International Journal of Business and Society, Vol. 24 No. 3, 2023, 1046-1064

EMERGING STOCK MARKET INTEGRATION: EVIDENCE FROM THE PRE- AND POST-FINANCIAL CRISIS OF 2007-2009

Carol O. Bruce-Tagoe
Lumpkin College of Business and Technology, Eastern Illinois University

Ingyu Chiou
Lumpkin College of Business and Technology, Eastern Illinois University

Menghistu Sallehu[♣]
Lumpkin College of Business and Technology, Eastern Illinois University

ABSTRACT

We investigate the interdependence between the US and seven emerging economy stock markets in Brazil, China, India, Malaysia, Mexico, Taiwan, and Thailand. Specifically, we examine how the 2007-2009 financial crisis influenced the dynamics of stock market integration between the US and seven emerging countries by analyzing the short-run and long-run effects of the crisis over pre-crisis (January 1995 to November 2007) and post-crisis (July 2009 to December 2018) periods. The results of Johansen co-integration tests confirm presence of co-integration in both sample periods. Short-run Vector Error Correction Model (VECM) results indicate a significant influence of the US market on the seven markets except for Brazilian and Chinese markets in the pre-crisis period. The pre-crisis long-run results demonstrate significant cointegrating relationships between the US market and the Indian, Malaysian, Mexican, and Thai markets. Only the Mexican market had the same cointegrating relationship with the US market in both periods. The insignificant pre-crisis period cointegrating relationships between the US and Brazilian, Chinese, and Taiwanese markets become significant post-crisis. Although the Indian stock market was cointegrated with the US market in the pre-crisis period, the relationship is insignificant post-crisis. Overall, our findings confirm that the US and seven emerging economy equity markets exhibit some degree of short-run and long-run cointegration. We also find that a negative shock such as a financial crisis may significantly change co-movements among the stock markets. We contribute to the existing literature on financial market integration by examining recent data around the global financial crisis.

Keywords: Emerging stock market, cointegration, global financial crisis.

Submission: 7th October 2020
Accepted: 21st September 2023
https://doi.org/10.33736/ijbs.6400.2023

♣ Corresponding author: 4016 Lumpkin Hall, School of Business, Eastern Illinois University, 600 Lincoln Avenue, Charleston, IL 61920, USA. Tel: 217.581.7052; e-mail: mmsallehu@eiu.edu.

1. INTRODUCTION

The 2007-2009 global financial crisis left indelible marks on the US economy as well as on financial markets. According to the US National Bureau of Economic Research (NBER), the recession that followed the crisis began in December 2007. Over the next eighteen months, key indicators of economic activities such as real GDP, real income, employment, industrial production, wholesaling, and retail sales showed persistent decline (NBER, 2019). The effect of the crisis on the financial markets was astronomical. From October 2007 to March 2009, the S&P 500 Index fell by about 57% by March 2009 from its October 2007 peak. Similarly, the net worth of US households and nonprofit organizations fell from a peak of approximately $69 trillion in 2007 to a trough of $55 trillion in 2009 (Rich, 2013). All told, the crisis is considered to be the worst economic disaster since the US Great Depression of the 1930s (Tong & Wei, 2008).

Even though the crisis started in 2007 as a result of elevated default rates in the subprime mortgage market, its effect did not remain confined to that segment of the credit market. Instead, the effect snowballed as it moved across other segments – eventually affecting nearly the entire financial services industry. At the height of the crisis, limited access to liquidity threatened the financial health of banks and contributed to the collapse of Lehman Brothers (an investment bank) in September 2008. Fear that further spread of the effect could virtually freeze the credit market and debilitate the economy prompted bailout and other rescue efforts. Crucially, the crisis also induced legislative and policy measures that are presumably aimed at rooting out unsafe and unsound lending practices and other risk taking behavior. Almost concurrently, other countries experienced similar effects of the crisis and implemented containment measures.

We examine the effect of the global financial crisis on linkages between the US equity market and equity markets of seven emerging markets. Economic and financial ties between two countries are fundamental drivers of stock market movements in the two countries. To a certain degree, changes in economic fundamentals and institutional factors shape the nature and degree of equity market linkages. Lehkonen (2015) finds that integration is mostly affected by the institutional environment, financial openness, and global financial uncertainty, with these determinants varying slightly between emerging and developed markets. Majid and Kassim (2009) suggest that countries with similar macroeconomic policies could end up having highly correlated stock markets. The 2007-2009 global financial crisis provides an opportunity to investigate how a financial crisis in one country affects activities in other nations and the nature of linkages in stock markets. In broad terms, increased stock market linkages can deliver benefits such as lower cost, greater competitiveness, and enhanced information sharing across financial institutions (Ncube & Mingiri, 2015). At the same time, concern that stock market integration could amplify the risk of contagion and the attendant disruptions in economic activities could temper enthusiasm for greater stock market linkages.

These concerns are likely to be especially salient after the global financial crisis. First, the global financial crisis occurred on the heels of substantial structural and policy changes in emerging market economies that increased economic ties between emerging and developed economies (IMF, 2016). Second, the source of the sharp decrease in capital flows to emerging markets following the global financial crisis was the severe liquidity freeze in developed markets (Uzkan & Unsal, 2012). In consequence, the opportunity for recovery through more export to developed markets was limited due to depressed consumer spending in developed markets. Third, because emerging

market residents now face lower capital controls, domestic investors and capital outflows have become important components of capital flows (Forbes, 2014; IMF, 2016). Altogether, the global financial crisis is distinct from other crises in ways that makes its effect different from the effects of other crises. In some respects, changes in capital flows that occurred during the global financial crisis generated more financial consequences than those either before or since (Lopez & Stracca, 2021). Thus, whether emerging markets advance policies and institutional conditions that strengthen economic and stock market linkages after the financial crisis is not clear. Furthermore, dislocations due to the crisis could potentially heighten uncertainty.

This study extends the existing literature in market integration by exploring the degrees of linkages between the US and emerging stock markets using index prices denominated in one common currency, the US dollar. Importantly, we highlight the impact of a major financial crisis that has the potential to trigger structural changes and to alter risk assessment by examining short-run and long-run linkage relationships before and after the 2007 – 2009 financial crisis. The study also examines overall equity market co-integration and related dynamics across equity markets using data from a diverse set of countries from different time zones, and with different economic and political orientations. Finally, results of our research offer suggestions to investors, who want to diversify their portfolio holdings by including stocks in emerging markets. Investment theory suggests that US investors can maximize return or manage portfolio risk by investing in emerging markets to the extent that US and emerging markets are not perfectly positively correlated. The results in this study show that whether such a strategy yields the desired outcomes can also be influenced by how linkages hold up following market driving events. A good understanding of the degree of co-movements among stock markets in both the short-run and the long-run enables an investor to appreciate the nature of short-run and long-run dynamics between markets. In that sense, the study helps portfolio managers make informed decisions while creating a well-diversified portfolio.

The remainder of this paper is structured as follows: Section 2 discusses the relevant literature on market integration. Section 3 describes our data while section 4 focuses on methodology. Section 5 presents the empirical results. Section 6 summarizes major findings of our study.

2. LITERATURE REVIEW

Equity markets that exhibit strongly positive correlation offer less portfolio diversification opportunities to investors than equity markets exhibiting negative or weakly positive relationship. When correlations are weak or negative, investors in one market can manage risk or increase returns by investing in other markets. For instance, US investors can benefit by investing in emerging equity markets if those markets do not move in tandem with the broad US equity market. In particular, investors could raise expected return and reduce variance in asset prices by investing in emerging markets (Koepke, 2019). However, such strategies can yield long-term portfolio diversification benefits insofar as the underlying factors linking the markets are sufficiently different and durable. Therefore, understanding the extent of linkages among equity markets and how those linkages evolve over time is important.

Two broad factors could strengthen or weaken linkages between the US equity market and those of emerging markets. First, structural changes and innovations in information technology induce

capital flows to emerging markets (Arshanapalli & Doukas, 1993; World Bank, 1997). In addition, as emerging markets become more integrated to the world economy, domestic economic fundamentals are likely to evolve. To the extent that fundamentals move markets, evolution in economic fundamentals is likely to be followed by change in the nature of linkages among equity markets. Second, financial crises and similar shocks generally lead to heightened uncertainty or trigger protectionist policy responses. Even though globalization or capital market integration has several benefits, the benefit from market integration may not be sustainable from portfolio management standpoint if it increases correlation among markets or if it increases the contagion effect of negative shocks (Bouri & Yahchouchi, 2014; Stiglitz, 2010). Thus, understanding how linkages are affected by financial crises is also crucial to US investors.

Whether sustainable portfolio diversification opportunities exist crucially depends on how linkages between equity markets behave in the short-run and long-run. Lamba (2005) examined this issue using data during July 1997 – December 2003 for three emerging and three developed markets. Specifically, the author investigated the short-run and long-run relationships between the equity markets of India, Pakistan, and Sri Lanka and those of Japan, UK, and US. Results from tests based on multivariate cointegration framework and vector error-correction model show that the Indian market is influenced by the Japanese, UK and US markets. Moreover, results show that co-movements among these markets persisted even after the September 11, 2001 terrorist attacks. For the equity markets of Pakistan and Sri-Lanka, however, the author finds that these markets were isolated from the major developed markets during the entire sample period. Taken together, these findings broadly suggest that sustained diversification benefits could be achieved by investing in the equity markets of Pakistan and Sri-Lanka. In contrast, the persistent positive relationship between the Indian equity market and those of developed markets indicates that investors could barely gain diversification benefits by investing in the Indian equity market.

Economic forces and institutional arrangements that drive capital flows between markets generally evolve with changes in the local economic environment. Thus, understanding how co-movements change over time is also important. Along these lines, Chaudhry, Boldin, Affaneh, and Khan (2012) investigate the level of integration among seven Asian emerging markets during February 28, 2001 to January 31, 2011. Using cointegration methodology of Johansen, the authors show that the equity markets of Bangladesh, China, India, Indonesia, Malaysia, Pakistan, and Sri Lanka are highly integrated. Chaudhry et al. (2012) also find that some of the emerging economies had started displaying divergence from each other due to dissimilarity in their level of development and growth.

Other studies focusing on regional economic conditions support the notion that the nature of co-movements among markets could change over time. Specifically, Kenourgios and Samitas (2011) examine the dynamics in the relationship between five major Balkan markets (Bulgaria, Croatia, Romania, Serbia, and Turkey) and developed markets in Europe (Greece, Germany, and the UK) and the United States. Employing conventional cointegration tests, regime-switching models, and Monte Carlo simulation, the authors provide evidence of long-run cointegrating relationships among Balkan markets and between Balkan and developed markets. Their results show that even though diversification benefits from a long horizon strategy may be limited, short-run diversification across these five Balkan stock markets would yield modest portfolio gains. Similarly, Lahrech and Sylwester (2011) study the extent to which the equity markets of Argentina, Brazil, Chile, and Mexico are integrated with the US equity market. Using data during December

30, 1988 to March 26, 2004, they provide evidence that shows increase in the degree of co-movement between the US market and each of the four equity markets. More specifically, the conditional correlation between the US equity market and that of Argentina, Brazil, or Mexico has increased substantially, implying that market disturbances in the US are more likely to be transmitted to those countries. Results also show that the magnitude and speed of co-movements greatly varied across the four markets. Thus, the findings broadly suggest that limited but diminishing portfolio diversification benefits exist over the longer term.

With respect to the impact of shocks, prior research suggests that financial crises alter cointegration among markets. Nikkinen, Vanja and Äijö (2011) investigate co-movements between Baltic stock markets, namely Estonia, Latvia and Lithuania and the European stock market during the 2008-2009 crisis. Using data from January 3, 2004 to June 30, 2009, they provide evidence that Baltic stock markets were segmented in the pre-crisis period. During the crisis period, however, correlations significantly increased, implying fewer diversification benefits at a time when needed most by investors.

Based on relationships among the world broader market and equity indices of five ASEAN countries, Bit-Kun, Arsad, and Chee-Wooi (2015) provide similar results regarding the impact of financial crises. Specifically, Bit-Kun et al. (2015) study the level of integration among equity markets of Indonesia, Malaysia, The Philippines, Thailand (emerging countries), and Singapore (a developed country), with the world market. Results from analysis of data during February 1988 to September 2009 confirm that Singapore's equity market is highly integrated with the world market while the equity market of The Philippines is fairly integrated. Markets in Indonesia, Malaysia, and Thailand, however, demonstrate fluctuations in the level of integration. Their study also reveals that the 2007 global financial crisis had less impact on the level of integration compared to the effect of the 1997/98 Asian financial crisis.

Mensi, Shahzad, Hammoudeh, Zeitun and Rehman (2017) examine portfolio risk and co-movements between three developed (Japan, UK, and US) and seven emerging and frontier markets (Brazil, China, India, Russia, Pakistan, South Africa, and Sri-Lanka). They find that co-movements among the equity markets changed after the global financial crisis, showing change in diversification opportunities in the post crisis period. In terms of risk reduction over the short term, the authors find that equity markets of Pakistan and Sri-Lanka offer better risk reduction opportunities in the pre-crisis and post crisis period, respectively. They also find that adding stocks from China in the pre-crisis period and from Sri-Lanka in the post-crisis period to portfolio of equity from developed markets reduced risk.

Mensi, Hammoudeh, Nguyen and Kang (2016) study the effect of the global financial crisis on volatility transmission between the US market and markets of BRICS countries (Brazil, Russia, India, and South Africa) using data over September 1997 through October 2013. Their results show that the Bankruptcy of Lehman Brothers, which sparked the more severe phase of the crisis, marked the common structural break date for the sample. Additionally, they find that there was no spillover effect from the US market to the Russian market after the crisis even though stronger linkages between the US market and the other four markets were detected for the same period. These findings suggest that US investors could obtain limited portfolio diversification opportunities by investing in equity from the four markets post-crisis due to recoupling of the markets. Taking a somewhat different perspective, Patel (2019) focuses on equity market integration among BRICS

countries (Brazil, Russia, India, and South Africa) during the pre- and post-crisis periods. Using Johansen cointegration, Granger causality, and factor analysis, the author performs tests using data for January 1, 1998 to December 31, 2017. The results show that the equity markets of the countries have been moving toward greater integration after the global financial crisis. In particular, stock markets of Brazil, Russia, India, and China have close causal linkages, with stock markets of China, India, and Russia showing relationships over both the short-term and long-term.

Yarovaya and Keung Lau (2016) employ conventional and regime switch cointegration techniques to analyze stock market co-movements of the UK and BRICS and MIST countries (Mexico, Indonesia, South Korea, and Turkey) around the global financial crisis. Their findings broadly suggest that UK investors would not realize diversification benefits by investing in the equity markets of BRICS and MIST emerging markets.

Collectively, prior research provides broad evidence that equity markets exhibit varying degrees of co-movement and that equity market linkages are generally dynamic. Based on data around financial crises, prior research also provides evidence that financial crises significantly alter linkages among national equity markets. Yet how the global financial crisis affected linkages and short-run and long-run dynamics between the US and emerging equity markets is not widely explored. We fill this gap by studying linkages between the US equity market and seven emerging stock markets (Brazil, China, India, Malaysia, Mexico, Taiwan, and Thailand) using more recent daily stock price data covering 1995-2018.

Our study differs from prior research in several ways. First, our sample includes major emerging markets. Second, we examine market interactions between national markets both in the same time zone and in different time zones. Third, because the 2007-2009 financial crisis negatively affected many countries, we explore how linkages change from the pre-crisis period to the post-crisis period. Using an expanded sample period, we investigate if potential diversification benefits from investing in emerging markets still exist in both the short- and long-run periods. Fourth, our methodologies include the Augmented Dickey-Fuller (ADF) test, maximum likelihood approach of Johansen (1988), and Johansen and Juselius (1990), and the Vector Error Correction Model (VECM). Using these methodologies, we investigate the existence of co-integrating relationships and dynamic relationships among markets both in the pre-crisis and post-crisis periods.

3. DATA AND KEY STATISTICS

The sample of this study covers equity markets of the US and seven emerging markets with complete data over the sample period. We include the US equity market of New York (main index: S&P 500 Index) as a key point of reference for tests involving both short-run and long-run linkages. Emerging market equity indices against which we assess these linkages include Sao Paulo (main index: BOVESPA), Shanghai (main index: SSE Composite Index), Bombay (main index: S&P BSE Sensex), Bursa Malaysia (main index: Kuala Lumpur Composite Index), Mexican (main index: S&P/BMV IPC Index-MEXBOL), Taiwan (main index: TAIEX), and Bangkok (main index: SET 50 Index) stock markets. For each equity market, we obtain daily stock market prices denominated in dollars from the Bloomberg database for the period covering January 1995 to December 2018. This process yields stock price data for the entire period of 6,258 observations.

To investigate the linkage effects of the financial crisis on stock markets before and after the 2007 – 2009 financial crisis, we divide the dataset into two sub-samples: the pre-crisis period and the post-crisis period. The pre-crisis period (January 1995 to November 2007) and the post-crisis period (July 2009 to December 2018) consists of 3,367 and 2,479 observations, respectively for each market. By grouping the data in this way, we aim to shed some light as to whether or not cross-market linkages between the US and emerging stock markets have changed after the financial crisis.

We also implement log transformation of stock prices following prior research. By so doing, we address at least two potential concerns related to the time series variables. First, taking the natural log of a variable can address the issue presented by positive skewness with a long right tail. Second, the log transformation can mitigate the problem of having a non-stationary mean and variance of a time series variable.

To provide an overview of the relationships between the US and the seven emerging stock markets, we generate two correlation matrices. The first correlation matrix, shown in Table 1, portrays the relationships based on 3,367 observations for each market during the pre-crisis period (January 1995 – November 2007). Similarly, the correlation matrix in Table 2 depicts relationships based on 2,479 observations for each market during the post-crisis period (July 2009 to December 2018). In both cases, we begin by computing the log-differences in stock prices. We then construct the correlation matrices using the log-difference data in the respective subperiod.

Results for the pre-crisis period, shown in Table 1, depict the existence of broad linkages between the US equity market and those of emerging markets. More specifically, the Mexican market had the strongest positive correlation with the US market (0.4982) while the Malaysian market had the weakest positive correlation with the US market (0.0079). The correlation coefficients between the US market and other markets fall within these two values except for that of the Chinese market. The Chinese equity market is negatively correlated (-0.0286) with the US market. Taken together, these results generally indicate that diversification opportunities range from negligible (when the relationship is strongly positive) to reasonably high, especially when the correlation coefficient is negative as in the result for the Chinese market.

Table 1: Pre-crisis Period: Correlation Matrix

	US	**BZL**	**CHN**	**IND**	**MALAY**	**MEX**	**THAI**	**TWN**
US	1.0000							
BZL	0.4509	1.0000						
CHN	-0.0286	0.0009	1.0000					
IND	0.0552	0.1183	0.0561	1.0000				
MALAY	0.0079	0.0604	0.0273	0.1412	1.0000			
MEX	0.4982	0.5604	-0.0208	0.1251	0.1148	1.0000		
THAI	0.0395	0.1161	0.0468	0.1755	0.3407	0.1104	1.0000	
TWN	0.0493	0.0911	0.0586	0.1860	0.2006	0.0805	0.2394	1.0000

Note: This table shows correlation coefficients for the pre-crisis period based on 3,367 observations for the series.

Table 2: Post-crisis Period: Correlation Matrix

	US	BZL	CHN	IND	MALAY	MEX	THAI	TWN
US	1.0000							
BZL	0.5252	1.0000						
CHN	0.1380	0.1668	1.0000					
IND	0.2983	0.3302	0.2370	1.0000				
MALAY	0.2416	0.3464	0.2290	0.4505	1.0000			
MEX	0.6160	0.6193	0.1815	0.4027	0.4069	1.0000		
THAI	0.2243	0.2482	0.2442	0.4616	0.4633	0.3150	1.0000	
TWN	0.2244	0.2536	0.3441	0.4186	0.5407	0.2933	0.4138	1.0000

Note: This table shows correlation coefficients for the post-crisis period based on 2,479 observations for the series.

With regard to the post-crisis period, there seems to be similar ordering of correlation coefficients to those observed during the pre-crisis period. The Mexican market is strongly positively correlated with the US market, with a correlation coefficient of 0.6160. Also, similar to the relationship in the pre-crisis period, the relationship between the US and Brazilian equity markets is strong and positive with a correlation coefficient of 0.5252. Overall, the correlation coefficients suggest that all seven emerging stock markets are positively correlated with the US market in the post-crisis period, with one notable shift in the sign of the correlation coefficient for the Chinese market.

Comparing coefficients in the pre-crisis period correlation matrix (Table 1) to those of the post-crisis period (Table 2), we observe increase in the correlation coefficient between the US market and each of the seven emerging stock markets. Interestingly, the Chinese market, which was initially negatively correlated with the US market, changed to become positively correlated (0.1380) after the crisis. Regardless of this shift, the magnitude of the coefficient is the lowest. The relatively strong and positive correlation coefficients for Brazilian and Mexican markets (0.5252 and 0.6160, respectively) suggest diminishing diversification opportunities from investing in those markets. Correlation coefficients for Indian, Malaysian, Taiwanese, and Thai markets are moderate, suggesting limited opportunities for diversification.

The above results suggest that though correlation coefficients are positive and, in some cases, strengthened in the post-crisis period, opportunities for diversification may exist in pockets of emerging markets. However, although a correlation matrix helps establish the linear relationship between two variables, it does not account for time variation (Paramati, Roca & Gupta, 2016). We conduct more rigorous tests in the sections that follow to address such concerns.

4. METHODOLOGY

The empirical framework of our study involves various steps. First, we employ the augmented Dickey-Fuller (ADF) test to evaluate whether each time series is stationary or to test for existence of a unit root process in the data. Second, we test cointegration among the stock markets using the maximum likelihood approach of Johansen (1988) and Johansen and Juselius (1990). Finally, we use the Vector Error Correction Model (VECM) to estimate the equilibrium long-run relationship between the US and other markets, to assess short-run relationships, and to examine the speed of adjustments in the event of a shock.

4.1. Test for Stationarity

A time series is said to be non-stationary if its mean and variance are time-varying. A unit root test is normally conducted to determine whether or not a time series is stationary. Non-stationary time series data can result in spurious regressions with high R-squared values and little correlation between variables. Therefore, before running a VECM/VAR (Vector Auto Regression) system, there is a need for all variables to be integrated in the order of 1, i.e., I(1). We employ the Augmented Dickey-Fuller (ADF) test, suggested by Said and Dickey (1984), to assess whether or not a unit root is present in a time series. The ADF test is preferred over the standard Dickey-Fuller (DF) test because the ADF test can be used even when a serial correlation exists in a time series. The general ADF test model is stated as:

$$\Delta \mathbf{y}_t = \alpha + \mu T + \rho y_{t-1} + \Sigma_{i=1 \text{ to } k} \gamma_i \Delta y_{t-i} + \varepsilon_i \quad (1)$$

where $\mathbf{y}_t$ is a time series variable (stock market index) and Δ is the difference operator. The null hypothesis of the ADF test is the presence of a unit root ($\rho = 0$) or non-stationarity in a time series variable (i.e., a stock market index). The time series variable is deemed stationary if ρ is negative and significantly different from zero. We conduct the ADF test for each stock market index in our sample.

4.2. Test for Cointegration

After establishing that the time series in our sample are integrated in the order of 1 or I(1), we proceed to conduct a cointegration test on the indices for the sub-periods. Specifically, we employ the cointegration test developed by Johansen and Juselius (1990). The test applies a maximum likelihood procedure to determine the presence of cointegrating vectors in a set of non-stationary time series. The null hypothesis for the test is the absence of cointegration between the national stock index series. The presence of cointegration suggests that although all of the time series are individually nonstationary, *I(1)*, their linear combination is stationary, *I(0)*. We can, therefore, infer that the time series will not drift apart in the long-term and any short-term drift will be reverted to the equilibrium level.

Johansen (1991) adopts the Trace Test and Maximum Eigenvalue test statistic to determine the number of cointegrating equations in a model. The Trace test evaluates the null hypothesis of no cointegration versus the alternative hypothesis of cointegration. With the eigenvalue test, the null hypothesis is *r* cointegrating vectors against the alternative hypothesis of *r + 1* cointegrating vectors.

4.3. Vector Error Correction Model

Once cointegration is established between time series variables, the next step is to explore the long-run relationships between these national stock markets as well as the short-run error corrections. We employ a vector error correction model (VECM) to detect the long-run relationships that may exist among the variables. The advantage of this model is that all variables are treated as endogenous, and tests relating to the long-run parameters are possible. By running the VECM, we can estimate the error-correction equations. Johansen's estimation model is as follows:

$$\Delta X_t = \mu + \Sigma_{i=1 \text{ to } k-1} \Gamma_i \Delta X_{t-i} + \Pi_i X_{t-1} + \varepsilon_t \quad (2)$$

where Δ is the first difference operator; I is Identity matrix, whose rank determines the number of distinct cointegrating vectors; X_i is (n x 1) vector of all the non-stationary indices in our study; Γ_i is (n x n) matrix of coefficients, which represents short run dynamics; Π is (n x r) matrix of r cointegrating vectors, so that $0 < r < n$. This is what represents the long-run cointegrating relationship between the variables. ε_t is multivariate random error.

5. RESULTS AND DISCUSSIONS

5.1. Stationarity Test

We begin by determining the appropriate trend lag needed for the time series to be stationary. For this purpose, we use Akaike's information criterion (AIC), Schwarz's Bayesian information criterion (SBIC), Final Prediction Error (FPE), and the Hannan and Quinn information criterion (HQIC).

Once we determine the appropriate lags, we conduct the Augmented Dickey-Fuller (ADF) test. Our tests show that time series levels exhibit non-stationarity while the first difference of those variables are stationary. Specifically, the results from the ADF test, shown in Table 3, for both sub-periods suggest the presence of unit root in the level form for all market indices. For the pre-crisis period, the null hypothesis of non-stationarity is not rejected for tests based on the log-level form of market indices, indicating the presence of a unit root process. On the other hand, tests using the first difference reject the null hypothesis of unit root in all cases. These results show that each national stock market series becomes stationary individually when integrated of order one, I (1), during the period.

Results for the post-crisis period show a similar pattern. Tests using the levels of the time series fail to reject the null hypothesis of non-stationarity. After we take the first difference, however, tests for all of stock market indices show stationarity. The null hypothesis of a unit root in the first difference is thus rejected for indices, suggesting that each national stock market index series becomes stationary individually when it is integrated of order one, I (1).

Table 3: ADF Unit Root Tests on Time Series with a Trend

		Pre-crisis		**Post-crisis**	
Country	**Variable**	**Levels**	**First diff.**	**Levels**	**First diff.**
United States	LnUS	-2.343	-42.643***	-3.936	-35.204***
Brazil	LnBZL	-1.065	-33.458***	-2.083	-34.178***
China	LnCHN	-0.786	-41.173***	-1.981	-35.335***
India	LnIND	-0.478	-32.638***	-2.684	-33.761***
Malaysia	LnMALAY	-1.194	-30.052***	-3.015	-27.198***
Mexico	LnMEX	-2.087	-29.704***	-3.728	-29.704***

Thailand	LnTHAI	-1.195	-27.693***	-2.79	-34.036***
Taiwan	LnTWN	-1.76	-38.693***	-3.133	-28.070***

5.2. Cointegration Test

Our results in the previous section show that all of stock market index series in the subsamples are integrated of order one, I(1). Therefore, the precondition for cointegration tests is satisfied. The appropriate lag length for the independent variable in both the Johansen cointegration test and VECM (vector error correction model) can be determined by the VAR (vector autoregression) lag order selection criteria such as the SBIC (Schwarz's Bayesian information criterion), FPE (Final Prediction Error), and HQIC (Hannan and Quinn information criterion). After selecting the lag length for the independent variable, we can proceed to estimate the Johansen cointegration equation.

Table 4: Pre-crisis Period: Cointegration Test

Max. Rank	Eigenvalue	Trace Statistic	5% Critical Value
0	.	179.3206	156.00
1	0.01612	124.6321	124.24
2	0.01301	80.581*	94.15
3	0.01010	46.4076	68.52
4	0.00653	24.3609	47.21
5	0.00372	11.8366	29.68
6	0.00227	4.1782	15.41
7	0.00124	0.0026	2.76
8	0.00000		
No. of obs.	3,365	Lags	2

Note: * shows the presence of cointegration.

Table 4 shows the result of our cointegration test for the pre-crisis period. Specifically, the trace and maximum eigenvalue statistics are significant at the 5% level, indicating the existence of two cointegrating equations between the US and emerging equity markets.

Table 5: Post-crisis Period: Cointegration Test

Max. Rank	Eigenvalue	Trace statistic	5% Critical Value
0	.	173.1579	156.00
1	0.02607	107.7476*	124.24
2	0.01234	76.9998	94.15
3	0.01100	49.6142	68.52
4	0.00833	28.8964	47.21
5	0.00519	16.0193	29.68
6	0.00406	5.9365	15.41
7	0.00180	1.4661	3.76
8	0.00059		

No. of obs.	2,476	Lags	3

Note: * shows the presence of cointegration

In Table 5, we present the result of our cointegration test for the post-crisis period. Similar to our findings for the pre-crisis period, the trace and maximum eigenvalue statistics show the existence of cointegration between the US and emerging equity markets in the post-crisis period. Specifically, the trace and maximum eigenvalue statistics are significant at the 5% level, indicating the existence of one cointegrating equation. All in all, the results in Table 4 and Table 5 confirm the existence of cointegration between the US and emerging markets in the pre-crisis and post-crisis periods.

5.3. Vector Error Correction Model Results

The cointegration tests in the previous section show presence of cointegration between the US and the seven emerging stock markets in both sub-periods. In this section, we build on those findings and proceed to show the short-run and long-run dynamics by estimating VECM systems for each subperiod.

We present the results for tests of short-term relationships using the US market as a variable of interest. Accordingly, lag of the LnUS variable ($LnUS_{t-1}$) is the independent variable and we interpret its coefficient as indicative of the influence of the US market at t-1 on each dependent variable (emerging market index) at time t. By using this approach, we examine the presence of a short-run relationship between the US and each of the seven emerging national stock markets. If the coefficient of $LnUS_{t-1}$ is positive and statistically significant, then a significant short-run relationship between the US and the other national market is deemed present. Furthermore, the second component of VECM permits us to assess whether convergence to long-term equilibrium occurs after a shock. Specifically, a negative and statistically significant coefficient for speed adjustment in VECM indicates convergence to the long-run equilibrium relationship after deviation due to a shock.

In Table 6, we present short-run results for the pre-crisis period where each emerging market equity index is shown in a column, with the coefficient for $LnUS_{t-1}$ and the speed of adjustment shown across rows. These results show that Indian, Malaysian, Mexican, Taiwanese and Thai markets are significantly related to the US market. In each of these cases, the coefficient of $LnUS_{t-1}$ is positive and statistically significant at the 1% level, showing that increases (decreases) in US equity prices were followed by increases (decreases) in equity prices in the respective equity market. In contrast, the results for Brazilian and Chinese markets show that these markets were not significantly related to the US market during the period. In sum, the results suggest existence of diversification opportunities in limited cases. The significantly positive relationships between the US and Indian (LnIND), Malaysian (LnMALAY), Mexican (LnMEX), Taiwanese (LnTWN), and Thai (LnTHAI) markets suggest that US investors could not achieve short-run diversification benefits by investing in these markets. But lack of significant association between the US market and Brazilian (LnBZL) and Chinese (LnCHN) markets indicates existence of short-run diversification opportunities through investment in these markets.

Table 6: Pre-crisis Period: VECM Short-run Dynamics and Error Corrections

Variable	LnUS	LnBZL	LnCHN	LnIND	LnMALAY	LnMEX	LnTHAI	LnTWN
Speed Adj Coeff.	-0.00285***	-0.00130	-0.000274	0.00897***	0.00664***	-0.00170	0.00179	0.00246
	(0.00105)	(0.00257)	(0.00177)	(0.00156)	(0.00173)	(0.00196)	(0.00189)	(0.00153)
$LnUS_{t-1}$	-0.0287	0.0551	0.0307	0.141***	0.320***	0.121***	0.208***	0.326***
	(0.0205)	(0.0502)	(0.0346)	(0.0305)	(0.0338)	(0.0382)	(0.0368)	(0.0299)
No. of obs.	3,365	3,365	3,365	3,365	3,365	3,365	3,365	3,365

Notes: Standard errors are shown in parentheses. *, **, and *** denote significance at 10%, 5%, and 1% levels, respectively. Columns 2-8 show dependent variables in log. $LnUS_{t-1}$ is the independent variable (lagged one period). Speed Adj Coeff is the speed adjusting coefficient.

Table 7: Pre-crisis Period: VECM Long-run Relationships

Variables	LnUS	LnBZL	LnCHN	LnIND	LnMALAY	LnMEX	LnTHAI	LnTWN
Normalization Coefficient	1	0.12490	0.16425	-1.13683***	-0.46934***	0.45653***	0.94116***	-0.63682
		(0.13618)	(0.10853)	(0.22324)	(0.17037)	(0.1601)	(0.15281)	(0.18427)
No. of obs.	3,365	3,365	3,365	3,365	3,365	3,365	3,365	3,365

Notes: Standard errors are shown in parentheses. *, **, and *** denote significance at 10%, 5%, and 1% levels, respectively. A negative normalization coefficient indicates a positive long-run relationship whereas a positive normalization coefficient indicates a negative long-run relationship.

The results in Table 6 also suggest that the seven emerging markets continue to move away from their long-run relationships with the US market after a shock. If an emerging market converges to its long-run relationship with the US market after a shock, the associated speed of adjustment coefficient would be negative and significant. However, Tables 6 shows that none of these coefficients (shown on the row for the speed of adjustment coefficient) is negative and significant. Put differently, these results suggest that the seven equity markets continue to move further away from their long-run relationships with the US market in the aftermath of a shock during the pre-crisis period

Table 7 shows results from tests of long-run relationships between the US and the emerging equity markets for the pre-crisis period. In broad terms, the normalization coefficients show that Indian, Malaysian, Mexican and Thai markets are significantly related to the US market. Closer examination of the normalization coefficients also shows that the Indian and Malaysian markets are positively related to the US equity market given that their normalization coefficients are negative. Two other emerging markets – Mexican and Thai – are negatively related to the US market since the sign of the normalization coefficient is positive in each case. Brazilian, Chinese, and Taiwanese markets do not appear to have significant long-run relationship with the US equity market during the period. Putting these results together, we observe that the Mexican and Thai

markets, although cointegrated, had negative relationships with the US market. Therefore, these pre-crisis period relationships imply the possibility of diversification gains during the period. In addition, because they lack significant normalization coefficients, Brazilian, Chinese, and Taiwanese stocks could form a well-diversified portfolio when combined with US stocks. Indian and Malaysian markets did not offer diversification opportunities during the pre-crisis period due to their positive relationships with the US market.

Table 8 reports the short-run results for the post-crisis period based on the same approach as we used to generate results presented in Table 6 for the pre-crisis period. Overall, the relationships between the US and other emerging markets are significantly positive with respect to the log of the US price lagged one day ($LnUS_{t-1}$). Five of the markets have statistically significant relationships with the US market at the 1% level whereas Mexican and Brazilian markets yield significance at the 5% and 10% level, respectively.

In terms of magnitude, the coefficients show change in log of equity price in response to a one unit change in $LnUS_{t-1}$. For example, the coefficient associated with the Chinese market (LnCHN) shows that a one unit change in US log price on day t-1 – $LnUS_{t-1}$ – is followed by 0.248 increase in LnCHN at day t. Similarly, a one unit change in $LnUS_{t-1}$ garners a 0.249 change a day later in the Indian (LnIND) market.A look at the coefficients of $LnUS_{t-2}$ shows that most of the markets continue to be influenced by the US market two days later. For those markets with significant association with the US market, the coefficient ranges from 0.0381 for the Malaysian (LnMALAY) market to 0.112 for the Taiwanese (LnTWN) market. However, Brazilian and Mexican markets do not appear to be affected by changes in the US market on the second day. In both cases, the log price on day t is not affected by the $LnUS_{t-2}$ (lagged two periods) variable. This suggests that, over two days, each of these markets becomes less responsive to the changes in the US market. Thus, some diversification gains can potentially be achieved by investing in these markets. However, the potential for such diversification gains in the short-run is diminished for the other five markets since those markets are positively associated with both $LnUS_{t-1}$ and $LnUS_{t-2}$.

Table 8 also reports negative and significant coefficients for the speed of adjustment for the Brazilian, Malaysian, and Mexican markets. This suggests that any deviation from the long-run equilibrium in these markets will eventually be reversed. Specifically, coefficients of the speed of adjustment for Brazilian, Malaysian, and Mexican markets suggest that a short-run disequilibrium induced by a shock is corrected toward the long-run cointegrating relationship at a speed of approximately 3.33%, 0.821%, and 2.77%, respectively, per day. In other words, in the event of a shock, 3.33%, 0.82%, and 2.77% of the deviation is corrected daily towards the long-run equilibrium. For the other four markets (Chinese, Indian, Taiwanese, and Thai), we do not observe such convergence. Deviations due to shocks appear to persist causing each of these markets to move away from its long-run equilibrium relationship with the US market.

Table 9 reports VECM (Vector Error Correction Model) long-run relationships for the post-crisis period. Taking the post-crisis period independently, we observe that only the Indian market does not show significant co-integrating relationship with the US market. Out of the six markets that show significant co-integrating relationships, two markets (Taiwanese and Thai) exhibit positive relationships while the other four (Brazilian, Chinese, Malaysian, and Mexican) exhibit negative relationships. With the exception of the result for Mexico, the results here differ from those presented in Table 7 for the pre-crisis period in important ways. First, the insignificant

cointegrating relationships of Brazilian and Chinese markets with the US market become significant in the post-crisis period. In addition, even though Malaysian and Thai markets continue to have cointegrating relationships in the post period, the relationships are opposite to what they were in the pre-crisis period. Finally, the Taiwanese market has a positive cointegrating relationship with the US market in the post-crisis period despite having no relationship in the pre-crisis period.

The results in Table 9 have inplications for portfolio management. First, adding Brazilian, Chinese, and Mexican stocks to a portfolio may reap substantial diversification gains in the long-run because these markets have positive normalization coefficients and thus are negatively cointegrated with the US market. Second, a portfolio of Indian and Malaysian stocks along with US stocks may yeild some diversification gains due to marginal or no cointegration relationship between the US market and either of these two stock markets. Finally, little benefits will accrue from holding a portfolio of stocks from Thailand and Taiwan along with US stocks due to the strong and positive cointegration relationships between these markets and the US market.

Table 8: Post-crisis Period: VECM Short-run Dynamics and Error Corrections

Variable	**LnUS**	**LnBZL**	**LnCHN**	**LnIND**	**LnMALAY**	**LnMEX**	**LnTHAI**	**LnTWN**
Speed Adj Coeff.	-0.0141***	-0.0333***	-0.00192	-0.000041	-0.00821***	-0.0277***	0.00166	0.00227
	(0.00305)	(0.00638)	(0.00453)	(0.00396)	(0.00253)	(0.0044)	(0.00344)	(0.00311)
$LnUS_{t-1}$	-0.0732***	0.103*	0.248***	0.249***	0.184***	0.0778**	0.211***	0.334***
	(0.0266)	(0.0556)	(0.0395)	(0.0345)	(0.022)	(0.0384)	(0.03)	(0.0271)
$LnUS_{t-2}$	0.0223	0.00473	0.0779*	0.109***	0.0381*	0.00151	0.111***	0.112***
	(0.0273)	(0.0571)	(0.0406)	(0.0355)	(0.0226)	(0.0394)	(0.0308)	(0.0278)
No. of obs.	2,476	2,476	2,476	2,476	2,476	2,476	2,476	2,476

Notes: Standard errors are shown in parentheses. *, **, and *** denote significance at 10%, 5%, and 1% levels, respectively. Columns 2-8 show dependent variables in log. $LnUS_{t-1}$ is the independent variable (lagged one period). Speed Adj Coeff is the speed adjusting coefficient.

Table 9: Post-crisis Period: VECM Long-run Relationships

Variables	**LnUS**	**LnBZL**	**LnCHN**	**LnIND**	**LnMALAY**	**LnMEX**	**LnTHAI**	**LnTWN**
Normalization Coefficient	1	0.39175***	0.20656***	0.135468	0.23763*	0.44038***	-0.32878***	-1.31951***
		(0.03543)	(0.06266)	(0.10996)	(0.13803)	(0.12746)	(0.07305)	(0.15353)
No. of obs.	2,476	2,476	2,476	2,476	2,476	2,476	2,476	2,476

Notes: Standard errors are shown in parentheses. *, **, and *** denote significance at 10%, 5%, and 1% levels, respectively. A negative normalization coefficient indicates a positive long-run relationship whereas a positive normalization coefficient indicates a negative long-run relationship.

In sum, our results regarding long-run relationships show that diversification gains can be reaped by investing in Brazilian and Chinese equity markets even though these two markets exhibited increased recoupling with the US market after the global financial crisis (Mensi et al, 2016). Moreover, the results here show that pockets of diversification opportunities exist for US investors despite findings in prior research that equity markets of BRICS emerging markets have shown greater integration, within the group, after the global financial crisis (Patel, 2019); and that investors from UK, a developed market, may not reap diversification benefits by investing in BRICS or MIST emerging markets (Yarovaya and Lau, 2016). Our results also show that examining the relationships between the US equity market and equity markets of a broad set of emerging markets provides insight into diversification opportunities for investors.

5.4. Stability Tests

To check whether our model is dynamically stable, we plot the eigenvalues of the VECM coefficient matrix and present the results in figures 1 and 2. The figures show that the moduli of the eigenvalues are within the unit circle for both the pre-crisis and post-crisis periods. These results indicate that both VECM models are dynamically stable.

Figure 1: Pre-Crisis: VECM Stability graph

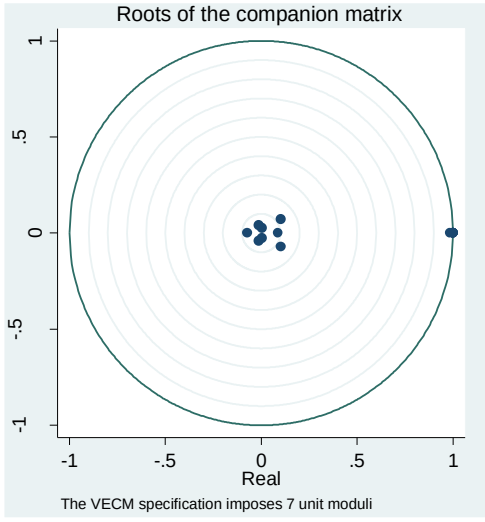
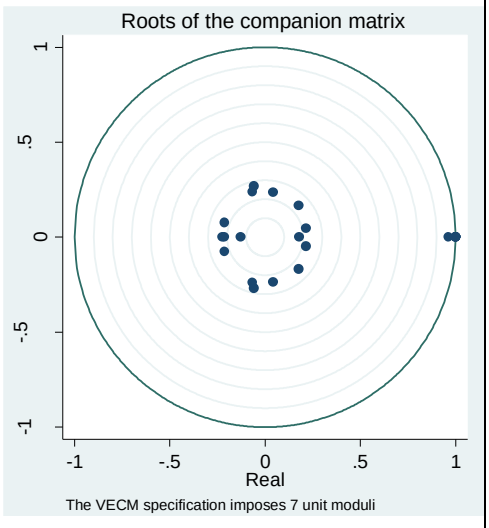


Figure 2: Post-crisis: VECM Stability graph



6. SUMMARY AND CONCLUSION

The 2007 – 2009 financial crisis originated from the troubled mortgage market. But its effect quickly morphed into a full blown financial crisis that eventually threw the wider economy into the ensuing recession. As the effect of the crisis was cascading through the financial services industry, what started in the troubled mortgage market threatened to freeze the entire credit market. In response, regulators moved to shore up liquidity through bailouts, quantitative easing, and other

policy measures. Even though the onset of the crisis prompted unprecedented cooperation among different players, its aftermath also sparked a backlash from groups with divergent persuations. In the end, the unprecedented rescue actions were followed by heightened regulation, uncertainty, and possibly protectionism.

To the extent that regulation, uncertainty and policy choices influence cross border capital flows and asset allocation decisions, relationships between the US and several national stock markets could be impacted by the 2007-2009 financial crisis. To better understand how the US market affects other national markets in both the short-run and long-run, this paper employs the theory of cointegration to investigate the impact of the financial crisis on the dynamic interactions between the US and seven emerging national stock markets in Brazil, China, India, Malaysia, Mexico, Taiwan, and Thailand. We begin by compiling daily stock market index prices in US dollars and divide the observations from each market into those related to the pre-crisis period (January 1995 to November 2007) and those related to the post-crisis period (July 2009 to December 2018). By using dollar denomination, we focus on linkages and the impact of the financial crisis on linkages independently of foreign exchange rate risk.

The major findings of this paper are as follows. First, the unit root tests indicate that each stock market index is nonstationary both in the pre-crisis and post-crisis periods. However, after we take the first difference for each series, those tests show that all market indices become stationary, suggesting that each index series is integrated of order one, I(1). Second, cointegration tests establish that the eight stock markets are cointegrated in each of the two subperiods. Third, tests related to the short-run relationships between the US and emerging markets reveal that relationships in the post-crisis period are somewhat different from those in the pre-crisis period. During the pre-crisis period, only equity markets of India, Malaysia, Mexico, Taiwan, and Thailand were affected by the US market. In the post-crisis period, all of the emerging markets are affected by changes in US equity prices. Increases (decreases) in US equity prices on day t-1 are generally followed by increases (decreases) in emerging market equity prices on day t. Furthermore, equity prices of markets in China, India, Malaysia, Taiwan, and Thailand are affected by day t-2 changes in US equity prices. Fourth, in the event of a shock, each emerging market continues to move away from its long-run relationship with the US market in the pre-crisis period. Post-crisis, only the Chinese, Indian, Taiwanese, and Thai markets move away from the long-run relationships with the US market. Brazilian, Malaysian, and Mexican markets move towards the long-run equilibrium relationship with the US market after a shock during the post-crisis period. Fifth, only the Mexican market maintains the same long-run cointegration relationship (i.e., a negative relationship) with the US market in both time periods. The Brazilian and Chinese markets exhibit negative long-run cointegration relationships in the post-crisis period even though these markets had no significant relationships with the US market in the pre-crisis period. In contrast, the positive long-run cointegration relationship between the Indian and US markets in the pre-crisis period is no longer present in the post-crisis period.

By and large, we provide broad evidence that opportunities still exist for US investors to diversify their portfolios by adding stocks from some emerging markets. At the same time, our results also show that cointegrating relationships between the US and emerging markets evolve over time. Significantly, we document that how cointegrating relationships change after a shock varies across countries. Given the impact of cross market correlations on portfolio risk, our results offer useful input for international portfolio management.

Our study contributes to the literature by examining dynamic linkages between US and emerging equity markets before and after the 2007-2009 financial crisis. Our study also provides new evidence on emerging financial market integration for a wide range of emerging markets.

REFERENCES

Arshanapalli, B., & Doukas, J. (1993). International stock market linkages: Evidence from the pre- and post-October 1987 period. *Journal of Banking and Finance, 17*, 193-208.

Bit-Kun, Y., Arsad, Z., & Chee-Wooi, H. (2015). Modeling time-varying stock market integration in ASEAN: A Kalman filter approach. *International Journal of Economics and Management, 9*(2), 1-16.

Bouri, E., & Yahchouchi, G. (2014). Do return and volatility traverse the Middle Eastern and North African (MENA) stock markets borders? *Journal of Economic Studies, 41*(2), 317–344.

Chaudhry, M., Boldin , R. J., Affaneh, I., & Khan, W. (2012). Seven Asian emerging equity markets: Are they integrated? *Asia Pacific Journal of Finance and Banking Research, 6*(6), 26–36.

Forbes, K. (2014, July 6). *Turmoil in emerging markets: What's missing from the story?* Retrieved June 16, 2023, from CEPR.og: https://cepr.org/voxeu/columns/turmoil-emerging-markets-whats-missing-story

International Monetary Fund. (2016). Understanding the slowdown in capital flows to emerging markets. In *World Economic Outlook* (pp. 63-99).

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control, 12*(2-3), 231-254.

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. *Econometrica, 59*(6), 1551-1580.

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration – With applications to the demand for money. *Oxford Bulletin of Economics and Statistics, 52*(2), 169–210.

Kenourgios, D., & Samitas, A. (2011). Equity market integration in emerging Balkan markets. *Research in International Business and Finance, 25*(3), 296–307.

Koepke, R. (2019). What drives capital flows to emerging markets? A survey of the empirical literature. *Journal of Economic Surveys, 33*(2), 516-540.

Lahrech, A., & Sylwester, K. (2011). U.S. and Latin American stock market linkages. *Journal of International Money and Finance, 30*(7), 1341–1357.

Lamba, A. S. (2005). An analysis of the short- and long-run relationships between South Asian and developed equity markets. *International Journal of Business, 10*(4), 383–402.

Lehkonen, H. (2015). Stock market integration and the global financial crisis. *Review of Finance, 19*(5), 2039–2094.

López, G., & Stracca, L. (2021). *Changing patterns of capital flows.* Bank for International Settlements.

Majid, M. S., & Kassim, S. H. (2009). Impact of the 2007 U.S. financial crisis on the emerging equity markets. *International Journal of Emerging Markets, 4*(4), 341–357.

Mensi, W., Hammoudeh, S., Nguyen, D., & Kang, S. (2016). Global financial crisis and spillover effects among the U.S. and BRICS stock markets. *International Review of Economics & Finance*, 257-276.

Mensi, W., Shahzad, S., Hammoudeh, S., Zeitun, R., & Rehman, M. (2017). Diversification potential of Asian frontier, BRIC emerging and major developed stock markets: A wavelet-based value at risk approach. *Emerging Markets Review*, 130-147.

National Bureau of Economic Research. (2019). *U.S. Business cycle expansions and contractions.* Retrieved May 19, 2019, from https://www.nber.org/cycles.html

Ncube, G., & Mingiri , K. F. (2015). Stock market integration in Africa: The case of the Johannesburg stock exchange and selected African countries. *International Business & Economics Research Journal, 14*(2), 367-386.

Nikkinen, J., Vanja, P., & Äijö, J. (2012). Baltic stock markets and the financial crisis of 2008-2009. *Research in International Business and Finance, 26*(3), 398-409.

Ozkan, F. G., & Unsal, D. F. (2012). *Global financial crisis, financial contagion, and emerging markets.* Retrieved June 16, 2023, from https://www.imf.org/-/media/Websites/IMF/imported-full-text-pdf/external/pubs/ft/wp/2012/_wp12293.ashx

Paramati, S. R., Roca, E., & Gupta, R. (2016). Economic integration and stock market dynamic linkages: Evidence in the context of Australia and Asia. *Applied Economics, 48*(44), 4210–4226.

Patel, R. (2019). BRICS emerging markets linkages: Evidence from the 2008 Global Financial Crisis. *The Journal of Private Equity*, 42-59.

Rich, R. (2013). *The Great Recession.* Retrieved May 19, 2019, from Federal Reserve Bank of Cleveland: https://www.federalreservehistory.org/essays/great_recession_of_200709

Said, S. E., & Dickey, D. (1984). Testing for unit roots in autoregressive-moving average models of unknown order. *Biometrika, 71*(3), 599-607.

Stiglitz, J. E. (2010). Risk and global economic architecture: Why full financial integration may be undesirable. *American Economic Review, 100*(2), 388–392.

Tong, H., & Wei, S.-J. (2008). *National Bureau of Economic Research (NBER) Working Paper Series.* Retrieved May 19, 2019, from Real Effects of the Subprime Mortgage Crisis: https://www.nber.org/papers/w14205

World Bank. (1997). *Private capital flows to developing countries: The road to financial integration.* Oxford : Oxford University Press.

Yarovaya, L., & Lau, M. (2016). Stock market comovements around the Global Financial Crisis: Evidence from the UK, BRICS and MIST markets. *Research in International Business and Finance*, 605-619.