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**STOCK MARKET INTEGRATION IN ASIA: GLOBAL OR REGIONAL?
EVIDENCE FROM INDUSTRY LEVEL
PANEL CONVERGENCE TESTS**

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Abstract

This paper examines global and regional stock market integration in Asia at both the aggregate and disaggregate (industry) level by applying the Phillips-Sul (2007) tests for panel and club convergence. The main findings can be summarised as follows. In the pre-2008 crisis period, no integration/convergence of any kind is found. By contrast, in the post-crisis period, the Asian stock markets appear to be integrated both globally and regionally at the aggregate level; at the industry level, there is evidence of both global and regional integration in 6 out of 10 cases, the exceptions being Financials and Telecommunication, both in a turn-around phase, and Gas & Oil and Technology, for which there is no panel convergence. Club convergence tests reveal the existence of convergence clubs and divergent economies within the full panel, which explains why panel convergence is not found for the pre-crisis period and for the Gas & Oil and Technology sectors in the post-crisis period.

Keywords: Asian stock markets, global and regional integration, Phillips-Sul tests, panel and club convergence

JEL classification: C32, C33, G11, G15

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1. Introduction

Cross-border financial integration is generally thought to bring benefits to an economy by lowering the costs of asset trading and offering more portfolio

She finds that the cross-market dispersion of weekly stock market returns has declined and returns have converged over time; as for bond markets, the sovereign debt problems experienced by some Asian countries combined with the global financial crisis has resulted in a lower degree of convergence. She also uses principal component analysis to model returns as having both expected and unexpected components, the latter including local, regional and global shocks. The evidence she obtains suggests that the Asian stock markets have become more integrated at the global than the regional level, whilst both types of integration have declined in the case of bond markets.

The present paper also examines stock market integration in Asia, more specifically whether the

Seth, 2012).¹ Some recent correlation studies include Loh (2013) (applying the wavelet coherence method), Abid et al. (2014) (using the multivariate General Dynamic Covariance (GDC)-GARCH model), Boubakri and Guillaumin (2015), Narayah et al. (2014) (both using GARCH-dynamic conditional correlations (DCCs)), Dewandaru et al. (2015) (using wavelet decomposition techniques), Cao et al. (2017) (using volatility constrained multi-sfractal de-trended cross-correlation analysis (VC-MF-DCCA)) and

convergence (including sub-group convergence). Specifically, it is based on a time-varying factor model using common stochastic trends, which can accommodate long-term co-movement in aggregate behaviour outside the cointegration framework and allows for the modelling of transitional effects. Being based on such a time-varying factor model, the Phillips and Sul (2007) method is more powerful than the traditional τ - and ρ -convergence tests, and it provides estimates of the speed of convergence for both the full panel and sub-groups through its club formation procedure. This method is explained in detail below.

3.1. Relative Transition

Phillips and Sul (2007) (P-S) proposed the new time-varying loading factor representation for the panel variable y_{it} :

squares regression is run, and a conventional robust statistics,

(iv) A subgroup of the units is formed for which $\hat{\alpha}_i$ in (iii). Run the $\hat{\alpha}_i$ test for this subgroup, and if $\hat{\alpha}_i < \alpha$, this cluster converges, and there are two convergent sub-groups in the panel. Otherwise, repeat (i)–(iii) on this sub-group to determine whether a smaller convergent sub-group exists. If there is no $\hat{\alpha}_i$ in (ii) for which $\hat{\alpha}_i < \alpha$, the remaining units diverge.

The Phillips and Sul (2007) method has been employed for a range of developed stock markets. For instance, Caporale et al. (2015) apply it to test for convergence in the stock returns of five EU countries (Germany, France, the Netherlands, Ireland and the UK) as well as the US between 1973 and 2008, for both sectors and individual industries within sectors. Concerning studies focusing on Asia, as already mentioned the only two previous applications are Apergis et al. (2012) and Tam and Tam (2012).

The Asian economies included in this study are China (PRC), Hong Kong, India, Indonesia, Malaysia, Pakistan, Philippines, Singapore, South Korea, Sri Lanka, Taiwan, and Thailand. The data source is Datastream. Stock market returns are calculated as monthly log first differences. Then three sets of return differentials are constructed vis-à-vis 1) the US; 2) Japan; and 3) Asia (excluding Japan).

We employ data at both the aggregate and industry level. The following ten sectors are included in the analysis: 1) Basic Materials, 2) Consumer Goods, 3)

convergence applying the logt test. The test results are displayed in Table 1. At the aggregate level, the null of convergence is rejected at the 5% level in the pre-crisis period in all three cases, suggesting absence of both global and regional integration. However, in the post-crisis period there is conditional convergence (convergence in rates) (given that β) in the return differentials at both the global and regional level, and the speed of convergence for the three sets of differentials is very similar (i.e., above 0.5 and below 0.6).

Moving on to the sector level results, in the pre-crisis period panel convergence is rejected in all three cases (i.e., relative to the US, Japan, and Asia (excluding Japan)) for all ten sectors, which suggests that the absence of convergence at the aggregate level in the pre-crisis period reflects lack of convergence at the sector level. By contrast, in the post-crisis period returns differentials in six out of ten sectors exhibit conditional convergence (since β), again at a very similar speed for all sets of differentials. The four exceptions are Financials, Telecommunication, Oil & Gas, and Technology. It is noteworthy that in the case of the former two sectors the point estimates are negative and not significantly different from zero; following Phillips and Sul (2009), this indicates that the Financials1((2009)3()nb(6.03 612

presence of divergent members. Hence our next step is to apply the P-S clustering algorithm to the panel and identify those.

Since we are more interested in the recent post-crisis period, we first carry out club convergence analysis for the Oil & Gas and Technology Sectors, the only two sectors where full-panel convergence is rejected in the post-crisis period. The results are presented in Table 2. Since full-panel convergence is rejected at both the aggr

Table 3 reports the club convergence tests for the Oil & Gas sector in the pre-crisis period. On the basis of the return differentials vis-à-vis the US, three clubs can be identified, with clubs 1 and 3 being in transitional divergence and a turn-around phase, and club 2 having conditional convergence given by $\beta_2 > 0$. The same three clubs can also be identified in the case of the return differentials vis-à-vis Japan and Asia, although only club 3 (Pakistan and Sri Lanka) is in a transitional phase while the economies in club 1 (China, Hong Kong, Thailand and South Korea) converge at a relatively faster speed than those in club 2. Therefore, the rejection of full-panel convergence in the pre-crisis period is due to the presence of some convergence clubs as well as some transitional clubs.

A comparison of the two sub-periods shows that, for the Oil & Gas Sector, both global and regional integration are stronger in post- than in pre-crisis period as most economies (with one or two exceptions) have experienced club convergence. There is slightly stronger evidence of regional integration (based on a faster speed of convergence and the existence of only one club in a transitional phase) in the pre-crisis period.

Table 3 reports club convergence test for the Technology sector in the pre-crisis period. There is one club where economies are in a transitional phase and one divergent country, i.e. China, for all three sets of differentials. Therefore, rejection of full-panel convergence in the pre-crisis period is due to China diverging and the other countries being in a transitional divergence and turn-around phase.

Although full-panel convergence is rejected for both pre- and post-crisis periods, there are signs of both global and regional integration in the latter period since two convergence clubs can be found, compared with no convergence clubs in the former. The divergence of China in the pre-crisis period and its belonging to one of the convergence clubs in the post-crisis period suggest that the Technology sector of this country has become regionally and globally integrated. Hong Kong and Taiwan form a convergence club in the post-crisis period, confirming their leading positions in this sector in Asia. The speed of convergence for the clubs is slightly faster at the regional level, which again indicates stronger regional integration within clubs in the post-crisis period.

Aggregate and other sector results in the pre-crisis period

Since full-panel convergence is rejected in all cases in the pre-crisis period, we now analyse the club convergence test results in Table 3 to establish whether this is due to the existence of convergence clubs and/or divergent economies.

At the aggregate level, there is one convergence club including India, Hong Kong, Indonesia, Malaysia, Philippine, Singapore, South Korea, Taiwan, Pakistan, and Sri Lanka, whilst China and Thailand form one transitional club. This is the case regardless of the differentials used. Therefore, the lack of full-panel convergence in the pre-crisis period at the aggregate level is mainly due to the fact that China and Thailand are in a transitional divergence and turn-around phase.

As for the sector level data, we first consider the Financials sector. Prior to the crisis, three convergence clubs and one transitional club can be identified in the case of the differentials vis-à-vis the US, whilst on the basis of those vis-à-vis Japan and Asia there are two convergence clubs. Although all three sets of differentials suggest that there are economies in a transitional phase in the post-crisis period, there is stronger evidence of regional integration prior to the crisis since only a few clubs can be identified when considering the differentials vis-à-vis Japan and Asia.

Concerning the Telecommunication sector, two convergence clubs are found for all three sets of differentials, although Singapore and Pakistan belong to club 1 in the case of the differentials vis-à-vis the US and Japan and instead to club 2 in the case of those vis-à-vis Asia. Hence there are two convergence clubs in the pre-crisis period and a transitional club in the post-crisis period.

Regarding the other six sectors, our results reveal that there are three convergence clubs for Basic Materials, two convergence clubs and one transitional club for Consumer Goods, two convergence clubs for the Utility sector, one convergence and one transitional club for the Industrial sector, one convergence club and two divergent economies (China and Taiwan) for the Consumer Services sector, and one convergence club, one transitional club, and two divergent countries (India and Philippine) for Healthcare. When convergence clubs are found, there is conditional convergence () except in the case of Healthcare and Consumer Goods in club 3 when level convergence () is found. This holds regardless of what type of differentials are used for the analysis.

Both at the aggregate and sector level, prior to the crisis, global and regional integration is only found for some sub-groups. The degree of global and regional integration are very similar in terms of their speed of convergence and convergence clubs, transitional clubs, and divergent economies across the three data set. There are only two exceptions. The first is the Financials sector where slightly stronger evidence of regional integration is detected given the smaller number of clubs. The second is the Oil & Gas sector where stronger evidence of regional integration is found since there are fewer transitional clubs and a faster speed of club convergence. It is also noteworthy that China has moved from often diverging or being in a transitional club in the pre-crisis period to becoming a member of a convergence club in the second sub-period, which suggests that it has become more integrated, both globally and regionally, after the crisis.

This paper investigates whether the Asian stock markets are more integrated at the global or regional level (the US being used as an indicator of the former, and Japan and the rest of Asia as two altern

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Table 2. Club convergence tests for the Oil & Gas and Technology Sectors in post-crisis period (2009M9-2016M9)

Oil & Gas Sector		
Relative to the US	Club 1	China, India, Hong Kong, Malaysia, Philippine, Thailand, Pakistan, Sri Lanka
	: 0.410	
	t-stat: 6.600	
	Divergent	Singapore, South Korea
	: -4.667*	
	t-stat: -5.545	
Relative to Japan	Club 1	China, India, Hong Kong, Malaysia, Philippine, Thailand, South Korea, Pakistan, Sri Lanka
	: 0.005	
	t-stat: 0.009	
	Divergent	Singapore
Relative to Asia (ex Japan)	Club 1	China, India, Hong Kong, Malaysia, Philippine, Thailand, South Korea, Pakistan, Sri Lanka
	: 0.009	
	t-stat: 0.150	
	Divergent	Singapore
Technology Sector		
Relative to the US	Club 1	Hong Kong, Taiwan
	: 0.364	
	t-stat: 1.868	
	Club 2	China, India, Singapore, Thailand, South Korea
	: 0.529	
	t-stat: 2.373	
Relative to Japan	Club 1	Hong Kong, Taiwan
	: 0.407	
	t-stat: 2.026	
	Club 2	China, India, Singapore, Thailand, South Korea
	: 0.575	
	t-stat: 2.675	
Relative to Asia (ex Japan)	Club 1	Hong Kong, Taiwan
	: 0.377	
	t-stat: 1.876	
	Club 2	China, India, Singapore, Thailand, South Korea
	: 0.553	
	t-stat: 2.512	

Note: * indicates rejection of the null hypothesis of convergence at the 5% significance level.

Table 3. Club

Relative to the US

Club 1 China, India, Hong Kong, Indonesia,
Philippine, Singapore, South Korea,
Taiwan, Pakistan, Sri

	t-stat: 1.560	
4. Consumer Services Sector		
Relative to the US	Club 1	India, Hong Kong, Malaysia, Philippine,
	: 0.785	Singapore, Thailand, South Korea, Pakistan,
	t-stat: 3.492	Sri Lanka
	Divergent	China, Taiwan
	: -4.803	
	t-stat: -6.053*	
Relative to Japan	Club 1	India, Hong Kong, Malaysia, Philippine,
	: 0.415	Singapore, Thailand, South Korea, Pakistan,
	t-stat: 1.842	Sri Lanka
	Divergent	China, Taiwan
	: -4.770	
	t-stat: -5.859*	
Relative to Asia (ex Japan)	Club 1	India, Hong Kong, Malaysia, Philippine,
	: 0.851	Singapore, Thailand, South Korea, Pakistan,
	t-stat: 3.093	Sri Lanka
	Divergent	China, Taiwan
	: -1.665	
	t-stat: -4.006*	
5. Oil & Gas Sector		
Relative to the US	Club 1	China, Hong Kong, Thailand, South Korea

	Club 2	Malaysia, Singapore, Thailand, South
	: 0.929	Korea, Pakistan
	t-stat: 8.833	

8. Healthcare Sector

Figure 1. Relative Transition Parameters for the Oil & Gas Sector in the post-crisis period 2009M9-2016M9: Return differentials vis-à-vis the US

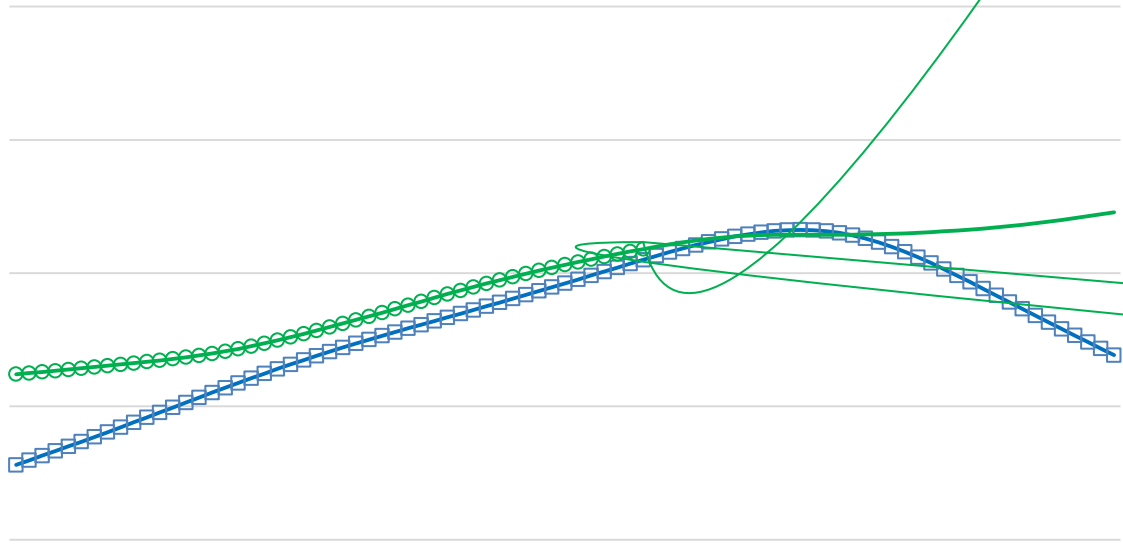


Figure 2. Relative Transition Parameters for the Oil & Gas Sector in the post-crisis period 2009M9-2016M9: Return differentials vis-à-vis Japan

