	0.01 (0.112)	-0.09 (0.098)	0.00 (0.075)	0.01 (0.137)	0.02 (0.086)	-0.03 (0.090)	0.01 (0.103)	-0.24*** (0.136)
TAIWAN	-0.03 (0.086)	-0.08 (0.133)	-0.13 (0.060)	-0.04 (0.075)	-0.04 (0.121)	-0.07 (0.093)	-0.12 (0.072)	-0.18 (0.155)	-0.27* (0.092)
THAILAND	-0.04 (0.060)	-0.09 (0.109)	-0.14 (0.139)	-0.01 (0.067)	-0.10 (0.109)	0.03 (0.114)	-0.20* (0.061)	-0.23** (0.099)	-0.29*** (0.161)

Note: The same as for Table 1.

Figure 1. Stock market index for Asia (MSCI AC Asian Index) (1996M10-2016M8)



Note: Countries in the MSCI AC Asian Index include: China, Hong Kong, India, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan and Thailand.