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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 global stock markets capitalisation (World Federation of Exchange, 2016). The global financial crisis of 2008 had a greater impact than the previous two crises, both in terms of the speed and the size of the decline in daily stock prices (see Hinojales and Park, 2011). An interesting question to ask is whether this reflects a greater degree of financial integration either at the regional or the global level. Financial integration generally has positive implications for the efficient allocation of capital and an economy's ability t

Second, it examines the impact of the 2008 crisis on the process of 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

2. Literature Review

Broadly speaking, three types of financial integration measures have been used in the existing literature: (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). Price-based measures are the most widely employed (Kearney and Lucey, 2004, and Sharma and Seth, 2012). VAR estimation (including Granger causality tests, variance decompositions, impulse responses and cointegration tests) as well as (time-varying) correlation analysis are often carried out.³

More recently, Loh (2013) has investigated co-movement between 13 Asia-Pacific stock market returns using the wavelet coherence method over the sample period 2001M1-2012M3, and found long-run co-movement between most of the Asia-Pacific stock markets as well as 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 (GDC)-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 (VC-MF-DCCA) and highlight the key role of the Hong Kong stock market. Wang et al. (2017) apply a coupling de-trended fluctuation analysis (CDFA) method to four Asian stock markets and find evidence of financial integration.

VAR studies on the Asian stock market include Huyghebaert and Wang (2010)ETBT1 0 0 1 279.0

financial integration in Asian stock markets we calculate the stock market return differentials between emerging Asian economies and the US. To examine integration at the regional level we calculate instead stock market return differentials between the emerging Asian economies and two alternative regional benchmarks: the first is Japan, which has been long regarded as the regional leader in terms of financial market development; the second is a regional stock index for emerging Asia, specifically the Morgan Stanley Capital International (MSCI) Asia (excluding Japan) index that includes the above mentioned ten emerging Asian economies; the frequency is monthly and the sample period is 2000M1-2016M8; the data source is Datastream. Stock market returns are calculated as monthly log first differences in each case, and then return differentials are computed between each of the ten emerging Asian economies considered and the US, Japan; and the regional index respectively.

As mentioned before, in addition to aggregate data, we also analyse industry level data. Using the same data sources and methods, we calculate three sets of differentials for the following sectors: 1) industrials; 2) consumer goods; and 3) financials. Further, in order to examine the impact of the 2007-08 financial crisis on the process of both global and regional integration, we

4.2.1 Full Sample and Pre- and Post-Crisis Results

Table 1 presents estimates of d for three sets of return differentials at the aggregate level. 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 Tables 2a and 2b. In the pre-crisis period, long memory ($d > 0$) or high persistence in the original series ($d > 1$) is only found for China vis-à-vis Japan, 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.

In the post-crisis period,

vis the US; there is instead a decrease in d (a move towards

crisis period, there is only one case of mean reversion, namely Thailand vis-à-vis Asia, whilst in the post-crisis period six economies exhibit mean reversion vis-à-vis Asia. 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 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.

The results by country are summarised in Table 12. The estimated value of d increases only in the case of China vis-à-vis the US, and 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, at the aggregate level there are various cases (Hong Kong, India, Taiwan and Thailand) indicating much stronger regional than global integration. The most persistent return differ

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 return differentials: Aggregate data (2000M1-2016M8)

i) Returns relative to the US			
	No det. Terms	an intercept	A linear time trend
CHINA	0.02 (-0.06, 0.12)	0.02 (-0.06, 0.12)	0.02 (-0.06, 0.12)

Table 4a: Estimates of d for the return differentials: Industrial sector data (2000M1-2007M12)

i) Returns relative to the US			
	No det. Terms	An intercept	A linear time trend
CHINA	-0.02 (-0.14, 0.12)	-0.02 (-0.12, 0.12)	-0.03 (-0.14, 0.11)
HONG KONG	-0.21 (-0.33, -0.02)	-0.21 (-0.36, -0.02)	-0.36 (-0.51, -0.09)
INDIA	0.00 (-0.09, 0.13)	0.00 (-0.09, 0.13)	-0.07 (-0.16, 0.08)
INDONESIA	-0.06 (-0.15, 0.07)	-0.07 (-0.16, 0.07)	-0.13 (-0.26, 0.03)
MALAYSIA	-0.05 (-0.17, 0.12)	-0.05 (-0.17, 0.12)	-0.05 (-0.17, 0.12)
PHILLIPPINES	-0.18 (-0.28, -0.02)	-0.19 (-0.30, -0.02)	-0.26 (-0.42, -0.06)

Table 4b: Estimates of d for the return differentials: Industrial sector data (2009M1-2016M8)

i) Returns relative to the US			
	No det. Terms	An intercept	A linear time trend
CHINA	-0.14 (-0.25, 0.03)	-0.14 (-0.26, 0.03)	-0.14 (-0.26, 0.03)
HONG KONG	-0.06 (-0.17, 0.10)	-0.07 (-0.18, 0.10)	-0.10 (-0.23, 0.10)
INDIA	0.08 (-0.04, 0.26)	0.08 (-0.04, 0.25)	0.08 (-0.04, 0.25)
INDONESIA	0.19 (0.07, 0.38)		

**Table 6a: Estimates of d for the return differentials: Consumer Goods sector data
(2000M1-2007M12)**

Table 6b: Estimates of d for the return differentials: Consumer Goods sector data (2008M1-2016M8)

i) Returns relative to the US			
	No det. Terms	An intercept	A linear time trend
CHINA			

Table 7. Estimates of d for the return differentials: Financial sector data (2000M1-2016M8)

i) Returns relative to the US			
	No det. terms	An intercept	A linear time trend
CHINA	-0.03 (-0.11, 0.07)	-0.03 (-0.11, 0.07)	

Table 8a. Estimates of d for the return differentials: Financial sector data (2000M1-2007M12)

	i) Returns relative to the US
No det. Terms	An intercept

Table 8b: Estimates of d for the return differentials: Financial sector data (2009M1-2016M12)

i) Returns relative to the US			
	No det. Terms	An intercept	A linear time trend
CHINA	-0.20 (-0.31, -0.04)	-0.22 (-0.34, -0.05)	-0.24 (-0.36, -0.06)
HONG KONG	-0.13 (-0.25, 0.06)	-0.14 (-0.27, 0.06)	-0.19 (-0.35, 0.04)
INDIA	0.01 (-0.12, 0.21)	0.01 (-0.12, 0.21)	0.01 (-0.12, 0.21)
INDONESIA	0.11 (-0.05, 0.35)	0.11 (-0.05, 0.33)	0.08 (-0.10, 0.34)
MALAYSIA	-0.03 (-0.13, 0.13)	-0.03 (-0.13, 0.13)	-0.11 (-0.25, 0.10)
PHILLIPPINES	-0.05 (-0.19, 0.14)	-0.05 (-0.18, 0.13)	-0.06 (-

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.