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### Comparative Analysis of Return Spillovers among Emerging Asian Currencies before and after the Inauguration of Belt and Road Initiative

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| <p><b>Dr. Muhammad Asif Ali</b><br/>Department of Management Sciences, Faculty of Arts &amp; Social Sciences, University of Swabi</p> <p><b>Dr. Faisal Khan*</b><br/>Department of Management Sciences, Faculty of Arts &amp; Social Sciences, University of Swabi. Corresponding Author<br/>Email: <a href="mailto:faisalkhanutm@yahoo.com">faisalkhanutm@yahoo.com</a></p> <p><b>Dr. Muhammad Sufyan</b><br/>Department of Management Sciences, Faculty of Arts &amp; Social Sciences, University of Swabi</p> <p><b>Mr. Junaid Ahmad</b><br/>Department of Management Sciences, Faculty of Arts &amp; Social Sciences, University of Swabi</p> <p><b>Mr. Hamid Hussain</b><br/>Department of Management Sciences, Faculty of Arts &amp; Social Sciences, University of Swabi</p> | <p><b>Abstract</b></p> <p>This study investigates return spillovers in emerging foreign exchange markets by comparing the pre and post BRI periods. We employed daily exchange rate returns from 10 emerging Asian economies including Turkey, India, Sri Lanka, Indonesia, Pakistan, Philippines, Thailand, China and Vietnam against United States Dollar. For calculation of total and directional connectedness, Diebold and Yilmaz (2012) methodology based of GFEVD has been used. For this purpose the data is categorized into 2 periods; Prior to and following the BRI, with 2013 as the demarcation year. The results indicate that spillovers remained robust during both the periods; however, the total spillover index experienced a minor fall following the inauguration of BRI. Some crucial shifts in the magnitude and direction of spillovers are also documented. Particularly, Chinese Yuan with a net recipient role in the pre BRI period transformed to net transmitter in preceding period. Our analysis carries important insights and significant ramifications for Investors Institutional and individual as well as regulators like central banks for formulating prudential regulations for market stability.</p> |
| <p><b>Keywords</b></p>  | <p>Belt and Road Initiative, Emerging Economies, Forecasted Error, Foreign Exchange markets, Variance Decomposition</p>   |



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### 1. Introduction

Investigating volatility spillovers among financial markets of emerging and developing Countries (EDCs) has become an important field of research in the last 2 decades. Due to the introduction of floating exchange rate systems and economic liberties, the number of foreign exchange activities increased. On one hand, above mentioned developments have smoothen the way for international trade and the flow of capital; on the other, they have led to increased foreign exchange risk exposure and caused volatility in financial markets. As evident from the recent crises, investors have withdrawn their capital from developed capital markets and have placed much confidence in Emerging and Developing Economies (EDEs) due to their insulation from global shocks. Diversification has made EDEs vulnerable to financial volatility. It does not pertain to the market in which it arises but disturbs the volatility of other markets, thus leads to volatility spillover.

The currency market is considered one of the largest and most liquid financial market dominating stock and bond markets. Different countries adopt different exchange rate policies; however, these markets were found to show interconnectedness and interdependence due to trade ties. Regional integrations further strengthened these Associations in the form of Association of Southeast Asian Nations (ASEAN), South Asian Association for Regional Cooperation (SAARC), World Trade Organization (WTO), European Union (EU) and North Atlantic Free Trade Agreement (NAFTA). Forbes and Rigobon (2000) show how uncertainty in one currency was spread to other currencies during the Asian financial crisis of 1997 and caused contagion in Global Forex Markets.

Like other classes of assets, the currency is used as investment tool and investors include various currencies in their portfolios for diversification purposes. Due to this treatment, it is eminent that one should understand the interdependence and movement of one currency with others. Moreover, the level of trade is directly associated with the degree to which different currency pairs fluctuate. If volatility in currency prices is high, more risk will be absorbed by importing and exporting countries. Changes in the global market will affect returns for international investors even if they don't hold any currency in their portfolios because stocks of each country are denominated in their local currency. Investigating dependence among currency markets is equal important as stock markets (Rajhans & Jain, 2015) and needs further attention (Liao *et al.*, 2019).

### 2. Literature Review

Spillover among currency and other markets received sufficient attention from academia. Like dependence among currencies with stock markets by Kumar *et al.* (2019) and Fedorova and Saleem (2009); currency with crude oil by Singh *et al.* (2018); currency with commodities by Jamil & Mobeen (2021) and Reboredo *et al.* (2021) and currency with cryptocurrencies by Kostika and Laopodis (2019) and Baumohl (2019). Researchers like Salisu *et al.* (2018), Barunik *et al.* (2017) and Salisu and Ayinde (2018) studied the transmission of volatility spillover among major traded currencies of the world. On the other side, studies of Antonakakis (2012) in Europe; Sehgal *et al.* (2017) in Asia and Uppal and Mudakkar (2020) discussed volatility spillover from strong to weak currencies.

Based on the above discussion, it can be easily inferred that much attention has been paid to few large traded currencies while weak currencies were ignored. Weak currencies mainly belong to emerging markets. Therefore, this study is aimed to investigate return spillovers among emerging market currencies.

### 3. Data and Methodology

The dataset consists of exchange rate returns on a daily basis calculated using log changes of 10 emerging market currencies of Asian region against US dollar from 2005 till 2023: USD/TRY, USD/INR, USD/LKR, USD/MYR, USD/IDR, USD/PKR, USD/PHP, USD/CNY, and USD/VND. The above pairs represent Turkish currency Lira, Indian currency Rupee, Sri Lanka Rupee, Malaysia Ringgit, Indonesia Rupiah, Pakistan's Rupee, Philippines Peso, Thailand Baht, China's Yuan, and Vietnam's Dong are examples of currency used. The daily log differences of the currency rate quoted on the Wall Street Journal, Yahoo-finance, and Investing.com websites are used to compute returns. The Covid-19 pandemic, the Belt and Road Initiative, and global financial crises are all included in the sample period. During this time, several regional and global shock incidents might be reflected in the dynamic return spillover profile.

To quantify various metrics of return spillovers, the study employed Diebold and Yilmaz's (2012) Spillover Index approach based on Generalized Forecast Error Variance Decomposition (GFEVD) of KPPS to an estimated VAR system of the returns. The three primary steps of the Spillover Index framework are data preparation, model estimation, and spillover index computation. The recommended software for executing the aforementioned procedure is R, which is used for all estimations.

#### 3.1 Returns Calculation and VAR Specification

The natural log formula is used to convert daily closing exchange rate prices against the US dollar into continually compounding returns.

$$R_t = \ln(P_i / P_{i-1})$$

$R_t$  represent returns,  $\ln$  for natural log,  $P_i$  for the today's price, and  $P_{i-1}$  for the yesterday's price.

The estimation of foreign exchange returns spillovers is centered on a stationary N-Variable Vector Autoregressive (VAR) framework which was introduced for the first time by Engle (1982).

$$X_t = \beta_1 X_{t-1} + \beta_2 X_{t-2} + \dots + \beta_p X_{t-p} + \epsilon_t$$

$$X_t = \sum_{i=1}^p \beta_i X_{t-i} + \epsilon_t$$

In the equation,  $X_t$  is a vector which is comprised of foreign exchange return spillovers,  $\beta_i$  shows the moving average coefficients of parameter metrics,  $X_{t-i}$  is used to represent one order lag value of Currency Returns Vector  $X_t$  and  $\epsilon_t \sim (0, \Sigma)$  is another vector used to denote identically and autonomously distributed disturbances.

When the Vector Auto-regressive model is expressed in moving average form, it becomes,

$$X_t = \sum_{i=1}^{\infty} A_i \epsilon_{t-i}$$

This procedure permits us to estimate the interdependence among considered currency markets and further proceed to start spillover analysis.

### 3.2 Generalized Forecast Error Variance Decomposition (GFEVD)

If the KPPS H-step-ahead forecast error variance decompositions is denoted with  $\theta_{ij}^g(H)$ , for  $H = 1, 2, \dots$ , we get

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

In the equation,  $\Sigma$  represents the variance matrix used to show error vector  $\epsilon$ , the standard deviation of the error term is written as  $\sigma_{jj}$  for the  $j$ th equation and the selection vector with 1 as the  $i$ th element is written as  $e_i$  and zeros otherwise.

Every entry of the row sum has been normalized through,

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

It is pertinent to note that by construction,  $\sum_{j=1}^N \tilde{\theta}_{ij}^g(H) = 1$  and  $\sum_{i,j=1}^N \tilde{\theta}_{ij}^g(H) = N$ .

### 3.3 Calculation of Spillovers

#### 3.3.1 Total Spillover Index

The Total Foreign Exchange market return spillover Index is constructed by using returns contributions from the Koop, Pesaran, Potter and Pesaran and Shin (KPPS) variance decomposition as,

$$S^g(H) = \frac{\sum_{i,j=1}^N \tilde{\theta}_{ij}^g(H)}{\sum_{i,j=1}^N \tilde{\theta}_{ij}^g(H)} \cdot 100 = \frac{\sum_{i,j=1}^N \tilde{\theta}_{ij}^g(H)}{N} \cdot 100.$$

#### 3.3.2 Directional Spillovers

The Directional spillovers 'FROM' which a market received from another corresponding Market  $i$  is written as

$$S_i^g(H) = \frac{\sum_{\substack{j=1 \\ j \neq i}}^N \tilde{\theta}_{ij}^g(H)}{\sum_{i,j=1}^N \tilde{\theta}_{ij}^g(H)} \cdot 100 = \frac{\sum_{\substack{j=1 \\ j \neq i}}^N \tilde{\theta}_{ij}^g(H)}{N} \cdot 100.$$

While the 'TO' is used for Directional Spillover and can be written as

$$S_{-i}^g(H) = \frac{\sum_{\substack{j=1 \\ j \neq i}}^N \tilde{\theta}_{ji}^g(H)}{\sum_{i,j=1}^N \tilde{\theta}_{ji}^g(H)} \cdot 100 = \frac{\sum_{\substack{j=1 \\ j \neq i}}^N \tilde{\theta}_{ji}^g(H)}{N} \cdot 100.$$

### 3.3.3 Net Spillovers

Net returns spillovers transmitted from markets  $i$  to all other markets  $j$  can be written as :

$$S_i^g(H) = S_{-i}^g(H) - S_i^g(H).$$

### 3.3.4 Net Pairwise Transmission (NPT)

The measure of net pairwise spillovers is derived from net spillovers and is written as:

$$S_{ij}^g(H) = \left( \frac{\tilde{\theta}_{ji}^g(H)}{\sum_{i,k=1}^N \tilde{\theta}_{ik}^g(H)} - \frac{\tilde{\theta}_{ij}^g(H)}{\sum_{j,k=1}^N \tilde{\theta}_{jk}^g(H)} \right) \cdot 100$$

$$= \left( \frac{\tilde{\theta}_{ji}^g(H) - \tilde{\theta}_{ij}^g(H)}{N} \right) \cdot 100.$$

## 4. Results of the Spillover Analysis

Table 1 exhibits results of the return spillovers estimated for the Pre-BRI period i.e May 2005 to August 2013 based on 10 variables VARs with 10-step-ahead forecasts. Based on the results, 5 main spillovers are discussed next.

### 1. Total Spillover Index

Total Return Spillover Index for the pre-BRI period is 39.51% which signifies that almost 40% of the forecast error variance is due to cross market spillovers. It represents moderate interconnectedness among considered markets. These results are similar to findings of Diebold and Yilmaz (2012), Demiralay and Bayraci (2015) and Fasanya *et al.* (2021) that return spillover is moderate to high during normal period.

### 2. Directional Spillovers (TO)

In context of Directional Spillovers Malaysian, Indian and Turkish currencies respectively transmitting 63.52%, 54.34% and 54.05% to the system and appears to be the top return spillover contributors during pre-BRI period. These currencies are highly influential in sending spillover to other markets in the sample.

### 3. Directional Spillovers (FROM)

Malaysian Ringgit and Philippine currency appears to be the largest receivers of return spillovers receiving 57.65% and 50.72% spillovers respectively from other markets. Indian and Indonesian currencies also followed the same pattern.

#### 4. Net Spillovers

Turkish currency market is the top net transmitter of spillover shocks with +12.18%. Indian Rupee and Malaysian Ringgit also appeared as positive net transmitters. Chinese Yuan is the top net receiver of return spillover with negative value of -8.45 followed by Sri Lankan rupee and Vietnamese Dong.

**Table 1:** *Return Spillovers among considered Foreign Exchange Markets during pre-BRI period i.e May 2005- August 2013.*

|                      | USD/<br>TRY | USD/<br>INR | USD/<br>LKR | USD/<br>MYR | USD/<br>IDR | USD/<br>PKR | USD/<br>PHP | USD/<br>THB | USD/<br>CNY | USD/<br>VND | FROM        |
|----------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>USD/TRY</b>       | 57.83       | 8.94        | 2.15        | 6.50        | 5.54        | 1.73        | 5.96        | 6.92        | 2.16        | 2.27        | 42.17       |
| <b>USD/INR</b>       | 9.54        | 51.12       | 2.94        | 9.66        | 6.57        | 2.03        | 7.30        | 6.67        | 2.65        | 1.52        | 48.88       |
| <b>USD/LKR</b>       | 2.91        | 4.02        | 73.50       | 2.99        | 3.56        | 2.93        | 2.52        | 2.77        | 2.79        | 2.01        | 26.50       |
| <b>USD/MYR</b>       | 9.08        | 8.82        | 1.92        | 42.35       | 12.21       | 1.64        | 10.46       | 7.42        | 4.20        | 1.90        | 57.65       |
| <b>USD/IDR</b>       | 8.02        | 6.97        | 1.43        | 13.24       | 51.38       | 1.59        | 8.19        | 4.89        | 2.58        | 1.72        | 48.62       |
| <b>USD/PKR</b>       | 3.03        | 3.30        | 2.20        | 2.93        | 3.11        | 77.12       | 2.35        | 2.13        | 2.11        | 1.72        | 22.88       |
| <b>USD/PHD</b>       | 8.32        | 7.94        | 1.76        | 12.21       | 8.21        | 1.82        | 49.28       | 5.94        | 2.87        | 1.65        | 50.72       |
| <b>USD/THB</b>       | 6.52        | 6.86        | 2.05        | 7.33        | 5.42        | 2.37        | 5.83        | 59.43       | 2.56        | 1.64        | 40.57       |
| <b>USD/CNY</b>       | 3.92        | 4.08        | 2.31        | 5.87        | 4.34        | 2.31        | 4.11        | 4.52        | 66.74       | 1.80        | 33.26       |
| <b>USD/VND</b>       | 3.00        | 3.12        | 1.79        | 2.80        | 3.11        | 2.23        | 2.89        | 2.04        | 2.90        | 76.12       | 23.88       |
| <b>TO</b>            | 54.34       | 54.05       | 18.55       | 63.52       | 52.06       | 18.66       | 49.60       | 43.31       | 24.82       | 16.22       | 395.14      |
| <b>Including Own</b> | 112.18      | 105.18      | 92.05       | 105.87      | 103.43      | 95.78       | 98.89       | 102.74      | 11.55       | 92.34       | CTCI/TCI    |
| <b>NET</b>           | 12.18       | 5.18        | -7.95       | 5.87        | 3.43        | -4.22       | -1.11       | 2.74        | -8.45       | -7.66       | 43.90/39.51 |
| <b>NPT</b>           | 8.00        | 7.00        | 0.00        | 7.00        | 6.0         | 4.00        | 4.00        | 6.00        | 2.00        | 1.00        |             |

#### 5. Net Pairwise Spillovers (NPT > 0)

Malaysia and Indonesia currencies exhibit the largest net pairwise spillover of 13.24%. The net pairwise spillover value for pair of Philippine-Malaysia is 12.21%. The NPT value for Turkish Lira is the largest i.e 8 which mean that it send volatility to more markets than it receives from. NPT of Indian and Malaysian currencies are equal to 7. Sri Lankan Rupee again is the least integrated in the system and appeared totally isolated and irrelevant in spillovers sharing with a NPT =0. Network Plot 1 confirms the results of net spillovers.

Table 2 provide results of the return spillovers estimated for the Post-BRI period i.e Spetmeber 2013 to December 2023 based on 10 variables VARs with 10-step-ahead forecasts. In the next section, 5 main spillovers are discussed.

### 1. Total Spillover Index

The value of Total Spillover Index is 44.78% which implies that almost 45% percent of the forecast error variance in the considered exchange rate system is due to cross market interactions while more than half is due to own/idiosyncratic shocks. These results corroborate the findings of Demiralay and Bayraci (2015), Karim and Naeem (2022) and Fasanya *et al.* (2021). The figure signals the presence of cross-border transmission of shock however not totally integrated and a moderate level of interdependence among considered markets during pre-BRI period.

### 2. Directional Spillovers (TO)

Directional spillover measure how influential a variable is towards other in terms of shock transmission. Turkish, Philippine and Indonesian currencies appeared as the major volatility spillover transmitters during pre-BRI period. They respectively send 56.92%, 53.20% and 51.89% shock to other regional markets in the considered spillover system. India, Vietnam and Malaysian currencies also followed the same pattern.

### 3. Directional Spillovers (FROM)

Malaysia and Indonesia respectively received 55.98% and 51.77% shocks from regional spillover system and thus entitled as the major spillover recipients in the considered sample. Indian Rupee and Chinese Yuan also fell in same line.

### 4. Net Spillovers

Turkish Lira appeared as top net transmitter with a value of +14.05 followed by Philippine currency and Vietnamese Dong. Malaysian currency with a net spillover value of -10.55% appeared as top net receiver. Chinese and Thailand currencies also followed the same pattern.

### 5. Net Pairwise Spillovers (NPT > 0)

The net pairwise spillover between Philippine and Malaysian currencies is the highest i.e 12.02% followed by Indonesian and Malaysian currencies. However Turkish market send shock to more markets than it receives from with a NPT value of 8.00, followed by India and Vietnam markets of value 6.00 each. Chinese and Thailand markets each have an NPT value of 1 and appeared to be nearly isolated from the regional spillover system. In the Network Plot shown in Figure 2 it can be seen that Turkish and Indonesian currency markets are major volatility transmitter across the region while Malaysian currency is major receivers. Pakistani Rupee and Sri Lankan Rupee were least affected and remained relatively isolated from the system.

**Table 2:** Return Spillovers among considered Foreign Exchange Markets during Post-BRI period. i.e Sept 2013-Dec 2023.

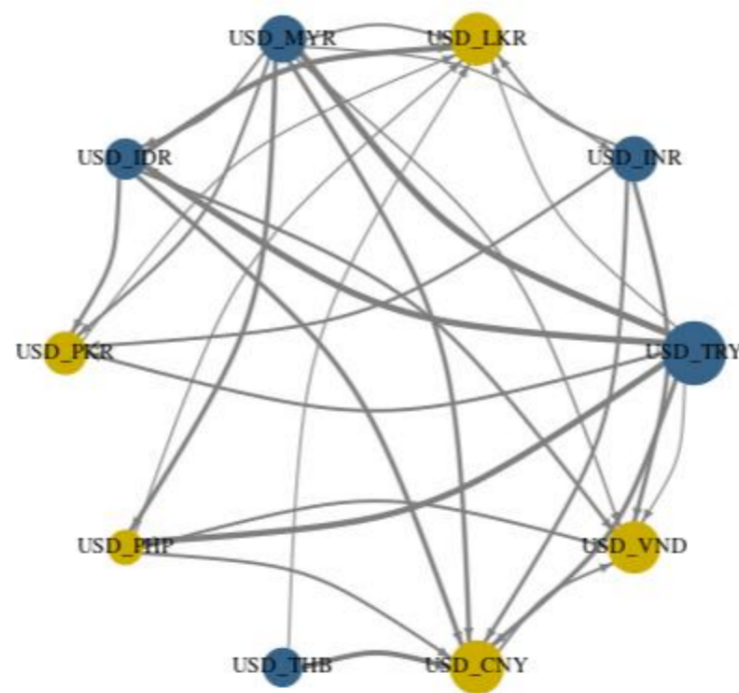
|                | USD/<br>TRY | USD/<br>INR | USD/<br>LKR | USD/<br>MYR | USD/<br>IDR | USD/<br>PKR | USD/<br>PHP | USD/<br>THB | USD/<br>CNY | USD/<br>VND | FROM  |
|----------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------|
| <b>USD/TRY</b> | 69.13       | 5.70        | 1.64        | 3.41        | 2.44        | 1.70        | 4.59        | 5.95        | 2.94        | 2.50        | 30.87 |
| <b>USD/INR</b> | 4.77        | 55.31       | 1.70        | 5.27        | 6.64        | 1.65        | 8.77        | 7.84        | 6.15        | 1.90        | 44.69 |
| <b>USD/LKR</b> | 2.11        | 2.50        | 80.12       | 2.39        | 2.26        | 1.99        | 2.00        | 2.13        | 2.21        | 2.29        | 19.88 |
| <b>USD/MYR</b> | 4.75        | 6.41        | 1.33        | 47.60       | 10.57       | 1.24        | 7.64        | 9.92        | 8.53        | 2.00        | 52.40 |
| <b>USD/IDR</b> | 4.57        | 9.25        | 1.61        | 11.47       | 48.55       | 1.01        | 6.89        | 8.19        | 6.10        | 2.36        | 51.45 |
| <b>USD/PKR</b> | 1.90        | 2.58        | 1.63        | 2.32        | 2.25        | 79.73       | 1.79        | 3.07        | 1.72        | 3.00        | 20.27 |
| <b>USD/PHD</b> | 4.05        | 9.25        | 1.01        | 6.54        | 5.38        | 1.00        | 55.67       | 9.86        | 5.38        | 1.88        | 44.33 |
| <b>USD/THB</b> | 5.06        | 7.70        | 1.33        | 6.45        | 4.79        | 1.58        | 8.91        | 54.04       | 8.36        | 1.78        | 45.96 |
| <b>USD/CNY</b> | 2.91        | 6.39        | 1.56        | 8.22        | 5.46        | 1.20        | 4.84        | 9.06        | 58.32       | 2.05        | 41.68 |

|                      |        |        |       |       |       |       |        |        |        |       |             |
|----------------------|--------|--------|-------|-------|-------|-------|--------|--------|--------|-------|-------------|
| <b>USD/VND</b>       | 2.24   | 2.60   | 2.11  | 4.24  | 3.63  | 2.01  | 3.07   | 3.53   | 4.32   | 72.24 | 27.76       |
| <b>TO</b>            | 32.37  | 52.39  | 13.92 | 50.33 | 43.42 | 13.37 | 48.49  | 59.54  | 45.69  | 19.77 | 379.29      |
| <b>Including Own</b> | 101.49 | 107.70 | 94.04 | 97.92 | 91.97 | 93.11 | 104.16 | 113.58 | 104.01 | 92.02 | CTCI/TCI    |
| <b>NET</b>           | 1.49   | 7.70   | -5.96 | -2.08 | -8.03 | -6.89 | 4.16   | 13.58  | 4.01   | -7.92 | 42.14/37.93 |
| <b>NPT</b>           | 4.00   | 8.00   | 0.00  | 4.00  | 3.00  | 1.00  | 6.00   | 9.00   | 7.00   | 3.00  |             |

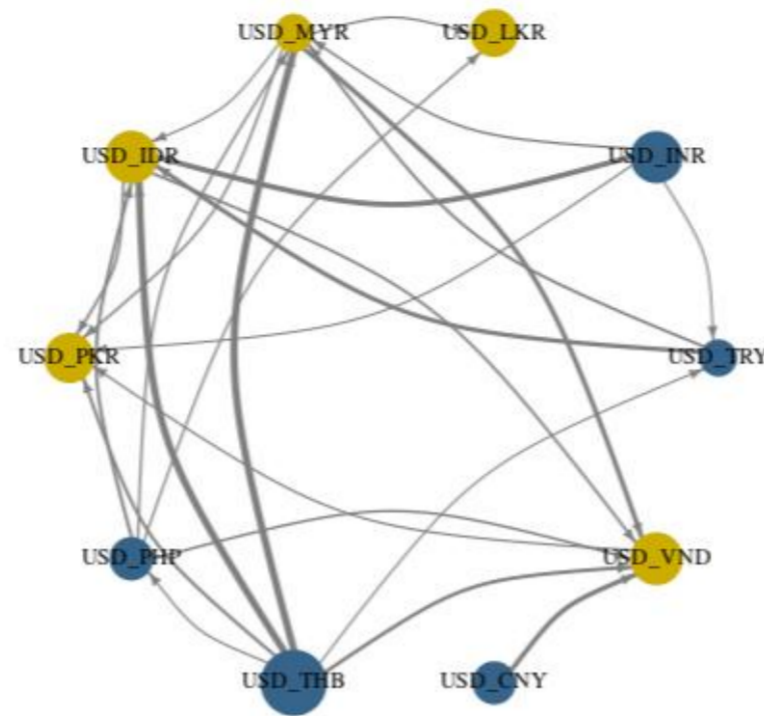
### 6. Conclusion and Recommendations

During Pre-BRI period, the return spillovers among sample foreign exchange markets stood at a moderate level. In the post-BRI period, both return and volatility spillovers slightly decreased. The decline in return spillover during post-BRI period suggests a modest reduction in return-based integration among considered foreign exchange markets. In pre-BRI period, Turkish Lira is the top net return transmitter while Chinese Yuan appeared as top net return spillover receiver. However; in post-BRI period, Thai Baht and Indonesian Rupiah appeared as top net return transmitters and receivers respectively. Long term investors should take position in Turkish Lira in order to earn stable returns. While portfolio managers are advised to take positions in relatively isolated and less integrated currencies like Pakistan Rupee, Vietnamese Dong and Sri Lankan Rupee for hedging and portfolio diversification.

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.



**Figure 1: Returns Spillovers Network Plot Pre BRI**



**Figure 2: Returns Spillovers Network Plot Post BRI**

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