Ekonomik ve Sosyal Araştırmalar Dergisi

The International Journal of Economic and Social Research

2023, 19(2)

Dynamic Volatility Spillover Among Emerging EAGLE Markets

EAGLE Piyasaları Arasındaki Dinamik Oynaklık Geçişkenliği

Gürkan BOZMA[1], **İlyas Kays İMAMOĞLU**[2], **Serkan KÜNÜ**[3]

Geliş Tarihi (*Received*): 04.10.2022 **Kabul Tarihi (*Accepted*):** 13.12.2022 **Yayın Tarihi (*Published*):** 31.12.2023

Abstract: The aim of this study is to investigate the volatility spillover between EAGLE stock market indices using the method proposed by Diebold and Yilmaz (2009, 2012). To achieve this aim, EAGLE stock market data was collected from the DataStream database for the period from 2005 to 2019. The Granger causality test was applied using the VAR model, and it was found that there are various causality relationships between countries. The findings indicate that, while the total volatility spillover index was approximately 10% in 2005, it nearly tripled during the financial crisis. The US debt crisis and the economic contraction in the Eurozone caused the total volatility spillover index to reach its maximum level of approximately 40%, and it continued to decrease until 2019. Turkey, Brazil, India, and Indonesia were found to be the net receivers of volatility, while China, Russia, and Mexico were identified as the net transmitters of volatility.

Keywords: EAGLE market, Volatility spillover, Market linkage, VAR, BRICMIT

&

Öz: Bu çalışma, Diebold ve Yılmaz (2009, 2012) tarafından önerilen yöntemi kullanarak EAGLE ülkeleri hisse senedi piyasası endeksleri arasındaki oynaklık yayılımını ortaya çıkarmayı amaçlamaktadır. Bu amaçla 2005-2019 yılları arasında EAGLE ülkelerinin borsa verileri DataStream veri tabanından toplanmıştır. VAR modelinin kullanılması nedeniyle ilk olarak Granger nedensellik testi yapılmış ve ülkeler arasında çeşitli nedensellik ilişkilerinin olduğu tespit edilmiştir. Elde edilen bulgulara göre, toplam oynaklık yayılma endeksi 2005 yılında %10 civarında iken, finansal kriz sırasında neredeyse üç katına çıkmıştır. ABD borç krizi ve Euro Bölgesi'ndeki ekonomik daralma, toplam oynaklık yayılma endeksini yaklaşık %40'lık maksimum düzeyine çıkarmış ve sonrasında 2019 yılına kadar düşmeye devam etmiştir. Türkiye, Brezilya, Hindistan ve Endonezya net oynaklık alıcılar olarak belirlenirken ve Çin, Rusya ve Meksika net oynaklık vericiler olarak tespit edilmiştir.

Anahtar Kelimeler: EAGLE piyasası, Volatilite yayılımı, Piyasa bağlantısı, VAR, BRICMIT

Atıf/Cite as: Bozma, G., İmamoğlu, İlyas K. & Künü, S. (2023). Dynamic Volatility Spillover Among Emerging EAGLE Markets. *Ekonomik ve Sosyal Araştırmalar Dergisi.* 19(2). 316-336.

İntihal-Plagiarism/Etik-Ethic: Bu makale, en az iki hakem tarafından incelenmiş ve intihal içermediği, araştırma ve yayın etiğine uyulduğu teyit edilmiştir. / This article has been reviewed by at least two referees and it has been confirmed that it is plagiarism-free and complies with research and publication ethics. https://dergipark.org.tr/tr/pub/ijaws

[1] Doç. Dr. Iğdır Üniversitesi, İktisat Bölümü, gurkan.bozma@igdir.edu.tr, (Sorumlu Yazar ise)
[2] Dr. Öğr. Üyesi. Bayburt Üniversitesi, Yönetim ve Organizasyon Bölümü, imamoglu@bayburt.edu.tr.
[3] Doç. Dr. Iğdır Üniversitesi, İktisat Bölümü, serkan.kunu@igdir.edu.tr.

1. Introduction

The rapid development of technology after 1980 has caused significant changes in investors' portfolio settings. In addition to stock markets, an investor who can trade 24 hours in forex markets can quickly get out of a stock exchange and enter another stock exchange (Abad, Chuliá, & Gómez-Puig, 2010; Aloui, Aïssa, & Nguyen, 2011; Forbes & Rigobon, 2002; Gilmore, Lucey, & McManus, 2008). Leaving aside speculative movements, the main reason investors move from one stock exchange to another can be expressed as profit maximization. Profit and risk are directly proportional to finances. Investors earn high profits in high-risk markets. Therefore, it can be said that investors prefer BRICMIT (Eagles Market) economies, where the risk and profit are higher than in developed countries such as the USA and the UK, where the risk is low. This study examines the spillover effects between the EAGLE stock markets.

The EAGLE concept refers to developing countries that contribute more to world growth than the average of the G6 countries. These countries are Brazil, Russia, India, China, Mexico, Indonesia, and Turkey. According to the BBVA Report, emerging markets will contribute 73% of global growth between 2013 and 2023. The EAGLE countries are expected to contribute 51% of their expected growth (BBVA, 2014).

Given the recent financial literature, spillover effects between stock markets have been frequently studied. Spillover occurs in both return and volatility. Many studies are addressing the return and volatility spillover, especially from the developed stock market to the emerging stock market (Bekaert & Harvey, 1995, 2003; Carrieri, Errunza, & Hogan, 2007; Foerster & Karolyi, 1999; Mensi, Hammoudeh, & Kang, 2017a, 2017b). These studies examine volatility spillovers between the US stock markets or stock markets of developed and developing economies. For example, Mensi et al. (2017a, 2017b) stated that analyzing the relations between BRICS countries and the stock markets of developed countries would benefit international investors. The general opinion obtained from these studies is that the return and volatility in the stock markets of developed countries affect the developing stock markets (Adrangi, Chatrath, Macri, & Raffiee, 2019; Dzielinski, 2012; Mensi, Hammoudeh, Reboredo, & Nguyen, 2014). At the same time, Adrangi, Chatrath, and Raffiee (2014), Cardona, Gutiérrez, and Agudelo (2017), Chan-Lau and Ivaschenko (2003), Chuliá, Guillén, and Uribe (2017), Demiralay and Bayraci (2015), Fink and Schüler (2015), Lahrech and Sylwester (2011), Y. Li and Giles (2015), Miyakoshi (2003), Verma and Ozuna (2005), Wei, Liu, Yang, and Chaung (1995) suggest that there are return and volatility spillover from developed countries to developing countries. In recent years, studies on the development of stock exchanges have increased (Ahmad, Sehgal, & Bhanumurthy, 2013; Bhar & Nikolova, 2009; Gilenko & Fedorova, 2014; Hammoudeh, Sari, Uzunkaya, & Liu, 2013; Korkmaz, Çevik, & Atukeren, 2012; Mensi et al., 2017a, 2017b; Mensi, Hammoudeh, Nguyen, & Kang, 2016). In addition, the rapid growth rates in developing countries have caused volatility to increase. In particular, owing to the quantitative easing programs launched by the FED, periods of capital flows are observed rapidly. The increase in global volatility expectations shows its effect on the markets of developing countries (Hacihasanoglu, Simga-Mugan, & Soytas, 2012). The effect of the stock market crisis that occurred in the Asian Tigers, especially in the 1990s, affected almost all stock markets in developing countries and directed researchers to research emerging stock markets (Guimaraes & Hong, 2016; Tsutsui & Hirayama, 2013).

Allen et al. (2013) examine the volatility spillover between the stock markets of China and its neighbors from 1991 to 2011. The results of the study show statistically significant volatility spillover in pre-GFC (Great Financial Crisis) and GFC. Y. Li and Giles (2015) examined the volatility spillover among the stock markets of US, Japan, and six developing Asian countries (China, India, Indonesia, Malaysia, the Philippines, and Thailand) from 1993 to 2012. The results show significant unidirectional shocks and volatility spillovers among developed and developing countries. Moreover, Alper and Yilmaz (2004) examined the stock return volatility spillover from Brazil, South Korea, and Russian stock markets and financial centers (DJIA, FTSE, and Hang Seng) to the Turkish stock market (ISE). The findings show a contagion effect from EMs and financial centers.

From the Chinese perspective, the Shanghai and Shenzhen stock markets are not affected by the American market; we can say unidirectional volatility spillovers from the Hong Kong Stock Exchange to the US stock markets (H. Li, 2007). Similarly, the volatility interaction between the Chinese, Hong Kong, and Taiwan exchanges appears to be more pronounced than that in Western markets (Zhou, Zhang, & Zhang, 2012). On the other hand, it is stated that the American stock market had a one-way shock and spread effects on the Chinese, Indian, and Indonesian markets, and it had a more powerful and two-way shock effect during the Asian Crisis (Y. Li & Giles, 2015).

From a Russian perspective, volatility in the American stock markets and global commodity markets seems to impact the Russian Stock Exchange (Mensi et al., 2014). Similarly, the US stock markets impact the Brazilian, Russian, and Indian stock markets (Bhar & Nikolova, 2007). It is shown that the volatility spread that started in the USA was effective in Brazil and spread from Mexico to Brazil (Gamba-Santamaria, Gomez-Gonzalez, Hurtado-Guarin, & Melo-Velandia, 2019). From Turkey's perspective, the Istanbul Stock Exchange is influenced by world markets such as the US, the UK, Japan, and Germany. In particular, the US and UK markets significantly impact BIST and other emerging markets (Darrat & Benkato, 2003).

This study differs from previous studies in many ways. First, when examining studies on volatility spillover between the stock markets of developing countries, we were unable to find a study specifically addressing the Eagle market as a whole. The method proposed by Diebold and Yilmaz (2009, 2012) was used to fill this gap in literature. Studies in related literature have generally addressed the average and volatility spillover between BRICS countries and Asian and Latin American countries. On the other hand, this study reveals the volatility spillover between the EAGLE market, which contributes almost 75% to world economic growth. Second, when the volatility spillover between markets is carefully examined in the relevant literature, volatilities are obtained using ARCH/GARCH models (Fang et al., 2019; Luo & Wang, 2019; Ordu-Akkaya & Soytas, 2020). In this study, following Diebold and Yilmaz (2009, 2012) and Alizadeh et al. (2002), daily variance was obtained and used as volatility. Thus, as stated by Alizadeh et al. (2002), calculating the volatility of financial assets provides us with a more efficient and valid approach. Finally, the global financial crisis affected the stock market and macroeconomic indicators of developed and developing countries. In this study, by examining these effects, the volatility spread between emerging markets before and after the global financial crisis can be more easily revealed using this perspective in the volatility calculation.

The remainder of this paper is organized as follows. Section 2 describes the economic framework and data. Section 3 presents empirical results and discusses the main implications of this study. Finally, Section 4 presents our empirical results.

2. Empirical Methodology and Data

In this study, the VAR-based model proposed by Diebold and Yilmaz (2009, 2012) was used to measure the volatile pass-through between the emerging Eagle stock market. For this purpose, EAGLE market data consisting of Brazil, Russia, India, China, Mexico, Indonesia, and Turkey stock markets, as put forward by BBVA (2014), were used. Stock market data were handled from the Datastream database for the period October 24, 2005, to September 19, 2019, due to data limitations. In the model proposed by Diebold and Yilmaz (2009, 2012), we can measure the volatility transition between stock markets (from i to j). In this way, we can determine which stock market is the receiver or transmitter of volatility. In this method, the volatility series is selected first. When examining the relevant literature, various methods are employed to obtain volatility series. As these are short GARCH-based models (univariate-GARCH, multivariate-GARCH), as suggested by Diebold and Yilmaz (2009, 2012), the volatility series can be obtained using the following equation: This study used the method recommended by Diebold and Yilmaz (2009, 2012): According to this:

$$\sigma_{it}^{2} = 0.361[\ln(p_{it}^{\max}) - \ln(p_{it}^{\min})]^2 \quad (1)$$

Here, P_{it}^{max} is the maximum price of t days in the market i, while P_{it}^{min} is the minimum price that occurs on the day t in the market i. As σ_{it}^{2} is the daily variance, the annualized volatility series is obtained as $\sigma_{it} = 100\sqrt{365.\sigma_{it}^{2}}$.

In this analysis, nations' contributions to each other's volatility are discussed within the scope of the forecast error variance decompositions from the VAR model. Following Diebold and Yilmaz (2009, 2012), the covariance stationary VAR model is given by equation (2).

$$X_t = \sum_{k=1}^{p} \lambda_k X_{t-k} + \varepsilon_t, \tag{2}$$

Here, X refers to the variable matrix of size (Nx1), λ refers to the autoregressive coefficient matrix, and ε is the error term. Moving average representation based on the assumption that Equation (2) is covariance stationery can be written as $X_t = \sum_{k=0}^{\infty} A_k \varepsilon_{t-k}$. Here, the N × N coefficient matrix and Ak obey a recursion of the form, where A0 is an (N × NxN) identity matrix and Ak = 0 for k <0.

According to Diebold and Yilmaz (2009, 2012), the total, directional, and net spillover indices can be produced using the L-step-ahead generalized forecast error variance decomposition proposed by Koop, Pesaran, and Potter (1996) and Pesaran and Shin (1998). The L-step early generalized forecast error variance decomposition is generated as follows:

$$K_{ij}^{g}(L) = \frac{\sigma_{jj}^{-1} \sum_{l=0}^{L-1} (e_i' A_l \sum ej)^2}{\sum_{l=0}^{L-1} (e_i' A_l \sum A_l' ej)} \tag{3}$$

Where Σ denotes the variance-covariance matrix for ε, σjj is the standard deviation of the error term for the jth equation, and ei is the selection vector with one as the ith element and zero otherwise. According to the equation given above, the sum of the rows of the $K_{ij}^{g}(L)$ variance-covariance matrix should not be equal to one ($\sum_{j=1}^{N} K_{ij}^{g}(L) \neq 1$). Then, the variance decomposition matrix is normalized as:

$$\tilde{K}_{ij}^{g}(L) = \frac{K_{ij}^{g}(L)}{\sum_{j=1}^{N} K_{ij}^{g}(L)} \tag{4}$$

Equation 4 appears as $\sum_{j=1}^{N} \tilde{K}_{ij}^{g}(L) = 1$ and $\sum_{ij=1}^{N} \tilde{K}_{ij}^{g}(L) = N$.

The decomposition of variance using the volatility contribution and the total spillover of volatility that calculates the spillover of volatility through the variables to the total forecast error variance is calculated as:

$$K^{g}(L)=\frac{\sum_{\substack{i,j=1\\ i\neq j}}^{N} K_{ij}^{g}(L)}{\sum_{i,j=1}^{N} K_{ij}^{g}(L)}.100=\frac{\sum_{\substack{i,j=1\\ i\neq j}}^{N} K_{ij}^{g}(L)}{N}.100 \quad (5)$$

Following, the directional volatility spillovers from all stock markets j to market i calculate as

$$K_{i.}^{g}(L)=\frac{\sum_{\substack{j=1\\ j\neq i}}^{N} K_{ij}^{g}(L)}{\sum_{i,j=1}^{N} K_{ij}^{g}(L)}.100=\frac{\sum_{\substack{j=1\\ j\neq i}}^{N} K_{ij}^{g}(L)}{N}.100.$$

Similarly, directional volatility spillovers from stock market i to all other stock markets j calculates as

$$K_{.i}^{g}(L)=\frac{\sum_{\substack{j=1\\ j\neq i}}^{N} K_{ij}^{g}(L)}{\sum_{i,j=1}^{N} K_{ij}^{g}(L)}.100=\frac{\sum_{\substack{j=1\\ j\neq i}}^{N} K_{ij}^{g}(L)}{N}.100.$$

Finally, we can define net volatility spillover from stock market i to all other stock market j as $K_{i}^{g}(L)=K_{.i}^{g}(L)-K_{i.}^{g}(L)$. Here, we can express that if the $K_{i}^{g}(L)$ value is positive, the i stock market is a net volatility transmitter, if the $K_{i}^{g}(L)$ value is negative, the i market is a net volatility receiver.

3. Empirical Results and Discussions

When examining the volatility between the stock market indices of the countries in the Eagle market, it is necessary to first look at the descriptive statistics and figures of the series. Table 1 presents the descriptive statistics of the series. According to Table 1, Russia has the highest volatility (standard deviation) among stock markets. India and Indonesia followed Russia. The table reveals that not all the series exhibit a normal distribution. The course of volatility in stock markets over time is shown in Figure 1.

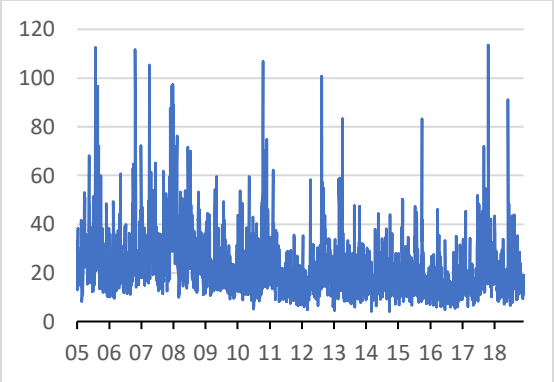
Table 1. Descriptive Statistics of Logged Volatility

	Turkey	Brazil	Russia	China	Mexico	India	Indonesia
Mean	-9.154	-8.887	-8.882	-9.195	-9.836	-9.386	-10.060
Median	-9.193	-8.939	-8.983	-9.295	-9.885	-9.460	-10.147
Maximum	-5.645	-4.585	-3.598	-5.499	-5.429	-4.203	-5.721
Minimum	-12.304	-12.488	-15.806	-12.238	-13.234	-12.736	-13.247
Std. deviation	0.979	0.932	1.154	1.112	1.093	1.144	1.128
Skewness	0.223	0.341	0.431	0.363	0.322	0.422	0.448
Kurtosis	0.225	0.902	1.240	-0.097	0.365	0.416	0.241

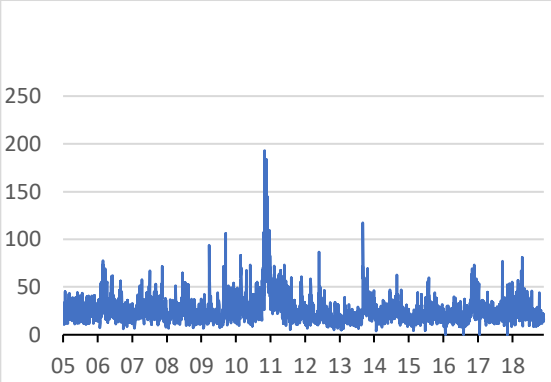
It is possible to draw a few different results from this table. First, Russia and Turkey exhibited the highest levels of volatility. For example, Turkey's volatility was 25% at the beginning of 2005 and increased by approximately 110% up to the mid-2005 levels. Later, the volatility, which dropped to the 50% band, reached 110% again towards the end of 2006. For Russia, volatility, which was in the 50% band in 2005, reached 180% levels at the beginning of 2006. In mid-2011, volatility of over 300% was observed. Second, the volatility of the stock market indices of countries in the Eagle market suddenly increased in mid-2011. In this context, with the downgrade of the US credit rating in August and the deepening of the European debt crisis, the stock indices depreciated in the second half of the year, and volatility increased (BIST, 2011). For example, in 2011, the Indian global and domestic factors explained the sudden increase in volatility.[4]

[4] Foreign portfolio investment net flow into the Indian markets for the first half of 2011 was $0.5 billion contrast to $4.66 billion for the same period in last year. India's inflation was a key

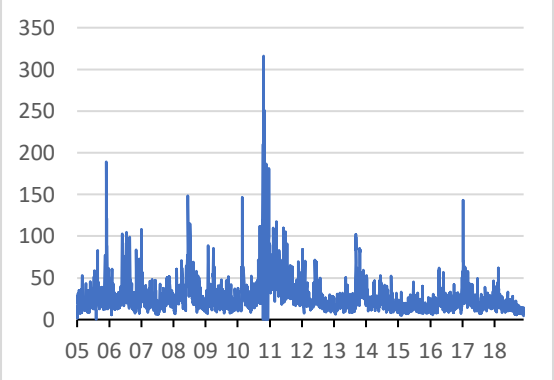
Finally, when considering India and Indonesia, the stock markets of these two countries did not experience a significant increase in volatility until the end of 2019, following a sudden jump in volatility that occurred in mid-2011.



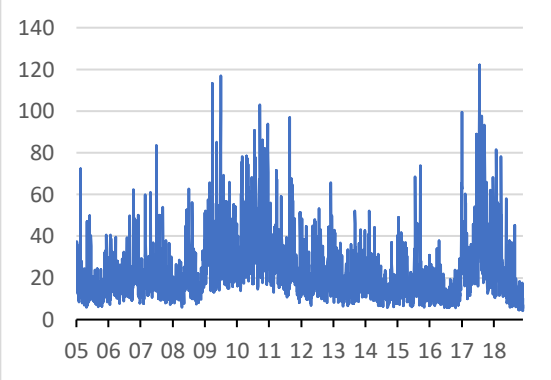
a) Turkey-BIST 100



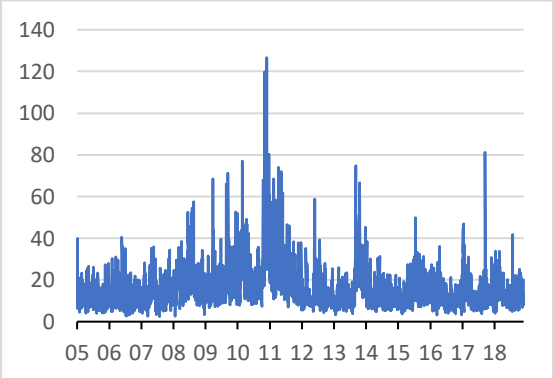
b) Brazil-BOVESPA



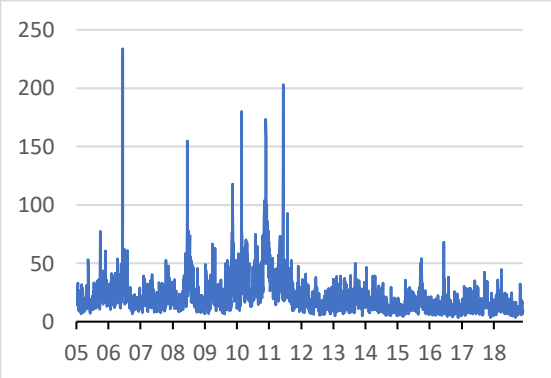
c) Russia-RTSE



d) China-Shanghai Composite

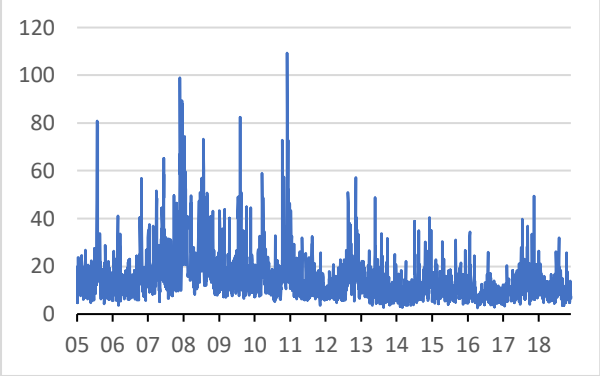


e) Mexico-BMV



f) India-Nifty 50

concern during 2011, staying regularly around 9% and reaching a high of 9.78% in August. The Reserve Bank of India (RBI) raised interest rates six times in a single year, adding a total of 225 basis points to its efforts to tackle rising inflation. (MINT, 2011).



g) Indonesia-IDX

Figure 1. Daily Stock Market Volatilities (annualized standard deviations, percentages)

Table 2 shows the Granger causality relationships between the volatility series. In the VAR-based model proposed by Diebold and Yilmaz (2009, 2012), information criteria such as Akaike, Schwartz, and Hannan-Quin were used to determine the lag length. In the model where the maximum lag length is 12, the optimal lag length is defined as 3, according to Schwartz's information criterion. As a result of applying the F-test to the lags of the variables in the VAR model, Granger causality test results were obtained. Accordingly, it can be seen that a bidirectional causality between Turkey and Indonesia's volatility of the stock market. Majdoub and Mansour (2014) and Korkmaz et al. (2012) indicate a volatility spillover between Turkey and Indonesia's stock markets. Similarly, it can be seen from the table that there are bidirectional causality relationships between Brazil, India, Russia, India, Russia, Mexico, India, Mexico, and India-Indonesia stock markets. Finally, we determined that there is one-way volatility transitivity from the Chinese stock market to the Brazilian, Indian, and Mexican stock markets. The findings of Padhi and Lagesh (2012) obtained from the multivariate-GARCH BEKK model suggest a strong volatility transition from Indonesia to India. In another study, Nath Mukherjee and Mishra (2010) emphasized the volatility transition from the Indian stock market to the stock markets of developing Asian economies. In their study on BRIC countries, Gilenko and Fedorova (2014) found that there was volatility spillover between the Brazilian and Indian stock markets during the pre-financial crisis period. However, during the post-crisis recovery period, they observed volatile spillovers from the Brazilian stock market to the Russian stock market and from the Chinese stock market to the Indian stock market. In the context of further consolidating the findings obtained from the Granger causality test, Table 3 shows the volatility spillover between stock markets.

Table 2. Granger Causality Test Results

Dependent\Independent	Turkey	Brazil	Russia	China	India	Mexico	Indonesia
Turkey		0.597 (0.616)	1.372 (0.249)	1.590 (0.189)	1.452 (0.225)	1.526 (0.205)	**20.979 (0.000)**
Brazil	1.082 (0.355)		**9.045 (0.000)**	**2.388 (0.067)**	**2.770 (0.040)**	1.116 (0.341)	1.284 (0.277)
Russia	0.403 (0.750)	1.257 (0.287)		0.833 (0.475)	**8.027 (0.000)**	**4.616 (0.000)**	1.086 (0.353)
China	0.529 (0.661)	0.195 (0.899)	0.870 (0.455)		0.931 (0.424)	1.833 (0.138)	1.119 (0.339)
India	0.154 (0.926)	**4.248 (0.000)**	**12.460 (0.000)**	**2.768 (0.040)**		**3.586 (0.013)**	**3.181 (0.023)**
Mexico	1.971 (0.116)	**2.192 (0.086)**	**5.165 (0.001)**	**6.967 (0.000)**	**4.564 (0.000)**		1.285 (0.277)
Indonesia	**22.310 (0.000)**	1.079 (0.356)	1.181 (0.315)	1.140 (0.331)	**2.678 (0.045)**	0.318 (0.812)	

Note: Parentheses indicate the probability values.

Table 3 presents the results of the volatility pass-through based on the VAR model proposed by Diebold and Yilmaz (2009, 2012). While creating the VAR model, according to Schwartz information criteria, we use three lag lengths and generalized variance decompositions of the 10-day ahead volatility forecast error. To test whether the model used in this study is robust, forecast horizons of 5-10 days with 1 and 10 lag lengths were calculated, as shown in Figures A1 and A2. As can be seen in the Figures, there is not much change in the total spillover index in the main line context.

Figure A1. Sensitivity of the index to VAR Lag Structure

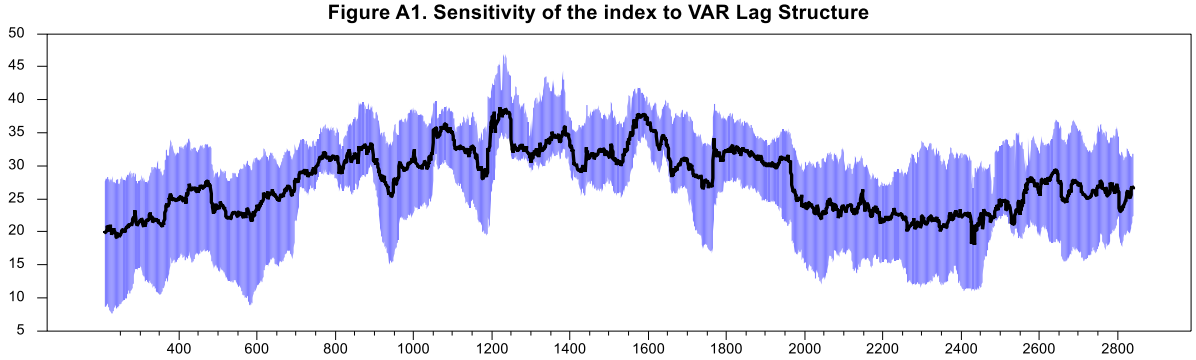
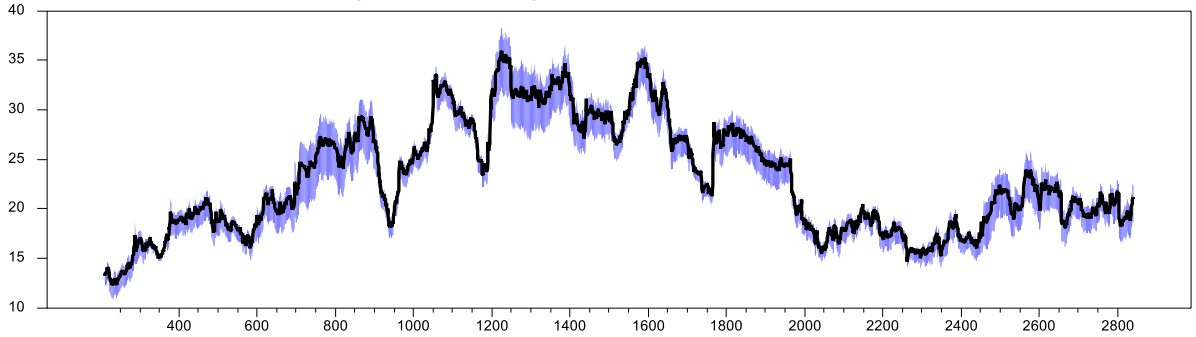


Figure A2. Sensitivity of the index to Forecast Horizon



Returning to Table 3, we can see that the volatility that will occur in the countries' stock markets (own) came from other stock markets (directional from others) and the contribution (directional to others) of different stock markets. On the other hand, we provide the net directional spillover, obtained by calculating the difference between directional spillover to others and directional spillover from others. This result indicates whether a country is a receiver (negative value) or transmitter (positive value) of volatility.

Table 3. Daily Volatility Spillover Between Emerging Stock Markets

	Turkey	Brazil	Russia	China	India	Mexico	Indonesia	From Others	Net
Turkey	89.67	0.05	0.37	0.19	0.49	0.12	9.11	10.3	-0,5
Brazil		74.01	7.42	1.57	3.28	13.51	0.14	26.0	-0,8
Russia	0.10	6.49	77.63	1.56	6.28	7.89	0.05	22.4	3,1
China	0.12	1.13	1.20	93.81	1.13	2.05	0.56	6.2	2,4
India	0.12	5.11	9.54	2.14	75.81	6.41	0.87	24.2	-7,6
Mexico	0.19	12.37	6.67	2.84	4.12	73.62	0.19	26.4	18,7
Indonesia	9.23	0.08	0.03	0.28	1.30	0.14	88.64	11.4	-0,5
Contribution to others	9.8	25.2	25.5	8.6	16.6	30.1	10.9	126.8	
Contribution including own	99.5	99.2	103.2	102.4	92.4	103.7	99.6	700.5	%18.1 (126.8/700.5)

According to Table 3, the Mexican stock market is the most affected (26.40%) by the volatility of stock markets in other developing countries. Brazil follows the Mexican stock market at 26.0%. The contribution of different stock exchanges to the volatility forecast error of the Indian stock market was 24.2%. It can be seen from the table that the least affected country among the analyzed countries is the Chinese stock market (6.2%). As the reason why China is less affected by developing stock markets, it can be said that China's being relatively bigger compared to the stock markets of other countries studied is an important factor. The coefficient (8.6%) showing China's volatility forecast error contribution to other countries' stock markets confirms this situation. Similar findings were reported by Patra and Panda (2019) and Panda, Vasudevan, and Panda (2020). In their analysis of BRICS countries, Patra and Panda (2019) found that China made the least contribution to the volatility of other countries before (6.52%) and after (6.22) the financial crisis. On the other hand, Panda et al. (2020), in their study of developed and developing countries, drew attention to the fact that China made the least contribution (7.9 %) to the volatility of other countries' stock markets. Turkey's stock contribution of at least (9.8%) emerged as second. The table shows that the stock markets of Russia, Mexico, and China are volatility transmitter countries. When the contribution of the analyzed countries to variance forecast errors is considered, Mexico (30.1%) ranks first. Mexico ranks first in net volatility transmitter countries (18.7 %) in terms of net directional spillover (directional to other-directional spillover from others). Turkey, Brazil, India, and Indonesia are net volatility receivers.

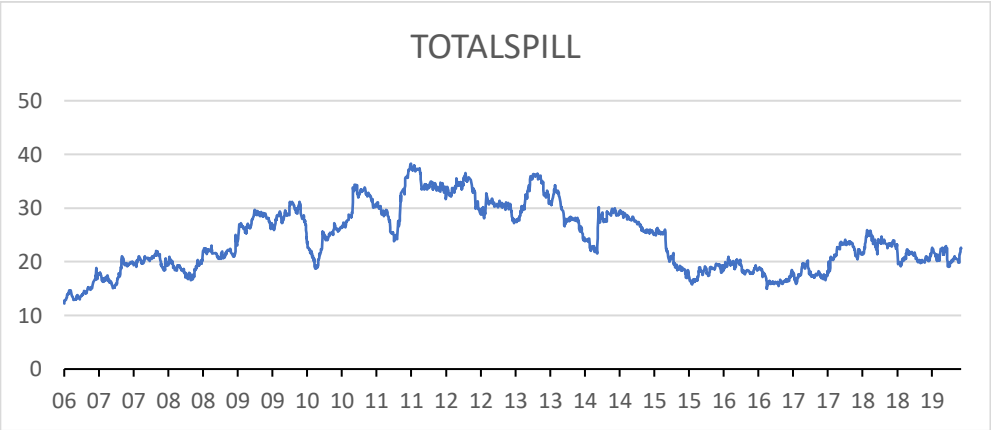
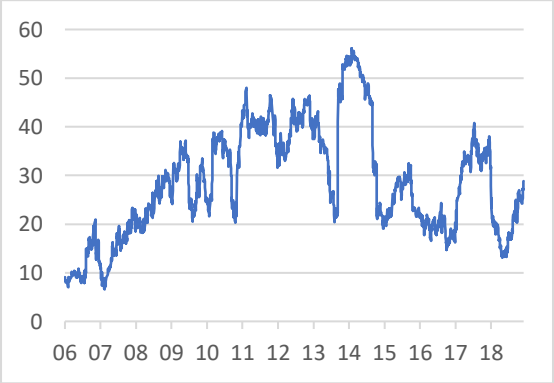


Figure 2. Total Volatility Spillovers, seven stock markets

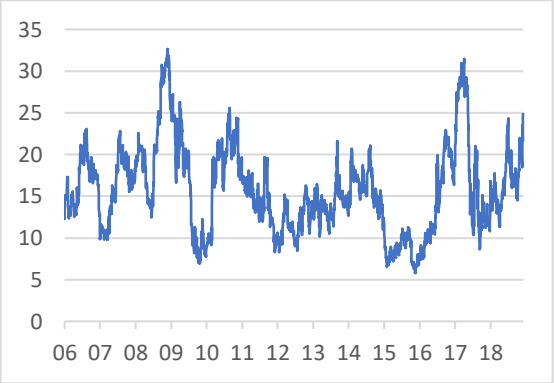
Figure 2 shows the changes in the total volatility spillover between the Eagle Stock Markets over time. When the Figure is examined, it can be seen that there was a break in 2011 between 2005-2019. While there was an increasing trend of volatility among stock markets between 2005 and 2011, it started to decrease after a decrease in the US financial market in August 2011. The impact of the 2008 financial crisis is shown in Figure. Volatility, which increased until 2009, fell sharply in mid-2009 to below 20%. After the economic recovery measures taken by the USA, the total volatility spillover increased to approximately 40% with the effect of financial markets. The total volatility spillover index started to decline again as the US credit rating decreased in 2011, and the economic crisis on the EU side created uncertainty in the economies. The changes in the financial markets and business cycles are shown in Figure. The volatility spillover of the stock market from other stock markets over the years is shown in Figure 3.

a) Turkey-BIST 100

b) Brazil-BOVESPA



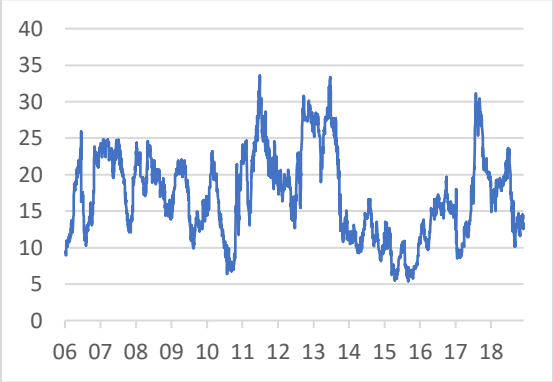
c) Russia-RTSE



d) China-Shanghai Composite

e) India-Nifty 50

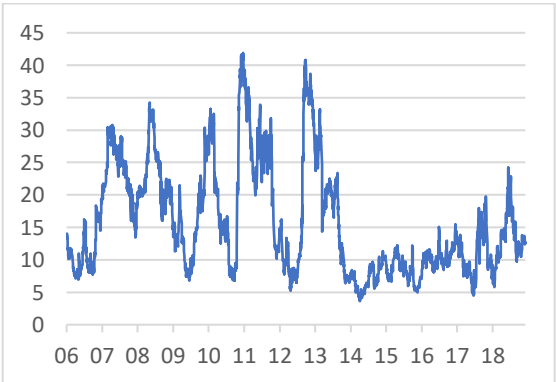
f) Mexico-BMV



g) Indonesia-IDX

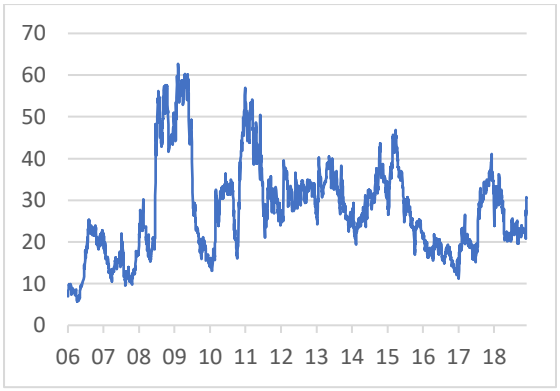
Figure 3. Directional volatility spillovers, FROM seven stock markets

Figure 3 shows the contribution of volatility in countries' stock markets to the volatility of other stock markets. First, it can be stated that within the seven stock markets, less volatility is experienced in China and Indonesia compared to other stock markets. During the period under review, the highest volatility was 30% in early 2009, when the effects of the 2008 financial crisis were observed, and in mid-2018, due to the US-China trade wars. In Turkey, the volatility fluctuates. The volatility, which was 30% before the 2008 financial crisis, declined to 10% after the crisis. With a sudden jump in mid-2012, volatility jumped sharply from 10% to 30%, and 30% in mid-2013. For Turkey, the reason for the high volatility can be attributed to developments in the Euro area's internal dynamics. The economic contraction in the Euro Area (0.6%), an important trade partner of Turkey in 2012, can be seen as increasing stock market volatility. When Figure 3 and 5 are examined together, the situation can be easily observed. As shown in Figure 5, Turkey emerged as a net volatility receiver in 2012. If we examine Figure 3 for Brazil, it can be said that it should be analyzed for the periods before and after 2011. From 2005 to the middle of 2011, there was an increasing trend in Brazil's stock market. The volatility, which was approximately 10%, reached 60% in 2011. After 2011, it decreased and oscillated in the 20-40% band. Russia's stock market volatility is similar to that of Brazil. Volatility, which decreased after 2011, suddenly increased in mid-2014. Volatility increased from 20% at the beginning of 2014 to 50% in mid-2014. The reasons for this situation can be stated as the annexation of Crimea by Russia in 2014, the outbreak of armed conflict in the southeastern region of Ukraine, and the increased tension between Russia and other countries in international relations. In addition to the imposition of economic sanctions on some Russian companies, credit institutions, and individuals by European countries and the USA, the uncertain future of relations between Ukraine, EU countries, the USA, and Russia, and the decreased interest in Russian assets and the financial market as a whole, can be stated as causes for the increase in volatility (NAUFOR, 2014). Ankudinov, Ibragimov, and Lebedev (2017) claimed that the uncertainty in some sectoral indices in Russia increased during the restriction period. According to Hoffmann and Neuenkirch (2017), sanctions implemented by numerous Western countries have weakened the Russian stock market. Furthermore, Gurvich and Prilepskiy (2015) suggest that sanctions have had a detrimental impact on the performance of the Russian economic sector and hampered the entrance of foreign money. It can be seen from the Figure that the volatility of India and Mexico from other markets over time is similar. The stock market volatilities of both countries rose to 55% in early 2011, and then declined. The figures show that the lowering of the US credit rating in 2011 and the economic crisis in the EU created more volatility than the 2008 financial crisis did. It can also be argued that this is not the case in China. China diverges owing to its economic conditions and foreign investments. It can be stated that the effect of the 2008 financial crisis in China has become more dominant, especially because it attracted too much investment from developed economies. The volatility of the countries' stock exchanges examined in Figure 4 shows that they have contributed to the stock markets of other countries.

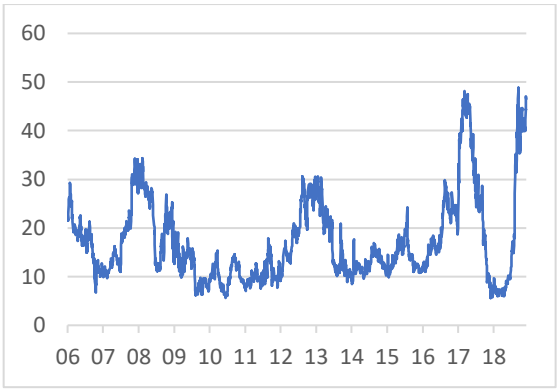


a) Turkey-BIST 100

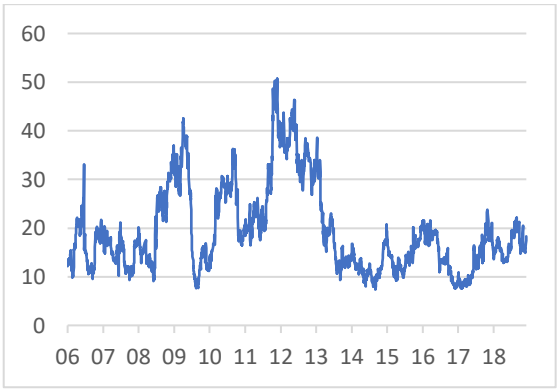
b) Brazil-BOVESPA



c) Russia-RTSE

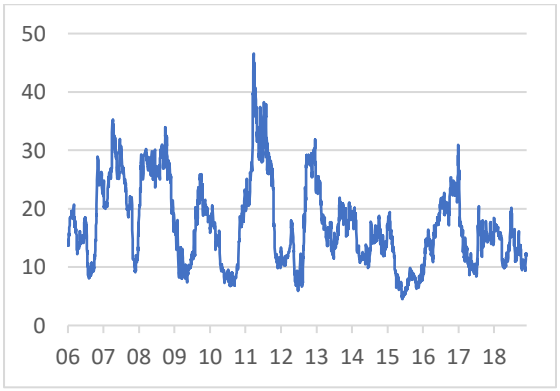


d) China-Shanghai Composite



e) India-Nifty 50

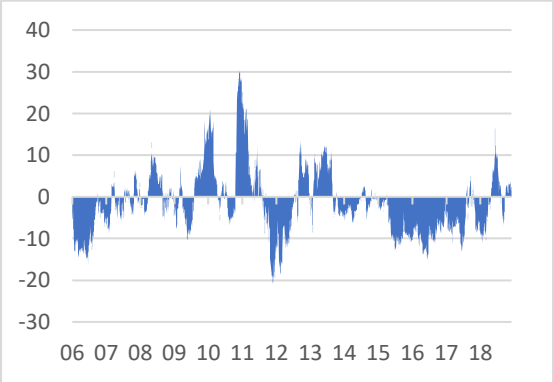
f) Mexico-BMV



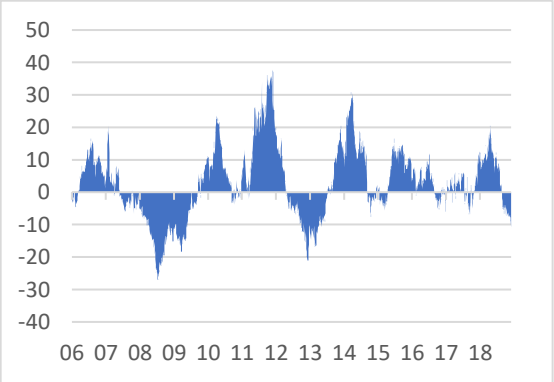
g) Indonesia-IDX

Figure 4. Directional volatility spillovers, TO seven stock markets

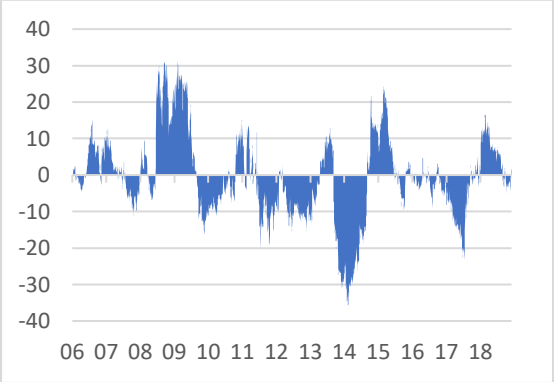
As shown in Figure 4, the contributions of countries to the stock market volatility of other countries vary. Brazil contributed the most at the beginning of 2012, accounting for approximately 80%. The contributions of other countries to Turkey's stock market volatility were experienced in 2008, especially in the context of the Eurozone financial crisis in 2012. It can be seen from the Figure that from 2014 to 2019, the volatility contribution was limited to 10-20%. On the Chinese side, especially the 2008 financial crisis and the US-China trade wars in mid-2018, were reflected in the volatility contribution. It can be expressed in the Figure that Indonesia has a limited effect on other stock markets. It can be seen that the countries examined in Figure 5 are net volatility receivers or transmitters.



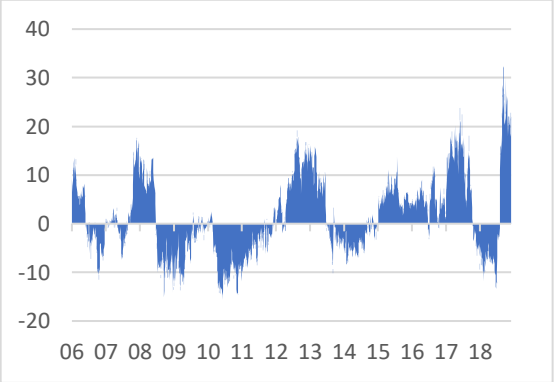
a) Turkey-BIST 100



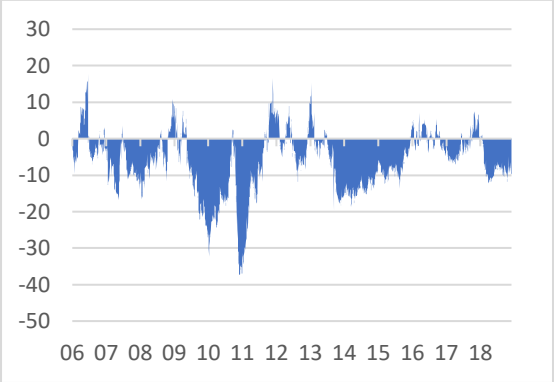
b) Brazil-BOVESPA



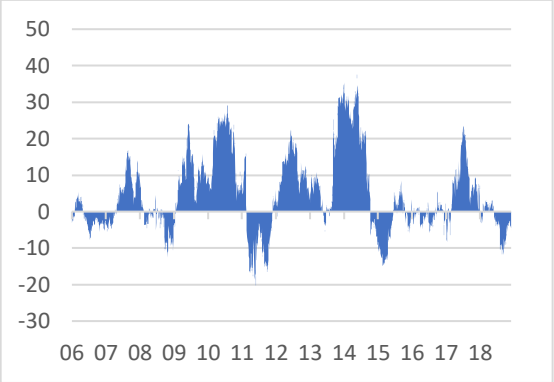
c) Russia-RTSE



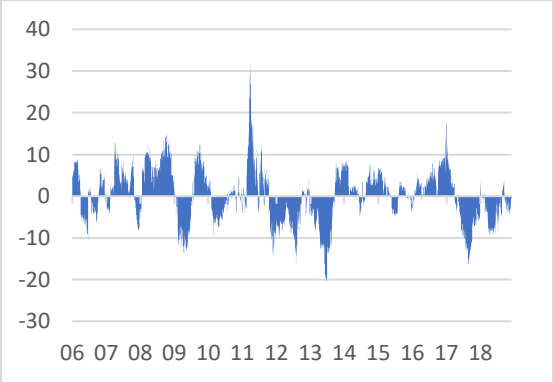
d) China-Shanghai Composite



e) India-Nifty 50



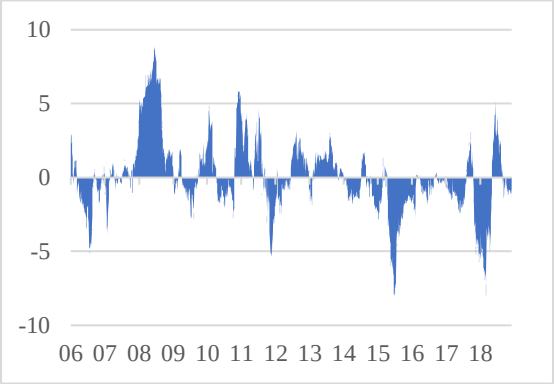
f) Mexico-BMV



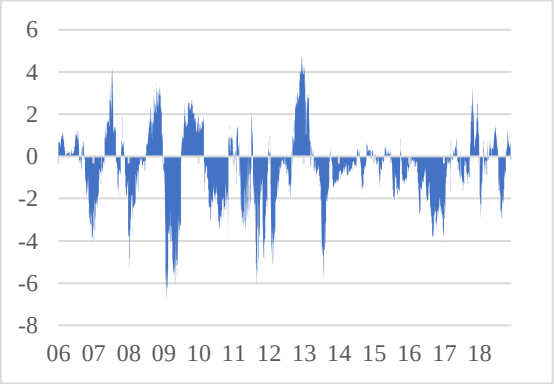
g) Indonesia-IDX

Figure 5. Net volatility spillovers, seven stock markets

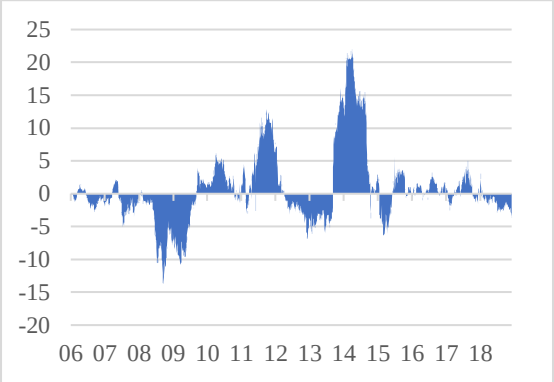
Figure 5 shows that when examined in a portion of the period dealing with more than half of Turkey, it is noteworthy that the volatility receiver. A similar situation exists for India, which is seen as a volatility receiver in almost all the studied periods. On the other hand, Brazil is a net volatility receiver because of factors such as the 2008 financial crisis, the increase in interest rates starting in 2012, and the decline in commodity prices in 2013 caused by low demand and the economic slowdown of Brazil's trading partners. Figure 6 provides a clear view of this situation. The net pairwise volatility between China and Brazil, which was in the position of net volatility transmitters in the first half of 2013, became a volatility receiver from China after the second half of 2013. On the other hand, the net pairwise volatility spillovers of the countries differed in the second half of 2011, when the total net volatility spillover index reached its maximum. For example, when we examine the Figure between Brazil and Turkey, in the second half of 2011, Turkey was a transmitter location in terms of volatility, whereas in the first half of the year, it was in a volatility receiver position from Brazil, and this effect was greater than that in the first half. On the other hand, Turkey is the volatility receiver from Russia and China in almost all of 2011. However, in 2011, Mexico was a transmitter of Brazil and Turkey's volatility. Although the US credit rating downgrade in 2011 and the economic crisis in the EU had varying effects on the economies, it can be stated that both influenced the uncertainties in the stock markets of the countries. Looking at the volatility transmitter-receiver relationship between stock markets, it can be said that volatility is higher in percentage after 2011 than before. It would not be wrong to state that developing markets became more integrated after 2011. Likewise, Bekiros (2013) emphasized that after the US financial crisis, the exchanges of BRIC countries became more integrated.



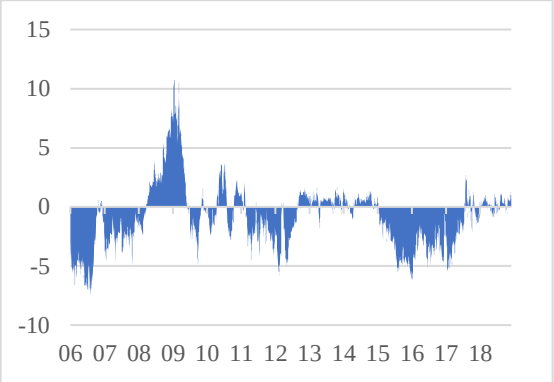
a) Turkey-Brazil



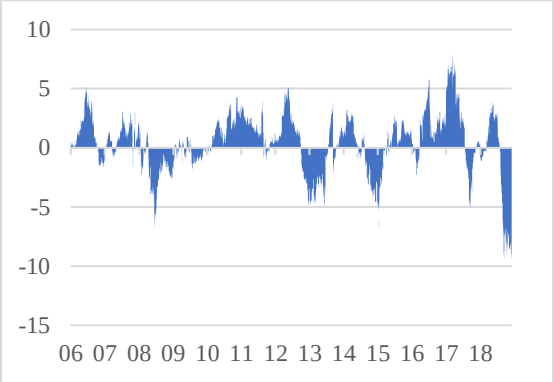
b) Turkey-Russia



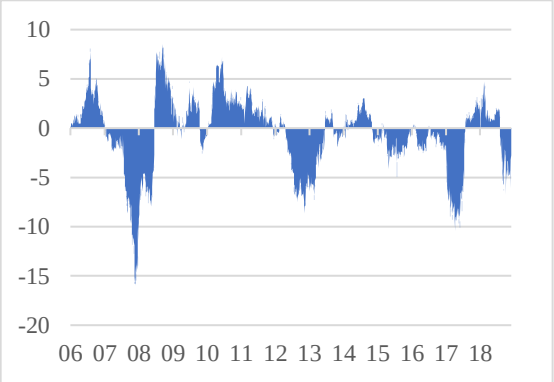
c) Brazil-Russia



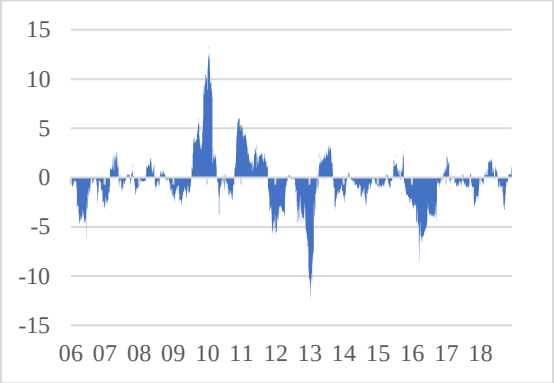
d) Turkey-China



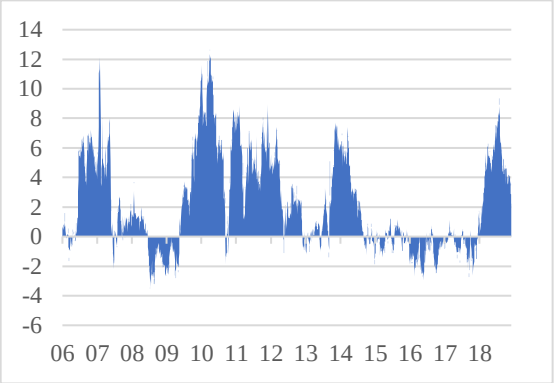
e) Brazil-China



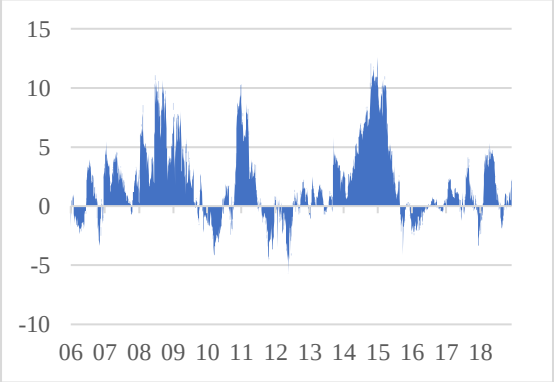
f) Russia-China



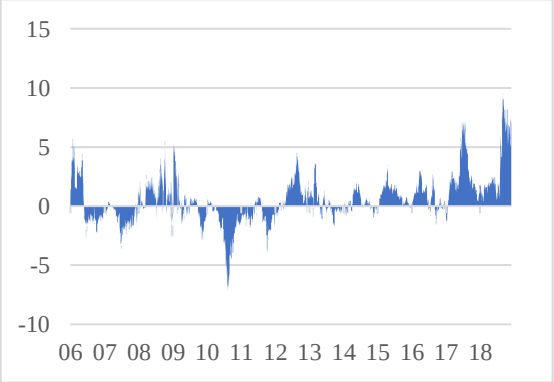
g) Turkey-India



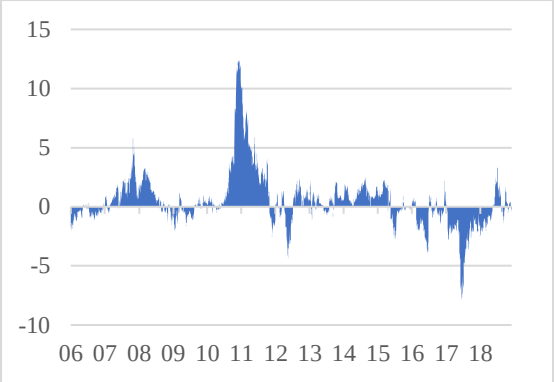
h) Brazil-India



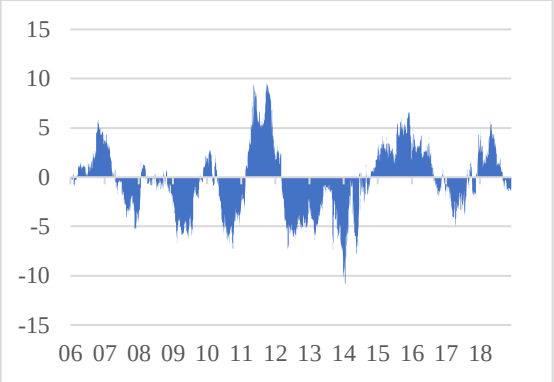
i) Russia-India



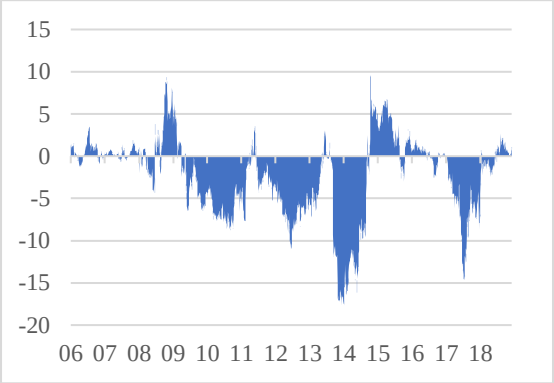
j) China-India



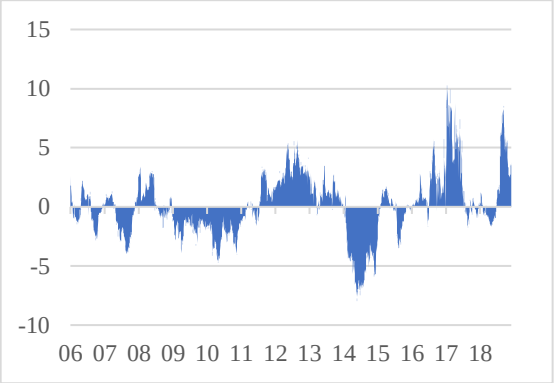
k) Turkey-Mexico



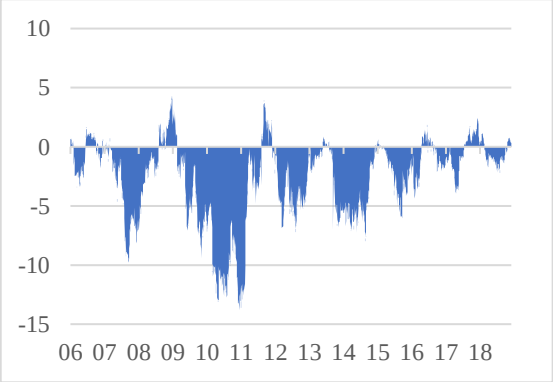
l) Brazil-Mexico



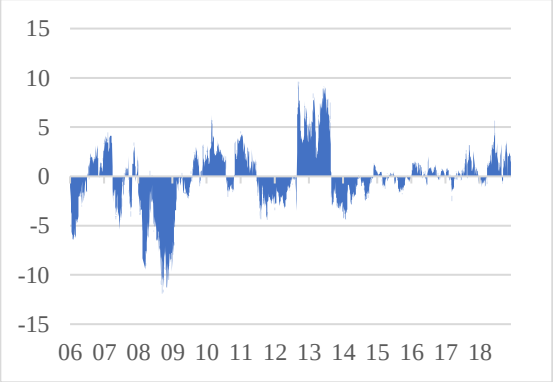
m) Russia-Mexico



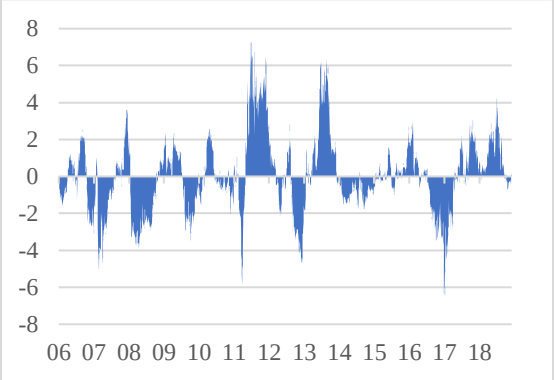
n) China-Mexico



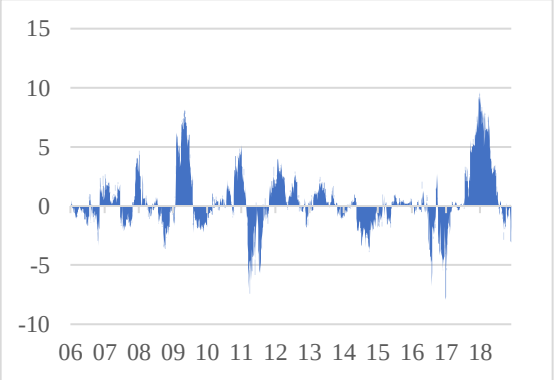
o) India-Mexico



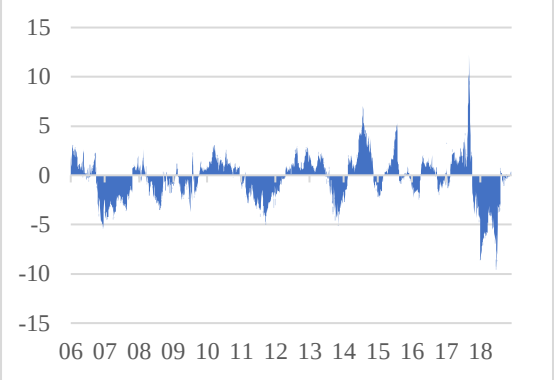
p) Turkey-Indonesia



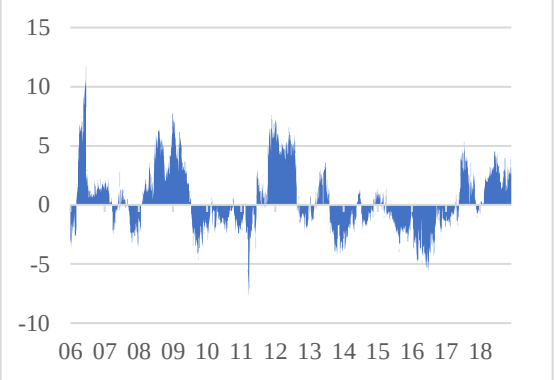
q) Brazil-Indonesia



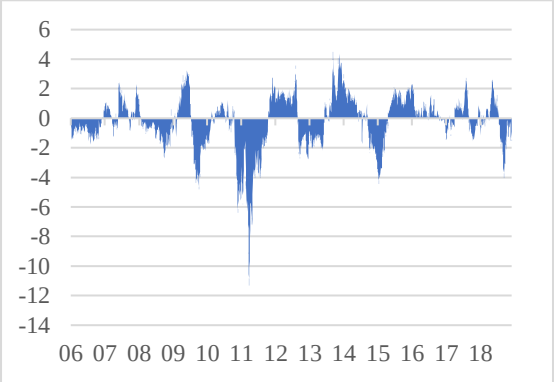
r) Russia-Indonesia



s) China-Indonesia



t) India-Indonesia



u) Indonesia-Mexico

Figure 6. Net pairwise volatility spillovers

4. Conclusion

In this study, we examine volatility transitivity between countries in the Eagle market. Numerous similar studies have been conducted in the literature, focusing on developing countries. In this respect, although this study is similar to the studies of Patra and Panda (2019) and Panda et al. (2020), it can be stated that it differs in terms of the countries and periods examined. While this study covers the period from October 24, 2005, to September 19, 2019, it includes the periods of the global financial crisis, the US credit rating crisis, the European Sovereign Debt Crisis, and the US-China trade wars.

First, we tried to provide insight to researchers by using data on why the Eagle market is important. Next, we provide an expanded literature review that addresses the volatility temporalities and returns between emerging markets. For empirical analysis, first, stationarity analysis of the series was performed, and it was found that all variables were stationary at the level. As a result of the Granger causality test, bidirectional causality between Turkey and Indonesia's stock market volatility was determined. We also find bidirectional causality relationships between Brazil, India, Russia, India, Mexico, India, Mexico, and India-Indonesia stock markets. In addition, there is a statistically significant Granger causality relationship between the Chinese stock exchange and the Brazilian, Indian, and Mexican stock exchanges. Using the VAR-based model proposed by Diebold and Yilmaz (2009, 2012), volatility relations between countries were determined. Mexico is the largest net volatility transmitter, while India is the most volatile receiver. Portfolio managers make stock choices among a country's stock markets by employing optimal portfolio weights and hedging rates. In stock markets with high volatility, uncertainty is high but the possibility of profit is higher. This result is of great importance to policymakers and portfolio managers. Finally, based on the Diebold and Yilmaz (2009, 2012) method, which provides dynamic rolling connectedness results, we empirically examine the dynamic relationships between countries' stock exchanges. The results obtained here are considered important in terms of minimizing the risk problem arising from portfolio choice.

Future studies should determine the hedging risk and optimal portfolio weights among countries in the Eagle market. With the achievement of these results, it is of great importance that policymakers, especially portfolio managers, provide risk minimization/profit maximization to evaluate future studies together with the results obtained in this study.

References

Abad, P., Chuliá, H., & Gómez-Puig, M. (2010). EMU and European government bond market integration. *Journal of Banking & Finance, 34*(12), 2851-2860.

Adrangi, B., Chatrath, A., Macri, J., & Raffiee, K. (2019). Dynamic Responses of Major Equity Markets to the US Fear Index. *Journal of Risk and Financial Management, 12*(4), 156.

Adrangi, B., Chatrath, A., & Raffiee, K. (2014). Volatility spillovers across major equity markets of Americas. *International journal of business, 19*(3), 255.

Ahmad, W., Sehgal, S., & Bhanumurthy, N. (2013). Eurozone crisis and BRIICKS stock markets: Contagion or market interdependence? *Economic Modelling, 33*, 209-225.

Alizadeh, S., Brandt, M. W., & Diebold, F. X. (2002). Range-based estimation of stochastic volatility models. *the Journal of Finance, 57*(3), 1047-1091.

Allen, D. E., Amram, R., & McAleer, M. (2013). Volatility spillovers from the Chinese stock market to economic neighbours. *Mathematics and Computers in Simulation, 94*, 238-257.

Aloui, R., Aïssa, M. S. B., & Nguyen, D. K. (2011). Global financial crisis, extreme interdependences, and contagion effects: The role of economic structure? *Journal of Banking & Finance, 35*(1), 130-141.

Alper, C. E., & Yilmaz, K. (2004). Volatility and contagion: evidence from the Istanbul stock exchange. *Economic Systems, 28*(4), 353-367.

Ankudinov, A., Ibragimov, R., & Lebedev, O. (2017). Sanctions and the Russian stock market. *Research in International Business and Finance, 40*, 150-162.

BBVA. (2014). *EAGLEs Economic Outlook*. Retrieved from

Bekaert, G., & Harvey, C. R. (1995). Time-varying world market integration. *the Journal of Finance, 50*(2), 403-444.

Bekaert, G., & Harvey, C. R. (2003). *Market integration and contagion*. Retrieved from

Bekiros, S. D. (2013). Decoupling and the Spillover Effects of the US Financial Crisis: Evidence from the BRIC Markets. *European University Institute, The Rimini Centre for Economic Analysis WP*.

Bhar, R., & Nikolova, B. (2007). Analysis of mean and volatility spillovers using BRIC countries, regional and world equity index returns. *Journal of Economic Integration*, 369-381.

Bhar, R., & Nikolova, B. (2009). Return, volatility spillovers and dynamic correlation in the BRIC equity markets: An analysis using a bivariate EGARCH framework. *Global Finance Journal, 19*(3), 203-218.

BIST. (2011). *Annual Report* Retrieved from

Cardona, L., Gutiérrez, M., & Agudelo, D. A. (2017). Volatility transmission between US and Latin American stock markets: Testing the decoupling hypothesis. *Research in International Business and Finance, 39*, 115-127.

Carrieri, F., Errunza, V., & Hogan, K. (2007). Characterizing world market integration through time. *Journal of Financial and Quantitative Analysis*, 915-940.

Chan-Lau, J. A., & Ivaschenko, I. (2003). Asian Flu or Wall Street virus? Tech and non-tech spillovers in the United States and Asia. *Journal of Multinational Financial Management, 13*(4-5), 303-322.

Chuliá, H., Guillén, M., & Uribe, J. M. (2017). Measuring uncertainty in the stock market. *International Review of Economics & Finance, 48*, 18-33.

Darrat, A. F., & Benkato, O. M. (2003). Interdependence and volatility spillovers under market liberalization: The case of Istanbul stock exchange. *Journal of Business Finance & Accounting, 30*(7-8), 1089-1114.

Demiralay, S., & Bayraci, S. (2015). Central and Eastern European Stock Exchanges under Stress: A Range-Based Volatility Spillover Framework. *Finance a Uver: Czech Journal of Economics & Finance, 65*(5).

Diebold, F. X., & Yilmaz, K. (2009). Measuring financial asset return and volatility spillovers, with application to global equity markets. *The Economic Journal, 119*(534), 158-171.

Diebold, F. X., & Yilmaz, K. (2012). Better to give than to receive: Predictive directional measurement of volatility spillovers. *International Journal of Forecasting, 28*(1), 57-66.

Dzielinski, M. (2012). Measuring economic uncertainty and its impact on the stock market. *Finance Research Letters, 9*(3), 167-175.

Fang, M., Yang, S., & Lei, Y. (2019). Residual contagion in emerging markets:'herd'and 'alarm'effects in informatization. *Electronic Commerce Research*, 1-21.

Fink, F., & Schüler, Y. S. (2015). The transmission of US systemic financial stress: Evidence for emerging market economies. *Journal of International Money and Finance, 55*, 6-26.

Foerster, S. R., & Karolyi, G. A. (1999). The effects of market segmentation and investor recognition on asset prices: Evidence from foreign stocks listing in the United States. *the Journal of Finance, 54*(3), 981-1013.

Forbes, K. J., & Rigobon, R. (2002). No contagion, only interdependence: measuring stock market comovements. *the Journal of Finance, 57*(5), 2223-2261.

Gamba-Santamaria, S., Gomez-Gonzalez, J. E., Hurtado-Guarin, J. L., & Melo-Velandia, L. F. (2019). Volatility spillovers among global stock markets: measuring total and directional effects. *Empirical Economics, 56*(5), 1581-1599.

Gilenko, E., & Fedorova, E. (2014). Internal and external spillover effects for the BRIC countries: multivariate GARCH-in-mean approach. *Research in International Business and Finance, 31*, 32-45.

Gilmore, C. G., Lucey, B. M., & McManus, G. M. (2008). The dynamics of Central European equity market comovements. *The Quarterly Review of Economics and Finance, 48*(3), 605-622.

Guimaraes, R. F., & Hong, G. H. (2016). Dynamic connectedness of Asian equity markets.

Gurvich, E., & Prilepskiy, I. (2015). The impact of financial sanctions on the Russian economy. *Russian Journal of Economics, 1*(4), 359-385.

Hacihasanoglu, E., Simga-Mugan, F. C., & Soytas, U. (2012). Do global risk perceptions play a role in emerging market equity return volatilities? *Emerging Markets Finance and Trade, 48*(4), 67-78.

Hammoudeh, S., Sari, R., Uzunkaya, M., & Liu, T. (2013). The dynamics of BRICS's country risk ratings and domestic stock markets, US stock market and oil price. *Mathematics and Computers in Simulation, 94*, 277-294.

Hoffmann, M., & Neuenkirch, M. (2017). The pro-Russian conflict and its impact on stock returns in Russia and the Ukraine. *International Economics and Economic Policy, 14*(1), 61-73.

Koop, G., Pesaran, M. H., & Potter, S. M. (1996). Impulse response analysis in nonlinear multivariate models. *Journal of econometrics, 74*(1), 119-147.

Korkmaz, T., Çevik, E. İ., & Atukeren, E. (2012). Return and volatility spillovers among CIVETS stock markets. *Emerging Markets Review, 13*(2), 230-252.

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

Li, H. (2007). International linkages of the Chinese stock exchanges: A multivariate GARCH analysis. *Applied Financial Economics, 17*(4), 285-297.

Li, Y., & Giles, D. E. (2015). Modelling volatility spillover effects between developed stock markets and Asian emerging stock markets. *International Journal of Finance & Economics, 20*(2), 155-177.

Luo, J., & Wang, S. (2019). The asymmetric high-frequency volatility transmission across international stock markets. *Finance Research Letters, 31*, 104-109.

Majdoub, J., & Mansour, W. (2014). Islamic equity market integration and volatility spillover between emerging and US stock markets. *The North American Journal of Economics and Finance, 29*, 452-470.

Mensi, W., Hammoudeh, S., & Kang, S. H. (2017a). Dynamic linkages between developed and BRICS stock markets: Portfolio risk analysis. *Finance Research Letters, 21*, 26-33.

Mensi, W., Hammoudeh, S., & Kang, S. H. (2017b). Risk spillovers and portfolio management between developed and BRICS stock markets. *The North American Journal of Economics and Finance, 41*, 133-155.

Mensi, W., Hammoudeh, S., Nguyen, D. K., & Kang, S. H. (2016). Global financial crisis and spillover effects among the US and BRICS stock markets. *International Review of Economics & Finance, 42*, 257-276.

Mensi, W., Hammoudeh, S., Reboredo, J. C., & Nguyen, D. K. (2014). Do global factors impact BRICS stock markets? A quantile regression approach. *Emerging Markets Review, 19*, 1-17.

MINT. (2011). The market in 2011 and your money. Retrieved from https://www.livemint.com/Money/1vf4csumMjaehDx8eMdh9K/The-market-in-2011-and-your-money.html

Miyakoshi, T. (2003). Spillovers of stock return volatility to Asian equity markets from Japan and the US. *Journal of International Financial Markets, Institutions and Money, 13*(4), 383-399.

nath Mukherjee, K., & Mishra, R. K. (2010). Stock market integration and volatility spillover: India and its major Asian counterparts. *Research in International Business and Finance, 24*(2), 235-251.

NAUFOR. (2014). *Russian Stock Market: 2014 Events and Facts*. Retrieved from https://www.naufor.ru/download/pdf/factbook/en/factbook_2014_eng.pdf

Ordu-Akkaya, B. M., & Soytas, U. (2020). Unconventional monetary policy and financialization of commodities. *The North American Journal of Economics and Finance, 51*, 100902.

Padhi, P., & Lagesh, M. (2012). Volatility spillover and time-varying correlation among the Indian, Asian and US stock markets. *Journal of Quantitative Economics, 10*(2), 78-90.

Panda, P., Vasudevan, S., & Panda, B. (2020). Dynamic Connectedness among BRICS and Major Countries Stock Markets. *Journal of Public Affairs, n/a*(n/a), e2265. doi:https://doi.org/10.1002/pa.2265

Patra, S., & Panda, P. (2019). Spillovers and financial integration in emerging markets: Analysis of BRICS economies within a VAR-BEKK framework. *International Journal of Finance & Economics*.

Pesaran, H. H., & Shin, Y. (1998). Generalized impulse response analysis in linear multivariate models. *Economics letters, 58*(1), 17-29.

Tsutsui, Y., & Hirayama, K. (2013). Are Chinese Stock Investors Watching Tokyo? International Linkage of Stock Prices Using Intraday High-Frequency Data. *Japanese Journal of Monetary and Financial Economics, 1*(1), 37-57.

Verma, R., & Ozuna, T. (2005). Are emerging equity markets responsive to cross-country macroeconomic movements?: Evidence from Latin America. *Journal of International Financial Markets, Institutions and Money, 15*(1), 73-87.

Wei, K. J., Liu, Y.-J., Yang, C.-C., & Chaung, G.-S. (1995). Volatility and price change spillover effects across the developed and emerging markets. *Pacific-Basin Finance Journal, 3*(1), 113-136.

Zhou, X., Zhang, W., & Zhang, J. (2012). Volatility spillovers between the Chinese and world equity markets. *Pacific-Basin Finance Journal, 20*(2), 247-270.