**Financial Integration and Diversification Benefits: China and ASEAN4 Countries**

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**Abstract**: In this paper, we investigate the level of financial integration of the equity markets in China and ASEAN4 countries: Indonesia, Malaysia, Philippines, and Thailand. Using beta and sigma convergence, dynamic conditional correlation, and wavelet correlation, we find that financial integration across these markets fluctuated between a moderate level before and after the recent crisis and a higher level during the crisis. Our results indicate that investors achieve higher diversification benefits from a cross-industry than a cross-country investment strategy within this region. The diversification benefits and the length of the investment horizon are inversely related.

**Keywords**: Investment constraints; Home bias; International diversification

**I. Introduction**

The strategic partnership established by China and ASEAN (Association of Southeast Asian Nations) on October 2003 represents an important milestone in the process towards financial and economic integration within the region. After the establishment of the partnership, the member countries completed significant financial reforms and commenced several initiatives, such as the ASEAN-China Free Trade Area (2010) and Chiang Mai Initiative (2010). The scale and pace of these changes call for systematic assessments of their bearing on the development and integration of financial markets in this region. Several studies document a relatively weak albeit increasing integration of the Asian financial markets compared with other regions of the world (Johansson, 2008; Park and Lee, 2011; Kim and Lee, 2012.) The increase in integration across these equity markets is partially attributable to a higher degree of integration of certain sectors (Basic Materials and Financials) and the contagion effects produced by the US subprime and European debt crises (Donadelli and Paradiso, 2014). Within the region, the relatively more developed equity markets are more affected by the movements of the dominant regional market than those in the ASEAN4 (Yu et al., 2010).[[1]](#footnote-1) Notwithstanding the increasing political and economic ties between China and ASEAN, the evidence on the linkages among their equity markets remains rather limited (Burdekin and Siklos, 2012; Dewandaru et al. 2015).

Against this background, we assess the degree and trend of integration of the Chinese and ASEAN4 (Indonesia, Malaysia, Philippines, and Thailand) equity markets in the aftermath of the 2004 adoption of the *Plan of Action to Implement the Joint Declaration on ASEAN-China Strategic Partnership*. The plan outlined the “financial and monetary integration” as an integral part of the financial cooperation among members of the partnership.

Our contribution to the literature on the integration of Asian financial markets in twofold. First, we use three approaches, the beta and sigma convergence, the dynamic conditional correlation, and the maximal overlap discrete wavelet transform to measure the integration, both at the national and sectoral level, of the five countries, during normal and crisis periods. Given the different focus of these indicators, we measure not only the degree and speed of integration of the five markets but also its change across different time scales. We add new evidence to the ongoing debate on whether the national or sectoral diversification is more beneficial to an investor who wants to diversify her portfolio by investing in a specific region (Balli et al., 2011; Balli et al., 2014; Donadelli and Paradiso, 2014.)

Second, we investigate how the integration of these markets or lack thereof translates into portfolio diversification benefits to Chinese investors. We use two diversification measures to assess the benefits to investors in China from a strategy of diversification within the ASEAN4 region as opposed to investing in a mature market, such as the EU region.

Our results are as follows. We find consistent evidence of a weak to moderate level of financial integration during normal or tranquil periods and a higher level of integration during the recent crisis. Thus, we argue that investors can still benefit from a strategy of cross-nation diversification across the set of five markets. However, the diversification benefits decrease for longer investment horizons. We also find that an investment strategy based on sectoral indices within this region is superior to that of national indices. Finally, we compare the diversification benefits of an equity portfolio that includes China and ASEAN4 versus China and EU and conclude that during our sample period was more beneficial for a Chinese investor to invest regionally.

The paper is structured as follows. In Section II, we discuss selected studies on this topic Section III introduces the measures the financial convergence and diversification benefits and presents the data the main results. Finally, Section IV presents the concluding remarks.

**II. Literature review**

There is a vast literature on the financial integration in Asia and in particular, the integration of the equity markets. Researchers have used an array of methodologies to assess the equity market integration within the region during tranquil and crises periods. Whereas no integration between the US and Asian markets is found using pre-1998 data (Chan et al., 1992, De Fusco et al., 1996, Tian, 2007), recent studies document an increase in integration between Asian and developed markets after the Asian crisis and especially during the Great Financial Crisis. For example, Pukthuanthong and Roll (2009) use the explanatory power of a multi-factor model to show that global markets are increasingly integrated.[[2]](#footnote-2) Chan and Mohd (2010) find intraregional linkages among the equity markets of the ASEAN-5 countries and that the region is more influenced by the U.S. than the Japanese market. Loh (2013) uses wavelet analysis to examine the co-movement across different time scales of the Asia-Pacific markets with that of Europe and US and finds that the co-movement concentrates at the medium time scale during the US subprime and at shorter scale during the European debt crisis. While there is ample evidence on the linkages among equity markets in the region and between the region and several developed markets, the linkages with the market in China have received scant attention. Among these studies, Huang and Hu (2000) find no evidence of co-integration among the equity markets of China and South China Growth Triangle (SCGT). Wang and Lu (2012) use the spillover index method to show that China stock market has a lower influence than the US on other markets in Asia (Malaysia, Philippines, Indonesia and Thailand). Hwang (2012) uses several GARCH models to measure the dynamic correlation between the US, China and Asian countries during the period from 2000 to 2010 and shows that China market has insignificant linkages with other Asian stock markets. These results confirm the evidence advanced by Chen et al. (2007) that, in spite of an increase in integration of the A- and B-share Chinese markets after the opening of the B-shares markets to domestic investors in 2001, the Chinese stock markets remained segmented from the international equity markets. However, Yilmaz (2010) suggests that the return and volatility spillover of China and East Asian’s equity markets, which rises during crises, reached its peak during the recent financial crisis. Narayan et al. (2014) find similar evidence of a stronger correlation during the global financial crisis for a group of selected emerging Asian markets against the US, Australia, China, and India. Burdekin and Siklos (2012) examine the relationship between the Chinese, US and Asia-Pacific equity markets using dynamic conditional correlation and contagion tests, and find that the growth of Shanghai stock market led to more integration with other markets, including the ASEAN5 group: Singapore, Thailand, Philippines, Indonesia and Malaysia. Nonetheless, Yu et al. (2010) show that prior to the Great Financial Crisis, the equity markets of different blocks in the region exhibited varying degrees of integration. The equity markets in the four-dragon block (Hong Kong SAR, Taiwan, South Korea, and Singapore) were more integrated with each other than those in greater China and ASEAN4.

In this paper, we revisit the evidence on the integration of China and ASEAN4 equity markets before and during the recent crisis and add new evidence on the degree and evolution of such integration through the post-crisis period. We also add to the recent examination of the benefits obtained by investors who choose to adopt a cross-country versus cross-industry diversification when investing in a region. Balli et al. (2011) argue that in recent years industry effects are predominant, whereas up until the end of the 1990s national factors were the dominant factors explaining stock return. Several studies confirm this argument and indicate that, based on recent sets of data, sectoral diversification is better than national diversification (Moerman, 2008; Donadelli and Paradiso, 2014). However, Balli et al. (2014) argue that the ASEAN national returns have a higher percentage of dependence on their own shocks than ASEAN-wide sector returns and a portfolio made up of ASEAN-national equities has a higher efficiency frontier than that of ASEAN-wide sector equities.

We reexamine the portfolio diversification strategy using national indexes versus a strategy using sectoral indexes of the ASEAN4 group. In particular, we investigate the extent to which the degree and trend of financial integration is reflected by diversification benefits to Chinese investors when investing regionally.

**III. Data description**

In this paper, we use data at the national and sectoral levels for a period spanning 2004 to 2014. The data sample, retrieved from the Morningstar Direct database, consists of weekly returns for China and ASEAN4 stock market indices and their corresponding sectoral indices. We treat the China stock market index returns as the benchmark series. As a member of the strategic partnership with ASEAN countries, China stock market is an appropriate external market for our analysis of changes in financial integration of ASEAN4 equity markets after the 2004 adoption of the *Plan of Action to Implement the Joint Declaration on ASEAN-China Strategic Partnership.*

For the financial integration analysis, we use the span of the recent crisis as defined by the National Bureau of Economic Research. While there are different expansion and recessions dates for countries in the ASEAN4-China group, we examine the level of integration of these markets during the financial crisis and pre- or post-crisis periods, as the contagion effect of the subprime crisis had a significant impact on the entire region (Valls and Chuliá, 2012; Narayan and Narayan, 2012; Loh, 2013).[[3]](#footnote-3) This classification also allows us to compare our results with the previous evidence (Donadelli and Paradiso, 2014). We define the pre-crisis period from 2004 to November 2007, the crisis period from December 2007 to June 2009, and the post-crisis period from July 2009 to 2014.

Panel 1 of Table 1 presents the national stock market indices for China, the four ASEAN countries, and the eight major EU countries used in this paper. All indices are calculated based on free-float capitalization-weighted method.

Panel 2 of Table 1 presents the sectoral stock market indices for the China and ASEAN4 countries. The four sectors, Consumer Goods, Financials, Industrials, and Properties and Real Estate are chosen based on the availability of the data sources. Philippine represents the only exception with only three sectors: Financials, Industrials, and Properties and Real Estate. According to the Philippine Stock Exchange, the Consumer Goods (food, beverage and tobacco) sector is listed as a subsector of the Industrials sector.

Figures I and II present the trends in returns of national indices and the four sectoral indices: Consumer Goods, Financials, Industrials, and Property and Real Estate. Trend values are obtained using the Hodrick-Prescott filter with the smoothing filter which corresponds to the weekly data and the returns series are tested for stationarity under standard tests (ADF).

Similar to the national stock indices, China’s sectoral indices seems to move together with those of the other countries during the Great Financial Crisis, except for the Consumer Goods sector. Before the crisis, all sectoral indices in China soar above all others, while during the post-crisis period sectoral indices of China are among the lowest of the five countries. Overall, the alignments among the five countries’ indices are higher for the Industrials and Property and Real Estate sectors than for the Consumer Goods and Financials.

**IV. Methodologies**

In this paper, we use several approaches to investigate the financial integration: the beta and sigma convergence, the dynamic conditional correlation, and the wavelet analysis.

***1. Financial integration: Beta and Sigma convergence***

Beta-convergence determines the speed at which differences in market indices’ returns between an individual stock market and a benchmark market are eliminated. A negative beta coefficient shows that there is indeed convergence of the two stock markets; and the closer value of beta coefficient to -1, the higher the speed of convergence. The beta coefficient is estimated by the following procedure

Where  is the difference in returns of the market index in consideration and the benchmark market (in this case the benchmark market is China) at time t, and is the difference operator, is the constant term, is the lag length and is the disturbance. Following Babecký, Komárek and Komárková (2012), we choose the lag length l to be 4. The value of indicates the speed of convergence and can take values between 0 and -2, with 0 and -2 being two points of no convergence. The speed of convergence is highest when is -1. Any value between 0 and -1 indicates monotonous convergence, while values from -1 to -2 imply oscillating convergence.

A related concept, the half-life of shock to the return differential between two markets (HL) is the period during which the shock declines to one half of its initial value. It provides another way to assess the beta convergence between the two markets. The lower the value of half-life of shock, the fewer days it takes for the difference in the returns of the two markets to decline. In short, the lower the value of half-life, the faster the speed of beta convergence is. The half-life is calculated as follows:

Sigma convergence determines the cross-sectional dispersion of returns on individual stock markets at a given moment of time. Therefore, it shows the degree of financial convergence between the benchmark country (China) and the selected markets (the set of four ASEAN markets.) The magnitude of convergence is measure by the sigma parameter. A smaller sigma parameter indicates a higher sigma convergence level. The sigma parameter at time t is calculated as follows

Where is the difference in returns of the selected market index and the benchmark market (China), is the mean of the difference in returns in the selected period and N is the number of observations (periods). The sigma parameter is positive and full integration is reached when sigma reaches zero.

***2. Financial integration: Dynamic conditional correlation***

In this paper, we create a time-varying measure for the financial integration level among China and the ASEAN countries using a traditional approach – the dynamic conditional correlation DCC-MGARCH model using a discrete wavelet transformation (DWT.)

Wavelet transformation, or wavelet analysis, has reached out from the realm of pure mathematics to other fields because of its power to analyze signals (including time series), shedding light on more complex and useful information that cannot be obtained from raw signals. Wavelet transformation is an improvement over Fourier transformation, which can only provide the frequency representation and the extent of each frequency in the series without the time when these frequency components exist. In turn, wavelet transformation gives simultaneous information on both time and frequency. In addition, wavelet transformation has several other advantages over Fourier transformation. For example, it does not require the series to be stationary and its nonparametric nature addresses potential nonlinear relationships without losing details.

In this paper, we use the discrete wavelet transformation (DWT) that decomposes a time series into approximation and detail coefficients. In the context of financial data, detail coefficients indicate the short-term and impulsive movement under factors such as news and events. The approximation coefficients provide the long-run behavior of financial data, in which the short-term fluctuations are removed. Thus, the approximation coefficients are better suited for analyzing the relationship between two or more time series.

We use the DWT to extract the approximation coefficients on all the stock market indices and then use the DCC-MGARCH to model the degree of financial integration among the five countries’ stock markets. We briefly present the specification and properties of the DCC-MGARCH model as follows.

First, consider the original Bollerslev model (1990):

where is a sequence of return vectors, is the information available to time t, and R is the correlation matrix containing the conditional correlations. Engle (2002) modifies the model by allowing the correlation matrix R to vary over time

One specification for the correlation matrix is suggested by the GARCH (1, 1) model

where is the unconditional correlation between and (Engle, 2002). The above equation can be written as follow

The correlation estimator will be calculated as

which is always positive and represents the financial integration level over time.

***3. Financial integration: wavelet correlation***

Using wavelet analysis, several studies show that the co-movements between stock markets change in time and vary across frequencies (Graham et al., 2012; Loh, 2013). The choice of wavelet analysis over other approaches is motivated by the fact it accounts for the fact that market participants have different investment horizons. Since investment decisions are made over different time scales, market co-movements vary across these scales. We use the wavelet correlation to capture the integration for different time scales from short-term (1-2 weeks) to long-term (32-64 weeks). The results provide evidence on the diversification benefits for different investment horizons and thus aid investors in choosing the appropriate time frames when implementing their investment strategies.

This methodology uses the Maximal Overlap Discrete Wavelet Transform (MODWT). DWT and MODWT are similar with respect to the decomposition of time series into approximation coefficients (signals) and detailed coefficients (noises), but MODWT offers an important advantage over DWT. While DWT cuts the number of data points into halves, MODWT retains the number of data points from the original data. Using this advantage, we can apply MODWT many times to an original data set to obtain the approximation coefficients (signals) at different time scales without losing any data points. Then in each time scale, we calculate the usual correlation coefficients between China and ASEAN4 equity markets.

***4. Diversification benefits***

The next step is to create a time-varying measure for the diversification benefit of an investor in China when diversifying her portfolio within the ASEAN4 region. Following Li et.al (2003) and Chiou and Lee (2014), we evaluate the diversification benefit in two aspects: higher return and lower volatility.

Consider a set up consisting of n assets whose returns are normally distributed. Let be the vector that represents the returns of n assets. Let be the vector representing the mean or expected return of these assets and V be the matrix representing the covariance of these assets. Consider the set S of all possible weights of the assets

With constraints related to the investment process, prohibition on short sales and over-weighting investment constraints, we construct C as a subset of S

where

The mean of a portfolio with weight is and the variance is . Now by the method of Markowitz (1952), we can form the efficient frontier by minimizing the following expression

where q is a positive constant

With the goal of seeking higher return per unit of risk by diversifying, we choose the point on the efficient frontier that maximizes the Sharpe ratio. Let be the risk free rate, then the maximum Sharpe ratio is calculated by

Following Chiou and Lee (2014), the first measure of diversification benefit with respect to increase in return per unit of risk is

where is the maximum Sharpe ratio of the diversified portfolio and is the maximum Sharpe ratio of the portfolio of the country we examine, which is China (US) in this case.

The second measure of the benefits of diversification is the reduction in volatility that results from international diversification. According to Chiou and Lee (2014), the unpredictability of expected returns leads some investors to minimize the risk. Thus, we choose the point on the efficient frontier that minimizes the variance of the portfolio. The minimum standard deviation is calculated by

The second measure of diversification benefit with respect to decrease in variance is

where is the minimum standard deviation the diversified portfolio and is the minimum standard deviation of the portfolio of China (US).

Finally, since we want to obtain a time-varying measure of diversification benefit, we use the rolling estimation technique (Fratzscher, 2003). We construct a 60-week window starting from the beginning of our observation and calculate the diversification benefit for this period and then move this window forward by one week at a time to obtain the time series of the diversification benefit.

**IV. Results**

***1. Financial integration using beta and sigma convergence***

In what follows, we discuss the results of the beta and sigma convergence analysis for the China-ASEAN4 group. In Table 2, Panel 1, we present the estimation of beta coefficient between China’s market and the markets of four countries in the ASEAN group. We find that all beta coefficients are negative and significant at the .01 level, consistent with the hypothesis of a beta convergence between China and ASEAN4. While the beta coefficients are close to -1, the shock half-lives are mostly between 2 and 3. The result suggests that it takes only a few days for the difference in stock markets returns to decline into halves. However, we find that the speed of beta convergence during the 2008 financial crisis is higher than the pre-crisis and post-crisis periods. Our results are consistent with the argument advanced by Corsetti et al. (2005) on contagion effects. Typically, the half-lives of shock during the crisis period is about half a day, lower than the half-lives of shock during the pre-crisis and the post-crisis periods. After the financial crisis, the beta convergence coefficients between China and the four ASEAN countries are further away from the -1 point, which can be interpreted as evidence that a high level of integration is not yet achieved.

Panel 2 of Table 2 shows the beta coefficients and shock half-lives of China and the ASEAN sectoral markets. We find similar patterns for the sectoral and national convergence. The speed of convergence is lower after the crisis and higher prior to and during the crisis for all sectors except for Properties and Real Estate. Typical half-lives measure in the pre-crisis period is between 2 to 5 days, while half-lives during and after the crisis takes values between 1.5 and 2.5 days. The speed of beta convergence for the Properties and Real Estate was already high before the crisis and remains stable afterwards.

Figure III indicates that the sigma convergences between China and each of the four ASEAN countries share the same pattern. There is an increase in return dispersion until 2008/2009, followed by a steady decrease in dispersion after 2009. Therefore, after the financial crisis 2008, the relationship between China and four ASEAN markets come back towards sigma convergence. Nevertheless, all four sigma parameters are high – all greater than 2.5% – which is consistent with our initial finding that a strong integration between China and ASEAN4 is not yet attained. A comparison of the parameters of the ASEAN countries indicates that the sigma convergence level between China and Malaysia is higher than the convergence levels of China and the other three countries, which are roughly the same across time.

Figure IV shows the sigma convergence analysis between China and ASEAN4 from a sectoral perspective. The results at the sectoral level are similar to those at the national level. There is an increase in dispersion level until 2009, which gradually corrects back towards convergence after that. On the sectoral level, the sigma parameters are generally higher than the parameters on national level, especially those of the Properties and Real Estate sector – with the highest sigma parameter reaching 7%. Therefore, we conclude that the sigma convergence of China–ASEAN4 sectoral markets is relatively low.

***2. Financial integration using the dynamic conditional correlation***

Figure V presents the financial integration levels measured by dynamic conditional correlations between China and the four ASEAN countries. The correlations range from less than 0.1 to at most 0.5 and fluctuate mostly around 0.3. Thus, the evidence of a weak to moderate co-integration of these markets is indicative of a potential to diversify when ASEAN4 equities are added to portfolios of Chinese equities. However, the correlations rose sharply from 2006 to 2009, right before and during the financial crisis, and reached a peak in 2009. Our results are consistent with the evidence advanced by Burdekin and Siklos (2012) of an increasing co-integration of Shanghai and ASEAN4 equity markets, prior and during the crisis. However, we argue that that the increase in correlations observed during the crisis was only temporary and not part of a permanent shift. The correlations fluctuated around lower levels in the years after the crisis and reached the pre-crisis level by the end of year 2014.

***3. Financial integration using wavelet correlation***

Table 3 and Figure VI show the wavelet correlation between China and four ASEAN countries. We observe the same patterns across the four countries: the integration levels generally increase when the time horizon gets longer. At the short-term scale 1-2 week, the correlation levels between China and four ASEAN countries are at the weak to moderate level. However, as the time horizon gets longer, at the long-term scale 32-64 week, the correlation levels between China and four ASEAN countries are relatively high. Also, the correlation between China and Malaysia seems to be the highest and the one between China and Thailand the lowest across all time scales. In essence, our results are similar to the results of Fernandez (2012) and Tiwari et al. (2013). We find evidence that investors get diminishing diversification benefits as the investment horizon gets longer.

***4. Diversification benefit, national versus sectoral***

In what follows, we measure the diversification benefits achieved by investors from both cross-industry and cross-country investment strategies within this region. Panel 1 of Table 4 and Figures VII show the first measure of diversification benefit δ, the increase in return per unit risk, between China and the ASEAN4 at both national and sectoral levels. At both levels, diversification benefits follow a similar pattern for the period 2005 to 2013. Diversification benefits declined sharply from 2005 to 2009, a decline that reflects the increasing financial integration of the group of equity markets. It is also noticeable that during the crisis period, diversification benefits among the five countries even reached a negative level. This means that during the crisis period, the integration lowered the diversification benefits to the point that it was disadvantageous to diversify regionally. After the financial crisis, diversification benefits increased and fluctuated around the pre-crisis level. Our results are consistent with the evidence that, in spite of an increase in the economic integration, local factors, cultural and political differences still play an important role in these equity markets (Donadelli and Prosperi, 2012, Chiou and Lee, 2013, Bekaert et al., 2014, Almekinders et al., 2015, Narayan et al., 2014). When comparing the diversification benefits with and without sectoral indices, we observe that diversifying with sectoral indices is slightly better than diversifying using country-level indexes. A confidence interval analysis shows that the return (per unit risk) increases by 0.02 to 0.1. Thus, we conclude that the equity markets at sectoral level are even less integrated than those at the country level and thus, a sectoral investment strategy yields a better return per unit risk.

Panel 2 of Table 4 and Figure VIII show the second measure of diversification benefit ε, the decrease in volatility, between China and ASEAN4 countries at both national and sectoral levels. Unlike the first diversification measure, the second measure fluctuates around a stable level throughout the whole period, with the only exception of a sharp decrease in 2012. This decrease also corresponds to a trough in the first measure of diversification benefit, indicating an increase in integration during the year 2012 among the five countries. When comparing the diversification strategy that includes sectoral indices and the one on national indices, we find that the former yields a significantly lower volatility in return than the latter. A confidence interval analysis shows that the variance decreases from 0.16 to 0.18. Although it is expected that adding assets to a portfolio will normally reduce the variance, this significant difference implies that the sectoral indexes are still not correlated at a high level. Our results differ from the evidence provided by Balli et al. (2014) that investors might be better off diversifying their assets across countries rather than sectors in ASEAN area, owing to differences in sample periods. While sample period used by Balli et al. (2014) includes the decade of the 1990s when national factors were more prominent than sectoral effects, our sample period largely captures the increasing importance of the sectoral effects.

***5. Diversification benefit, regional versus international***

Next, we compare the diversification benefits of a portfolio including China and ASEAN4 countries and a portfolio including China and several major countries in the EU group. Generally, an investor is more likely to invest in the neighboring countries than in a different part of the world, due to the familiarity with regional stock markets. However, one may argue that investing in more mature markets could result in higher diversification benefits as these stock markets are presumably less integrated with Asian emerging markets. Therefore, we examine the difference in diversification benefits for a Chinese investor who contemplates adding European or ASEAN equities to her portfolio of domestic equities.

Panel 3 of Table 4 and Figure IX show the first measure of diversification benefit δ, the increase in return per unit risk, between a portfolio consisting of China and the ASEAN stock market indexes (China-ASEAN4) and a portfolio consisting of China and the EU stock market indexes (China-EU). At a first glance, both diversification benefits follow a similar pattern. However, since mid-2006 the diversification benefit of the China-EU portfolio is significantly lower than the diversification benefit of the China-ASEAN portfolio. Using a confidence interval analysis, the China-ASEAN portfolio outperforms the other by 0.11% to 0.15% return per unit risk. Panel 4 of Table 4 and Figure X present the second measure of diversification benefit ε between the two portfolios, China-ASEAN and China-EU. Again, we observe that before the financial crisis, the diversification benefits of the two portfolios are similar, while after the financial crisis, the diversification benefits of the China-ASEAN portfolio are higher than the China-EU portfolio. Similarly, we use a confidence interval analysis to show that the decrease in variance of the China-ASEAN portfolio is 12% to 15% more than the decrease in variance of the China-EU portfolio. This again indicates that after the financial crisis, Chinese investors enjoyed higher return and lower volatility by investing regionally.

**V. Conclusion**

This paper investigates the diversification benefits and financial integration of stock markets among China and four fast-growing Asian countries: Indonesia, Malaysia, Philippines, and Thailand. We use beta and sigma convergence and the dynamic conditional correlation to measure of degree of financial integration across these markets.

Overall, we find that the level of financial integration between China and the four ASEAN countries has fluctuated during the recent decade and that the post-crisis levels of integration are at weak to moderate levels. It is also notable that as the investment horizon, or time scale, get longer, China and ASEAN countries’ stock markets become more correlated, signaling a decrease in diversification benefits.

The results of the diversification benefits analysis are consistent with those based on the financial integration. As a result, we conclude that regional investors can still benefit from diversifying their portfolios across these five countries. A diversification strategy using sectoral indices instead of national indices leads to a substantial increase in unit-risk return and decrease in variance, indicating that it is more advantageous for investors to diversify using sectoral instead of national indices. Finally, we also compare the diversification benefits of a portfolio including China and the ASEAN4 countries and a portfolio including China and several EU countries and conclude that during our sample period it was more beneficial for a Chinese investor to diversify regionally.

From a policy standpoint, our results contribute to the ongoing debate on how the degree and evolution of regional financial integration are used to maximize the potential to allocate capital efficiently and mitigate the ensuing cross-border financial contagion during crises.

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**Appendix**

**Figure I: National Stock Market Indices Returns**

**Figure II: Sectoral Stock Market Indices Returns**

Consumer Goods

Financial

Industrial

Property and Real Estates

**Figure III: Sigma convergence on the national level, China versus other countries**

**Figure IV: Sigma convergence on the sectoral level, China versus other countries**

Consumer Goods

Financial

Industrial

Properties and Real Estates

**Figure V: Dynamic conditional correlation between China and the ASEAN countries**

**Figure VI: Wavelet correlation between China and ASEAN countries**

**Figure VII: Diversification benefit China-ASEAN national and sectoral, first measure δ**

**Figure VIII: Diversification benefit China-ASEAN national and sectoral, second measure ε**

**Figure IX: Diversification benefit China-ASEAN and China-EU, first measure δ**

**Figure X: Diversification benefit China-ASEAN and China-EU, second measure ε**

**Table 1: Stock market indices**

*Panel 1 National indices*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Country | Stock market index | Nr. of constituents | Market capitalization (national currency) |
|  | China | Shanghai SE A Share | 943 | 14,974,400 |
| ASEAN4 | Malaysia | FTSE Bursa Malaysia | 30 | 512,098 |
| Philippines | PSE PSEI Philippines | 30 | 2,558,038 |
| Indonesia | JSX Composite | 489 | 4,430,000,000 |
| Thailand | SET 50 | 50 | 8,375,962 |
| EU | Austria | Wiener Borse ATX PR EUR | 76 | 82,324,181 |
| Spain | Spain IBEX 35 | 35 | 485,736,351 |
| Finland | OMXH Helsinki Cap PR EUR | 126 | 229,557,360 |
| Italia | FTSE Italia MIB Storico PR EUR | 217 | 266,522,000 |
| Germany | FSE DAX TR EUR | 30 | 824,100,000 |
| France | Euronext Paris CAC 40 PR EUR | 40 | 1,187,960,000 |
| Belgium | Euronext BEL 20 PR EUR | 20 | 277,120,000 |
| Netherland | Euronext AEX PR EUR | 25 | 461,390,000 |

*Panel 2 Sectoral indices*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sector | China | Malaysia | Philippines | Indonesia | Thailand |
| Consumer Goods | FTSE China 600/Consumer Goods | KLSE Consumer Products Malaysia | N/A | JSX Consumers Goods Industry | SET Consumer Products |
| Financial | FTSE China 600/Financial | KLSE Finance Malaysia | PSE Financial Philippine | JSX Finance | SET Financials |
| Industrial | FTSE China 600/Industrial | KLSE Industrial Malaysia | PSE Industrial Philippine | JSX Manufacturing Industry | SET Industrials |
| Property and Real Estates | Shanghai SE Property | KLSE Property Malaysia | PSE Property Philippine | JSX Property and Real Estates | SET Property and Construction |

**Table 2: Beta convergence**

*Panel 1: Beta coefficient and shock half-life between China and the ASEAN, national*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Country vs China | Pre-crisis | | Crisis | | Post-crisis | |
| Beta | HL | Beta | HL | Beta | HL |
| Malaysia | -.886 | 2.23 | -1.090 | 2.02 | -1.141 | 2.48 |
| Indonesia | -.842 | 2.63 | -1.087 | 1.99 | -1.188 | 2.90 |
| Philippines | -.855 | 2.51 | -1.098 | 2.09 | -1.121 | 2.30 |
| Thailand | -.793 | 3.08 | -1.165 | 2.69 | -1.264 | 3.64 |

*Panel 2: Beta coefficient and shock half-life (days) between China and the ASEAN, sectoral*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sector | Country /China | Pre-crisis | | Crisis | | Post-crisis | |
|  |  | Beta | HL | Beta | HL | Beta | HL |
| Consumer Goods | Malaysia | -.634 | 4.83 | -1.034 | 1.43 | -1.107 | 2.17 |
| Indonesia | -.650 | 4.62 | -1.112 | 2.22 | -1.205 | 3.06 |
| Philippines | N/A | N/A | N/A | N/A | N/A | N/A |
| Thailand | -.573 | 5.70 | -1.088 | 2.00 | -1.094 | 2.05 |
| Finance | Malaysia | -.912 | 2.00 | -.918 | 1.94 | -1.012 | 1.10 |
| Indonesia | -.805 | 2.97 | -1.030 | 1.38 | -1.072 | 1.84 |
| Philippines | -.806 | 2.96 | -.855 | 2.51 | -1.132 | 2.40 |
| Thailand | -.868 | 2.40 | -.979 | 1.26 | -1.105 | 2.15 |
| Industrials | Malaysia | -.647 | 4.66 | -1.095 | 2.06 | -1.146 | 2.52 |
| Indonesia | -.645 | 4.69 | -1.053 | 1.65 | -1.102 | 2.13 |
| Philippines | -.978 | 1.27 | -1.271 | 3.72 | -1.137 | 2.44 |
| Thailand | -.727 | 3.74 | -.892 | 2.18 | -1.164 | 2.68 |
| Properties and Real Estate | Malaysia | -1.085 | 1.97 | -1.064 | 1.77 | -.991 | 1.03 |
| Indonesia | -.977 | 1.29 | -1.064 | 1.77 | -.955 | 1.56 |
| Philippines | -.899 | 2.12 | -1.021 | 1.26 | -1.016 | 1.17 |
| Thailand | -.895 | 2.15 | -1.135 | 2.42 | -1.014 | 1.14 |

**Table 3: Wavelet correlation between China and ASEAN4 countries**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Time scale (weeks) | 1-2 | 2-4 | 4-8 | 8-16 | 16-32 | 32-64 |
| China-Malaysia | 0.397251 | 0.397615 | 0.530531 | 0.693758 | 0.774126 | 0.790628 |
| China-Indonesia | 0.347894 | 0.332963 | 0.422974 | 0.600801 | 0.682003 | 0.709098 |
| China-Philippines | 0.294097 | 0.30599 | 0.369651 | 0.604491 | 0.691324 | 0.638972 |
| China-Thailand | 0.223714 | 0.214829 | 0.295543 | 0.479639 | 0.537074 | 0.432383 |

**Table 4: Summary statistics for the diversification benefits**

*Panel 1: China-ASEAN4 national and sectoral*

|  |  |  |
| --- | --- | --- |
| Diversification benefit δ | National | Sectoral |
| Mean | 0.2062 | 0.2688 |
| Median | 0.1809 | 0.1993 |
| Standard deviation | 0.1555 | 0.1961 |
| Max | 0.6111 | 0.7700 |
| Min | -0.024 | -0.073 |
| Confidence interval for the difference | (0.02, 0.1) | |

*Panel 2: China-ASEAN4 national and sectoral*

|  |  |  |
| --- | --- | --- |
| Diversification benefit ε | National | Sectoral |
| Mean | 0.5332 | 0.7104 |
| Median | 0.5311 | 0.7420 |
| Standard deviation | 0.0760 | 0.0775 |
| Max | 0.6776 | 0.8000 |
| Min | 0.3486 | 0.5160 |
| Confidence interval for the difference | (0.16, 0.18) | |

*Panel 3: China-ASEAN4 and China-EU*

|  |  |  |
| --- | --- | --- |
| Diversification benefit δ | China-ASEAN4 | China-EU |
| Mean | 0.2062 | 0.0792 |
| Median | 0.1809 | 0.0306 |
| Standard deviation | 0.1555 | 0.1943 |
| Max | 0.6111 | 0.7201 |
| Min | -0.024 | -0.1573 |
| Confidence interval for the difference | (0.11, 0.15) | |

*Panel 4: China-ASEAN4 and China-EU*

|  |  |  |
| --- | --- | --- |
| Diversification benefit ε | China-ASEAN4 | China-EU |
| Mean | 0.5332 | 0.4018 |
| Median | 0.5311 | 0.3698 |
| Standard deviation | 0.0760 | 0.1627 |
| Max | 0.6776 | 0.6673 |
| Min | 0.3486 | 0.1103 |
| Confidence interval for the difference | (0.12, 0.15) | |

1. The regional benchmark market is the MSCI AC Far East Free Index [↑](#footnote-ref-1)
2. The authors find Malaysia to be one of the four exceptions to the trend of enhanced integration. [↑](#footnote-ref-2)
3. For additional details on expansion and recession dates, see Burdekis and Siklos (2012) [↑](#footnote-ref-3)