New Evidence of Financial Integration in Asian Markets

Andrew C. Worthington* and Helen Higgs**

This paper measures the extent of interdependence suggestive of financial market integration among Asian equity markets after January 1993 until December 2010 using daily data. The analysis includes three developed (Hong Kong, Japan and Singapore) and eight emerging (China, India, Indonesia, Korea, Malaysia, the Philippines, Taiwan, and Thailand) markets. The methodology uses panel unit root tests to test for nonstationarity, and conducts multivariate cointegration, Granger causality and level VAR procedures and variance decomposition to examine the equilibrium and causal relationships between these markets. The results indicate that there is a stationary long-run equilibrium relationship among, and significant and substantial short and long run causal linkages between these Asian equity markets. This evidence suggests that a high level of financial integration currently exists in the Asian region, notwithstanding the absence of extensive formal regional agreements aimed at promoting financial integration as found elsewhere, especially in the European Union.

JEL Codes: F36 and G15

1. Introduction

Financial integration is the process by which a country’s financial markets—including money, bond, bank credit and equity markets—become more closely aligned with those in other countries. Three widely accepted and interrelated benefits accrue from this process: more opportunities for risk sharing and diversification, the better allocation of capital across investment opportunities, and the potential for higher economic growth. First, sharing risk across regions enhances specialisation, increases the set of financial instruments available, and thereby provides additional possibilities for portfolio diversification (at least in terms of diversification across industries and companies, but not countries). Second, the elimination of barriers to trading, clearing, and settlement allows firms to choose the most efficient location for their financing activities. Investors too are free to invest their funds where they will attain their most productive end-use. The improvement in capital allocation also enhances financial development, thereby assisting the process of economic growth with additional funds flowing to (often less-developed) countries that have sometimes have more (and better) productive opportunities.

Financial integration arises in two main ways. One is from formal efforts to integrate financial markets with particular partners, typically those that share membership in some wider regional agreement. Integration in this sense involves the elimination of cross-border restrictions on the activities of firms and investors within the region, as well as the harmonisation of rules, taxes, and regulations between member countries. The European Union is an obvious example. The expectation is that financial integration should follow from these developments. However, financial integration may also emerge...
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less formally, very often but not always, as a precursor to explicit regional agreements. Several factors contribute to this means of financial integration. These include foreign bank entry into domestic markets, direct borrowing by firms in international markets, bilateral financial and trade agreements, strengthening finance and trade relationships between countries, and the convergence of business and investor practices. Financial integration such as this is relatively more common in the developing world, especially in geographically close regions.

Financial markets in Asia are a pertinent context in which to consider financial integration, especially in terms of equity markets. Within-Asia cross-border investment and financing opportunities benefited from a succession of booming economies, most recently in China and India. Taking a lesson from the 1997 financial crisis, many Asian countries have now restructured and reformed their economic and financial systems to attract equity capital to assist financial development and economic growth. Simultaneously, the formation of monetary and trade unions in Europe and elsewhere encouraged similar developments and their benefits are now considered in Asia. Key factors in these developments include the increasing shares of intra-regional trade and investment, the large number of emerging markets in the region and their strong growth potential.

This paper employs a quantitative method for measuring financial integration in Asian equity markets. The paper comprises four main parts. Section 2 briefly discusses the literature while Section 3 explains the methodology and presents the data employed. Section 4 deals with the findings. The paper ends with a conclusion in Section 5.

2. Literature Review

To inform policy and provide guidance for investing and financing in Asia, empirical work is needed which reflects, recognizes, and appropriately measures the complex market interrelationships that exist in this globally important region. The key requirements are that the measures should assess the current level of financial integration, and indicate whether integration is progressing, stable, or regressing. One possible approach is the use of cointegration, causality, and variance decomposition methods to assess the equilibrium and causal relationships between financial markets.


This paper addresses this deficiency by including 11 Asian equity markets, both developed and developing in a single analysis using daily data after January 1993 until December 2010. This allows us to generalise the nature of financial integration in Asia for a period of nearly two decades, encompassing long-run changes in financial and product market conditions, trade relationships and investment and capital flows, and
national and regional regulation. Over shorter periods, the impact of short-run changes, especially in financial market conditions, are likely to be more keenly felt, but would largely be unreflective of any longer run effects. In addition, by including a larger number of national markets than generally found in the extant literature, we can especially highlight the patterns of interrelationships between developed and developing markets.

3. Methodology

The data employed in the study is composed of value-weighted equity market indices for 11 Asian markets namely, China (CHN), Hong Kong (HKG), India (IND), Indonesia (INA), Japan (JPN), Korea (KOR), Malaysia (MLY), the Philippines (PHL), Singapore (SNG), Taiwan (TWN) and Thailand (THA). Three of these markets are ‘developed’ (Hong Kong, Japan, and Singapore) while the remainder are ‘emerging’ or ‘developing’. All index data is from MSCI (2011) in US dollar terms. These indices are widely employed because of the degree of comparability, the avoidance of dual listing and the breadth and reflectivity of index coverage [see, for instance, Meric and Meric (1997), Yuhn (1997), Cheung and Lai (1999), Worthington and Higgs (2004a; 2004b)].

This paper investigates the integration and interdependence among Asian equity markets as follows. Panel unit root tests are first conducted as a pre-test of the subsequent empirical analyses. Multivariate cointegration, Granger causality, level VAR, and variance decomposition methods are then employed to examine the integration and interrelationships among markets (Granger 1969; Sims 1980; Engle and Granger 1987; Johansen and Juselius 1990; Johansen 1991; Osterwald-Lenum 1992; Toda and Yamamoto 1995; Hadri 2000; Choi 2002; Levin et al. 2003; Im et al. 2003). These approaches are widely established in the literature. However, rather than tediously reproducing the theoretical method at length in this section, we direct the interested reader to the aforementioned literature. In addition, we use the discussion of the results in the next section to explore the methodology on a step-by-step basis. We therefore provide a more useful guide for future researchers wishing to replicate the method used in this paper in this or another regional context.

4. Discussion

Table 1 includes the panel unit root tests comprising statistics for the LLC \( t \) (Levin et al. 2003), IPS \( W \) (Im et al. 2003) and Hadri (2000) homoskedastic and heteroskedastic Z-tests and their corresponding \( p \)-values at price levels and first-differences for the 11 Asian markets. The LLC \( t \)-test statistic and \( p \)-value for the price level series are 0.5582 and 0.7117, respectively. This implies that the sample evidence on the whole panel of 11 Asian markets does not provide sufficient evidence to reject \( H_{0, LLC} \). This suggests that there is insufficient evidence to conclude that each individual price level series is stationary. The LLC \( t \)-test for the first-differenced price series overall panel produced a \( t \)-statistic of -231.7150 and a \( p \)-value of 0.0000, which concludes the rejection of \( H_{0, LLC} \) at the 5 percent level of significance. The rejection of the null hypothesis implies that each price-differenced series is stationary.
Table 1: Panel unit root tests

<table>
<thead>
<tr>
<th></th>
<th>Level series</th>
<th>First-differenced series</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Statistic</td>
<td>p-value</td>
</tr>
<tr>
<td>Levin, Lin &amp; Chu t*</td>
<td>0.5582</td>
<td>0.7117</td>
</tr>
<tr>
<td>Im, Pesaran and Shin W-stat</td>
<td>1.8923</td>
<td>0.9708</td>
</tr>
<tr>
<td>Hadri Homoskedastic Z-stat</td>
<td>29.5510</td>
<td>0.0000</td>
</tr>
<tr>
<td>Hadri Heteroskedastic Z-stat</td>
<td>58.0591</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

According to the IPS test at price levels across the 11 Asian markets, the IPS \( W \)-statistic of 1.8923 and \( p \)-value of 0.9708 suggest that the null hypothesis, \( H_{0,IPS} \), that all cross-section units in the panel are non-stationary cannot be rejected. The IPS panel unit root test then indicates that at price levels all 11 Asian markets are non-stationary. The first differenced series across all 11 Asian markets gave a IPS \( W \)-statistic of -197.8160 and a \( p \)-value of 0.0000 thus rejecting the null, \( H_{0,IPS} \) which concludes that at least one of the price differenced series in the eleven Asian markets is stationary.

The Hadri homoskedastic and heteroskedastic \( Z \)-tests of the null hypothesis is that all series in the panel are stationary; for the price level series, the null hypothesis is rejected with a homoskedastic \( Z \)-statistic of 29.5510 and a \( p \)-value of 0.0000 and a heteroskedastic \( Z \)-statistic of 58.0591 and a \( p \)-value of 0.0000. This suggests that the price level series for all Asian markets tend to be non-stationary. With respect to the first-differenced series, the Hadri homoskedastic \( Z \)-statistic of -1.7010 and \( p \)-value of 0.9555 and the heteroskedastic \( Z \)-statistic of 0.5902 and \( p \)-value of 0.2775 fail to reject the required null thus indicating that all price differenced series are stationary.

Table 2: Johansen cointegration tests

<table>
<thead>
<tr>
<th>( r )</th>
<th>( H_0 )</th>
<th>( H_1 )</th>
<th>Eigenvalue</th>
<th>Trace test</th>
<th>Critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( r = 0 ) ( r &gt; 0 )</td>
<td>0.0209</td>
<td>**384.1003</td>
<td>310.8100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( r \leq 1 ) ( r &gt; 1 )</td>
<td>0.0168</td>
<td>**309.8591</td>
<td>263.4200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( r \leq 2 ) ( r &gt; 2 )</td>
<td>0.0162</td>
<td>**250.4497</td>
<td>222.2100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( r \leq 3 ) ( r &gt; 3 )</td>
<td>0.0146</td>
<td>**193.1358</td>
<td>182.8200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( r \leq 4 ) ( r &gt; 4 )</td>
<td>0.0115</td>
<td>141.4251</td>
<td>146.7600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( r \leq 5 ) ( r &gt; 5 )</td>
<td>0.0086</td>
<td>100.7337</td>
<td>114.9000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( r \leq 6 ) ( r &gt; 6 )</td>
<td>0.0075</td>
<td>69.7911</td>
<td>87.3100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( r \leq 7 ) ( r &gt; 7 )</td>
<td>0.0046</td>
<td>43.4837</td>
<td>62.9900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( r \leq 8 ) ( r &gt; 8 )</td>
<td>0.0037</td>
<td>27.3488</td>
<td>42.4400</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

According to the panel unit root tests, analysis of the price level series indicates non-stationarity in all 11 Asian markets while the first-differenced price series exhibit stationarity. The finding of non-stationarity in levels and stationarity in differences suggests that each index price series is integrated of order I(1). The finding of non-stationarity in levels and stationarity in first differences provides comparable Asia-Pacific evidence to Elyasiani et al. (1998), Masih and Masih (1999), and Worthington and Higgs (2004). As a result, we use the differenced series to carry out lag length selection, causality tests and decomposition of the forecast error variance for the markets to be analysed.
Table 3: Granger causality tests

<table>
<thead>
<tr>
<th>Market</th>
<th>CHN</th>
<th>HKG</th>
<th>INA</th>
<th>IND</th>
<th>JPN</th>
<th>KOR</th>
<th>MLY</th>
<th>PHL</th>
<th>SNG</th>
<th>THA</th>
<th>TWN</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHN</td>
<td>–</td>
<td>6.4837</td>
<td>0.3089</td>
<td>0.3086</td>
<td>0.9569</td>
<td>1.8707</td>
<td>0.0053</td>
<td>4.7128</td>
<td>1.8842</td>
<td>0.6716</td>
<td>0.1241</td>
<td>2</td>
</tr>
<tr>
<td>HKG</td>
<td>0.0179</td>
<td>–</td>
<td>2.3446</td>
<td>0.0399</td>
<td>2.4283</td>
<td>0.0613</td>
<td>0.1052</td>
<td>0.0802</td>
<td>1.9150</td>
<td>9.6039</td>
<td>3.5959</td>
<td>2</td>
</tr>
<tr>
<td>INA</td>
<td>0.8937</td>
<td>0.1258</td>
<td>0.8416</td>
<td>–</td>
<td>0.1192</td>
<td>0.8045</td>
<td>0.7457</td>
<td>0.7770</td>
<td>0.1665</td>
<td>0.0020</td>
<td>0.0580</td>
<td></td>
</tr>
<tr>
<td>IND</td>
<td>5.1989</td>
<td>0.5544</td>
<td>–</td>
<td>0.1164</td>
<td>1.4946</td>
<td>1.3141</td>
<td>4.5660</td>
<td>36.8903</td>
<td>0.0151</td>
<td>0.5507</td>
<td>0.2066</td>
<td>3</td>
</tr>
<tr>
<td>PHL</td>
<td>0.0227</td>
<td>0.4566</td>
<td>0.7329</td>
<td>–</td>
<td>0.2216</td>
<td>0.2517</td>
<td>0.0327</td>
<td>0.0000</td>
<td>0.9022</td>
<td>0.4581</td>
<td>0.6495</td>
<td></td>
</tr>
<tr>
<td>SNG</td>
<td>0.0344</td>
<td>2.8171</td>
<td>5.8639</td>
<td>–</td>
<td>5.7946</td>
<td>22.7973</td>
<td>1.3130</td>
<td>1.0648</td>
<td>0.3068</td>
<td>1.2852</td>
<td>4.3124</td>
<td>5</td>
</tr>
<tr>
<td>THA</td>
<td>0.8530</td>
<td>0.0934</td>
<td>0.0155</td>
<td>–</td>
<td>0.0161</td>
<td>0.0000</td>
<td>0.2519</td>
<td>0.3022</td>
<td>0.5797</td>
<td>0.2570</td>
<td>0.0379</td>
<td></td>
</tr>
<tr>
<td>TWN</td>
<td>3.0604</td>
<td>9.9014</td>
<td>1.7360</td>
<td>1.0134</td>
<td>–</td>
<td>2.9116</td>
<td>1.6957</td>
<td>0.8648</td>
<td>3.5976</td>
<td>3.6398</td>
<td>2.3474</td>
<td>5</td>
</tr>
</tbody>
</table>

Johansen cointegration tests are used in order to obtain the cointegration rank. The eigenvalues and trace test statistics are detailed in Table 2 for the various null and alternative hypotheses. As multivariate cointegration tests cover all eleven markets rather than simple bivariate combinations they consider the wide range of options available to Asian investors and financiers, as well as the scope of financial integration that may not be reflected in pairwise combinations. The trace test statistic is greater than the critical value for the null hypotheses of r = 0 thereby rejecting the null hypothesis. However, the null hypothesis of r ≤ 1 fails to be rejected in favour r > 1 indicating the order of cointegration is 1. However, similar hypothesis are rejected up to, but not including, r ≤ 4 thereby suggesting an order of integration of four. The primary finding obtained from the Johansen cointegration tests is that a stationary long-run relationship exists between the 11 Asian equity markets.

As cointegration exists, we perform Granger causality tests. F-statistics are calculated to test the null hypothesis that the first market index series does not Granger-cause the second, against the alternative hypothesis that the first index Granger-causes the second. The calculated statistics and p-values for the markets are in Table 3. Among the 11 Asian markets, 40 significant causal links are found at the 0.10 level or lower. For example, column 1 shows that the Indian, Japanese, Malaysian, Taiwanese, and Thai markets Granger-causes the Chinese market. In turn, Thailand (column 10) has a Granger causal relationship with Hong Kong, Japan, and Malaysia.

We gain further insights by examining the rows in Table 3 indicating the effects of a particular market on all markets. It is evident that the Malaysian and Thai markets are among the most influential in the 11 Asian markets. Malaysia influences six markets namely, China, India, the Philippines, Singapore, Taiwan, and Thailand. Thailand also Granger causes six markets, namely, China, Hong Kong, India, Korea, the Philippines, and Taiwan. The least influential market in terms of Granger-causality is the Philippines. There is also an indication that there is feedback at play in several combinations: for example, Thailand Granger-causes Hong Kong and Hong Kong Granger-causes...
Thailand. Generally, high levels of market linkages arise because of the presence of common investor and financing groups.

One implication in Table 3 is that there may be no portfolio diversification gains possible between countries where a significant causal relationship exists (at least in terms of country-level diversification, though not diversification across industries and companies). Another is that as we have a finding of causality these markets must violate weak-form efficiency as one of the markets can help forecast the other. A final implication is that the law of one price holds in part: often used as a simple indicator of financial integration. Overall, the presence of Granger causality implies that there are sufficient short-run interrelationships between the markets to believe that some form of financial integration is present.
The long-run causality Wald test statistics and p-values based on Toda and Yamamoto’s (1995) level VAR procedure are in Table 4. We estimate the model for levels, such that a significant Wald test statistic indicates a long-term relationship. This serves to supplement the findings obtained from the Granger causality (short run) results in Table 3. Among the 11 markets, 54 significant causal links are found at the 10 percent level or lower. For example, column 3 shows that the stock markets in China, Hong Kong, Japan, Korea, Malaysia, the Philippines, Singapore, Taiwan, and Thailand
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affect the Indian market. The rows in Table 4 indicate the effects of a particular market on all markets. It is evident that markets in Japan and Taiwan are the most influential markets in the long run among the 11 Asian equity markets: together these markets affect China, Hong Kong, India, Korea, Malaysia Singapore and Thailand. The least influential markets are China and India.

However, we qualify these results in that Granger causality tests only indicate the most significant direct causal relationship. For example, it may be that some markets influence non-Granger caused markets indirectly through other markets. In order to address this concern, Table 5 presents the decomposition of the forecast error variance for the 2-day, 5-day, 10-day, and 15-day ahead horizons for the eleven Asian member equity markets. Each row indicates the percentage of forecast error variance explained by the market indicated in the first column.

For example, at the 2-day horizon, the variance in the Chinese market explains 84.39 percent of its own innovations, whereas we explain 6.75 percentage of variance by innovations in the Malaysian market, 3.01 percent by the Singaporean market, 2.44 percent by the Thai market, and 1.38 percent by the Japanese market. All Asian home markets explain at least 75 percent of their own innovations with the exception of Singapore and Hong Kong. Singapore influences some 68 percent of its own innovations and Hong Kong only 54 percent. The Singaporean market significantly influences the Malaysian market by 19 percent, even after 15 days. It is readily apparent from the decomposition of the forecast error variance in Table 5 that sizeable differences in the percentage of variance explained by domestic and international markets prevail across Asian stock markets.

Overall, our results have contributed to this important literature on financial integration in three main ways. First, we have focused on the Asian context and therefore provided new and up to date on the state of financial integration as it presently exists in this key regional market, especially in assessing the position of China and a large number of other rapidly developing financial markets. No comparable evidence exists in the extant work. Second, we have focused on a region where formal efforts aimed at economics and financial integration are limited but actively canvassed. This provides a useful benchmark for future policy and other efforts aimed at market integration. Once again, there has been relatively little focus in this regard in the existing literature. Finally, we have applied genuine multivariate techniques to all of the cointegration, Granger causality, level VAR, and variance decomposition methods used in this analysis, not merely simple bivariate combinations as often found outside the theoretical econometric literature.

5. Conclusion

This paper investigates financial integration and interdependence in Asian equity markets. Three of these markets are regarded as developed (Hong Kong, Japan and Singapore) and the majority are viewed as emerging (namely, China, India, Indonesia, Korea, Malaysia, the Philippines, Taiwan, and Thailand). Panel unit root tests are used to test for non-stationarity, and multivariate cointegration, Granger causality and level VAR procedures and variance decomposition are conducted to examine the equilibrium and causal relationships among these markets. The results indicate that there is a stationary long-run equilibrium relationship among, and significant and substantial short and long-run causal linkages between, these Asian equity markets. Possible reasons in
the absence of explicit regional agreements aimed at financial integration include long-standing trends in trade and investment interaction, the more recent convergence in monetary policies and the almost universal process of economic reform.

The findings obtained in this paper indicate that three main benefits thought to accrue from financial integration—more opportunities for risk sharing and diversification across industries and companies (but not countries), the better allocation of capital across investment opportunities, and the potential for higher economic growth—are present in Asian regional markets. Three caveats apply. First, the level of financial integration is relatively higher in economies like Japan, Indonesia, Malaysia, Singapore, and Taiwan that share many interdependent relationships. The evidence for financial integration is less convincing for economies such as China and India.

Second, financial integration in this paper has only been examined in the context of equity markets. Accordingly, we make no comment on the extent of integration in the bond, money, and bank credit markets, or realistically on the financial sector as a whole. Finally, despite the relatively high number of interdependencies and the overall level of integration, Asian domestic markets are relatively isolated. All Asian home markets explain at least 75 percent of their own innovations with the exception of Singapore and Hong Kong: Singapore influences some 68 percent of its own innovations and Hong Kong only 54 percent. As a point of comparison, work by Worthington et al. (2003a) found that non-domestic markets explained 48.1 percent of the variance for France, 64.9 percent for Germany, 38.7 percent for Italy, 60.1 for the Netherlands and 65 for Spain. This would indicate, in line with the policy emphasis and interests of the European Union and the European Central Bank that advances in financial integration exist in at least one other regional setting.

References

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