

FINANCIAL MARKET INTEGRATION OF ASEAN-5 WITH CHINA: AN ECONOPHYSICS APPROACH

Rui Dias¹ 
Paula Heliodoro² 
Paulo Alexandre³ 
Cristina Vasco⁴ 

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Abstract: *The main objective of this research is to estimate whether portfolio diversification is feasible in the financial markets of Indonesia, Malaysia, Philippines, Singapore and Thailand (ASEAN-5), and the market of China, in the context of the stock market crash in China in 2015. The purpose is to answer two questions, namely whether: (i) has the stock market crash in China increased financial integration in the ASEAN-5 financial markets and China? (ii) If the presence of long memories may put in question the diversification of portfolios? The results suggest that these markets are segmented, except for Malaysia/Singapore, bi-directional, and China/Filipinas, pre-crash. However, when analysing the stock market crash period, the results indicate 16 integrated market pairs with structure breakdown (in 30 possible). When compared with the previous sub-period it was found that during the stock market crash the level of financial integration increased significantly (533%). In the post-crash period, there were eight integrated market pairs with broken structure. When compared to the crash period, the level of integration decreased in 50%. In addition, we observed that during the stock market crash these Asian markets did not have long memories, except for the Malaysian market, which reveals some predictability, that is, the increase in integration does not lead to persistence in these Asian markets. In conclusion, the ASEAN-5 markets and China mostly exhibit strong signs of efficiency in their weak form. The authors consider that the implementation of portfolio diversification strategies is beneficial for investors. These conclusions also open space for market regulators to take action to ensure better information between these regional markets and international markets.*

Keywords: *ASEAN5, Financial integration, Long memories, Portfolio diversification.*

1. INTRODUCTION

The Efficient Market Hypothesis (HEM) is one of the most important assumptions in financial economics, considering that yields have no memory (correlation), which implies that agents cannot obtain anomalous returns in financial markets through arbitrage-adjusted trading strategies (Ferreira e Dionísio, 2016).

Financial instability is a very important factor for society, since a financial crisis or stock market crash can affect, directly or indirectly, the level of economic well-being of a country's inhabitants. If a given stock market is strongly correlated with the stock market of another country, the financial stability of the first depends in part on the financial stability of the second. For this reason, a strong or close connection between markets increases the levels of vulnerability

¹ Escola Superior de Ciências Empresarias - Institute Polytechnic of Setúbal, Portugal & CEFAGE, University of Évora, Portugal

² Escola Superior de Ciências Empresarias – Institute Polytechnic of Setúbal, Portugal

³ Escola Superior de Ciências Empresarias – Institute Polytechnic of Setúbal, Portugal

⁴ IEFP – Instituto do Emprego e Formação Profissional, Alcácer do Sal, Portugal

to external shocks and, as a consequence, influences the economic conditions and welfare levels of the respective countries. Thus, the occurrence of integration between markets can have significant implications for international risk diversification (Dias, da Silva e Dionísio, 2019).

This research will assess whether portfolio diversification is feasible in the financial markets of Indonesia, Malaysia, Philippines, Singapore and Thailand (ASEAN-5), and China, in the period of the stock market crash in China in 2015. The results suggest strong levels of integration during the stock market crash, but there is not persistence in the profitability of these regional markets, which would allow for portfolio diversification in these regional markets.

Thus, this research adds two relevant contributions to the literature. The first contribution refers to the study of financial integration and the persistence of profitability in the financial markets of Indonesia, Malaysia, Philippines, Singapore and Thailand (ASEAN-5), and China, in the context of the stock market crash in 2015. The second contribution is of an econometric nature, because of comparing results between econometric methods and mathematical models that have the possibility of evaluating correlations in a non-stationarity context. In particular, the test of Gregory and Hansen (1996), which demonstrates the presence of integration between financial markets, showing structural breaks. In corroboration and despite not directly using the exponent of Hurst, a methodology will be applied that indirectly proposes the same information: Detrended Fluctuation Analysis (DFA). The DFA is a method of analysis that examines the time dependency in non-stationary data series. This technique by assuming that the time series are non-stationary avoids spurious results when the analysis focuses on the relationships of the data series in the long-term period.

In terms of structure, this paper is organised into 5 sections. Section 1 is the current introduction. Section 2 presents a Literature Review of articles on integration in financial markets. Section 3 describes the methodology and data used. Section 4 contains the results. Section 5 presents the main conclusions.

2. LITERATURE REVIEW

The understanding of the links between financial markets in times of financial crisis is relevant for investors, fund managers and academics, in different aspects, namely in the topic of portfolio diversification (Lee, 2017).

Phylaktis and Ravazzolo (2002), Gerlach, Wilson, and Zurbruegg (2006), Chambet and Gibson (2008), Binner et al. (2011) studied financial integration in the Asia Pacific financial markets. Phylaktis and Ravazzolo (2002) found significant regional and global evidence that financial integration goes hand in hand with economic integration, this seems to suggest that economic integration provides a channel for financial integration, which explains, at least in part, the high degree of financial integration found in this study and others for this region, even in the presence of exchange controls. This outcome has important implications for the use of restrictions to isolate these regional markets from international influences. Gerlach, Wilson, and Zurbruegg (2006) demonstrated that Asia-Pacific markets are integrated, despite a structural change that occurred at the time of the 1997 Asian crisis. These results are a particularly important for fund managers concerned about the impact of globalization on their portfolio performance, demonstrating that in the Asia-Pacific region the benefits of diversification are very small. Chambet and Gibson (2008) emphasized that countries with a non-diversified trade structure have more

integrated financial markets. Finally, the results suggest that countries less open to trade are more segmented. Binner et al. (2011) tested the ASEAN countries and Taiwan for consistency in implementing a single currency.

Glick and Hutchison (2013), Auer and Mehrotra (2014), Boubakri and Guillaumin (2015), Pradhan et al. (2016), Wu (2019), Gulzar et al. (2019) examined the interconnections between China's market and Asia's financial markets, and how these links changed during and after the 2008-2009 global financial crisis. Glick and Hutchison (2013) evidenced little synchronization between long-term interest rates, but the financial integration between the stock markets is very significant. This conclusion is consistent with the further development and liberalization of stock markets in relation to the Chinese market, as well as with the increase in trade links in the region. Auer and Mehrotra (2014) argue that the increase in integration has led to greater movement in asset prices. The authors show that true integration through the supply chain is important for the dynamics of asset prices in the Asia-Pacific region. Boubakri and Guillaumin (2015) have demonstrated that East Asian stock markets were partially segmented (except Japan) in the region until 2008. However, the last few years are characterized by an upward trend in the regional integration of these stock markets. Pradhan et al. (2016) used a multivariate structure, showing that all variables are cointegrated and revealing a network of causal connections, including short-term two-way causality between market access and economic growth.

Wu (2019) argues that a large part of this evident high level of integration is demonstrated by common global factors. After filtering out these factors in each stock market, the magnitude of integration decreases substantially. In concluding notes, the results suggest that stock market integration in East and Southeast Asia is not as strong as it appears, while governments in the region are promoting cooperation and financial integration in these regional markets. Gulzar et al. (2019) have analysed Asian financial markets (India, China, Pakistan, Malaysia, Russia and Korea) and the USA. The analysis included daily stock yields from July 1, 2005 to June 30, 2015, with the sample divided into three periods. The authors point out long-term integration between the US market and emerging stock markets, and the level of cointegration increased after the crisis period.

3. METHODOLOGY AND DATA

The data used for the test were the prices index (daily) for the markets Indonesia, Malaysia, Thailand, Singapore, Philippines and China. The source of information used was the *Thomson Reuters* platform, with local currency quotes being used to mitigate exchange rate distortions. In addition, in order to answer the research questions formulated and to highlight the impact of the Shanghai stock market crash on the evolution of the different markets, it was decided to divide the sample into three sub-periods, a pre-crash that corresponds to the sub-period from January 5, 2015 to June 11, 2015, a crisis subperiod, which we call the stock market crash, covering the subperiod from 12 June 2015 to 30 January 2016, and a third subperiod, which contains the time period from 1 February 2016 to 31 January 2019, which we call the post-crash subperiod. (Ahmed and Huo, 2018).

The development of research has taken place in several stages. In order to verify the integration or segmentation of the financial market indices analysed, we used the methodology of Gregory e Hansen (1996), because we are considering a very troubled period in the financial markets. Additionally, the reason for standard cointegration tests such as Engle e Granger (1987) e Johansen (1988), are not suitable for testing cointegration with regime change is that such tests assume that

the cointegration vector is invariant in time. Although Hurst's exponent will not be used directly, a methodology will be applied that indirectly proposes the same information: *Detrended Fluctuation Analysis (DFA)*. DFA is a method of analysis that examines time dependency in non-stationary data series. This technique, by assuming that time series are non-stationary avoids spurious results when the analysis focuses on long-term data series relationships. This methodology was developed by Peng et al. (1994) and its origin was in the study of the behaviour of the DNA. Later this method was used to examine the behaviour of financial series. The DFA has the following interpretation: anti-persistent series; series present *random walk*; persistent series.

Table 1. The name of countries and their indices used in this paper

Country / Region name	Index
INDONESIA / ASEAN-5	Jakarta Stock Exchange Composite Index
MALAYSIA / ASEAN-5	FTSE Bursa Malaysia Index
PHILIPPINES / ASEAN-5	Philippines Stock Exchange PSEi Index
SINGAPORE / ASEAN-5	Singapore Exchange - SGX
THAILAND / ASEAN-5	Stock Exchange of Thailand
CHINA / ASIA	Shanghai Stock Exchange Composite Index

Source: Own elaboration

Figure 1 shows the fluctuations, in first differences, of the ASEAN-5 financial markets, and China. The sample comprises the time frame from January 5, 2015 to January 31, 2019, which is a very complex period due to the stock market crash in China. The financial market indices analysed clearly reveal the instability experienced in these markets in the years 2015-2016. It is also possible to observe an „equilibrium” movement in the year 2017, however, the year 2018 suggests an increase in volatility.

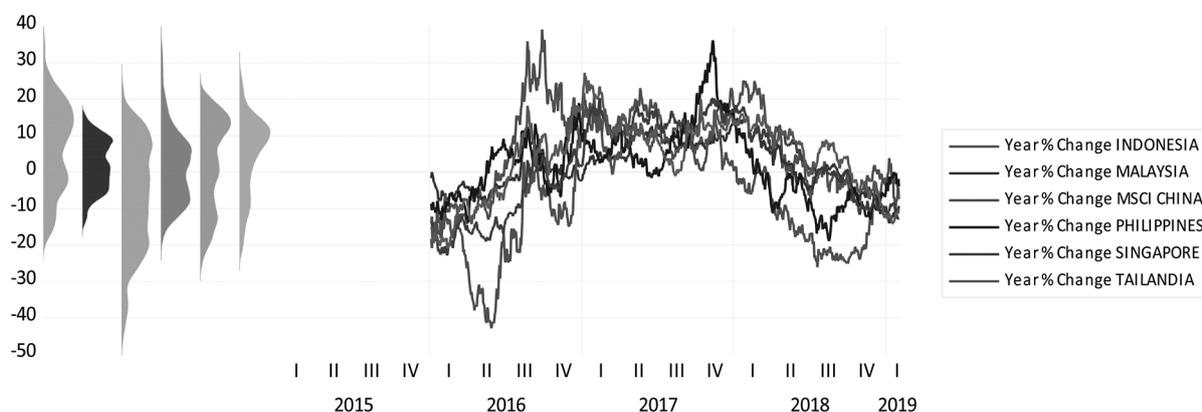


Figure 1. Trends (first annual differences) in the 6 financial markets, from 05/01/2015 to 30/01/2019.

Source: Own elaboration

Notes: Thomson Reuters: 5 January 2015, 1063 data at the point

The results of the integration test between the ASEAN-5 and China markets in the pre-crash subperiod show that these markets are segmented, except for Malaysia/Singapore, bi-directional, and China/Filipinas. However, when we analyse the stock market crash period, the results show 16 integrated market pairs with structure breakdown (in 30 possible). It is easy to detect that the Indonesian and Chinese markets are the most integrated stock indexes with their pairs, 5 integration (out of 5 possible). The markets of Malaysia, Philippines, and Thailand present 4 and 1 integration, respectively; we find that the structure breaks are synchronized between

August and December 2015, showing the impact of the crash in these regional markets. When compared to the previous sub-period we found that during the stock market crash the level of financial integration increased significantly (533%). In addition, when we examine the post-crash period, we find 8 pairs of integrated markets with a breakdown in structure. Indonesia and China are the indexes that have most integrated with their pairs, 3 integration (in 5 possible). While Thailand and Singapore present a single integration. We found that Malaysia and the Philippines did not integrate with their regional peers, while the breakdown of structure is mostly in 2018. When it is compared to the crash period, the integration level is reduced by 50%. In addition, this evidence is also of interest to policy makers and investors in relation to regional development policies and portfolio diversification strategies in the ASEAN-5 region. These results are in line with the evidence suggested by the authors Pradhan et al. (2016), and Wu (2019).

Table 2. Financial integration tests with structural breaks of Gregory e Hansen (1996), for the price indices of the 6 financial markets in the Crash subperiod

Markets	t-statistic	Method	Lags	Break Date	Results
INDONESIA / MALAYSIA	-5.90***	Trend	1	10/09/2015	Cointegration
INDONESIA / PHILIPPINES	-4.96*	Trend	1	12/08/2015	Cointegration
INDONESIA / SINGAPORE	-5.99***	Regime	1	06/10/2015	Cointegration
INDONESIA / THAILAND	-5.20**	Trend	1	12/08/2015	Cointegration
INDONESIA / CHINA	-5.20**	Trend	1	12/08/2015	Cointegration
MALAYSIA / INDONESIA	-5.50***	Trend	1	10/09/2015	Cointegration
MALAYSIA / PHILIPPINES	-5.08**	Regime	5	24/09/2015	Cointegration
MALAYSIA / SINGAPORE	-4.89*	Regime	3	21/09/2015	Cointegration
MALAYSIA / CHINA	-5.13**	Regime	5	07/10/2015	Cointegration
PHILIPPINES / SINGAPORE	-4.74*	Regime	0	08/12/2015	Cointegration
THAILAND / CHINA	-4.88	Trend	5	20/11/2015	Cointegration
CHINA / INDONESIA	-5.92***	Regime	4	18/12/2015	Cointegration
CHINA / MALAYSIA	-6.07***	Regime	4	18/12/2015	Cointegration
CHINA / PHILIPPINES	-4.86	Trend	5	09/10/2015	Cointegration
CHINA / SINGAPORE	-5.95***	Trend	4	15/12/2015	Cointegration
CHINA / THAILAND	-5.14**	Trend	5	13/08/2015	Cointegration

Source: Own elaboration

Notes: Data worked on by the authors (software: Stata). The AIC information criterion was chosen. The critical values are found in Gregory and Hansen (1996). The critical values for the ADF and Zt parameters are: -5,45 (1%); -4,99 (5%); -4,72 (10%). For the Za parameter, the critical values are: -57,28 (1%); -47,96 (5%); -43,22 (10%). The asterisks ***, **, * indicate statistical significance at 1%, 5% and 10%, respectively.

In table 3 it is possible to verify the results of the DFA exponents, in the three subperiods. to the results, during the pre-crash period, the Indonesian market is persistent (long memories), while the markets of the Philippines, Thailand and China show anti persistence, and the markets of Malaysia and Singapore show an equilibrium trend. In addition, during the stock market crash, these Asian markets do not have long memories, except for the Malaysian market, which shows some predictability, i.e. the increase in integration does not imply persistence in these Asian markets. However, when evaluating the post-crash period, these markets exhibit a very significant anti persistence, except for Malaysia and China. These results are consistent with the evidence from the authors Shirvani e Delcoure (2016), Ngene, Tah e Darrat (2017), Mensi, Tiwari e Yoon (2017), Ali, Shahzad, Raza e Al-Yahyaee (2018), which have demonstrated that markets are efficient in their weak form and that portfolio diversification is a hypothesis to consider.

Table 3. DFA results. The hypotheses are : $\alpha = 0.5$ and : $\alpha \neq 0.5$.

Stock market	DFA exponent (before crisis)	DFA exponent (crisis period)	DFA exponent (after crisis)
INDONESIA	0.60 \cong 0,0003	0.47 \cong 0.0011	0.42 \cong 0.0023
MALAYSIA	0.54 \cong 0.0076	0.62 \cong 0.0010	0.50 \cong 0.0014
PHILIPPINES	0.39 \cong 0.0054	0.52 \cong 0.0033	0.47 \cong 0.0039
SINGAPORE	0.55 \cong 0.0025	0.52 \cong 0.0024	0.43 \cong 0.0021
TAILANDIA	0.43 \cong 0.0023	0.45 \cong 0.0035	0.46 \cong 0.0032
CHINA	0.42 \cong 0.0032	0.49 \cong 0.0035	0.49 \cong 0.0040

Source: Own elaboration

5. CONCLUSION

The general conclusion to be retained and sustained in the results obtained, through the tests carried out with econometric models, was that the level of financial integration increased during the crash but adjusted in the post-crash. In corroboration we observed that these regional markets, in their majority, do not show signs of market efficiency, in their weak form. Therefore, it is reasonable for the ASEAN-5 markets and China to implement efficient portfolio diversification strategies. These conclusions also open space for market regulators to take action to ensure better information between these regional and international markets.

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