International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

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PAPER ID: 11A12F

DYNAMIC CONNECTEDNESS AMONG BOND MARKETS OF PAKISTAN AND ITS MAJOR TRADING PARTNERS

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ARTICLEINFO

Article history:
Received 09 March 2020
Received in revised form 01 June 2020
Accepted 10 June 2020
Available online 19 June 2020

Keywords:
Financial connectedness; Return & volatility spillover; Bond market; Net spillover index; Forecast error variance; Shock spillover; Directional spillover index; Pakistan's trading partners.

ABSTRACT

This study investigates the intensity and direction of return and volatility spillovers of Pakistan and its major trading partner's bond markets. This study employs the most recent Diebold and Yilmaz (2009, 2012) approach and consequently, calculates the total spillover, directional spillover, and net spillover indexes. For this purpose, daily data set spanning 5/4/2011-7/30/2019 have been used. To capture the secular and cyclical movements in trading partner's bond markets, this study carries out the rolling window analysis. The study finds evidence of dynamic connectedness among the bond markets of major trading partners on the base of spillovers indexes. In addition, the USA, EU, Singapore, and Malaysia are the main sources and originators of shocks spillover, and Pakistan, India, and Japan are the net shock receiver in this group, while China seems isolated to be market. The rolling window analyses conclude that relevant plots of returns and volatility spillovers intensify during the phases of financial or economic anxiety. These results have practical implications for researchers, practitioners, policymakers, and investors.

Disciplinary: Management and Financial Sciences

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1. INTRODUCTION

Since the 1990s, developing markets' financial systems have become gradually integrated with the international financial system. Two major driving forces lead to the expansion and deepening of financial ties between developing and developed financial markets (Wooldridge et al., 2003; Bekaert and Harvey, 2000). The first is Information and Computing Technology advancement and the second force is the liberalization policies mostly followed by the developing economies. These economies have encouraged removing restrictions for capital inflows in global financial transactions. They are also focusing on deregulating local markets by applying reforms (market-based) in exchange, monetary and credit management. Additionally, the development in financial connectedness is further complemented as a result of formal trade and several agreements on investment among

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various countries groups (such as BRICS, ASEAN, EU, and GCC) that have offered main motivation to local and global integration as well.

Development of financial integration has facilitated developing markets by optimal capital allocation and idiosyncratic risk sharing, consequently, encouraging economic growth. The recent wave of financial crisis starting in the late 1990s has cautioned different stakeholders e.g., policymakers that irrespective of potential return, integration in different economies involves considerable costs. This is the potential cause that in a world of imperfect economies, financial connectedness may increase the vulnerability of developing countries to financial and economic shocks. The most recent global financial crisis (2007-08), European debt crisis (2012-14), China stock market crash and European Crisis (2015-16), and 2018-19 overall global depression are incidents in point that are evident that financial and economic shocks spillover to developing markets innovate from developed markets.

The academic literature on bond markets documents very limited studies regarding financial connectedness on the base of trade links. Connectedness between advanced markets such as the UK, USA, and developing markets like India, China, Indonesia and Thailand and other economies of Pacific Basin (e.g. Worthington and Higgs, 2004; Abd. Majid et.al. 2008; Ghauri and Ashraf, 2018; Jain and Sehgal, 2019) and economies of Latin American (e.g. Calvo and Reinhart, 1996; Meric et al., 2012) have been extensively studied. However, literature review on dynamic connectedness or cross-market interdependence exposes that merely a handful of papers have empirically attempted to evaluate frontier and developing economies (Akdogan, 1996; Demirer, 2013; Gomes and Chaibi, 2014; Chen et al., 2014; Singh and Singh, 2018; Mohti et. al., 2019). The importance of frontier and developing markets both at the domestic and global level cannot be underestimated, because these economies in the past have provided unexpected revenues to investors. Due to segment from advanced economies these markets provided attractive diversification avenues.

Based on detailed discussion, this study empirically contributes in various directions to the literature of bond markets. First, this study contributes to a quite emerging body of financial literature on bond markets and offers comprehensive insights into dynamic connectedness with respect to Pakistan trade partner's bond markets. Second, the selection of the most recent methodology of Diebold and Yilmaz (2009, 2012) provides a unique contribution. The methodology enables calculations of static/dynamic return and volatility spillovers between markets, by applying the Vector autoregression model of N-Variables with H-step ahead forecast error variance decomposition. This method has several distinctions over others (Abbas et al., 2019,). Third, this study contributes and provides evidence for the varying return and volatility spillovers intensity around the recent episodes of crisis (European debt crisis (2012-14), EU and China financial markets crisis (2015) and 2018-19 overall depression) with respect to volatility structural breaks of bond markets returns, as this contributes to the literature of contagion.

2. LITERATURE REVIEW

The study of connectedness in financial markets has value and direct implications for investors and the portfolio theory respectively. Substantial variations in financial markets volatility can adversely affect the risk of averse investors. Although Grubel (1968) document the evidence that efficiency improves based on international portfolio diversification, while now another emerging evidence is the proponent of a portfolio which are investment dominated in one's vicinity, and also the markets that are close economically and geographically tend to affect each other Janakiramanan and Lamba, (1998). The investors' interest in other economies has initiated the debate on the integration of markets. The integration of financial markets into global markets is growing as they are influenced by international financial and economic shocks (Backus et al. 1992; Bergin and Pyun, 2016; Mensi, et al., 2018). Advanced financial markets are highly integrated because they are highly international and this is another good quality that these markets use to attract investors around the world Demirer (2013). On the other hand, emerging markets have low outreach into the international area and are weakly integrated Harvey (1995). Advanced markets are likely to respond more quickly to the international financial crisis than to the developing financial markets with less integration. As a result, asset portfolios from highly integrated, advanced financial markets are expected to be highly risky because they are extremely vulnerable to international crises. On the other side portfolio diversified with the assets from less integrated financial markets of developing economies are less risky. This describes why the diversification of the portfolio of less correlated assets is very beneficial Miralles-Marcelo et al. (2015). It is imminent; to reduce the risk of the portfolio by rationally diversifying investment portfolio with low integrated assets.

In contemporary literature, one of the main proxy indicators for the international financial connectedness is the links and correlations between the return and volatility of global stock indices VO & Ellis, (2018). These links and correlations point out the interests of researchers in investigating the returns and volatility spillover as important aspects of international financial connectedness. Also, few studies have investigated bond market volatility spillover by using recent methodology "spillover index" (Diebold and Yilmaz, 2009, 2012). Claeys and Vašíček (2014) examine correlation extent and direction among 16 EU sovereign bond markets by using the Vector autoregression model (factor augmented version) in Diebold and Yilmaz (2009). Fernández-Rodríguez et al. (2015) investigate volatility spillover among sovereign bond markets in EMU countries. Their findings indicate that slightly more than 50% contribution in the total variance of forecast error variance decomposition is from across countries shocks and others are idiosyncratic shocks. Results also display that most of the shocks of volatility spillover during the pre-crisis time were from the European monetary union central countries (peripheral countries) while these countries become significant shock transmitters during the crisis period. Fernández-Rodríguez et al. (2016) investigate the dynamic trends of directional connectedness (net pair-wise connectedness) at successive stages of a sovereign debt crisis.

In the background of emerging markets, there are limited studies that have responded to the bond market need. Kim et al. (2018) investigated the dynamic connectedness among emerging European bond markets and documented the weak relationship in these markets. Investigating the Asian economies bond markets with Australia and USA, VO (2009) documents the moderate type of interconnectedness because the institutional structure is different in these economies. Cifarelli and Paladino (2006) investigate co-movements in the spread of volatility among ten particular developing economies. The results indicate that more volatility and co-movement exists within the countries rather than outside the geographical zone. Recently, Piljak and Swinkels (2017) investigated dynamic connectedness between USA and frontiers economies sovereign debt markets. The findings of this study report limited opportunities for diversification are present between the selected USA and frontier bond markets.

3. METHODOLOGY

To examine the connectedness among the bond markets of Pakistan's major trading partners, this study discusses? a recently developed model that was given by Diebold-Yilmaz (2012) and is called the spillover index approach. This approach is the generalized version of the Diebold and Yilmaz model (2009) and is relied on the (Koop et al., 1996; Pesaran and Shin, 1998) Forecast error variance decomposition under the Vector autoregression framework, which is independent for the model variables. This approach aims to calculate the total spillover, directional spillover, and net spillover indexes. To capture the secular and cyclical movements rolling window analysis is used. The start of the spillover index measures specifications using the following Equation which has the *p*-th order for stationary N- variable Vector autoregression

$$x_t = \sum_{i=1}^{p} \phi_i x_{t-1} + \varepsilon_t \quad (1),$$

where x_t stands for a vector of N endogenous variables, ϕ_i represents N×N matrix of estimated parameters, t =1…. T denotes time index, i = 1…. p denotes variable index. Moreover, $\varepsilon \sim (0, \Sigma)$ represents a vector of error terms that is identically and independently distributed over time.

In Equation (1), the representation of the moving average of the Vector auto regression system can be written as

$$x_t = \sum_{i=1}^{\infty} A_i \varepsilon_{t-i} \quad (2).$$

In Equation (2), A_i represents $N\times N$ coefficient matrices derived as $A_i = \sum_{t=1}^{p} A_{i-t}\ \phi_{\ t,}$ with A_0 is the $N\times N$ identity matrix and $A_i = 0$ where $i < 0$. The coefficients of moving average translate Vector auto regression model dynamics and this approach has benefits. It is invariant to the order of the variables in the model. The generalized forecast error variance decomposition at H-step ahead is expressed as

$$\theta_{ij}^{g}(H) = \frac{\sigma_{ij}^{-} \Sigma_{h=0}^{H-1}((e_i' A_h \Sigma e_j)2}{\Sigma_{h=0}^{H-1}(e_i' A_h \Sigma A_h' e_i)} \quad (3),$$

where Σ represents the variance matrix of the error vector (ε), σ_{ij} is the error term SD for the equation *j*th, and e_i represents selection vector, value one with the *i*th element, and otherwise zero. This produces $N\times N$ matrix $\theta\ (H) = [\theta_{ij}(H)]_{\ i,\ j=1,\ N,}$ where each entry provides a contribution of *j* variable to the *i* variable forecast error variance. In θ (*H*) matrix the main diagonal elements denote the contribution of own shock, whereas off-diagonal elements denote contributions "from other" and "to other" variables in the forecast error variance decomposition. The sum of own and cross variables variance contributions is not equal to one under general variance decomposition i.e. $\Sigma_{j\cdot=1}^{N} \theta_{ij}^{g}(H) \neq 1$.

As statistically independent shocks to each variable, hence each entry in θ (*H*) matrix becomes normalized by dividing with the sum of a row as

$$\tilde{\theta}_{ij}^{g}(H) = \frac{\theta_{ij}^{g}(H)}{\Sigma_{j\cdot=1}^{N} \theta_{ij}^{g}(H)} \quad (4).$$

With $\Sigma_{j=1}^{N} \tilde{\theta}_{ij}^{g}(H) = 1 \quad and\ \Sigma_{i\ ,j=1}^{N} \tilde{\theta}_{ij}^{g}(H) = N$ this is by construction. As Fengle and Gisler (2015) have mentioned that Equation (4) is the approximation fraction representation of *H*-step ahead FEV of *i* variable coming from the *j* variable. The total spillover index is

$$S^g(H) = \frac{\Sigma_{i,j=1,i\neq j}^{N}\tilde{\theta}_{ij}^{g}(H)}{\Sigma_{i,j=1}^{N}\tilde{\theta}_{ij}^{g}(H)} = \frac{\Sigma_{ij=1,i\neq j}^{N}\tilde{\theta}_{ij}^{g}(H)}{N} \quad (5).$$

This index in Equation (5) measures the average contributions of spillover to the forecast error variance. The transmission of directional spillover from the variable *i* to the variable *j* is defined as

$$S_{i\to j}^{g}(H) = \frac{\Sigma_{i,j=1,i\neq j}^{N}\tilde{\theta}_{ji}^{g}(H)}{\Sigma_{i,j=1}^{N}\tilde{\theta}_{ji}^{g}(H)} = \frac{\Sigma_{i,j=1,i\neq j}^{N}\tilde{\theta}_{ji}^{g}(H)}{N} \quad (6).$$

Likewise, directional spillover received from variable *j* to variable *i* is

$$S_{j\to i}^{g}(H) = \frac{\Sigma_{i,j=1,j\neq i}^{N}\tilde{\theta}_{ij}^{g}(H)}{\Sigma_{i,j=1}^{N}\tilde{\theta}_{ij}^{g}(H)} = \frac{\Sigma_{i,j=1,j\neq j}^{N}\tilde{\theta}_{ij}^{g}(H)}{N} \quad (7).$$

The directional spillover here gives a breakdown of the index into a spillover effect “to” and “from” the variables *i j* where $i \neq j$. hence, the directional spillovers detect the specific factors of the total spillover index. Also, the net-directional spillovers from the variables *i* to *j*, where a net result of the Equations (6) and (7) $i \neq j$ can be obtained and can be written as

$$S_i^g(H) = S_{i\to j}^{g}(H) - S_{j\to i}^{g}(H) \quad (8).$$

When the value is positive of the net spillover index, it specifies that *i* variable is the spillover effect transmitter and spillover direction is from *i* variable to all variables *j* and vice versa.

3.1 DATA DESCRIPTION

This study investigates the intensity and direction of return and volatility spillovers of bond markets of Pakistan and its twelve major trading partners. This study uses daily data of 10-year government bond yields for Pakistan, China, EU, India, Japan, Malaysia, Singapore, and the USA, taken from investing.com and Thomson Reuter’s databases. Afghanistan, Iran, Kuwait, Saudi Arabia, and the United Arab Emirates are not included in the investigation because of the unavailability of data. The study makes use of the timespan 5/4/2011-7/30/2019 for daily government bonds data, comprising 2274 observations. This sample data timespan is selected, first, to accommodate the most recent crisis and secondly, the availability of data. The study calculates the returns denoted as: $R_{i,t} = \log(P_{i,t} / P_{i,t-1}) * 100$

Here, $P_{i,t}$ symbolizes the closing price of the 10-year government bond index of a relevant country *i* at day *t*. The study follows Antonakakis and Kizys (2015) to compute the volatility as; volatility is the absolute return value;

$V_t = | \ln P_t - \ln P_{t-1} |$ Here, P_t is the closing price on day *t* of market *i*.

4. RESULT AND DISCUSSION

4.1 DESCRIPTIVE STATISTICS

Tables 1 and 2 provide bond returns and volatility statistics respectively for eight countries of the group. Table 1 shows that all countries return indicate negative values for average return (mean) except the EU and Japan has high volatility followed by the USA, while India and Malaysia show low values. In addition, Pakistan, China, and the EU are negatively skewed while others are positively skewed. The kurtosis values are high, indicating series are leptokurtic. Bond volatility in Table 2 shows that all countries indicate positive values for average return (mean) and SD. These values indicate that Japan and the EU are more volatile while China, India, and Malaysia show low values (less volatile). In addition, the volatility series are positively skewed. The kurtosis values are high, indicating series are leptokurtic. Both series are stationary at level, rejecting the null hypothesis of unit root at a 1% level of significance.

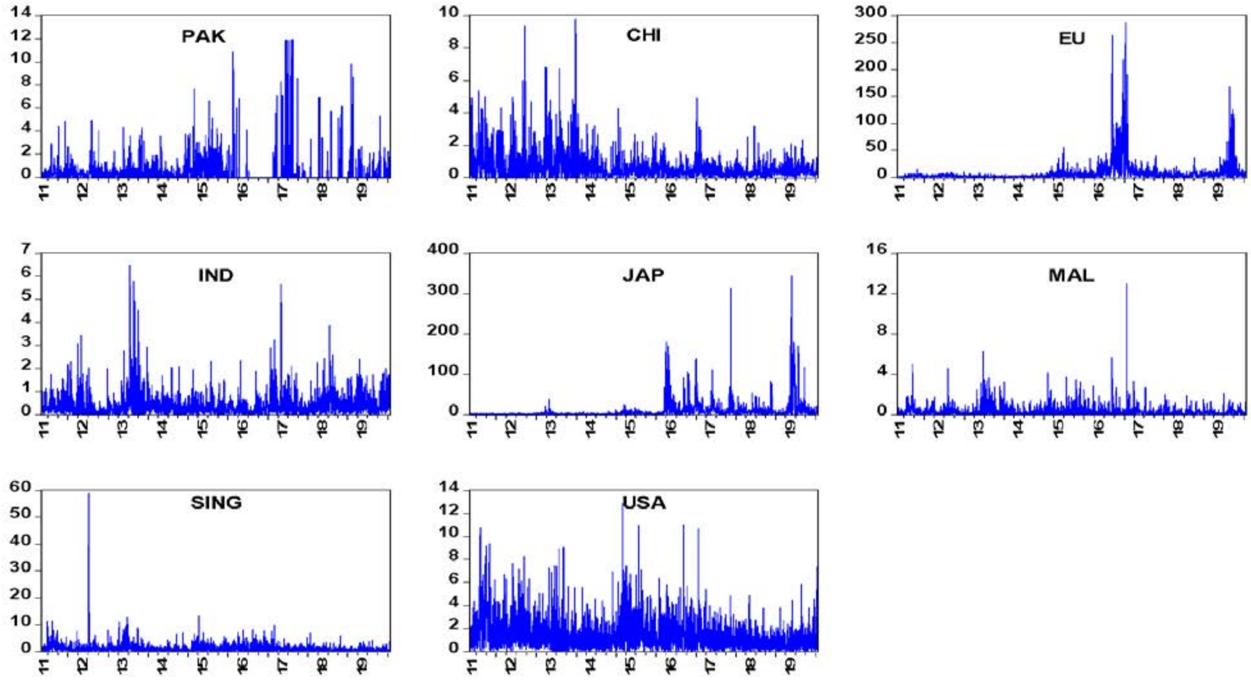
Table 1: Descriptive statistics for bond return.

	Mean	SD	Skewness	Kurtosis	Jarque Bera	Augmented Dickey-Fuller	Phillip-Perron	Obs
Pakistan	-0.002	1.478	-0.226	34.091	91611.97	-23.59	-69.99	2274
China	-0.011	1.148	-0.558	13.281	10133.43	-32.98	-62.94	2274
EU	0.142	20.764	-0.472	68.218	403089.9	-12.23	-58.19	2274
India	-0.012	0.698	0.350	17.255	19300.63	-31.58	-46.35	2274
Japan	-0.142	23.883	1.772	54.874	256153.9	-15.55	-54.36	2274
Malaysia	-0.006	0.704	3.089	64.014	356339.7	-28.84	-42.38	2274
Singapore	-0.012	2.516	2.532	202.270	3764817	-58.42	-59.42	2274
USA	-0.028	2.139	0.019	6.347	1061.626	-49.17	-49.35	2274

Table 2: Descriptive statistics for Bond Volatility

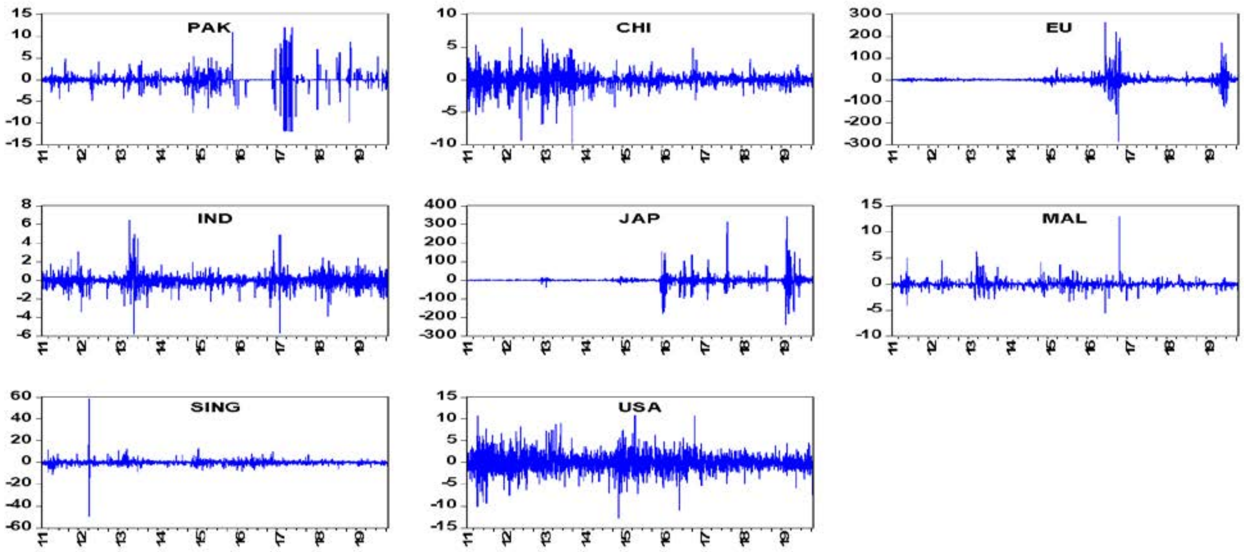
	Mean	SD	Skewness	Kurtosis	Jarque Bera	Augmented Dickey-Fuller	Phillip-Perron	Obs
Pakistan	0.52	1.38	5.23	35.81	112367.4	-14.52	-43.56	2274
China	0.7	0.91	3.27	19.86	30987.04	-8.26	-48.07	2274
EU	7.89	19.21	7.48	79.83	580416.7	-4.04	-42.41	2274
India	0.43	0.55	3.91	28.36	66716.81	-10.43	-53.19	2274
Japan	9.15	22.06	6.46	63.56	363341.4	-8.82	-48.34	2274
Malaysia	0.36	0.6	6.7	99.82	905114.4	-16.23	-44.60	2274
Singapore	1.28	2.16	14.06	333.52	10425857	-15.03	-36.75	2274
USA	1.51	1.51	2.1	9.89	6173.41	-10.33	-54.91	2274

From Figures 1 & 2, all the series have been most volatile showing bursts in the series through sample period except EU and Japan before 2016. During the crisis periods, the European debt crisis (2010-12), and especially China's stock market crash and EU crisis (2015-16) all returns and volatilities series show more connectedness with some demonstrating huge jumps, while Singapore remains unaffected.



All the x-axes represent consecutive year from 2011, all the y-axes are the bond return (percent).

Figure 1: Bond Return Plot.



All the x-axes represent consecutive year from 2011, all the y-axes are the bond volatility (percent).

Figure 2: Bond volatility plot

4.2 ANALYSIS OF SPILLOVER TABLES

The results of this empirical study are presented in the spillover table's form. Table 3 documents the input/output decomposition of the spillover indexes for bond market returns, and Table 4 deals with bond volatility. Diebold and Yilmaz (2009) report that the magnitude of return and volatility is the same, as the Total connectedness index for daily bond return (17%) is approximately the same as daily volatility Total connectedness index (15%); therefore, the return and volatility spillovers have the same magnitude.

Table 3: Bond Daily return Dynamic Connectedness

	Pakistan	China	EU	India	Japan	Malaysia	Singapore	USA	FROM
Pakistan	87.37	1.788	2.017	1.915	1.148	1.857	1.777	2.129	12.63
China	1.709	85.128	2.29	1.759	2.247	2.324	2.537	2.007	14.872
EU	2.246	2.067	81.81	2.444	2.698	2.544	2.128	4.062	18.19
India	1.537	1.676	1.737	84.799	1.974	2.963	2.784	2.532	15.201
Japan	1.376	2.182	3.047	1.759	83.816	1.849	2.54	3.431	16.184
Malaysia	2.076	1.781	2.192	2.699	2.173	82.469	3.298	3.312	17.531
Singaore	1.896	2.445	2.425	3.208	2.217	2.327	82.074	3.408	17.926
USA	2.285	1.975	4.737	1.909	3.363	3.611	2.193	79.928	20.072
TO	13.124	13.914	18.445	15.693	15.82	17.475	17.257	20.879	132.607
Own	100.494	99.042	100.255	100.492	99.636	99.944	99.33	100.807	TCI
Net	0.494	-0.958	0.255	0.492	-0.364	-0.056	-0.67	0.807	16.576

Note: spillover indices are estimated by using 2 lag, 10-day forecast horizon and 150 days rolling windows

Table 4: Bond Daily Volatility Dynamic Connectedness.

	Pakistan	China	EU	India	Japan	Malaysia	Singapore	USA	FROM
Pakistan	87.724	1.545	1.808	1.692	2.224	1.782	1.528	1.697	12.276
China	1.867	86.459	2.25	1.555	2.574	1.881	1.598	1.816	13.541
EU	2.17	1.794	82.605	2.77	2.774	2.855	2.204	2.828	17.395
India	1.69	1.684	1.901	85.103	2.025	3.499	1.98	2.118	14.897
Japan	1.943	2.149	3.89	2.633	82.919	1.665	1.987	2.814	17.081
Malaysia	2.153	2.071	2.222	3.22	1.583	83.116	2.389	3.246	16.884
Singapor	1.964	1.559	1.993	2.436	2.047	2.732	85.504	1.764	14.496
USA	2.28	2.157	2.864	2.019	2.506	3.583	1.724	82.866	17.134
TO	14.068	12.959	16.928	16.325	15.733	17.997	13.41	16.283	123.704
Own	101.793	99.418	99.533	101.428	98.652	101.112	98.915	99.15	TCI
Net	1.793	-0.582	-0.467	1.428	-1.348	1.112	-1.085	-0.85	15.463

Note: spillover indices are estimated by using 2 lag, 10-day forecast horizon, and 150-day rolling windows

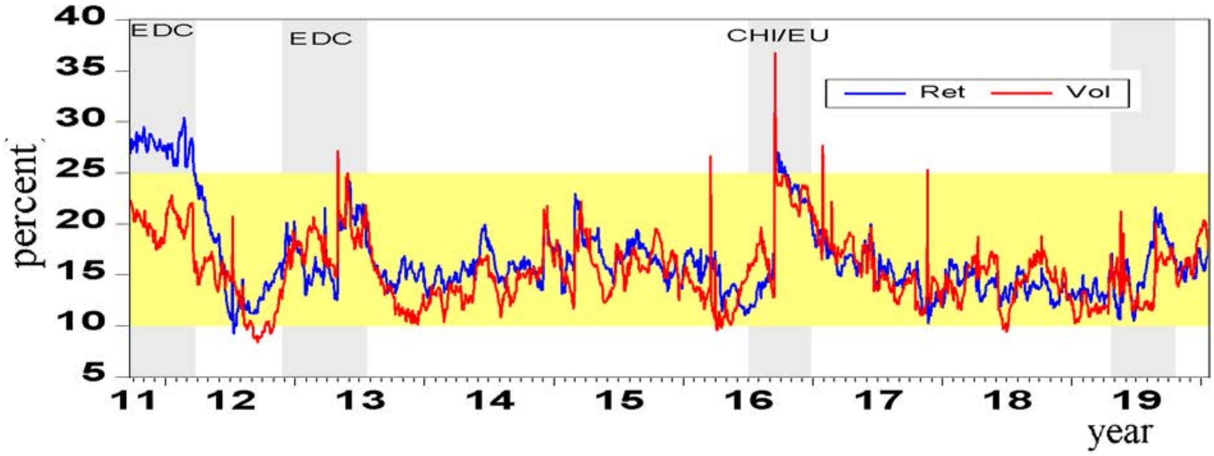
Table 3, bond return, the contribution to row demonstrates among the group which market has the most influence on the other. Directional spillover to other values of bond return indicates that the USA has the highest spillover value (21%), followed by other countries having comparable values while Pakistan (13%) has the lowest value in the group. Also, the “from other” column suggests, which bond market is the most vulnerable to foreign shocks. For the USA, EU, Singapore, and Malaysia the bond return spillover value from external markets shows a high (20%, 18%, 17.9%, and 17.5% respectively). Pakistan has the lowest value (13%) of spillover from foreign markets. In table 4, bond volatility, directional spillover to others values indicate that Malaysia has the highest spillover value (18%), followed by EU (17%), India and USA (16%), and other countries having comparable values, while China (13%) has the lowest value in the group. The “from other” column indicates the same findings as a return as for USA, EU, Singapore, and Malaysia the bond volatility spillover from foreign markets shows a high value while Pakistan has the lowest value of spillover from foreign markets. Qarni and Gulzar (2018) indicate that the USA is the dominant market, also endorsing our spillovers findings.

Finally, from the tables, the study discusses the “net directional connectedness”, as according to Diebold and Yilmaz (2012), markets showing positive values indicate net shock transmitter while negative values indicate net shock receivers. Net spillover results of bond return demonstrate that four markets (Pakistan, EU, India, and the USA) show positive (net shock transmitter) values and others with negative (net shock receivers) values. Similarly, from bond volatility net spillovers three markets (Pakistan, India, and Malaysia) showing positive values, and remaining shows negative values. From both the tables, the magnitude of net spillover values is very low suggesting these markets are less influential and sensitive to other markets.

From results, Pakistan is characterized as a poorer level of spillover among the trading group bond markets as compared to other bond markets. High return spillovers come from the EU, USA, and India. In regard to the spillover of volatility majorly comes from China, EU, Japan, and India. In this group the bond markets of USA, EU, Japan, and Singapore are more connected with each other as compared to other markets, this also supports the argument that developed markets are more connected with each other as compared to developing markets. The study also found that the majority of the bond markets in this group show their own market contribution is higher, assembling them as an independent market.

4.3 ROLLING SAMPLE ANALYSIS

The behavior of total bond return and volatility spillovers over the full sample including financial crises are investigated in this segment. Figure 3 displays the total spillover plots for the return and volatility indices for the full sample based on the rolling window estimation of 100-day. Hence, the cyclical movement of bond return and volatility spillover display similar behavior, the magnitude of return spillover is slightly higher than volatility at the start, confirming the results of tables. The significant jumps in both return and volatility spillover in 2011 and 2013 were due to the European debt crisis (2010) and during 2012 and after 2013 a significant decrease in spillovers can be interpreted as a symbol of international recovery of the economy. From 2013 to the start of 2016, the value of total connectedness remains between 11-20% while again spillover jumps to 27%, due to China and the European Union crisis. Again, 2017-18 years are stable and the last jump in 2019 shows a connectedness value of 21%.



Note: spillover indices are estimated by using 2 lag, 10-day forecast horizon and 150 days rolling windows

Figure 3: Bond Total Return and Volatility Plots

To further increase the concept of spillover findings among bond markets and how they indicate behavior over time the study presents Figures 4-7. The return and volatility directional plots that show spillovers trend that innovates from the market individually, that is transformed into the individual market and also net spillovers. Significant spillovers intensity change during the crisis periods are recorded over the sample period.

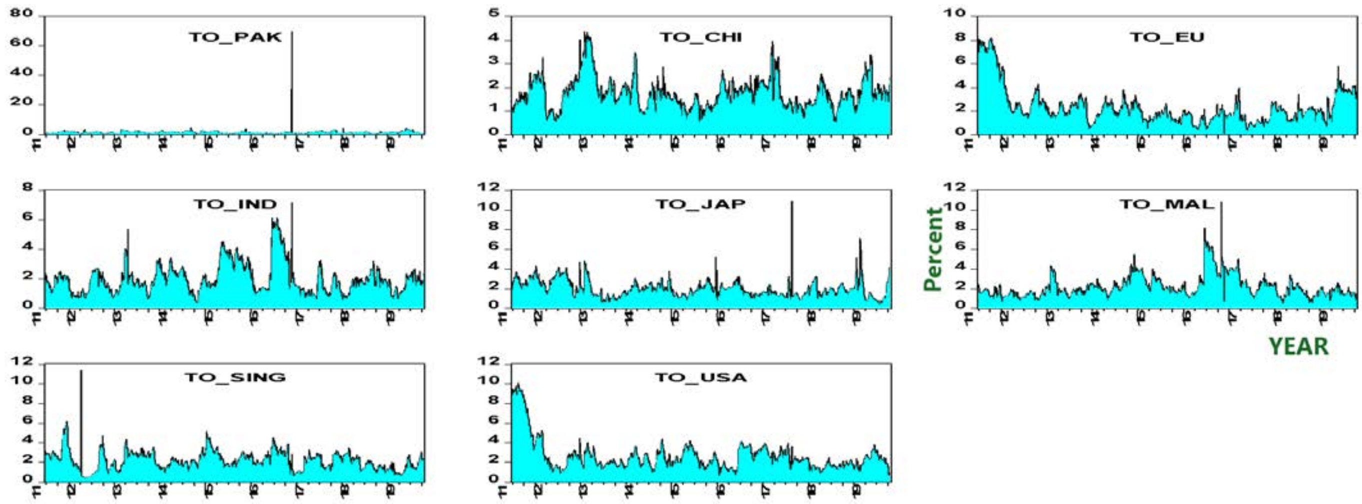


Figure 4: To Bond Return

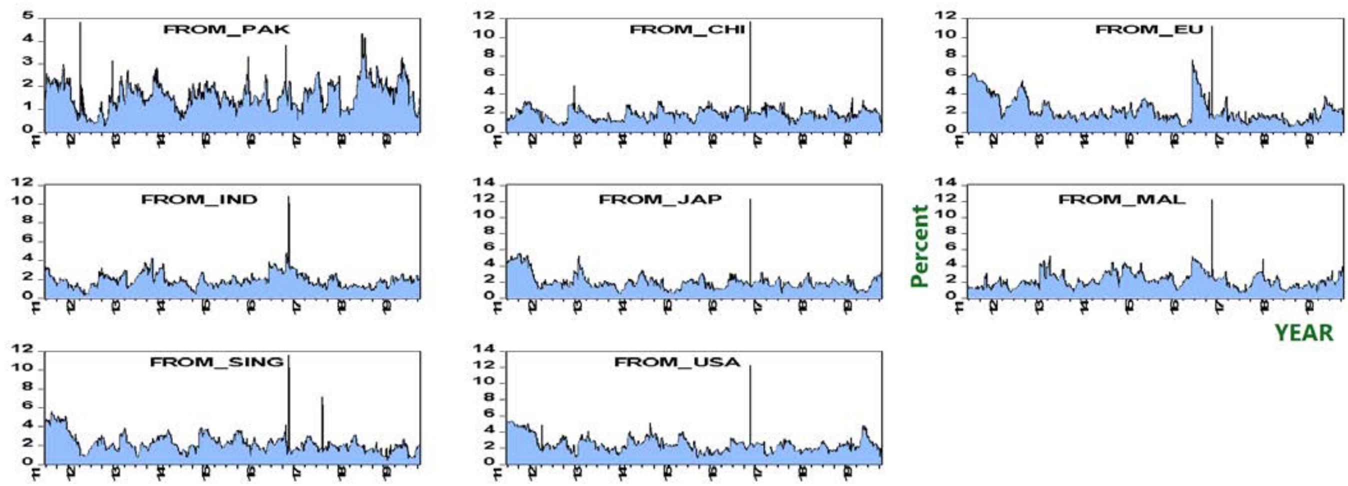


Figure 5: From Bond Return

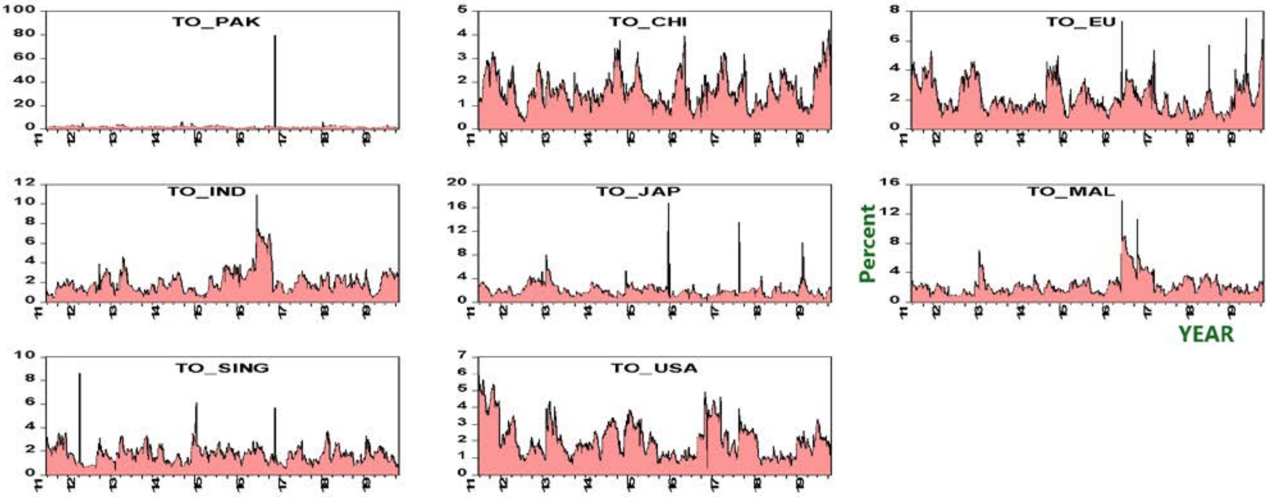


Figure 6: To Bond Volatility

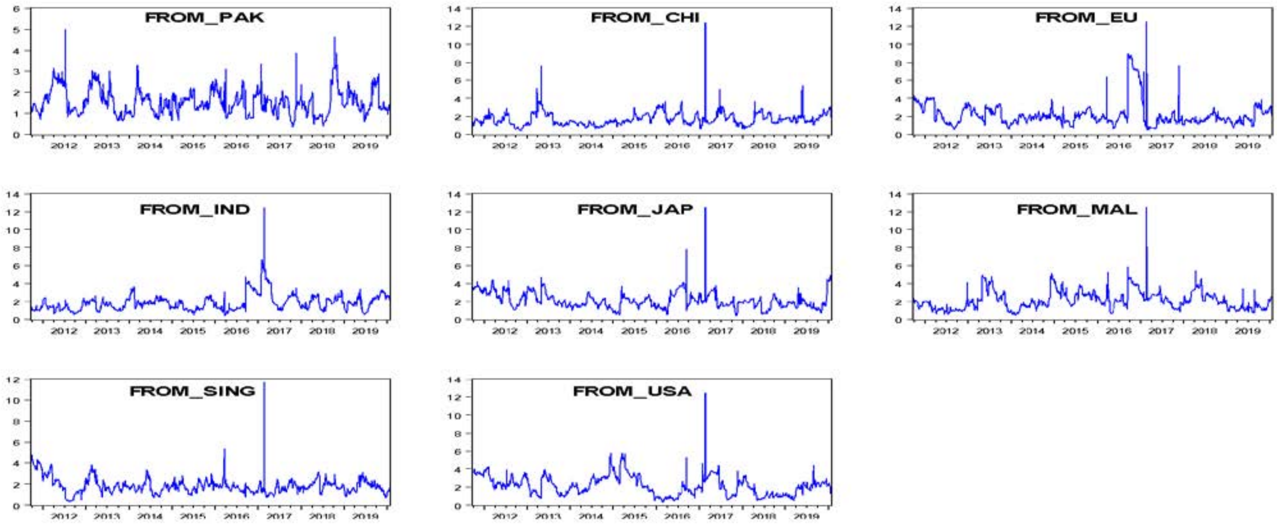


Figure 7: From Bond Volatility

Figures 8 & 9 show net return and volatility spillovers for the respective bond markets. The net spillover plots are near to zero-line indicating that all the bond markets are independent, consequently, each market is less sensitive and vulnerable to other markets.

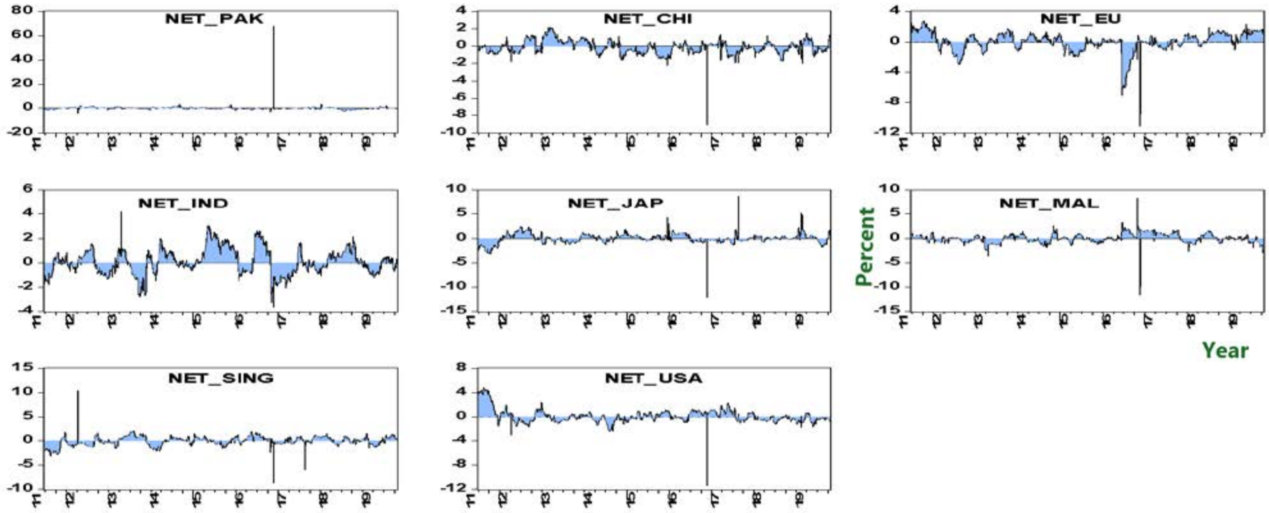


Figure 8: Net Bond Return.

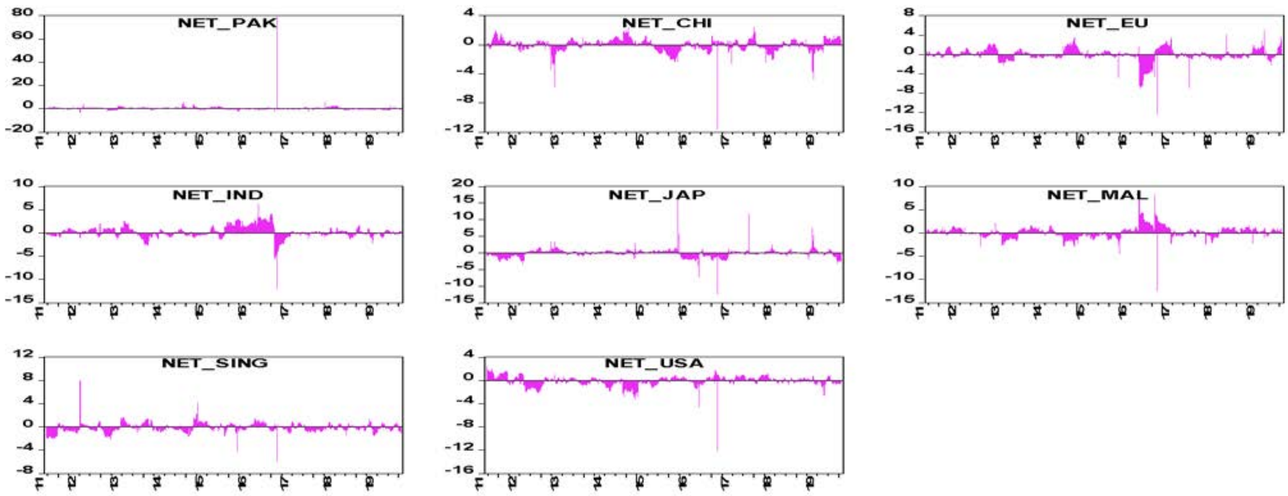


Figure 9: Net Bond Volatility

5. CONCLUSION

This study employs the most recent Diebold and Yilmaz (2012) approach, and subsequently, estimates the total spillover, directional (to others / from others) spillover, and net spillover indexes. To capture the cyclical movements in trading partner bond markets, this study carries out the rolling window analysis. This study found for the return and volatility total connectedness, different system-wide values of 17%, 15%, respectively among the bond markets of selected countries over the full sample. These values suggest that there is overall less connectedness and spillovers among the bond markets.

For the directional return and volatility spillovers, this study found that four markets such as the USA, EU, Singapore, and Malaysia are more influential bond markets and also sensitive for external shocks. Also, the Pakistan and China bond markets indicate more independent markets as they have a high value for their own contribution, while India and Japan are more sensitive to other markets.

Based on the bond net spillovers, the study finds that the magnitude of net spillover values is very low suggesting these markets are less influential and sensitive to other markets. In short, the USA, EU, and Singapore bond markets are net shock originators while other markets are shock receivers. The study also found that the majority of the bond markets in this group show their own market contribution is higher, assembling them as an independent market.

Bond returns and volatility spillovers strengthen during the episodes of a financial crisis. These findings have practical implications in relation to international investment diversification and risk reduction. For this group, especially Pakistan, for financial system solidarity, reviving macroeconomic fundamental and financial reforms from policy designers are critical to framing efficient policies for the economy.

6. AVAILABILITY OF DATA AND MATERIAL

Data can be made available by contacting the corresponding authors

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