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RETURN AND VOLATILITY SPILLOVERS AMONG EMERGING ASIAN CURRENCY MARKETS ALONG BELT AND ROAD INITIATIVE DURING COVID-19 PANDEMIC

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Abstract
This study investigated the dynamics of return and volatility spillovers among emerging Asian Currencies associated with countries along the Chinese Belt and Road Initiative during Covid-19 Pandemic. Connectedness Index introduced by Diebold and Yilmaz (2012) based on Generalized Forecast Error Variance Decomposition was used for analyzing daily exchange rate data from December 2019 till June 2021 of the respective countries. Findings of the study revealed that volatility spillovers remain consistently higher than return spillovers, which is an indication of stronger financial risk transmission across currency markets. Sharpe increase in both the spillovers during the pandemic period reflects significant contagion effect. Our results are important for investors in order to make portfolio diversification strategies and policy makers to formulate policies for financial stability during global and regional shocks.

1. INTRODUCTION

China launched the Belt and Road Initiative (BRI) for regional economic cooperation in 2013. The program's main objective was to promote the free flow of various macroeconomic factors (Wei, 2020). The primary purpose of the BRI is the economic development of regional economies through cooperation and joint prosperity. The official document of BRI states that this program is intended to create and increase mutual trust and understanding while strengthening friendship ties and channels of communication among member countries of the region. These objectives will be accomplished on the basis of four main principles; cooperation and openness to each other, inclusiveness and harmony among member countries, market-based operations and creating win-win and mutually beneficial situations. According to the Emerging market index of Morgan Stanley Capital International (MSCI), BRI is another name for an emerging market. However, there is open offer to every country to join the program; even Korea and Japan are invited to be members. Beyond the provision of physical and infrastructure facilities, BRI played an influential role in policy coordination, lowering trade obstructions, integrating financial markets of the region and particularly open gateways for people-to-people contact of member countries (Huang, 2016).

BRI has a positive impact on the economic development of the member countries. It is evident from the growing trade volume among the countries and job creation. BRI's official website states that trade volume among member countries surpassed US $6 trillion and created 244 thousand jobs. This increase in

multinational cooperation causes severe stock market and exchange rate volatility (Ali *et al.*, 2025; Geng & Guo, 2022). Aslam and Saeed (2023) and Li *et al.* (2020) found that stronger trade ties among BRI countries leads to higher integration of financial markets. Moreover, the researcher elaborated that most BRI countries have shifted to a floating exchange rate system. Volatility of foreign exchange rates has affected investors' returns in currency and stock markets. This rise in volatility affects many parts of the domestic economy. It has critical implications for investors of member countries as well as other international investors who select these markets for portfolio diversification. Furthermore, the possibility of systematic risk arising due to the heterogeneous status of economic development of member countries had severe implications for hedgers, investors and policymakers.

Initially emerging in Wuhan city of China in late 2019, Corona Virus Disease (COVID-19) was declared by the World Health Organization (WHO) as a global Pandemic in March 2020. In a short time, the number of cases exponentially multiplied worldwide and collective cases in America and Italy crossed the number of reported cases in China. According to Yousaf (2021), the total number of confirmed cases and death trolls across the world reached 90 million and 1.94 million respectively. The pandemic spread to about Two Hundred countries and covered all regions of the world. Particularly Europe and US became the epicenters and received severe death casualties. Due to the Lockdown and stoppage of economic activities, various countries suffered rapid economic losses. On one side, the real economy faced recession; production stagnated and shocks in consumer and service industries, turnover and firing of employees. On the other side, financial markets witnessed liquidity pressure, investors' panic, and deteriorated confidence.

Furthermore, the pandemic negatively affected the socioeconomic dimensions and has disturbed the global financial markets. The Economist (2020) magazine states that the recent outbreak of the Corona virus is a global threat to financial markets. The effect of COVID-19 on economic and financial activities has increased the level of risk aversion behavior which was previously noted significantly after the Global Financial Crisis. Organization of Economic Cooperation and Development (OECD) report state that COVID has caused a 30 percent decline in stock markets (OECD, 2020). The implied volatility of equities and global oil prices has increased to the level of crisis. Breaking news and Bulletins on the pandemic in international media further caused negative sentiments, uncertainty and fear (Aslam *et al.*, 2020). As a result of increased negative sentiments and fear of losses, financial markets have collapsed (The Economist Magazine, 2020). For example, Level 1 circuit breakers were triggered 4 times in US stock markets within 10 days of March 2020 to prevent market crashes (World Economic Forum, 2020). These circuit breakers are normally triggered based on a 7% drop from the previous closing price and were triggered only once in 1997. COVID-19 proved more destructive to US stock markets than all other previous infectious diseases (Baker *et al.*, 2020). Moreover, the Standard and Poor 500 index and Dow Jones Industrial Average dropped 29 and 33% respectively, in less than 3 months, i.e., December 31, 2019, to March 20, 2020. The Pandemic also affected UK's Financial Times Stock Exchange (FTSE) 100 index, which dropped 24.80 % (The Guardian, 2020), while Japan's representative index experienced a 20 percent drop (Bloomberg, 2020). In short, the said pandemic significantly affected global financial markets (Nicola *et al.*, 2020). To prevent further losses and market crashes, central banks and other regulatory bodies have stimulated massive interventions so that economy should get out of the short-term crises.

According to the International Monetary Fund's (IMF) estimations, a stimulus package of USD 3.3 Trillion and USD 4.5 Trillion additional loans, guarantees and equity injections were stimulated by Government (Congressional Research Service, 2020). In addition, US federal reserves announced a USD 700 billion Quantitative Easing program and a zero percent interest rate in monetary policy on March 15, 2020, to curb the economic effect of the COVID-

19 pandemic. This initiative was followed by many central banks in other countries and reduced policy rates and reserve requirements of commercial banks. Moreover, the Pandemic has damaged the economic and financial variables on a short-term basis, due to which the total spillover reached the highest level in the previous 10 years. However, if not contaminated timely, it will lead to sustained economic and financial crises (Wang *et al.*, 2021).

2. Literature Review

Since the pandemic was termed a global economic threat by the World Economic Forum, literature on COVID-19 has exponentially increased due to its substantial economic impacts. Several researchers investigated different dimensions of COVID-19 on financial markets. Like Khan *et al.* (2020) discussed the economic effect on aggregate markets. Conlon *et al.* (2020) studied the haven potentials of Bitcoins, while McKibbin and Fernando (2020) studied the impact on the global economy. Furthermore, Sharif *et al.* (2020) and Yarovaya *et al.* (2020) investigated crypto-currency markets during the outbreak. Similarly, Sharif *et al.* (2020) and Hung (2020) studied spillovers between oil and stock markets. Akhtaruzzaman *et al.* (2021) studied financial contagion among China and G7 countries and found that stock returns of financial firms react more significantly than nonfinancial firms.

In addition, Ammy and Garcin (2020) investigated the efficiency of financial markets during the COVID-19 pandemic. Ashraf (2020) studied the response of stock markets of 64 countries and found that the stock market reacts negatively to confirmed cases and returns decline as the number of cases increases. Aslam *et al.* (2020) studied the efficiency of foreign exchange markets and found that intraday multifractality exists in Forex markets. Moreover, Aslam *et al.* (2021) analyzed the efficiency of European stock markets and confirmed that multifractality increased during March 2020. Ali *et al.* (2020) and Barro *et al.* (2024) found significant spillovers in stock market volatility. This increased volatility has caused substantial losses to investors and portfolio managers (Zhang *et al.*, 2020). However, little attention has been paid to the effect of the COVID-19 outbreak on returns and volatility spillover among financial markets of BRI region. This study has tried to fill this gap.

3. Data and Methodology

With an emphasis on the COVID-19 epidemic, the paper examines the return and volatility spillovers among developing Asian Foreign Exchange markets along the Belt and Road Initiative. For empirical analysis, daily exchange rates of 10 MSCI based emerging markets: Turkey, India, Sri Lanka, Malaysia, Indonesia, Pakistan, Philippine, Thailand, China, and Vietnam are used against US dollar. In November 2019, the first Covid-19 case was found in China. Thus, in accordance with Choi (2022), our suggested data sample covers the period from December 02, 2019, to June 30, 2021. The continuously compound logarithmic discrepancies in the closing prices of the corresponding exchange rates are used to compute daily stock returns.

$$R_{i,t} = \ln(P_{i,t}) - \ln(P_{i,t-1})$$

Where Pi,t stand for index i's closing prices on a specific day t. We employed realized volatility series to capture the dynamics of volatility.

We also used the spillover index approach developed by Diebold and Yilmaz (2012) to calculate several aspects of return and volatility spillovers. In accordance with Koop, Pesaran, and Potter (1996) and Pesaran and Shin (1998), this approach is based on Vector-Auto regression (VAR) and Generalized Forecast Error Variance Decomposition (GFEVD).

Initially, a Vector Auto-regressive (VAR) model of nth order is calculated;

$$\mathbf{R}_t = \sum_{i=1}^{p} \mathbf{A}_i \mathbf{R}_{t-i} + \varepsilon_t$$

Where εt, the error term, is a vector of innovations, Ai represents parameter matrices, and Rt represents the N×1 vector of return and

volatility series at time t. The GFEVD is expressed as follows, regardless of variable ordering:

$$\theta_{ij}(H) = \frac{\sigma_{jj}^{-1} \sum_{h=0}^{H-1} (e_i' \Psi_h \Sigma e_j)^2}{\sum_{h=0}^{H-1} (e_i' \Psi_h \Sigma \Psi_h' e_i)}$$

where σjj is the standard deviation (SD) of the error term for variable j, Σ is the variance-covariance matrix of errors, and Ψh represents the moving average coefficients. For each market, the variance decompositions should be normalized so that the total of all sources of volatility spillovers equals 100%.

$$\tilde{\theta}_{ij}(H) = \frac{\theta_{ij}(H)}{\sum_{j=1}^{N} \theta_{ij}(H)} \times 100$$

The formula for calculating the Total Spillover Index is:

$$TSI = \frac{\sum_{i,j=1, i \neq j}^{N} \tilde{\theta}_{ij}(H)}{N} \times 100$$

The volatility spillovers that are sent from stock market i to every other market denoted by "TO" and received by market i from every other market denoted by "FROM":

$$TO_i = \sum_{j=1, j \neq i}^{N} \tilde{\theta}_{ji}(H)$$

$$FROM_i = \sum_{j=1, j \neq i}^{N} \tilde{\theta}_{ij}(H)$$

The distinction between received and transferred volatility spillovers is expressed as follows:

$$NET_i = TO_i - FROM_i$$

4. Results and Discussion

4.1. Foreign Exchange Market Return Spillovers

Table 1 show results of the Return spillovers estimated for the Covid-19 Period i.e December 2019 to June 2021 based on 10 variables VARs with 10-step-ahead forecasts. Based on the results, 5 main spillovers are discussed below.

4.1.1. Total Spillover Index

The total spillover index value of 31.61% shows that Approximately 1/3rd of forecast error variance in the exchange rate system of returns spillovers during Covid-19 is due to cross market shocks. This signals a moderate to low interconnectedness among Asian emerging foreign exchange markets. This means that these currencies are less prone to contagion effect during crises. These results are in line with findings of Mensi *et al.* (2018) and Agarwal *et al.* (2024).

4.1.2. Directional Spillovers (TO)

Thai Baht appears to be the major return spillover contributor to the system with the highest value of 60.54%.Chinese Yuan and Indian Rupee also followed the pattern with respective values of 54.97% and 51.20%.

4.1.3. Directional Spillovers (FROM)

Malaysian Ringgit and Indonesian Rupiah appear to be the top return spillover receivers among other markets in the system during Pandemic Period. They respectively received 50.46% and 46.40% shocks from the system.

4.1.4. Net Spillovers

Thai Baht is the top net return spillover transmitter with a value of +15.17 followed by Indian Rupee and Chinese Yuan. On the other side Indonesian Rupiah appear to be the top net receiver of shocks as it send less shock to markets than it received from i.e -11.02. Vietnamese Dong and Pakistani Rupee also followed the same pattern and are entitled as net receivers.

4.1.5. Net Pairwise Spillovers (NPT > 0)

Chinese Yuan and Malaysian Ringgit share the highest net pairwise value of 11.22%. However Thai Baht appears to be at the top of the list with an NPT value of 9.00 followed by Indian and Chinese with 7.00 each. This suggests that these markets transmit spillover during Pandemic to more markets than they received from. Figure 1 shows return spillovers network plot for considered markets during Covid-19 pandemic. It can be clearly seen that Thailand and Chinese

currencies play a vital role in transmitting spillovers across the system. Malaysian and Indonesia received most of the edges and entitled as top return spillover receivers.

Table 1: Return Spillovers during Covid-19 i.e Dec 2019-June 2021.

	USD/TRY	USD/INR	USD/LKR	USD/MYR	USD/IDR	USD/PKR	USD/PHP	USD/THB	USD/CNY	USD/VND	FROM
USD/TRY	81.06	2.10	0.18	4.27	0.94	1.56	1.40	5.44	2.81	0.25	18.94
USD/INR	1.55	64.68	0.55	7.42	1.96	0.65	8.71	4.69	8.33	1.46	35.32
USD/LKR	2.33	0.90	86.23	2.07	2.09	1.53	0.53	2.15	1.38	0.80	13.77
USD/MYR	2.30	5.34	0.17	53.91	6.64	3.45	5.75	9.69	11.58	1.17	46.09
USD/IDR	1.76	3.91	1.24	9.03	59.92	0.43	4.88	9.93	5.51	3.39	40.08
USD/PKR	1.41	2.31	1.53	5.25	1.35	80.07	1.01	2.96	0.94	3.17	19.93
USD/PHP	0.99	10.07	0.31	6.29	3.51	0.63	61.95	8.24	6.51	1.50	38.06
USD/THB	4.34	4.22	0.76	7.47	3.35	0.78	7.18	59.02	12.01	0.86	40.98
USD/CNY	1.95	6.72	0.42	10.37	1.80	0.50	3.73	12.11	60.10	2.31	39.90
USD/VND	0.63	1.85	5.79	1.64	5.06	1.41	1.64	1.80	3.16	77.00	23.00
TO	17.25	37.42	10.95	53.80	26.71	10.95	34.82	57.01	52.24	14.92	316.07
Including Own	98.32	102.11	97.18	107.71	86.63	91.01	96.77	116.02	112.33	91.92	CTCI/**TCI**
NET	-1.68	2.11	-2.82	7.71	-13.37	-8.99	-3.23	16.02	12.33	-8.03	35.12/**31.61**
NPT	3.00	6.00	1.00	7.00	3.00	2.00	5.00	9.00	8.00	1.00	

Table 2: Volatility Spillovers during Covid-19 i.e Dec 2019-June 2021.

	USD/ TRY	USD/ INR	USD/ LKR	USD/ MYR	USD/ IDR	USD/ PKR	USD/ PHP	USD/ THB	USD/ CNY	USD/ VND	FROM
USD/TRY	58.10	9.87	3.89	1.92	2.80	3.43	1.35	10.63	5.58	2.41	41.90
USD/INR	5.12	62.93	1.27	3.40	4.28	2.02	7.52	10.27	1.43	1.76	37.07
USD/LKR	2.83	2.93	62.41	4.64	7.72	4.25	4.75	4.21	1.87	4.39	37.59
USD/MYR	2.07	8.65	1.39	39.73	7.62	7.34	8.54	14.18	4.54	5.94	60.27
USD/IDR	1.93	14.39	4.20	8.32	42.65	3.25	8.32	11.61	2.51	2.82	57.35
USD/PKR	1.59	9.66	2.09	10.57	6.97	44.50	9.55	6.21	3.23	5.63	55.50
USD/PHP	4.10	11.32	4.68	4.12	1.17	2.02	61.33	3.86	6.63	0.77	38.67
USD/THB	1.67	7.30	1.40	12.22	3.04	1.54	5.78	62.52	2.39	2.14	37.48
USD/CNY	2.24	0.99	2.48	2.94	11.51	1.31	2.23	4.94	66.39	4.97	33.61
USD/VND	1.47	6.50	8.96	10.30	3.52	2.63	7.94	9.65	4.34	44.68	55.32
TO	23.02	71.61	30.36	58.44	48.62	27.79	56.00	75.56	32.54	30.82	454.77
Including Own	81.13	134.53	92.77	98.17	91.27	72.29	117.33	138.08	98.93	75.50	CTCI/ **TCI**
NET	-18.87	34.53	-7.23	-1.83	-8.73	-27.71	17.33	38.08	-1.07	-24.50	50.53/ **45.48**
NPT	2.00	7.00	3.00	4.00	5.00	2.00	6.00	8.00	5.00	3.00	

4.2. Foreign Exchange Market Volatility Spillovers

Table 2 provide results of the Volatility spillovers estimated for the Covid-19 Period i.e December 2019 to June 2021 based on 10 variables VARs with 10-step-ahead forecasts. Based on the results, 5 main spillovers are discussed below.

4.2.1. Total Spillover Index

The total spillover index value of 45.48 % shows that approximately half of the forecast error variance is due to cross market spillovers during pandemic period. This shows moderate to high level of interconnectedness in the considered exchange rate system. Major portion of spillover is due to own market shocks. These results confirms the findings of Diebold and Yilmaz (2009), Arouri *et al.* (2011), Amar *et al.* (2025) and Habibi and Mohammadi (2022) that regional financial markets exhibit strong interdependence.

4.2.2. Directional Spillovers (TO)

Thai Baht and Indian Rupee appears to be the top volatility contributors with a TO value of 75.56% and 71.61% respectively. Other major volatility transmitters are Malaysian and Indonesian currencies sending 58.44 % and 48.62% respectively.

4.2.3. Directional Spillovers (FROM)

Malaysia, Indonesia and Pakistani Currency markets respectively receive 60.27%, 57.35% and 55.50% volatility spillover and entitled as top recipients in considered sample. Vietnamese and Turkish currencies are also among major receivers of shocks.

4.2.4. Net Spillovers

Thai Baht and Indian Rupee appeared as the top net transmitters of volatility spillover shock with a positive value +38.08% and 34.53%, followed by Philippine as 17.35%. Pakistani currency and Vietnamese Dong appeared as top net receivers with a negative value of -27.71% and -24.50 respectively.

4.2.5. Net Pairwise Spillovers (NPT > 0)

Thai Baht and Malaysian Ringgit share the largest Net pairwise volatility spillover as compare to other pairs in the exchange rate system during pandemic i.e 14.18%. Thai Baht and Indian Rupee have an NPT value of 8.00 and 7.00 respectively, which entitle these to transmit spillover shocks to more markets than they receive from. Whereas NPT value for Turkish Lira and Pakistani Rupee is 2.00 each, which signifies that they have transmit shocks to less market than they received from. Figure 2 shows volatility spillover network plot. Indian Rupee and Thai Baht appear to be major sources of spillover transmission. Pakistan Rupee and Vietnamese Dong appeared as major receivers during the pandemic.

5. Conclusion and Recommendations

The study found significant differences in return and volatility spillovers among emerging foreign exchange markets along BRI during Covid-19 Pandemic. Volatility spillovers remain consistently higher than return spillovers in normal periods. Before the Pandemic, return spillovers shows moderate interconnectedness among currencies.

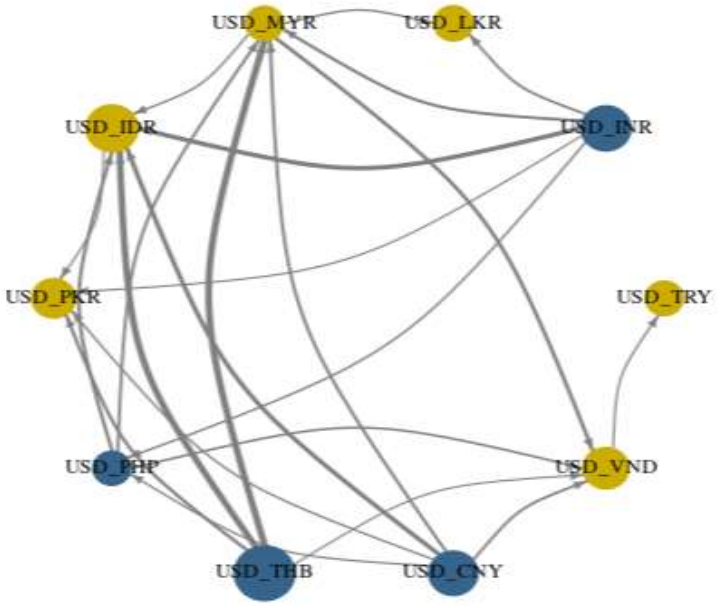


Figure 1: Network plot for Foreign Exchange Markets Returns Spillovers during Covid-19 Pandemic.

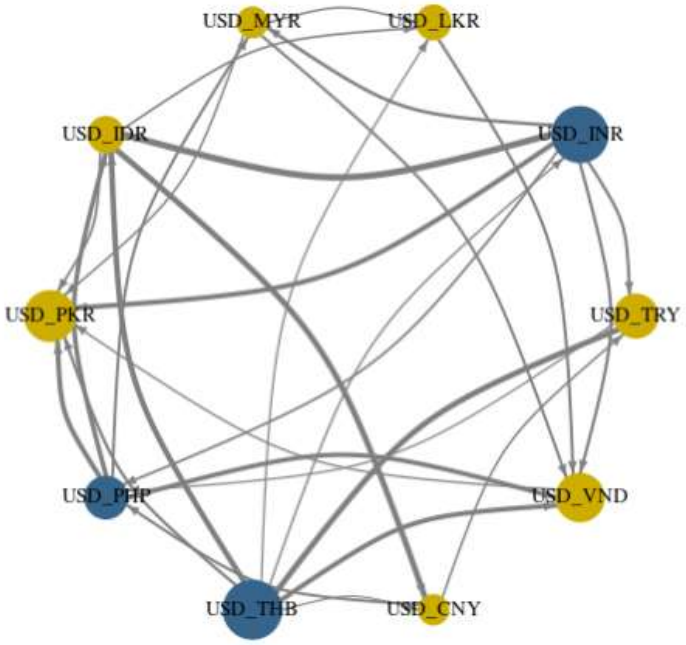


Figure 2: Network plot for Foreign Exchange Markets Volatility Spillovers during Covid-19 Pandemic.

However, notable spikes are seen during Covid-19 period, taking spillovers to maximum height in the sample indicating a significant contagion effect. In the post-pandemic period, return spillover normalizes; however remain elevated as compare to pre-pandemic Period. High volatility spillovers during the pandemic signals that shock transmission among markets become stronger. Diversification becomes less attractive during Covid-19 due to higher correlation among currencies. Investors shall avoid such markets during Pandemic period. They are advised to be cautious during high volatility spillover episodes and should search for less correlated regions during global shocks.

These results are helpful for individual investors and institutional portfolio managers in order to make efficient portfolio management decisions during pandemic episodes. These findings are also useful for policy makers of emerging Asian economies to deal with higher interconnectedness among stock and foreign exchange markets during crises period. Policy makers shall proactively consider the results of this study in order to make effective strategies for economic and financial stability. They can also predict the impact of volatility spillovers in one market on their own market and respond accordingly.

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