CAPITAL UNIVERSITY OF SCIENCE AND TECHNOLOGY, ISLAMABAD

Revisiting Granger Causality Between Stock Price Indices and Exchange Rate in Asian Countries Through Quantile Regression

by

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Dedicated to my Beloved Parents and my friend Rimsha Ejaz

CERTIFICATE OF APPROVAL

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(Tooba Azad)

Abstract

The main objective of the study is to provide insight about the lead-lag relationship between stock market and currency market along with the behavior of lead-lag relationship across quantile in Asian countries before and during COVID-19. Daily data of stock market and currency market is use from the period of January 1, 2010 to 30 July 2020. Johansen Cointegration test and Quantile Regression is employed in order to find out the results. The empirical results of Granger Causality provide information that unidirectional relationship between the stock market and currency market exists in Pakistan. Moreover, a bidirectional relationship exists between the stock market and currency market of Japan, Thailand, Indonesia, South Korea, and Malaysia, and no unidirectional or bidirectional relationship exists between the stock and currency market of China and Saudi Arabia. For estimating the impact of COVID-19 on the returns of stock and currency market intercept dummy and slope dummy shows that during COVID-19 returns of stock and currency market of all countries increases at upper and lower quartiles. Therefore, this study has several policy implications for investors related to construction of portfolio and profit maximization and regulators for attracting foreign investors.

Keywords: Exchange rate, Stock market, Johansen Cointegration, Granger Causality, Quantile Regression, COVID-19.

Contents

List of Tables

Abbreviations

ADF	Augumented Dicky Filler
AIC	Akaike Information Crietrion
BDS	Brock, Dechert and Scheinkman
BIST	Borsa Istanbul
CNY	Renminbi
COVID-19	Coronavirus disease of 2019.
GDP	Gross Domestic Profit
HQIC	Hannan and Quinn Information Criteria
IDR	Indonesian rupiah
IMF	International Monetary Fund
INR	Indian Rupee
JKSE	Jakarta Stock Exchange
JPY	Yen
KLSE	Kuala Lumpur Stock Exchange
KOSPI	Korea Composite Stock Price Index
KPSS	Kwiatkowski Philips Schmidt Shin
KRW	South Korean won
MYR	Malaysian ringgit
NIKKIE	Nihon Keizai Shimbun
PKR	Pakistani RUPEES
PP	Philips Peron
PSX	Pakistan stock exchange
SAR	Saudi riyal
SENSEX	Stock Exchange Sensitive Index.

SET	Stock Exchange of Thailand
SIC	Schwarz information criterion
SSE	Shanghai Stock Exchange
TADAWUL	Saudi Stock Exchange
Thai baht	THB
TWD	New Taiwan dollar
TWI	Taiwan Weighted Index
TYR	Turkish Lira
VAR	Vectoautogresive model
VECM	Vector Error Correction Model
WHO	World Health Organziation
ZA	Zivot Andrew

Chapter 1

Introduction

Globalization and the advancement of trade and investment liberalization, international financial market integration, and the rapid flow of capital have strengthened the links between global stock and foreign exchange markets, strengthening the relationship between exchange rate changes and stock market fluctuations. Academic scholars and researchers try to explore this phenomenon during multiple financial crises such as the Asian financial crisis 1997, the subprime mortgage crisis, and the European debt crisis (Lee & Wang, 2015). The stock market and foreign exchange rate market are the most important indicator of the state of the country's financial markets so, a detailed understanding of the long and short-run relationships between global stock markets and foreign exchange markets enables the governments and market players in formulating relevant financial policies and investment portfolios, as well as reducing any potential negative effects on a country's economy.

The stock market and foreign exchange market of the country play a significant role in the development of the country's economy. Moreover, the investors is also interested to predict the future trends of the economy and corporations for making their investment decision due to the impact of exchange rate movement on the company's stock price (Tsai, 2012). Because fluctuation in the exchange rate leads towards a change in the stock price. However, exchanges rate and stock prices move up and down with good and bad news, and changes in the exchange rate affect the balance sheet and profit margin of the company, and changes in stock

prices also affect the exchange rate. In order to explain the dynamic relationship between stock price and exchange rate, there are two underpinning theoretical perspectives of the academic researcher which are the traditional approach and portfolio approach.

According to the traditional approach, when the currency of a country depreciates leads to an increase in the exports of the country by making the goods of the domestic exporter more attractive and competitive in the market. Besides this depreciation of the currency also increase the stock price in the country. However, the portfolio approach which is conflicting with the traditional approach propose that when the prices of the stock increase it also increases the investors demand for the assets of the country and currency. Because increases in the country's stock price increase the value of the currency of that county and make the currency strong as compare to the foreign currency. Therefore, the exchange rate represents the measurement of the foreign currency in terms of domestic currency then traditional approach concludes that stock price and exchange rate are positively correlated with each other but on the other hand according to the portfolio approach the relationship between stock price and exchange rate are of negative correlation.

According to the results of the study conducted by the Dornbusch and Fischer (1980) that there exists a positive correlation between exchange rate and stock prices. Empirical findings suggest that the foreign exchange rate positively impacts stock prices. In another study, Branson (1981) find out the relationship between exchange rate and stock prices and the findings of the study are contradictory and conclude the negative relationship between stock price and exchange rate. Later on found the same results and support both positive and negative relationship between the stock market and exchange rate. All these studies are conducts by scholars in order to provide insights into the relationship between stock price and exchange rate by extending the sample size and time horizon and conclude the coexistence of the positive and negative relationship between stock price and exchange rate e.g South Korea follows the traditional approach and results show that exchange rate leads the stock prices but contrary Philippine

shows the existence of the negative relationship between stock price and exchange rate while supporting the portfolio approach because here stock price leads the exchange rate.

A stream of the literature suggests that there exists a short-run relationship between stock price and exchange rate. Further studies which are conducted by noted that both short-run and long-run relationships between stock price and exchange rate exists. But some studies of suggests that there exists long-run and no relationship between stock price and exchange rate. Hence the relationship stock market is not concluded and becomes inconclusive due to the mixed results of various studies. Therefore, the purpose of this research is to provide the relationship between stock price and exchange rate by revisiting the Quantile Granger causality in emerging countries.

Therefore, the purpose of this research is to provide the relationship between stock price and exchange rate by revisiting the Quantile Granger causality in emerging countries. Because, Quantile Regression is use to estimates the conditional quantile of the dependent variable in order to provide insights about the cause-and-effect relationship between exogenous and endogenous variables in a linear model (Belnap, 2003). Quantile regression is employed by the academic researcher and scholar in order to find out the relationship between stock market and currency market Tsai (2012) because it allows researcher to estimate the functional relationship between variables for all the proportions of the probability distribution (Koenker & Bassett, 1978). Moreover, Quantile regression also enable to estimate the comprehensive identifying the structure and the range/degree of dependence for the multiple subperiod of pandemic (Khan, Ahmed, & Mughal, 2021). Because, during the pandemic volatility in the financial and non-financial markets increases which impacts differently according to the riskiness of the markets. Due to advantages of the Quantile regression over OLS the use of Quantile regression in order to explore the cause-and-effect relation is rapidly increase (Chang et al., 2020; Koenker, 2004).

The global economy is badly impacted by the COVID-19 because it has created uncertainity in the global financial markets. Covid-19 is declared as a pandemic

by world Health Organization (WHO) on Jan 31, 2020 and it affect the financial markets and created unprecedented volatility in various markets. The pandemic negatively impacted every aspect of the global economy such as supply chain, trade consumption, manufacturing, and financial behaviors. Due to the COVID-19, disturbances in business are seen as a result of problems in supply chains of merchandise and investment plan of business. A pandemic-based monetary decline suggests lower corporate profit and more debt obligation may cause troubles for organizations.

COVID-19 negatively influance the stock market by increasing the volatility and investors fear sentiments which cause stock prices to move down across the world. According to the statistics of the British Broadcasting Corporation (BBC), the Dow Jones Industrial Average and the FTSE 100 both fall, by 23% and 25%, respectively, which is the largest decline in the Dow Jones Industrial Average and the FTSE 100 since 1987. During the same time frame, the Standard & Poor's 500 Index drop 20%, and this is the largest decline since the financial crisis of 2008. Economists predict that the economic slump may be catastrophic. According to the 'Global Economic Outlook' (June 2020), the pandemic may drive the majority of the world's economies into recession, resulting in the lowest annual per capita production since 1870. According to the research, real world GDP shrinkage may be 5.2 percent. studies the impact of COVID-19 on GDPs in 30 different countries and concludes that, on average, these countries' GDPs are anticipated to fall by at least 2.8 percent by 2020.

Therefore, this study investigates the relationship between exchange rate and stock prices indices in Asian countries. At this time of the COVID-19 crisis currency market and stock market facing a lot of fluctuation so we also investigate the COVID-19 effect on the stock market and currency market and integration of the two markets. Due to fluctuation in exchange rate stock prices and market value of the firm can be significantly affected by many factors and fluctuation in the exchange rate is one of the important factors. Exchange rate and interest rate influence on the value of firm and movement in exchange rate either upward or downward may determine the stock prices of the firm.

1.1 Theoretical Background

The Efficient Market Theory, proposed by Fama (1970) based on the assumption that capital markets are efficient and securities reflect all available information, provides theoretical foundation for this study. Prices of securities adjust in response to new information, according to the efficient market theory. The weak form of efficiency, the semi-strong form of efficiency, and the strong form of efficiency are the three types of market efficiency based on information adjustment. Prices reflect all historical available information in the weak form of efficiency. As a result, the effect of all past information is reflected in the price of securities. In the semi-strong form of efficiency, the main concern is information, and adjustments are made based on publicly available information such as stock splits and dividend announcements, among other things.

Security prices represent information from historical data, publicly available information, and insider information in the last strong form of efficiency, which is the third and final form of efficiency based on the efficient market hypothesis. Based upon the theory, it is assumed that information in one market is also move towards other markets and also impact the other market because information spillover exits between markets. Therefore, information in stock market may transmit to currency market which further effects the lead/lag relationship between two markets.

1.2 Gap Analysis

Historically relationship between the stock prices and exchange rates has been discussed by various researchers (Arslan, Ahmed, & Akhter, 2020; Farooq, Keung, & Kazmi, 2004; Pardis Parsva & Lean, 2011; Parham Parsva & Lean, 2017; Türsoy, 2017). Studies like smith (1992) and solnik (1987) provide that there is bidirectional causality between stock prices and exchange rate in short run but not in long run. Ajayi and Mougoue (1996) investigate the relationship between stock prices and exchange rate and the results shows that stock prices increase has a negative short run effect on the value of domestic currency due to inflation but when

the domestics stock prices increases the domestic currency also appreciate in long run. Similar supporting study Aydemir and Demirhan (2009) also find a negative causal relationship between the stock markets and forex markets. It is a common practice in developing nations investors prefers to invest in forex during the recession times in stock markets. As it well understood that in long run they move together (Kasman, 2003). Various studies highlights the variation in forex market significantly trigger the variation in stock markets (Fang, 2001; Grossmann, Love, & Orlov, 2014; Kearney, 1998; Koutoulas & Kryzanowski, 1996; Walid, Chaker, Masood, & Fry, 2011). The relationship between exchange rate and stock prices is "portfolio balance approach". In current period we see the large variation in stock prices and exchange rate. So the interaction between stock prices and exchange rate is required to revisit whether changes in stock prices cause the changes in exchange rate or vice versa. To capture the whole phenomenon multiple methodologies has been performed historically. Granger causality proposed by Granger (1969) being a popular methodology have been previously used by the researchers. However on Asian countries as collective quantile regression by Buchinsky (1998) is still missing.

1.3 Problem Statement

The findings of earlier studies are conflicting and inconclusive. Studies like Kim (2003); Nieh and Lee (2001); Wu, Lu, Jono, and Perez (2012); Megaravalli and Sampagnaro (2018) show the long run relationship between stock market and exchange market and studies like Areli Bermudez Delgado, Bermudez Delgado, and Saucedo (2018); Bahmani-Oskooee and Sohrabian (1992); Nieh and Lee (2001); Shirodkar (2017); Smyth and Nandha (2003) report short run relation between these two variables. Granger, Huangb, and Yang (2000) states that the currency market leads the stock market and whereas Tachibana (2018) states that stock markets lead to the currency market. This requires the revisit of the relationship between the stock market and exchange market and also a comparison of the link across different quantiles. The integration of the stock market and exchange

market may also have been influenced by COVID-19. This study examines the effect of COVID-19 on the stock market and currency market. This study will also examine the link between currency and the equity market during the pandemic.

1.4 Research Questions

1. Is there exist a lead-lag relation between the currency market and the stock market?
2. Is this lead-lag relation across the quantile is same or different?
3. Does COVID-19 affect the stock market and currency market?

1.5 Objectives of the Study

1. To provide insight about the lead-lag connection between currency and stock market.
2. To provide insight about the behavior of lead-lag relation across the quantiles
3. To examine the impact of COVID-19 on stock market and currency market.

1.6 Significance of the Study

In 2008-2009, world economic crisis came and after this crisis financial markets became more integrated. Market portfolio channel and the traditional trade balance channel explain the relationship between exchange market and stock market. These two channels provide theoretical foundation and economic link between the two markets. Exchange rate affects growth of real output and trade of balance and positive correlation occur between the two asset, on the other side portfolio balance channel effects on financial asset and their demand and supply (Mikhaylov, 2018). The exchange rate increase or decrease also effect economic variables like inflation and output (Berument & Pasaogullari, 2003; Bleaney & Fielding, 2002).

For the monetary policymakers it is essential to watch the fluctuation of financial markets and the stock market liquidity and exchange rate reflects the capital flow in short run and fluctuation of exchange rate in long run affects the company's cash flow and international competitiveness affecting by the prices (Li, 2018).

Due to uncertainties stock and stock price index are difficult to predict that's why investors use two types of analysis which are fundamental analysis and technical analysis and initially for the predication of stock trend classical regression method is used (Patel, 2014). For predicting the movement of stock price and trend in exchange rate, economic theory suggest the inflation, interest rate, money supply , price level and other macro element and all of these variables are important elements for the investors for prediction (Paramati, 2013). If the stock prices has upward trend, it means that there is a possibility of inflow of foreign capital and if stock prices has downward trend then there is a devaluation in country wealth and corporate. investors now a days are more informative than the past. They follow the current news, financial position, political and economic positions, so list goes on. Based on past information analysis, past experiences and heuristic approach, they takes the investment decision (Ariyabuddhiphongs, 2011; Parveen, Satti, Subhan, & Jamil, 2020). Stock market prices and exchange rates are two important factors for the investors. It is important for the investor to know about the causality between stock price and exchange rate. If the investors have the information of these two variables, then they use the historical information for predicting the behavior of market. This study helps investors to identify the long and short run relationship between the stock market and forex markets. It leads them to better investment decision based on technical assistance not purely on heuristics.

1.7 Organization of Study

The study is based on five chapters. The first chapter contains the information related to the introduction, theoretical background, research gap, problem statement, and significance of the study. The second chapter is a literature review

and contains all the previous studies on the relationship between exchange rate and stock prices in order to provide the literature support and hypothesis of the study. The third chapter which is data and methodology contains the information of the sample, empirical methodologies such as Granger causality, and Quantile regression. The fourth chapter which is results and discussion contains the results and their description along with the discussion of the study. This chapter also provides empirical and theoretical justification of the results. The last chapter of the study is the conclusion and recommendation in which recommendations are given based on the results of the Granger causality and Quantile regression for the investors, policymaker, and academic researcher.

Chapter 2

Literature Review

2.1 The lead-lag connection Between Currency and the Stock Market

Exchange rate and stock price are the most important two economic indicators of the country's economic condition and its development. Therefore, exchange rate and stock price got attention in both domains of literature such as theoretical and empirical. Theoretically, the relationship between the exchange rate and the stock price has three forms that are unidirectional, reverse directional, and weak or no association between exchange rate and stock price (Kollias, Mylonidis, & Paleologou, 2012). On the basis of the goods market hypothesis proposed by Dornbusch and Fischer (1980) that, there exists a unidirectional relationship between exchange rate and stock price because the change in the exchange rate impacts the competitiveness of the local firm in the international markets which further influences the earnings and share price of the firm. But the direction/sign of change in the stock price due to the exchange rate cannot be easily determined. For example, depreciation in the currency of country cause increase in the competitiveness of the firm's among the firm's in the international market along with earning of the firm and exports. Moreover, depreciation of the currency also increases the expected domestic share price of the firm because the stock price is identified by discounting the future expected cash flows. Hence appreciation of

the country's currency leads towards a decrease in exports and domestic share price due to the decrease in the exports and increase in the imports from a foreign country.

However, according to the second form of association between exchange rate and stock price, which is reverse causality exchange rate plays the role for balance the demand and supply for the assets which is theoretically supported by the portfolio balanced method proposed by Frankel (1983) for the identification of exchange rate. For example, the surge in the stock markets causes an increase in the local and foreign investors demand for domestic assets and currency. Therefore, these shifts in the demand and supply of the country's currency increase the intrinsic value of the domestic currency, and this appreciation of the currency is also caused by the change in the domestic wealth.

Finally, based on the under arching asset market models Frenkel (1976), there exist weak or no association between exchange rate and stock price. According to this model, exchange rate is the price of the assets due to the assumption that the present value of the assets depend upon the expected future cash flows/returns. Moreover, the development of stock market is due to multiple factors but the asset market model support that there exists no or weak relationship between exchange rate and stock price.

After providing the theoretical relationship between exchange rate and stock price empirical literature also provide mixed results about the relationship between exchange rate and stock price. To investigate this relationship, cointegration analysis and Granger causality tests have been used extensively. The empirical results of the cointegration analysis provides information about the absence of a long-term relationship between the exchange rate and stock price(Bahmani-Oskooee & Sohrabian, 1992; Granger et al., 2000; Morales, 2009; Nieh & Lee, 2001; Bhandari, Genberg, & Khan, 1989; Smyth & Nandha, 2003). Zarei, Ariff, and Bhatti (2019) explores the impact of exchange rate on the stock market return using the unique data set of the countries which use free-floating exchange rate regimes. The sample consists of monthly data of Australia, Canada, Germany, Japan, Sweden, the United Kingdom (UK), and the US from February 1999 to March 2016 extracted

from DataStream and the IMF CD-ROM and empirical methodology applied on the monthly data is Ordinary least square, Generalized least Square and Maximum likelihood in order to obtain the results for estimating the impact of exchange rate on stock market returns. Empirical findings of the study provide information that there exists a significant impact of the exchange rate on the stock market index across selected countries of the sample.

Asad, Tabash, Sheikh, Al-Muhanadi, and Ahmad (2020) investigate the asymmetric association between gold-oil-exchange rates and Bombay stock indexes. In order to achieve the objective of the study, time series data of gold prices, oil prices exchange rates, and Bombay stock indexes are divided into three regimes which are before the crisis, over the time period, and post-crisis over the time period of April 2003 to May 2020. Within the data seasonality impact is estimated by apllying multiple unit root analysis e.g Philips Peron (PP), augmented dickey-fuller test (ADF), and Kwiatkowski Philips Schmidt Shin (KPSS) test, and Zivot Andrew (ZA) for determining structural break. BDS test is applied to the time series data in order to determine the nonlinearity. Empirical findings represent that only gold, oil prices, and currency values show that asymmetrical relationship with the Bombay stock indexes such as positive shocks to the gold, oil, and currency has no effect on the Bombay stock index in the longer horizon and before crisis regime.

Moreover, in the post-crisis period, the asymmetrical relationship is statistically significant between the exchange rate and stock indexes, and in the long run impact of exchange rate and oil price on the stock, indexes are statistically insignificant. On the basis of findings, it is concluded that the impact of the regime is more significant and prominent while identifying the contribution of the impact of the oil, gold prices, and appreciation and depreciation of the local currency on the Bombay stock indexes. Abdalla and Murinde (1997) conduct a study to find the causal link between exchange rate and stock price in the developing countries which are India, Korea, Pakistan, and the Philippines.The sample of the study consist of monthly observations from 1985 to 1994. The objective of this study is to find out the causal relationship between the leading prices in the exchange rate and stock

prices and results show that the existence of unidirectional causality in India, Korea, and Pakistan except for the Philippines. Hatemi and Irandoust (2002); Smyth and Nandha (2003) applly the (VAR) model to determine the possible causal correlation between the two series.

Empirical findings of the Granger causality show that a unidirectional relationship exists between stock price and effective exchange rate. Moreover, the results also provide information that increases in Swedish stock prices is also linked with the increase in the intrinsic value of the Swedish krona (Hatemi & Irandoust, 2002). Alagidede, Panagiotidis, and Zhang (2011) identifies the relationship between the exchange rate and the stock market in Bangladesh, India, Pakistan, and Sri Lanka over the time period of six years from 1995 to 2001. Empirical findings of the Johansen cointegration and Granger causality conclude that there exists no long-run equilibrium relationship between exchange rate and stock market prices in all selected countries. Besides this Granger causality explore the existence of a unidirectional relationship running from exchange rate to stock price in India and Sri Lanka but there is no lead and lag relationship between exchange rates and stock prices in Bangladesh and Pakistan. Morales (2009); Wu (2000) finds the same unidirectional relationship between the exchange rate and stock price in Singapore and eastern European countries which provides information that the stock market follows the exchange rate market.

Bahmani-Oskooee and Sohrabian (1992) argue that on the basis of the portfolio approach the exchange rate is also determined by the change in the stock price. To achieve the objective of the study Johsenan cointegration test and Granger causality are employed and empirical findings suggest that there exists bidirectional causality in the short run between stock prices and exchange rate. Megaravalli and Sampagnaro (2018) conduct a study to identify the relationship between the stock market and key macroeconomic indicators such as exchange rate and inflation rate. The sample of the study consists of the monthly data of three Asian countries which are India, China, and Japan over the period 2008 - 2016. To measure the short-run and long-run dynamic link between the stock market and key economic variables such as exchange rate and inflation Cointegration test,

Granger causality and pooled mean group estimator is applied and empirical findings conclude that exchange rate has a significant positive impact on the stock market in the long run while the impact of inflation on the long run on the stock market is negative. Moreover, in the short run exchange rate and inflation does not show any impact on the stock price. Park, Binh, and Kim (2019) explores the time-varying conditional correlation and causal relationship between the stock and foreign exchange rate markets.The sample of study consist of markets of China, Japan and Korea over the period of July 2005 to November 2013. Findings of the this study provides information that there exist no significant,consistent pattern of lead and lag relationship between stock market and foreign exchange markets in China and the pattern of cross market relationship between the markets varies over the time and the magnitude of crossmarket relation of each country is different from other. Moreove,on the basis of findings there exist strong lead and lag relationship between foreign exchange rate to stock market in Japan but in the crisis period stock market lead the foreign exchange market.However, in Korea there exist strong casualties relationship between stock market and exchange rate markets except 2009.

2.2 COVID-19 Affect the Stock Market and Currency Market

It is established fact that stock markets respond to the pandemic in the same way as other catastrophes, like natural disasters(Gao, Liu, & Shi, 2020). Stock market values have plummeted since the outbreak of the COVID-19 pandemic, putting unprecedented burden on global financial markets. Number of studies have examined the Covid-19 impact on different stock markets around the globe (Al-Awadhi, Alsaifi, Al-Awadhi, & Al-hammadi , 2020; Anh & Gan, 2020; Kartal, Depren, & Depren, 2020; Ramelli & Wagner, 2020; Sharif, Aloui, & Yarovaya, 2020). Another study by Liu, Huynh, and Dai (2021) investigat the stock market reaction due to outbreak of novel COVID-19 pandemic in China. Study estimate stock market crash risk by using GARCH-S model. Results of GARCH-S model

shows a negative reaction in growth of daily confirmed cases that increases the probability of stock market crash. Further fear sentiment worsens this risk. In simple words, when this fear sentiment increases, probability of stock market crash increases due to pandemic like Covid-19. Anh and Gan (2020) examine the Covid-19 lock down impact on Vietnamese stock market returns. Study use panel data regression to analyze the impact of daily increasing cases on 723 listed companies. Results of study reveal that increasing number of confirmed cased has negative impact on Vietnamese stock market. Further stock market reacts in opposite direction during and before the lock down. Study conclude that this covid-19 outbreak is a toughest hit on equity market(Anh & Gan, 2020).

Al-Awadhi et al. (2020) investigate the effect of infectious diseases on stock market returns. Previously EVD and SARS outbreak has also effected the stock market returns. The study employ panel data analysis to investigate the impact of the COVID-19 virus, a transmittable infectious disease, on the Chinese stock market. Study results show the number of confirmed cases and deaths has negative effect across the Chinese firms. Zeren and Hizarci (2020) investigate the effect of Covid-19 on major stock markets indices like SSE, KOSPI, IBX35, FTSE, MIB, CAC, and DAX. Study use cointegration techniques to find the cointegration between number of deaths and stock market returns. Study finds the cointegration between number of deaths and Stock markets (SSE, KOSPI and IBEX35) and no integration in FTSE MIB, CAC40, and DAX30. It is regarded one of the best options for investors to ignore stock market investments and instead invest in gold markets, which is the safest investment port during any crisis period in the long term(Zeren & Hizarchi, 2020).

Lee (2020) explore the covid-19 impact on US stock market by using daily News sentiment index and google trends on Covid-19. Study examines the correlation between the Covid-19 and selected sector of US stock market. The findings of this study provide a complete picture of COVID-19 sentiment's early influence on the US stock market by industry, as well as strategic investment planning based on time lag views by visualizing changes in the correlation level by time lag differences. Covid-19 not only developed, developing nations stock markets also share the same

property of jittery trends (Waheed, Sarwar, Sarwar, & Khan, 2020). Study focus on developing country like Pakistan to check the impact of COVID-19 on Pakistan stock market. Study applies quantile regression and concluded that COVID-19 has adverse effect and witnessed a positive raise in stock market returns. furthermore, study conclude that government interventions in such conditions safeguard the investors interest. Gil-Alana and Claudio-Quiroga (2020) investigate the COVID-19 disaster impact on the performance of Asian stock markets mainly Nikkei, Kopsi, CSI market indices from Japan, Korea and China respectively. The results based on fractional integration methods by using daily data, show that returns deviation and a temporary impacts of market shocks exist in the Nikkei index. But Kospi and CSI market index shows persistent of shocks in longer time period.

Liu, Choo, and Lee (2020) examine the world stock market reaction in response to world health organization announcement on COVID-19 as global pandemic. The study examine the key stock market indices form 77 countries around the globe and conclude that with the announcement of global pandemic stock market react negatively with considerable negative market shocks hits the global financial markets. Secondly, magnitude of reaction varies from country to country based on income class. Countries with higher income overreacted in start as compared to low income countries. However these countries bounce back more quickly than the low income class countries(Liu et al., 2020).

To check the direct effect and spillover He, Liu, Wang, and Yu (2020) conduct a study on stock markets by using conventional t-tests and Mann–Whitney tests as a non parametric test using daily stock market data of USA, China, Japan, Germany, Spain, Italy and South Korea. Results of study reveal that Covid-19 has short term impact on equity markets of respective countries. Also it has been witnessed that this impact is bidirectional in nature in Asian, European and Americans equity markets. However study find no evidence that can conclude that Covid-19 impact the respective stock market as it hits the globally. Zhang, Hu, and Ji (2020) conduct a comprehensive study on global pandemic Covid-19 on financial markets performance. Study find a significant increment of lagged variance in financial markets which substantially affect these markets. Result shows a

significant difference in market linkages before and after pandemic announcement. Padhan and Prabheesh (2021) conduct a survey on economics of covid that highlighted the some incredible work by different scientist on Covid-19 relationship with no only stock markets but also with forex, oil and policy suggestions. Studies like Al-Awadhi et al., (2020); Corbet, Larkin, and Lucey (2020); Gil-Alana and Claudio-Quiroga (2020); Haroon and Rizvi (2020); Liu, Sun, and Zhang (2020); Mishra, Rath, and Dash (2020); Phan and Narayan (2020) comprehensively analyze the Covid-19 impact on stock markets and find a negative impact of global pandemic on stock market and also this effect he volatility of stock markets as well.

For an economy's external stability to be maintained, the exchange rate is critical. The currency rate is linked to the trade balance, export efficiency, external debt, and capital flows, and this is a an important goal for the policymakers to maintain a stable exchange rate (Padhan & Prabheesh, 2021). Garg and Prabheesh (2021) examine the interest rate difference cause by the exchange rate during the pandemic 2019. Also how investors took advantage of new outbreak of covid-19 in forex and international assets markets. The study use Granger causality test approach to achieve its objectives empirically.

The study find the difference of interest rate enhance the predictability of forex market during the pandemic whenever investors are optimist and bullish. This volatile forex market may cause changes in the share prices, capital inflows, fiscal deficits, foreign debt obligations, and financial instability (Iyke, 2020; Padhan & Prabheesh, 2021).

2.3 Hypothesis of the Study

On the basis of above literature, the following hypothesis are drawn:

H1: There exist a lead lag relationship between currency market and stock market.

H2: The lead lag relation across the quantile is same.

H3: COVID-19 has impact on stock market and currency market.

H4: COVID-19 has impact on currency and stock market connection.

Chapter 3

Research Methodology

3.1 Data Description

This study examines the relationship between exchange rate and stock prices in order to provide information on which one of these markets exhibits a lead or lag relationship. The sample of the study consists of the stock and exchange rate of eleven emerging Asian countries which are India, Pakistan, Malaysia, Indonesia, South Korea, Philippines, Saudi Arabia, Thailand, Turkey, China, and Taiwan.

This study uses daily prices of equity markets and currencies of these countries for the period 1 January 2010, to 30 July 2020. The name of the stock market and exchange rate market are explained in Table 3.1 along with the sample time frame. Daily data of all indices are extracted from Yahoo finance.

Daily data of exchange rate and the stock market is converted into return by taking log return. Return of exchange rate and the stock market is computed by using the formula given below.

$$R_t = \ln \frac{P_t}{P_{t-1}} \tag{3.1}$$

P_t = price of stock and currency on day t.

P_{t-1} = closing price of stock and currency at t-1.

R_t = return of stock and currency

TABLE 3.1: Data description

Country name	Stock market index	Abbreviation	Exchange rate market	Abbreviation
PAKISTAN	Pakistan stock exchange	PSX	Pakistani RUPEES	PKR
TURKEY	Borsa Istanbul	BIST	Turkish Lira	TYR
JAPAN	Nihon Keizai Shimbun	NIKKIE	Yen	JPY
THAILAND	Stock Exchange of Thailand	SET	Thai baht	THB
SOUTH KOREA	Korea Composite Stock Price Index	KOSPI	South Korean won	KRW
INDONESIA	Jakarta Stock Exchange	JKSE	Indonesian rupiah	IDR
CHINA	Shanghai Stock Exchange	SSE	Renminbi	CNY
INDIA	Stock Exchange Sensitive Index.	SENSEX	Indian Rupee	INR
TAIWAN	Taiwan Weighted Index	TWI	New Taiwan dollar	TWD
MALAYSIA	Kuala Lumpur Stock Exchange	KLSE	Malaysian ringgit	MYR
SAUDI ARABIA	Saudi Stock Exchange	TADAWUL	Saudi riyal	SAR

3.2 Empirical Methodology

3.2.1 Johansen Cointegration

One of the objectives of this study is to analyze the long-run relationship between stock price and exchange rate. In this backdrop, the maximum-likelihood approach is applied. The maximum-likelihood approach, test all distinct cointegrating vectors between stock price and exchange rate in the multivariate setting, and after testing the cointegrating vectors between stock price and exchange rate the parameters of these cointegration relationships are estimated. The estimation of these cointegration relationships is computed on the basis of trace statistics and maximum eigenvalue tests. Johansen cointegration empirical methodology considered all variables as dependent variables in order to avoid any misspecification for the selection of exogenous variables.

Furthermore, the Johansen cointegration approach also provides a unified framework for examining and estimation the relationship within the framework of the vector error correction (VECM). Since the stock price and exchange rate which are in the cointegration framework have a similar trend becomes the reason for the existence of the causality in the Granger at least in one direction. Hence, on the basis of the multiple variables system used in this study Johansen Cointegration is applied as an empirical methodology to examine the existence of the long-run relationship between stock price and exchange rate.

3.2.1.1 Stationarity Test

In order to find out the integration level of the eleven Asian emerging stock markets and exchange rate stationary tests is firstly applied to the data. According to the literature the most appropriate approach to find out the stationarity of the data are (ADF), (PP), and (KPSS). All of these three tests are used in order to examine the order of the integration of each series Id. The basic difference between ADF, PP, and the KPSS test is the construction of the null hypothesis, such as the null hypothesis for the test of ADF and PP states that the series are non-stationary in which order of integration will examine.

Whereas, the null hypothesis of KPSS states that the series is stationary in which order of integration Id is to be estimated but in this study, only ADF and PP tests are used to investigate the order of integration between the series of stock price and exchange rate of the eleven Asian emerging countries because ADF and PP test have a limitation that they show biased results in the case of the small sample but shows unbiased results in the case of the large sample whereas, KPSS test overcome this limitation and also shows unbiased results in a small sample to identify the order of integration. Therefore, the procedure of testing the null hypothesis that series are non-stationary according to the ADF test is explained below equation 3.2.

$$\Delta \mathrm{X}_{t-1} = \omega_o + \mu_o t + \mu_1 \mathrm{X}_{t-1} + \sum_{i=0}^{\mathrm{I}} \omega_1 \Delta_{\mathrm{X}t-1} + \lambda_t \tag{3.2}$$

In the above equation 3.2 represent the variable such as stock price and exchange at time t, X_{t-1} denotes the $\mathrm{X}_{t-1} - \mathrm{X}_{t-2}$ and λ_t is the error term with zero mean and variance 1, linear time trend is denoted by t and is the order of the lag. Therefore, in order to find out the presence of unit root in X_1 the null hypothesis is tested that X_1 is zero in equation 3.2. If $\mathrm{X}_1 = 1$ is statistically significant and less than zero causes the rejection of the null hypothesis that the series are non-stationary. Another test used in this study for identifying the stationery and level of integration is Phillips-Perron (PP) also test the null hypothesis in the same way as the ADF but it has a limitation that it cannot accurately handle the sensitivity of the heteroscedasticity and the autocorrelation of the residuals.

3.2.1.2 Lag Selection for VAR Model

After establishing the stationarity and integrating level next step is to find out the optimal number of lag length for testing the Johansen cointegration test. In this study Akaike (AIC), Hannan and Quinn (HQIC), and Schwarz's Bayesian (SIC) information criteria are used to find out the optimal lag length according to the procedure of the maximum number of lag length K_{max} and the number of dependent variables has been linked in the system to the sample size (H) according to the formula $H^{\frac{1}{3}}$. But in the case of the conflicting results of the AIC, PP, and SIC then the selection of lag length for the VAR model is on the basis of AIC.

3.2.1.3 Johansen Cointegration Test

Since all variables are integrated in the same order, a cointegration approach is used to estimate the long-run relationship(s) between the variables included in the vector. Initially, Johansen cointegrating test follows the general approach to estimate the long-run relationship between stock price and exchange rate but meanwhile it moves towards a more specific approach to estimate the long-run relationship between the stock price and exchange rate in the vector Υ_t whereas Υ_t containing the number of integrated series at the same level. The long-run relationship between stock price and the exchange rate in the vector Υ_t is estimated by using the Johansen Maximum Likelihood approach explained below in equation 3.3 and 3.4.

$$\Upsilon_t = \Upsilon_o + \sum_{i=1}^{\mathrm{I}} \Upsilon_i \Upsilon_{t-1} + \lambda_t \tag{3.3}$$

$$\Delta\Upsilon_t = \Upsilon_o + \alpha\Upsilon_{t-1} + \sum_{i=1}^{\mathrm{I}} {}_i\Pi_i \Delta\Upsilon_{t-1} + \lambda_t \tag{3.4}$$

Whereas, Υ_t denotes (2×1) vectors consisting of stock price and exchange rate. Both these variables are estimated by the natural algorithm so that their first difference is used to measure the growth rate. Any long-term relationship between stock price and the exchange rate is measured by (2×2) matrix α as represented in

equation 3.4. Johansen test is applied in this study on the data set of eleven Asian emerging countries to estimate the long-run relationship between stock price and exchange rate in order to estimate the $r \leq 3$ the cointegration relation between the selected variables. However, this provides information, this is the same as testing the hypothesis that the maximum value of the matrix ‖ in equation 3.4 is r. Therefore, reduced rank regression is used in order to develop a likelihood ratio test of that hypothesis based on the trace statistic, or the maximum eigenvalue statistic.

Noted that maximum eigenvalue statistics show slightly more accurate results as compare to trace statistics while investigating the characteristic of a small sample. Therefore, in equation 3.4 it is reported that the unrestricted model is estimated by using the rank of the matrix. Moreover, the rank of the matrix ‖ is decomposed further in equation 5 as described below to provide the overall and detailed understanding of the cointegrating vectors system.

$$\Delta\Upsilon_t = \Upsilon_o + \nu\beta\Upsilon_{t-1} + \sum_{i=1}^{\mathrm{I}} {}_i\Pi_i\Delta\Upsilon_{t-1} + \lambda_t$$

$$\Delta\Upsilon_t = \Upsilon_o + \nu(\sum_{i=1}^{r} \beta_i^t\Upsilon_{t-1}) + \sum_{i=1}^{\mathrm{I}} {}_i\Pi_i\Delta\Upsilon_{t-1} + \lambda_t \tag{3.5}$$

In the above equation no 3.5 β repeat the cointegrating vector $(2 \times r)$ and in the matrix speed of the adjustment is shown by the ν. Moreover, Π_i denotes the matrix (2×2) which provides information short term dynamics of the model. Hence, while following the Johansen in order to find the cointegrating relationship(s) I had applied a zero limitation on β to test for eliminating all of the proposed variables. Therefore, the model represent in equation 5 is estimated by considering all of the identified matric of the cointegrating vectors β as explained below in equation no 6.

$$\Delta\Upsilon_t = \Upsilon_o + \nu(\sum_{i=1}^{r} \beta_i^t\Upsilon_{t-1}) + \sum_{i=1}^{\mathrm{I}} {}_i\Pi_i\Delta\Upsilon_{t-1} + \lambda_t \tag{3.6}$$

3.2.1.4 Granger Causality

To explore the direction of causality between two variables which are exchange rate and stock market indices in this study the empirical methodology named Granger Causality is employed proposed by the Granger (1969) and popularized by Sims (1972). Granger Causality empirical methodology is designed in order to identify that whether lag price values/past prices of a variable help to predict the change in another variable. Additionally, it also includes the calculation/estimation of the two-regression equation based on the assumption of the Classical Linear Regression Model presented below in equation no 7 and equation no 8.

$$\phi_t = \sum_{i=1}^{\lambda} \theta_i \phi_{t-i} + \sum_{i=1}^{\kappa} \beta_j \sigma_{t-j} + \mu_t \tag{3.7}$$

$$\sigma_t = \sum_{i=1}^{\lambda} \theta_i \phi_{t-i} + \sum_{i=1}^{\kappa} \beta_j \sigma_{t-j} + \mu_t \tag{3.8}$$

However ϕ_t represent the logarithm of the daily stock price and σ_t denotes the logarithm of the daily exchange rate, μ_t which is the error term and normally the uncaptured portion of the dependent variable and optimal lag length of the stock price and the exchange rate is presented by λ, κ. The Granger Causality test includes the establishment of the joint null that coefficient of the ϕ_t and μ_t are all concurrently 0. More specifically, the two-sided joint null hypothesis is explained below for equations 7 and equation no 8.

$$H_o : \beta_1 = \beta_2 = ... = \beta\kappa = 0 \tag{3.9}$$

$$H_o : \theta_1 = \theta_2 = ... = \theta\lambda = 0 \tag{3.10}$$

The Granger Causality test is implemented within the framework of the F-test. According to the F-test if the null hypothesis of any regression is rejected then this confirms the existence of the causal relationship between the variables which leads toward the acceptance of hypothesis.

3.2.2 Quantile Regression Model

The advanced form of ordinary least square is Quantile regression which is used to estimate models for different conditional quantile function by considering the effects of a covariates impact on a dependent variable. However, the ordinary least square estimation method provides information about the change in the conditional mean of the endogenous variables due to the change in the independent variables, additionally quantiles regression also specifies the variation in the conditional quantile regression of the regression. Due to this reason, various quantiles can be estimated by using quantile regression in order to provides complete information that how the response distribution is impacted by the independent variable from the obtained information e related to the variation in locations, spread and change. Similarly, base upon the assumption of the ordinary least square estimation method, a linear model for the conditional quantile for the dependent variable μ_i in equation as given below.

$$\theta_{\mu i}(\omega)a_i = a_i^t \alpha_\omega \tag{3.11}$$

In the above equation α_ω is the coefficient vector, a_{i^t} is the $K \times 1$ vectors of explanatory variables.

$$\theta_\omega \left(\varepsilon_{i,\omega} \left| a_{i,\omega} \right.\right) = 0 \tag{3.12}$$

Given below Quantile regression approaches, in contrast to standard linear regression methods focused on reducing sums of squares residuals, are based on minimizing asymmetrically weighted absolute residuals.

Chapter 4

Results and Discussion

4.1 Descriptive Statistics

Descriptive statistics is very important to observe the behavior of data. The descriptive for Pakistan, Turkey, Japan, Thailand, Indonesia, China, India, Taiwan, South Korea, Malaysia, Saudi Arabia are represented in Table 4.1.1 and 4.1.2. In this chapter, we used different statistical tools and tests by taking the natural log of closing stock prices and exchange rates of time series data of selected dependent and independent variables.

Table 4.1.1 shows the results of mean, maximum, minimum, and standard deviation for the selective stock market indices. Performance measure indicator "the mean values" for PSX, BIST, NIKKIE, SET, JKSE, SSE, SENSEX, TWI, KOSPI, KLSE, and TADA are 0.000357, 0.000194, 0.000211, 0.000141, 0.000162, 7.22E-05, 0.000173, 0.000126, 7.60E-05, 5.74E-05, and 6.16E-05. Mean values depict the positive returns for respective markets at a given time. Maximum values show the maximum returns for given markets. Statistics show SSE with maximum returns of 0.112078 greater than the other markets along with JKSE, SENSEX, KOPSI, and TADA with maximum returns of 0.097042, 0.096983, 0.082513, and 0.085475 for respective markets. Other than this, PSX, BIST, NIKKIE, SET, TWI, and KLSE have maximum returns of 0.046840, 0.068951, 0.077314, 0.076531, 0.097042, 0.112078, 0.096983, 0.074066, 0.082513, and 0.066263 respectively.

Minimum values show the maximum loss earn by a single stock market during a certain time period. Stock market indices BIST, NIKKIE, SET, SSE, and SENSEX show maximum loss of -0.110633, -0.111534, -0.114282, -0.132394, and -0.128586 respectively, among sample stock markets. PSX, TWI, KOSPI, KLSE, and TADA stock markets have earned the maximum loss of -0.071024, -0.096416, -0.08767, -0.054047, and -0.086846 respectively.

Standard deviation measures the risk of a specific market. SSE and SENSEX have the highest risk among the markets with values of 0.015672 and 0.014559 respectively. Whereas, KLSE has the lowest risk among the sample Asian stock markets. Skewness measures the location of data on a normal distribution curve which shows the variation of data from a normal distribution. Given values in Table 4.1.1, shows all of the markets are left-skewed. Similarly, kurtosis values of all selected markets show leptokurtic behavior as the values of kurtosis is higher than the 3. Normality test Jarque Bera values show the non-normality of data which means none of the market data is normally distributed.

Table 4.1.1: Descriptive Statistics(stock Markets)

	Mean	**Max**	**Min**	**Std. Dev**	**Skew**	**Kurt**	**JB**
PSX	0.0004	0.049	-0.0710	0.0085	-0.7123	10.932	10204.65
BIST	0.0002	0.069	-0.1106	0.0120	-0.7014	10.071	8165.28
NIKKIE	0.0002	0.077	-0.1115	0.0111	-0.5283	12.623	14724.21
SET	0.0001	0.077	-0.1143	0.0088	-1.2950	25.203	78512.62
JKSE	0.0002	0.097	-0.0930	0.0092	-0.4627	15.976	26654.86
SSE	7.22E-05	0.112	-0.1324	0.0157	-0.3833	10.856	9813.72
SENSEX	0.0002	0.097	-0.1286	0.0146	-0.5338	10.534	9118.49
TWI	0.0001	0.074	-0.0964	0.0114	-0.6478	11.250	10983.32
KOSPI	7.60E-05	0.083	-0.0877	0.0085	-0.4278	16.248	28295.14
KLSE	5.74E-05	0.066	-0.0540	0.0052	-0.4843	19.648	44645.03
TADA	6.16E-05	0.086	-0.0868	0.0093	-1.1873	21.570	56269.55

Table 4.1.2 depicts the descriptive statistics for the selective Asian countries' currencies. Mean values which show the average returns for the specific time frame for selective currencies PKR, TRY, JPY, THB, IDR, CNY, INR, TWD, KRW, MYR, and SAR are 0.000182, 0.000405, 3.34E-05, -9.89E-06, 0.000110, 8.54E-06, 0.000124, -0.000592, 1.73E-05, 5.71E-05, and 0.000739 respectively. THB and TWD have negative returns during the sample time period. TWD also shares the

TABLE 4.1.2: Descriptive Statistics(Currencies Markets)

	Mean	**Max**	**Min**	**Std. Dev.**	**Skew**	**Kurt**	**JB**
PKR	0.0002	0.079	-0.0540	0.003	4.261	141.925	3043952
TRY	0.0004	0.205	-0.0870	0.008	4.598	136.070	2795612
JPY	3.34E-05	0.038	-0.0320	0.005	0.127	9.606	6867
THB	-1.00E-05	0.035	-0.0490	0.006	-0.03	12.312	13624
IDR	0.0001	0.049	-0.0390	0.004	0.751	23.248	64928
CNY	8.54E-06	0.018	-0.0110	0.002	0.657	16.503	28986
INR	0.0001	0.061	-0.0760	0.007	-0.28	16.691	29573
TWD	-0.006	2.816	-2.7870	0.089	-3.38	794.126	98583266
KRW	1.73E-05	0.054	-0.0370	0.006	0.194	11.042	10406
MYR	5.71E-05	0.050	-0.0530	0.007	-0.01	9.008	5795
SAR	0.0008	0.434	-0.4060	0.068	0.039	8.090	4159

highest maximum return of 2.816238 and a minimum return of -2.787397 among the sample currencies. This shows the high variation existence in TWD. The standard deviation for TWD also shows the highest values of 0.088849. In terms of safe heaven with in sample currencies, CNY shows the lowest losses of -0.011291 and standard deviation of 0.001656. THB, INR, TWD, and MYR are left-skewed with skewness values of -0.03111, -0.282667, -3.382844, and -0.008905 respectively. The rest of the currencies are right-skewed on the normal distribution curve. All of the currencies markets data shows the leptokurtic behavior and the Jarque Bera test shows the non-normality of data.

4.2 Data Preprocessing

4.2.1 Unit Root Test

Granger and Joyeux (1980) suggested having a data look before estimating any statistical analysis. The normality of data in time series is under the question mark most of the time. So stationarity check is essential before proceeding with any statistical process. The presence of seasonality and trend Argumented Dickey Fuller (ADF) test has been applied on the respective data set. Table 4.2 explains the results of the ADF and PP test on the respective series.

Results show that BIST, KRW, SENSEX, and TWD are normally distributed

Table 4.2.1: Unit Root Test

		ADF		PP	
		Level	1st Diff	Level	1st Diff
PAKISTAN	PSX	0.878	0.0000	0.6152	0.0001
	PKR	0.9946	0.0001	0.9944	0.0001
TURKEY	BIST	0.0413	-	0.0273	-
	TYR	0.8291	0.0000	0.8794	0.0001
JAPAN	NIKKIE	0.1158	0.0000	0.1053	0.0001
	JPY	0.8719	0.0001	0.6943	0.0001
THAILAND	SET	0.1427	0.0001	0.1423	0.0001
	THB	0.4455	0.0000	0.3139	0.0001
SOUTHKOREA	KOSPI	0.0521	0.0000	0.0414	-
	KRW	0.0252	-	0.0095	-
INDONESIA	JKSE	0.4012	0.0001	0.1663	0.0001
	IDR	0.3757	0.0000	0.3086	0
CHINA	SSE	0.1467	0.0000	0.1641	0.0001
	CNY	0.6373	0.0000	0.6119	0.00
INDIA	SENSEX	0.0271	-	0.0221	-
	INR	0.2613	0.0000	0.1877	0.0001
TAIWAN	TWI	0.0999	0.0000	0.0676	0.0001
	TWD	0.0024	-	0.00	-
MALAYSIA	KLSE	0.4399	0.0001	0.0706	0.0001
	MYR	0.4915	0.0000	0.434	0.0001
SAUDI ARABIA	TADA	0.2173	0.0000	0.2107	0.0001
	SAR	0.9996	0.0000	0.9832	0.0001

as these series do not need any differencing for normality. Also, trends have been witnessed with a significant p-value in BIST, TYR, NIKKIE, IDR, CNY, SENSEX, INR, TWI, and MYR. Rest markets data showed an insignificant p-value of the unit test at the level, which means data is not normally distributed. For normality of data, first level difference has been applied and presented in table 4.2.1.

Based on the results of ADF Turkey, India and Taiwan show different differencing orders for the respective stock markets and currency markets and violating the basic requirement of applying the Johansen cointegration test which is that series have same differencing order. So, due to different differencing order Johansen cointegration test cannot be applied on these countries for exploring the relationship between stock market and exchange rate market. Therefore, Turkey, India and Taiwan are dropped from sample for the estimation of relationship between stock market and currency market but for exploring the impact of COVID-19 on

stock and currency market of emerging Asian countries Quantile regression is also applied on Turkey, India and Taiwan.

4.2.2 Lag Length Selection

To find out the relationship between two series this study applies VAR (Vector Auto Regression) model. A statistical model which is used to define the relationship between multiple quantities. And used as a structural framework for the estimation of causality test (Borozan, 2013). Table 4.2.2 present the results of VAR model which depicts the values of AIC, SIC, HQIC and Lag length of all selected countries. For model selection Based of AIC Values lag length for each country have been selected(Haouraji, Farchi, Mounir, & Mounir, 2019). The results show only Indonesia and China has the lag of 7 whereas rest of countries have lag length of 8.

Table 4.2.2: Lag Length Selection

	AIC	**SIC**	**HQIC**	**Lag**
PAKISTAN	15.1810	-15.2750	-15.3106	8
JAPAN	14.4866	-14.0537	-14.0892	8
THAILAND	6.8159	6.8711	6.8355	8
SOUTHKOREA	15.0647	15.11984	15.0843	8
INDONESIA	21.0441	-14.6026	-14.6340	7
CHINA	4.2476	-15.6020	-15.6334	7
MALAYSIA	2.3653	-14.9109	-14.9466	8
SAUDIA ARABIA	9.2545	-9.4210	-9.4567	8

4.2.3 Co-integration Test

If two series are cointegrated with each other than they must persist a long run relationship also the prospect of long term relationship exists as well (Engle & Granger, 1987). To find out the long run relationship between two series Trace statistics and maximum eigen values statistics have been used in this study. Which tell us about the cointegrating vectors between two series(Ali, Kiani, & Hafeez, 2018).

TABLE 4.2.3: Co-Integration Test-Trace Statistics

	Hypothesis	Eigen value	Trace Statistic	Critical Value at 5%	Prob
PAKISTAN	None	0.0011	5.9553	15.4947	0.7008
	At most 1	0.0005	1.7398	3.8415	0.1872
JAPAN	None *	0.1967	1506.1020	12.3209	0.00001
	At most 1 *	0.1574	660.8907	4.1299	0.0001
THAILAND	None *	0.1967	1506.1020	12.3209	0.00001
	At most 1 *	0.1574	660.8907	4.1299	0.0001
SOUTHKOREA	None *	0.1967	1506.1020	12.3209	0.00001
	At most 1 *	0.1574	660.8907	4.1299	0.0001
INDONESIA	None *	0.2963	2416.0590	12.3209	0.00001
	At most 1 *	0.2401	1059.6740	4.1299	1.0000
CHINA	None *	0.1638	1307.0540	12.3209	0.00001
	At most 1 *	0.1484	618.4965	4.1299	0.0001
MALAYSIA	None *	0.2695	1816.0740	12.3209	0.00001
	At most 1 *	0.1464	608.4463	4.1299	0.0001
SAUDI ARABIA	None *	0.0980	771.4205	12.3209	0.0001
	At most 1 *	0.0935	376.2078	4.1299	0.0001

TABLE 4.2.4: Multivariate Co-Integration Maximum Eigenvalue Statistics

	Hypothesis	Eigen value	Trace Statistic	Critical Value at 5%	Prob
PAKISTAN	None	0.0011	4.2155	14.2646	0.8359
	At most 1	0.0005	1.7398	3.8415	0.1872
JAPAN	None *	0.1967	845.2110	11.2248	0.0001
	At most 1 *	0.1574	660.8907	4.1299	0.0001
THAILAND	None *	0.1967	845.2110	11.2248	0.0001
	At most 1 *	0.1574	660.8907	4.1299	0.0001
SOUTHKOREA	None *	0.1967	845.2110	11.2248	0.0001
	At most 1 *	0.1574	660.8907	4.1299	0.0001
INDONESIA	None *	0.2963	1356.3840	11.2248	0.0000
	At most 1 *	0.2401	1059.6740	4.1299	0.00001
CHINA	None *	0.1638	688.5577	11.2248	0.0001
	At most 1 *	0.1484	618.4965	4.1299	0.0001
MALAYSIA	None *	0.2695	1207.6280	11.2248	0.0000
	At most 1 *	0.1464	608.4463	4.1299	0.0001
SAUDI ARABIA	None *	0.0980	395.2128	11.2248	0.0001
	At most 1 *	0.0935	376.2078	4.1299	0.0001

Table 4.2.3 depicts the estimated results for trace statistics. Estimated results show the 2 cointegrating eqn(s) for all selected stock and respective stock markets at 5% level of confidence. Which indicate the existence of common patterns in mentioned markets. Also * sign shows the rejection of null hypothesis that series has no co-integration vectors(Ali et al., 2018)

Table 4.2.4 present the estimated results for maximum eigen values statistics. The results show the 2 cointegrating eqn(s) for all stock market and respective currencies at 5% level of confidence and also * sing shows the rejection of null hypothesis at 95% confidence interval(Ali et al., 2018). Based on both trace and eigen values statistics are persistent for all selected countries.

4.3 Pairwise Granger Causality Test

Granger (1969) proposed that existence of cointegration vectors indicates the existence of granger causality for at least in one direction. Granger causality test a statistical hypothesis help us to determine either one series is useful to forecast another time series. If the estimated p-value is less than the critical value at 95% confidence interval than hypothesis will be rejected (Wei, 2016). To achieve the first objective of this study, Granger causality test has been applied that provides the lead and lag relationship between the two series. This may have a unidirectional or bidirectional relationship. Statical p-values determine the lead and lag value if the value is more than critical value of 0.05 than the series does not contains the lead and lag relationship. Table 4.3 present the results of granger causality test for all selected countries stock markets with respective currencies.

Starting from Pakistan, F-statistics and P-value of PSX shows significant lead lag relationship with PKR but PKR does not have any lead lag relationship with PSX. Which shows the unidirectional relationship between two series(Abbas, Bhowmik, Koju, & Wang, 2017). Japanese stock market and currency both shows the lead lag relationship. Significant p-value show the Nikkei (stock market) lead the JPY and in second hypothesis JPY leads the Nikkei. Thai, and Indonesian stock markets and currency markets shows a bidirectional relationship because estimated p-value

for both stock and currency market are less than 0.05%. That shows in both cases stock market and currencies both granger causes and these results are supported by Tudor and Popescu-Dutaa (2012) and contradict to Hussain and Liew (2005); Judge and Reancharoen (2014) study results. South Korean stock market show a granger cause to its currency but currency does not show and granger cause. That indicates a unidirectional relationship which supported by previous the study of (Ajayi, Friedman, & Mehdian, 1998). However, China and Saudi Arabia shares the similar properties where no lead lag relationship has been identified between respective stock markets and currency markets due to the possibility regarding existence of structural break with given data set that again supported by Tudor and Popescu-Dutaa (2012) but contradict to Parham Parsva and Tang (2017) results. Malaysia witnessed the bidirectional relationship among the respective stock market and currency at given level of critical values. Stock market lead the currency which mean stock market creates granger causes for MYR and in second hypothesis MYR leads the stock markets and creates the granger cause for KLSE (Yusuf & Rahman, 2012).

Table 4.3: Granger Casualty Test

COUNTRIES	**VARIABLR**	**F-Statistic**	**Prob.**
PAKISTAN	RPSX does not Granger Cause RPKR	10.079	0.000
	RPKR does not Granger Cause RPSX	1.246	0.285
JAPAN	RNIKKIE does not Granger Cause RJPY	3.819	0.002
	RJPY does not Granger Cause RNIKKIE	90.650	0.000
THAILAND	RJPY does not Granger Cause RNIKKIE	90.650	0.000
	RNIKKIE does not Granger Cause RJPY	3.819	0.002
SOUTHKOREA	KOSPI does not Granger Cause KRW	50.571	0.000
	KRW does not Granger Cause KOSPI	2.033	0.071
INDONESIA	RJKSE does not Granger Cause RIDR	8.068	0.000
	RIDR does not Granger Cause RJKSE	5.739	0.000
CHINA	RCNY does not Granger Cause RSSE	1.248	0.284
	RSSE does not Granger Cause RCNY	0.677	0.641
MALAYSIA	RMYR does not Granger Cause RKLSE	8.325	0.000
	RKLSE does not Granger Cause RMYR	12.237	0.000
SAUDI ARABIA	RTADA does not Granger Cause RSAR	0.705	0.619
	RSAR does not Granger Cause RTADA	1.740	0.122

4.4 Quantile Regression

The following section deals with empirical results of the Quantile regression in order to conclude the impact of COVID-19 on stock markets and exchange rate markets. Quantile regression is an empirical methodology used to estimate the relationship between independent variables with a conditional quantile of an endogenous variable without considering any specific conditional distribution.

The major difference between ordinary least square regression and quantile regression is the estimation of quantiles, instead of mean which is computed in ordinary least square methodology and the violation of the assumption of the standard regression such as homoscedasticity of the data are violated in order to estimate the relationship between exogenous and endogenous variables in the outer region of the conditional distribution enables quantile regression to provide insight about the relationship/dependencies more effectively and appropriate as compared to the standard regression(Waldmann, 2018).

Therefore, for the estimation of the impact of COVID-19 on stock and exchange rate market along with the dependencies of stock and exchange rate market during COVID-19quantile regression is employed on the daily data of Asian countries which are Pakistan, Turkey, Japan, Thailand, South Korea, Indonesia, China, India, Taiwan, Malaysia, and Saudi Arabia. In this backdrop, this section further consists of the empirical results of intercept dummy and slope dummy to explain the impact of COVID-19 on the stock and exchange rate market. Moreover, this section also provides information related to the association between the stock market and the exchange rate market during COVID-19.

Table 4.4.1 represents the estimated results of the impact of COVID-19 on the Pakistani stock exchange (PSX) and Pakistani exchange rate (PKR). On the basis of the Table, 4.4.1 it is deduced that the quantile regression model is able to describe and estimate describe and the dependencies between exogenous and endogenous variables appropriately. The estimated results show that the PKR (-1) impact on the PSX is statistically significant at the 0.3 quartiles and negative which means that the previous day's return of PKR (-1) causes a change in

the current return of the PSX. At conditional quartiles of 0.3 the coefficient of PKR(-1) is negative which means that increase in the lag return of the PKR(-1) causes decrease in the PSX return. In Table PSX(-1) represent the lag return of the Pakistan Stock Exchange which is statistically significant at 0.1,0.2,0.3 and 0.7 quartiles except 0.4,0.5,0.6,0.8 and 0.9. The coefficient of the PSX(-1) is positive but shows decreasing trend which means that lag return of PSX(-1) causes increase in the return of the PSX.

TABLE 4.4.1: Lead lag Relationship between Equity and Currencies markets across Quantile in Pakistan

					PSX					
	C	**t-Stat**	**PKR(-1)**	**t-Stat**	**PSX(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR***	**t-Stat**
10%	-0.008	-25.063	-0.161	-1.821	0.161	5.133	-0.341	-4.640	0.002	4.386
20%	-0.003	-15.373	-0.112	-1.740	0.125	5.476	-0.107	-1.800	0.001	1.832
30%	0.001	-12.460	-0.035	-2.020	0.045	4.180	-0.050	-1.788	0.001	1.805
40%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
50%	0.001	0.001	0.001	0.001	0.001	0.001	-0.017	-1.897	0.001	1.915
60%	0.001	0.001	0.001	0.001	0.001	0.001	-0.548	-1.759	0.001	1.778
70%	0.001	8.500	0.057	0.848	0.036	2.057	-0.082	-3.863	0.001	3.878
80%	0.004	19.112	0.029	0.801	0.423	1.431	-0.088	-1.946	0.001	2.024
90%	0.009	30.368	-0.009	-0.206	0.031	1.304	0.005	0.147	-1.41E	-0.067
					PKR					
	C	**t-Stat**	**PSX(-1)**	**t-Stat**	**PKR(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR****	**t-Stat**
10%	-0.001	-20.650	-0.002	-5.839	-0.006	-4.335	-0.135	-3.429	3.14E	2.817
20%	0.001	-16.842	-0.163	-5.832	-0.045	-4.220	-0.006	-3.047	1.71E	2.768
30%	-6.91E	-12.683	-0.006	-3.465	-0.015	-1.710	0.000	-0.463	1.13E	0.360
40%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
50%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
60%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
70%	0.001	6.626	-0.005	-2.306	-0.013	-5.202	0.002	0.011	-1.54E	-2.505
80%	0.001	19.931	-0.006	-1.895	-0.183	-8.909	0.013	1.694	-3.24E	-1.547
90%	0.001	21.045	0.000	0.182	-0.032	-16.744	0.018	10.702	-4.42E	-7.743

COVID-19 denotes the intercept dummy of the COVID-19 and provides information whether before COVID-19 and during COVID-19 returns of PSX is same or change. The coefficient of COVID-19 is statistically significant at 0.1 and 0.7 quartile and the value of the coefficient is -0.341 and -0.082 which shows that the return of PSX is decreased during COVID-19 as compare to the pre COVID-19. In Table 4.4.1 INTR* represent the interactive dummy of COVID-19 and PKR(-1) associated with PSX. On the basis of reported results INTR* is statistically significant at 0.1,0.7 and 0.8 quantile with a positive coefficient which denotes that during and before COVID-19 returns of PSX are the change that is predicted due to PKR(-1) or this provides information that during COVID-19 PKR(-1) cause

the change in the returns of the PSX differently (increase or decrease) as compare to pre-COVID-19 period. According to the estimated results coefficient of INTR* is positive at 0.1,0.7 and 0.8 but shows decreasing pattern.

After explaining the empirical results with respect to PSX Table 4.4.1 also contains the results of all exogenous variables with respect to PKR. PSX (-1) shows the significant negative impact on the return of the PKR at conditional quartiles of 0.1,0.2,0.3 and 0.7 while at the rest of the conditional quantiles the impact of PSX(-1) is statistically insignificant. However, the estimated results of PKR(-1) in Table shows that the existence of a very significant and strong negative association between PKR(-1) and PKR at lower and upper quartiles which means that the previous day return of PKR (-1) impact the PKR returns. COVID provides information related to the impact of COVID-19 on the returns of the PKR and the impact of COVID is statistically significant at 0.1,0.2,0.7 and 0.9 conditional quartiles along with the positive coefficient at 0.1 and 0.2 quartile and negative coefficient at 0.7 and 0.9 quatiles.

The significant value of COVID shows that the return of the PKR is impacted by the COVID-19 which leads towards a change in the return of the PKR in the pre-covid and during the COVID-19 time period. Based on the reported results the positive coefficient shows that during COVID-19 returns of the PKR are more than the before COVID-19 and vice-versa. In order to provide IV and DV links, an interactive dummy is computed between COVID-19 and PSX(-1) with PKR. The empirical results show that the existence of impact of slope dummy at lower and upper quartiles and the magnitude of slope dummy relationship with PKR is negligible but still statistically significant which means that during COVID-19 change in the return of PSX(-1) caused an increase in the PKR returns.

In Table 4.4.2 empirical results of BIST and TYR are reported in order to explain the impact of COVID-19 on the stock exchange market and exchange rate market. Firstly, computed results of all exogenous variables on the dependent variable are reported which is BIST and the next section of the Table contains information related to the estimated results of the TYR along with its predictors. According to the computed results of Table 4.4.2 TYR (-1) shows a statistically significant

relationship with BIST at the lower quartiles but at 0.4 and higher quartiles, the relationship between TYR (-1) and BIST becomes statistically insignificant. The coefficient of TYR (-1) is negative and shows decreasing trend because at 0.1 the value of TYR(-1) coefficient is -0.132 and at 0.3 it becomes -0.044 which provides information between the dependencies of the TYR(-1) and BIST. Therefore, lag returns of the TYR(-1) impact the current return of the stock exchange (BIST) returns. BIST(-1) have a statistically significant coefficient with BIST at the 0.8 and 0.9 quartiles and the coefficient value of BIST(-1) is negative which means that previous return of stock exchange market (BIST) cause decrease in the today's return of BIST.

COVID represents the intercept dummy and captures the impact of COVID on the BIST returns that whether pre-covid and during covid how much change in the returns of BIST occur due to the COVID-19 pandemic. On the basis of results reported in Table 4.4.2 impact of intercept dummy (COVID) is statistically insignificant at all quartiles which means before COVID-19 and during Covid-19 returns of BIST is same. INTR* represents the slope dummy between the Covid and TYR(-1) with BIST. INTR* is computed in order to estimate the IV and DV link before COVID and during the COVID-19 pandemic. The coefficient value of the interactive dummy is statistically in-significant at all quartiles.

In the next section of the table computed results of BIST (-1), TYR (-1), COVID, and INTR** with respect to TYR are reported in order to explain the impact of all exogenous variables at the exchange rate market represented by TYR. In Table 4.4.2 the coefficient value of BIST(-1) is statistically significant at lower quartiles from 0.1 to 0.4 and at 0.9 but with negative sign. The negative sign shows that increase in the value of BIST(-1) cause decrease in the current period price of TYR. Moreover, according to the estimated results TYR(-1) is statistically significant at all quartiles from 0.1 to 0.9.The sign of the coefficient is negative from 0.1 to 0.6 quartile which indicates the existence of inverse relation and becomes positive at upper quartiles (0.7 to 0.9) which indicates that increase in TYR(-1) creates increase in positive returns of the current period.

COVID represents the intercept dummy of the COVID -19 and TYR in order

to compute the difference in the return of the TYR predicted by the COVID-19 dummy. The value of COVID is statistically significant at the lowermost quartiles which are 0.1 and at the uppermost quartiles which are 0.8 and 0.9 with a positive coefficient. The value of the coefficient of COVID at lower quartile is -0.019 and 0.025at 0.8 quartile and 0.026 at 0.9 conditional quartiles provide the information related to the magnitude of the increase in the return of TYR which is caused by the COVID-19. INTR** represents the slope dummy in order to estimate the dependencies between the exogenous and endogenous variables. According to the represented results in Table 4.4.2 INTR** is statistically significant at the 0.1,0.2,0.8 and 0.9 quartiles which tell us that during COVID-19 returns of the TYR firstly increase at 0.1,0.2 at lower quartiles and then decrease at upper quartile due to the change in the returns of the BIST(-1).

TABLE 4.4.2: Lead lag Relationship between Equity and Currencies markets across Quantile in Turkey

					BIST					
	C	**t-Stat**	**TYR(-1)**	**t-Stat**	**BIST(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR***	**t-Stat**
10%	-0.013	-30.203	-0.132	-2.348	0.073	1.608	-0.215	-0.288	0.031	0.293
20%	-0.005	-16.645	-0.117	-2.109	0.030	1.041	-0.049	-1.139	0.007	1.221
30%	-0.001	-13.343	-0.044	-2.075	-0.008	-1.022	-0.006	-0.737	0.001	0.819
40%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
50%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
60%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
70%	0.002	8.379	0.020	1.909	-27.000	-1.424	-0.045	-1.741	0.006	1.794
80%	0.007	20.650	-0.004	-0.442	-0.074	-3.684	0.042	0.217	-0.006	-0.214
90%	0.013	36.654	0.009	0.272	-0.134	-5.471	0.067	0.645	-0.009	0.621
					TYR					
	C	**t-Stat**	**BIST(-1)**	**t-Stat**	**TYR(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR****	**t-Stat**
10%	-0.006	-29.139	-0.058	-2.271	-0.165	-17.994	-0.019	-1.961	2.10E	2.371
20%	-0.003	-20.441	-0.075	-2.804	-0.145	-13.308	-0.014	-3.149	1.44E	3.758
30%	-0.001	-12.280	-0.054	-3.210	-0.120	-11.598	0.001	0.775	1.88E	1.13E
40%	-0.001	-3.909	-0.024	-2.164	-0.080	-7.750	0.001	-0.079	3.34E	0.194
50%	0.001	0.001	-0.011	-1.019	-0.076	-6.990	0.001	0.627	-9.14E	-0.482
60%	0.001	7.359	-0.005	-0.469	-0.083	-7.796	0.007	1.796	-6.69E	-1.745
70%	0.001	11.672	0.001	0.022	-0.128	-9.989	0.016	1.501	-1.44E	-1.558
80%	0.003	20.330	0.019	0.496	-0.175	-15.114	0.025	6.782	-2.35E	-7.253
90%	0.007	28.007	0.035	7.023	-0.205	-11.771	0.026	3.106	-2.63E	-3.441

Quantile regression is used to estimate the impact of the COVID-19 pandemic on the exchange rate market and stock market of the Japan at lower and upper quartiles. Because quantile regression enables to capture of the appropriate dependencies between the independent and dependent variable at different conditional quartiles. In this backdrop, the Table 4.4.3 represents the estimated results of the

stock exchange and exchange rate market represent by NIKKIE and JPY of Japan. Table 4.4.3 consists of two sections in order to provide the exact picture of the impact of COVID-19 on the stock exchange and exchange rate market. Firstly all results related to the impact of all independent variables on NIKKIE are reported and then in the second section of the impact of all independent variables which are NIKKIE(-1), JPY(-1), COVID, and INTR** is represented on the exogenous variable which is JPY.

In the first section of Table 4.4.3, NIKKIE is the dependent variable while the remaining all variables are independent variables. JPY(-1) is statistically signifcant at all quartiles from 0.1 to 0.9 with a positive coefficient which provides evidence that change in the previous day returns of the exchange rate represents as the JPY(-1) impact positively in the current day returns of the NIKKIE(stock market). NIKKIE(-1) represents the returns of the previous day and is computed in order to estimate that whether previous day returns impact the current day returns of the NIKKIE. According to the results reported in the Table 4.4.3 the NIKKIE(-1) is statistically significant at the 0.2, 0.3, 0.7,0.8, and 0.9 quartiles. The sign of the coefficient of NIKKIE(-1) is negative which means that increase in the previous day price creates decrease in the current price of NIKKIE. After estimating the impact of JPY(-1) and NIKKIE(-1) on NIKKIE, further intercept and slope dummy is computed in order to estimate the impact of COVID-19 on the link between the stock market and currency market of Japan.

In this backdrop, COVID represents the intercept dummy which is statistically insignificant at all lower and upper quartiles. Therefore, this provides information that during COVID-19 and before COVID-19 returns of the NIKKIE are same or COVID-19 does not impact the returns of the NIKKIE. After estimating the impact of COVID-19 on the returns of NIKKIE another type of dummy which is interactive dummy is estimated by taking the product of COVID-19 with JPY(-1) and regressed at all quartiles on NIKKIE for exploring the link/relationship between NIKKIE and JPY(-1) during and before COVID-19. On the basis of estimated results in Table 4.4.3 the coefficient of INTR* is statistically insignificant at all quartiles because the t-statistic is less than 1.96 which means that during

COVID-19 and before COVID-19 JPY(-1) does not impact the current returns of the NIKKIE.

TABLE 4.4.3: Lead lag Relationship between Equity and Currencies markets across Quantile in Japan

					NIKKIE					
	C	**t-Stat**	**JPY(-1)**	**t-Stat**	**NIKKIE(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR***	**t-Stat**
10%	-0.010	-20.537	0.763	9.983	-0.030	-0.605	-0.374	-0.732	0.003	0.715
20%	-0.004	-14.121	0.674	11.237	-0.053	-2.617	-0.140	-1.281	0.001	1.254
30%	0.001	-11.743	0.000	13.560	0.001	-3.981	0.360	-0.914	0.364	0.907
40%	0.001	0.001	0.585	12.213	0.001	0.001	0.001	0.001	0.001	0.001
50%	0.001	0.001	0.585	11.959	0.001	0.001	0.001	0.001	0.001	0.001
60%	0.001	0.001	0.593	12.743	0.001	0.001	0.001	0.001	0.001	0.001
70%	0.002	10.866	0.641	13.401	-0.077	-5.633	0.021	0.384	0.000	-0.371
80%	0.005	19.575	0.689	17.402	-0.119	-6.754	0.005	0.078	-3.840	-0.062
90%	0.011	28.492	0.744	18.693	-0.138	-4.349	-0.301	-0.890	0.002	0.911
					JPY					
	C	**t-Stat**	**NIKKIE(-1)**	**t-Stat**	**JPY(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR****	**t-Stat**
10%	-0.005	-25.005	-0.009	-0.178	0.034	1.104	0.001	0.164	-1.200	-0.253
20%	-0.002	-16.891	-0.101	-4.982	0.023	1.297	-0.001	-0.353	6.190	0.332
30%	0.001	-7.495	-0.069	-3.701	0.014	2.074	-0.003	-0.504	1.330	0.432
40%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
50%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
60%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
70%	0.001	9.017	-0.740	-4.738	0.010	1.801	0.005	1.753	-2.550	-1.881
80%	0.002	20.407	-0.087	-6.421	0.007	0.629	0.014	2.071	-6.880	-2.271
90%	0.005	28.832	-0.066	-2.911	0.005	0.294	0.024	4.650	-1.160	-4.783

In the second section of the Table 4.4.3 estimated results of the Quantile regression are reported of the JPY and all independent variables. C denotes the intercept of the Quantile regression and it is statistically significant at all quartiles. NIKKIE(-1) has a statistically significant relation with JPR at 0.2,0.3,0.7,0.8 and 0.9 conditional quartiles.The estimated results of NIKKIE (-1) show that incraese in NIKKIE(-1) cause decrease in the current return of the JPY. The Table 4.4.3 shows that JPY(-1) is statistically significant at 0.3 conditional quartile because the t-statistic is greater than 1.96.

However, the relationship between JPY(-1) and JPY becomes statistically insignificant at all remaining lower and upper quartiles demonstrating that the previous day return of JYP(-1) has no impact on the current day returns of the JPY. COVID represents the estimated results of the intercept dummy which is computed in order to measure the impact of COVID-19 on the relationship between the stock market and the currency market of Japan. The coefficient value of COVID is statistically insignificant at upper and lower quartiles which means that before COVID-19 and during COVID-19 returns of the JPY are same or COVID-19 does not impact the

return of the JPY. After, the intercept dummy, the slope dummy is computed in order to provide information related to the IV and DV link. The coefficient of INTR** is statistically insignificant at all upper and lower conditional quartiles which demonstrate that during COVID-19 lag return of the NIKKIE(-1) does not impact the current return of the JPY.

In Table 4.4.4 represent the computed results of the stock exchange market (SET) and currency market (THB) of Thailand. The first section of the Table 4.4.4 represents the information related to the impact of COVID-19 and the currency market on the stock exchange market (SET). The coefficient value of the THB(-1) is statistically insignificant at all quartiles because the t-statistic is less than 1.96 which means that lag returns of the THB(-1) have not impacted the current return of the SET. SET(-1) denotes the lag return of the SET impact on the current period returns of the SET. The coefficient value of the SET(-1) is statistically significant at 0.7,0.8 and 0.9 quartiles with a negative coefficient of 0.001 which means that a 1% increase in SET(-1) will leads towards decrease in the current period return of the SET of 0.07%.

COVID captures the impact of COVID-19 on the current day return of the SET. The coefficient value of the COVID is statistically insignificant at 0.1 to 0.6 because the t-statistic is less than 1.96 but at 0.7 to 0.9 quartiles the coefficient value of COVID-19 I statistically significant with negative values which are -0.077, -0.156 and -0.236.The negative sign of coefficient denotes that during COVID-19 returns of the SET decreased before COVID-19 period. INTR* denotes the interactive dummy Quantile regression which demonstrates that during COVID-19 change in the previous day returns of the THB(-1) cause change in the returns of the SET differently as compare to the before COVID-19 pandemic. The coefficient value of the INTR* is statistically significant at 0.7 to 0.9 quartiles and shows increasing pattern in the values of coefficient while at the remaining lower quartiles the impact of the slope dummy is statistically insignificant. The sign of the INTR* coefficient is positive which means that during COVID-19 lag returns of the THB(-1) impact the current returns of the SET positively as compared to the returns of the before COVID-19.

TABLE 4.4.4: Lead lag Relationship between Equity and Currencies markets across Quantile in Thailand

					SET					
	C	**t-Stat**	**THB(-1)**	**t-Stat**	**SET(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR***	**t-Stat**
10%	-0.007	-21.735	0.009	0.251	0.075	1.438	-0.015	-0.353	0.001	0.149
20%	-0.003	-13.181	-0.030	-1.371	0.029	1.229	-0.063	-0.697	0.001	0.669
30%	0.001	-8.544	-0.009	-1.105	-0.011	-1.870	-0.038	-1.742	0.001	1.745
40%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
50%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
60%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
70%	0.001	8.889	-0.029	-1.279	-0.071	-4.185	-0.077	-3.105	0.002	3.082
80%	0.004	20.643	0.007	0.328	-0.072	-4.371	-0.156	-4.467	0.005	4.423
90%	0.008	28.870	0.018	0.758	-0.109	-3.866	-0.236	-6.459	0.007	6.422
					THB					
	C	**t-Stat**	**SET(-1)**	**t-Stat**	**THB(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR****	**t-Stat**
10%	-0.003	-20.815	-0.182	-6.142	-0.051	-5.899	-0.005	-1.924	4.57E	2.333
20%	-0.001	-18.927	-0.147	-4.878	-0.037	-3.953	-0.005	-1.510	3.70E	1.504
30%	0.001	-10.905	-0.124	-6.523	-0.029	-4.657	-0.003	-0.925	2.29E	0.969
40%	-5.57E	-4.090	-0.090	-4.278	-0.022	-4.582	0.001	-0.980	5.91E	0.941
50%	0.001	0.001	-0.088	-4.175	-0.021	-4.242	0.001	0.001	0.001	0.001
60%	0.001	5.427	-0.097	-4.683	-0.022	-4.321	0.001	-0.689	4.90E	0.706
70%	0.001	9.016	-0.171	-7.440	-0.042	-4.303	0.001	0.538	-9.13E	-0.411
80%	0.002	17.642	-0.255	-12.769	-0.062	-4.889	0.002	1.028	-0.04E	-1.054
90%	0.005	12.387	-0.419	-13.001	-0.084	-2.480	0.005	1.694	-4.80E	-2.039

In the second section of Table 4.4.4, the coefficient value of SET(-1)is statistically significant at all quartiles because t-statistic is greater than 1.96. The sign of the SET(-1) coefficient is negative which provides information regarding the significant negative impact of the SET(-1) on the current day returns of THB.THB(-1) shows the statistically significant impact on the current day return of the THB at all conditional quartiles with negative coefficient values. The magnitude of the coefficient is -0.0051 at 0.1 quratile which means that an increase in 1% of the THB(-1) creates decrease of 0.1% in THB current day return. COVID represents the intercept dummy and is computed in order to estimate the change in the current return of the THB caused due to the COVID-19. The coefficient of the COVID is statistically insignificant at all conditional quartiles which provides information that during COVID-19 and before COVID-19 returns of the THB are same. INTR** represents the link between exogenous variables and endogenous variables. The coefficient of INTR** is statistically significant at lowermost quartiles with a positive sign and uppermost quartiles with negative sign which demonstrates that during COVID-19 change in the lag return of the SET impact negatively current period returns of the currency market (THB) or during COVID-19 period returns

of the THB are decreased due to increase in the SET as compare to the before COVID-19 returns of the THB predicted due to change in the SET(-1).

Table 4.4.5 depict the estimated results of the impact of COVID-19 on the South Korean stock exchange (KOPSI) and South Korean won (KRW). On the basis of the Table 4.4.5, it is deduced that the quantile regression model is able to describe and estimate describe and the dependencies between exogenous and endogenous variables appropriately. The estimated results show that the KRW (-1) impact on the KOPSI is statistically significant at the 0.1 and 0.6 quartiles and with negative coefficient which means that the previous day's return of KRW (-1) causes a change in the current return of the KOPSI. At conditional quartiles of 0.1 and 0.6, the coefficient of KRW(-1) is negative and decreasing which means that increase in the lag return of the KRW(-1) causes decline in the current period return of KOPSI.

In Table 4.4.5 KOPSI(-1) represent the lag return of the Korea Stock Exchange which is statistically insignificant at all quartiles except 0.1, 0.7,0.8 and 0.9. The coefficient value of the KOPSI(-1) is statistically negative with increasing trend which demonstrates that KOPSI(-1) is inversely related with current period return of the KOPSI. COVID-19 denotes the intercept dummy of the COVID-19 and KOPSI which provides information about the difference in the KOPSI. The coefficient of COVID-19 is statistically significant at 0. 8 quartile and the value of the coefficient is -0.825 which shows that the return of KOPSI is decreased by -0.825 during COVID-19 as compare to the pre COVID-19 and COVIID-19 impacts the daily returns of the KOPSI. In Table 4.4.5 INTR* represent the interactive dummy of COVID-19 and KRW(-1) associated with KOPSI. On the basis of reported results INTR* is statistically significant at 0.8 quantile with a positive coefficient which denotes that during and before COVID-19 returns of KOPSI are the change that is predicted due to KRW(-1) or this provides information that during COVID-19 KRW(-1) cause the change in the returns of the KOPSI differently (increase or decrease) as compare to pre-COVID-19 period.

After explaining the empirical results with respect to KOPSI Table 4.4.5 also contains the results of all exogenous variables with respect to KRW. KOPSI (-1) shows the significant impact on the return of the KRW at all of conditional

quartiles (0.1,0.2,0.3,0.4,0.5,0.6,0.7,0.8). However, the estimated results of KRW(-1) in Table shows that the existence of a very significant and strong negative association between KRW(-1) and KRW at lower and upper quartiles which means that the previous day return of KRW (-1) impact the KRW returns. COVID provides information related to the impact of COVID-19 on the returns of the KRW and the impact of COVID is statistically significant at 0.8 and coefficient value is -0.285 at 0.8 conditional quartiles along with the positive coefficient.

TABLE 4.4.5: Lead lag Relationship between Equity and Currencies markets across Quantile in South Korea

					KOPSI					
	C	**t-Stat**	**KRW(-1)**	**t-Stat**	**KOPSI(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR***	**t-Stat**
10%	-0.008	-24.395	-0.072	-2.067	0.112	3.239	-0.082	-0.105	5.92E	0.090
20%	-0.003	-15.489	-0.008	-0.245	0.024	0.546	-0.125	-1.059	0.000	1.039
30%	0.001	-14.492	-0.011	-1.219	-0.009	-2.404	-1.190	4.57E	1.197	0.001
40%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
50%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
60%	2.68E	9.71E	-2.23E	-2.99E	-3.63E	-8.16E	-0.011	-1.206	9.53E	1.231
70%	0.001	6.878	0.005	0.357	-0.047	-3.642	-0.134	-1.823	0.000	1.820
80%	0.004	19.163	-0.014	-0.436	-0.095	-3.072	-0.285	-5.276	0.000	5.227
90%	0.008	30.855	-0.007	-0.295	-0.120	-2.974	-0.310	-1.135	0.000	1.169
					KRW					
	C	**t-Stat**	**KOPSI(-1)**	**t-Stat**	**KRW(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR****	**t-Stat**
10%	0.005	-28.056	-0.209	-4.052	-0.151	-7.563	-0.013	-1.567	6.76E	1.687
20%	-0.002	-20.026	-0.153	-7.232	-0.138	-12.155	0.001	-0.158	5.32E	0.189
30%	-0.001	-11.626	-0.119	-7.363	-0.104	-8.369	-0.004	-1.095	2.05E	1.626
40%	0.001	-5.939	-0.083	-5.353	-0.068	-5.967	0.000	0.242	-1.81E	-0.193
50%	0.001	0.001	-0.081	-5.108	-0.066	-5.634	4.83E	2.48E	-6.80E	-7.14E
60%	0.001	5.693	-0.085	-5.536	-0.068	-5.796	0.001	-0.436	4.19E	0.442
70%	0.001	11.281	-0.140	-6.827	-0.117	-8.119	0.001	-0.033	1.62E	0.043
80%	0.003	20.505	-0.227	-9.964	-0.173	-14.357	0.013	3.152	-6.51E	-3.148
90%	0.006	23.089	-0.309	-14.116	-0.186	-7.898	0.016	1.656	-8.01E	-1.581

The significant value of COVID shows that the return of the KRW is impacted by the COVID-19 which leads towards a change in the return of the KRW in the pre-covid and during the COVID-19 time period. Based on the reported results the positive coefficient shows that during COVID-19 returns of the KRW are more than the before COVID-19. In order to provide IV and DV links, an interactive dummy is computed between COVID-19 and KOPSI(-1) with KRW. The empirical results show that the existence of impact of slope dummy at (0.8) upper quartiles and the magnitude of slope dummy relationship with KRW is negligible but still statistically significant which means that during COVID-19 change in the return of KOPSI(-1) caused an increase in the KRW returns.

Table 4.4.6 represents the estimated results of the impact of COVID-19 on the

JKSE and IDR. On the basis of the Table, 4.4.6 it is deduced that the quantile regression model is able to describe and estimate describe and the dependencies between exogenous and endogenous variables appropriately. The estimated results show that the IDR (-1) impact on the JKSE is statistically significant at the 0.1 to 0.3, 0.7, and 0.9 quartiles and negative which means that the previous day's return of IDR (-1) causes a change in the current return of the JKSE. At conditional quartiles of mentioned quartiles the coefficient of IDR(-1) is negative which means that increase in the lag return of the IDR(-1) causes decrease in the JKSE return. In Table JKSE(-1) represent the lag return of the JKSE which is statistically significant at 0.1,0.7, and 0.9 quartiles except 0.2, 0.3,0.4,0.5,0.6, and 0.8.

The coefficient of the JKSE(-1) is positive at 0.1 quartile and negative at 0.7 and 0.9 quartile which means that lag return of JKSE(-1) causes increase initially and than decrease in the return of the JKSE. COVID-19 denotes the intercept dummy of the COVID-19 and provides information whether before COVID-19 and during COVID-19 returns of JKSE is same or change. The coefficient of COVID-19 is statistically significant at 0.1 quartile and the value of the coefficient is 0.090 which shows that the return of JKSE is increased during COVID-19 as compare to the pre COVID-19.

In Table 4.4.6 INTR* represent the interactive dummy of COVID-19 and IDR(-1) associated with JKSE. On the basis of reported results INTR* is statistically significant at 0.1 quantile with a negative coefficient which denotes that during and before COVID-19 returns of JKSE are the change that is predicted due to IDR(-1) or this provides information that during COVID-19 IDR(-1) cause the change in the returns of the JKSE differently (increase or decrease) as compare to pre-COVID-19 period. According to the estimated results coefficient of INTR* is negative and shows decreasing pattern.

After explaining the empirical results with respect to JKSE Table 4.4.6 also contains the results of all exogenous variables with respect to IDR. JKSE (-1) shows the significant negative impact on the return of the IDR at conditional quartiles of 0.1,0.2,0.3, 0.7, 0.8, and 0.9 while at the rest of the conditional quantiles the impact of JKSE(-1) is statistically insignificant. However, the estimated results of

IDR(-1) in Table shows that the existence of a significant and positive association between IDR(-1) and IDR at 0.3 quartile which means that the previous day return of IDR (-1) positive impact the IDR returns at 3rd quartile. COVID provides information related to the impact of COVID-19 on the returns of the IDR and the impact of COVID is statistically significant at 0.1,0.7 and 0.9 conditional quartiles along with the negative coefficient at 0.1 and 0.7 quartile and positive coefficient at 0.9 quartile.

TABLE 4.4.6: Lead lag Relationship between Equity and Currencies markets across Quantile in Indonesia

					JKSE					
	C	**t-Stat**	**IDR(-1)**	**t-Stat**	**JKSE(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR***	**t-Stat**
10%	-0.008	-23.613	-0.135	-9.340	0.116	3.285	0.090	2.150	-6.28E	-2.361
20%	-0.003	-14.976	-0.243	-5.931	0.040	1.439	0.001	0.052	-3.78E	-0.280
30%	0.001	-9.675	-0.036	-2.609	0.002	0.396	-0.010	-0.464	6.56E	0.451
40%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
50%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
60%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
70%	0.001	10.410	-0.096	-2.568	-0.043	-2.335	-0.029	-1.282	2.06E	1.231
80%	0.004	23.061	-0.142	-1.920	-0.059	-1.902	-0.080	-1.447	5.63E	1.443
90%	0.008	24.883	-0.093	-2.220	-0.066	-2.120	-0.136	-0.949	9.76E	0.962
					IDR					
	C	**t-Stat**	**JKSE(-1)**	**t-Stat**	**IDR(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR****	**t-Stat**
10%	-0.003	-19.158	-0.108	-5.367	-0.016	-1.112	-0.037	-7.356	1.72E	6.574
20%	-0.001	-14.116	-0.070	-7.134	-0.004	-0.388	-0.006	-1.073	3.14E	0.988
30%	0.001	-8.361	-0.040	-3.192	0.001	-8.361	-0.002	-0.878	1.21E	0.833
40%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
50%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
60%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
70%	0.001	6.794	-0.035	-2.284	-0.004	-0.509	-0.002	-2.284	1.56E	1.386
80%	0.001	17.677	-0.070	-2.608	-0.021	-1.417	0.001	0.354	-3.19E	-0.166
90%	0.003	27.945	-0.091	-3.285	-0.028	-1.744	0.003	5.922	-1.44E	-5.296

The significant value of COVID shows that the return of the IDR is impacted by the COVID-19 which leads towards a change in the return of the IDR in the pre-covid and during the COVID-19 time period. Based on the reported results the positive coefficient shows that during COVID-19 returns of the IDR are more than the before COVID-19 and vice-versa.In order to provide IV and DV links, an interactive dummy is computed between COVID-19 and JKSE(-1) with IDR. The empirical results show that the existence of impact of slope dummy at lower and upper quartiles and the magnitude of slope dummy relationship with IDR is negligible but still statistically significant which means that during COVID-19 change in the return of JKSE(-1) caused an increase in the IDR returns.

In Table 4.4.7 empirical results of SSE and CNY are reported in order to explain the impact of COVID-19 on the stock exchange market and exchange rate market. Firstly, computed results of all exogenous variables on the dependent variable are reported which is SSE and the next section of the Table contains information related to the estimated results of the CNY along with its predictors. According to the computed results of Table 4.4.7 CNY (-1) shows a statistically significant relationship with SSE at the lower quartile at 0.1 only, the relationship between CNY (-1) and SSE becomes statistically insignificant. The coefficient of CNY (-1) is negative and shows decreasing trend because at 0.1 the value of CNY(-1) coefficient is -0.481 which provides information between the dependencies of the CNY(-1) and SSE.

Therefore, lag returns of the CNY(-1) impact the current return of the stock exchange (SSE) returns. SSE(-1) have a statistically significant coefficient with SSE at all quartiles and the coefficient values of SSE(-1) is negative which means that previous return of stock exchange market (SSE) cause decrease in the today's return of SSE. COVID represents the intercept dummy and captures the impact of COVID on the SSE returns that whether pre-covid and during covid how much change in the returns of SSE occur due to the COVID-19 pandemic. On the basis of results reported in Table 4.4.7 impact of intercept dummy (COVID) is statistically in significant at 0.1,0.2, and 0.8 all quartiles which means during COVID returns of SSE decreased. INTR* represents the slope dummy between the Covid and CNY(-1) with SSE. INTR* is computed in order to estimate the IV and DV link before COVID and during the COVID-19 pandemic. The coefficient value of the interactive dummy is statistically significant at 0.1, 0.2 and 0.8 quartiles with positive coefficient sign which shows an increasing trend.

In the next section of the table computed results of SSE(-1), CNY(-1), COVID, and INTR** with respect to CNY are reported in order to explain the impact of all exogenous variables at the exchange rate market represented by CNY. In Table 4.4.7 the coefficient value of SSE(-1) is statistically significant at lower quartiles from 0.1,0.2,0.3 and at upper quartile 0.7 and 0.8. The impact of the SSE(-1) is decreasing at the lower quartiles then at upper quartiles impact of SSE(-1) increases

and becomes -0.046 which demonstrates that the previous day's return of SSE(-1) and negative coefficient cause decrease in the current day return of the CNY. Moreover, according to the estimated results CNY(-1) is statistically significant at 0.3 only with a positive coefficient of 0.001. COVID represents the intercept dummy of the COVID -19 and CNY in order to compute the difference in the return of the CNY predicted by the COVID-19 dummy. The value of COVID is statistically insignificant at the all quartiles except 0.9 with a positive coefficient. The values of the coefficient of COVID are 0.005 at 0.9 conditional quartile provide the information related to the magnitude of the increase in the return of CNY which is caused by the COVID-19. INTR** represents the slope dummy in order to estimate the dependencies between the exogenous and endogenous variables. According to the represented results in Table 4.4.7 INTR** is statistically significant at 0.9 quartile only which tell us that during COVID-19 returns of the CNY decrease due to the change in the returns of the SSE(-1) because the coefficient of INTR** is -1.60E at 0.9 quartile.

TABLE 4.4.7: Lead lag Relationship between Equity and Currencies markets across Quantile in China

					SSE					
	C	**t-Stat**	**CNY(-1)**	**t-Stat**	**SSE(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR***	**t-Stat**
10%	-0.015	-32.977	-0.481	-2.698	-0.239	-9.894	-0.761	-6.138	0.108	6.130
20%	-0.001	-28.409	-0.191	-1.242	-0.256	-10.652	-0.436	-0.466	0.061	0.467
30%	-0.004	-22.342	-0.202	-1.747	-0.231	-10.492	-0.260	-2.296	0.037	2.307
40%	-0.002	-11.322	-0.070	-0.533	-0.216	-9.191	-0.090	-0.719	0.012	0.728
50%	0.001	1.008	0.030	0.234	-0.186	-7.891	0.021	0.150	-0.002	-0.143
60%	0.002	12.227	0.002	0.016	-0.204	-8.708	0.111	1.421	-0.015	-1.394
70%	0.001	22.156	-0.172	-1.035	-0.232	-11.143	0.086	0.855	-0.012	-0.831
80%	0.009	28.109	-0.022	-0.096	-0.261	-9.459	0.306	2.228	-0.042	-2.209
90%	0.015	32.274	-0.095	-0.388	-0.270	-11.429	-0.031	-0.222	0.004	0.240
					CNY					
	C	**t-Stat**	**SSE(-1)**	**t-Stat**	**CNY(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR****	**t-Stat**
10%	-0.001	-25.165	-0.087	-3.643	-0.002	-0.690	-0.001	-0.270	7.48E	0.184
20%	0.001	-16.604	-0.085	-4.370	0.000	0.142	-0.001	-0.381	1.32E	0.137
30%	0.001	-8.736	-0.001	-4.110	0.001	2.101	-0.001	-1.297	5.80E	1.335
40%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
50%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
60%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
70%	0.001	6.939	-0.046	-3.172	0.001	1.444	0.000	-0.057	3.53E	0.076
80%	0.001	18.502	-0.094	-4.928	0.001	0.750	0.002	0.493	-5.86E	-0.408
90%	0.001	21.155	-0.054	-1.877	0.005	1.052	0.005	3.305	-1.60E	-2.939

Table 4.4.8 represents the estimated results of the impact of COVID-19 on the SENSEX and INR. On the basis of the Table, 4.4.8 it is deduced that the quantile

regression model is able to describe and estimate describe and the dependencies between exogenous and endogenous variables appropriately. The estimated results show that the INR (-1) impact on the SENSEX is statistically significant at the Upper quartiles from 0.6 to 0.9 and positive which means that the previous day's return of INR (-1) causes an increase in the current return of the SENSEX. In Table SENSEX(-1) represent the lag return of the Indian Stock Exchange which is statistically significant for all quartiles. The coefficient of the SENSEX(-1) are negative but shows increasing trend which means that lag return of SENSEX(-1) causes decrease in the return of the SENSEX.

COVID-19 denotes the intercept dummy of the COVID-19 and provides information whether before COVID-19 and during COVID-19 returns of SENSEX is same or change. The coefficient of COVID-19 is statistically significant form 0.4 to 0.9 quartiles and the value of the coefficient are negative which shows that the return of SENSEX is decreased during COVID-19 as compare to the pre COVID-19. In Table 4.4.8 INTR* represent the interactive dummy of COVID-19 and INR(-1) associated with SENSEX.

On the basis of reported results INTR* is statistically significant at 0.4 to 0.9 quantiles with a positive coefficient which denotes that during and before COVID-19 returns of SENSEX are the change that is predicted due to INR(-1) or this provides information that during COVID-19 INR(-1) cause the change in the returns of the SENSEX differently (increase or decrease) as compare to pre-COVID-19 period. According to the estimated results coefficient of INTR* are positive and also shows increasing pattern.

After explaining the empirical results with respect to SENSEX Table 4.4.8 also contains the results of all exogenous variables with respect to INR. SENSEX (-1) shows the significant negative impact on the return of the INR at conditional quartiles of all quartiles. However, the estimated results of INR(-1) in Table shows that the existence of a very significant and strong negative association between INR(-1) and INR at all lower and upper quartiles which means that the previous day return of INR (-1) impact the INR returns. COVID provides information related to the impact of COVID-19 on the returns of the INR and the impact of

COVID is statistically significant at lower quartile 0.1,0.2 and upper quartile 0.9 conditional quartiles along with the positive coefficient at 0.9 quartile and negative coefficient at 0.2 and 0.2 quartiles.

The significant value of COVID shows that the return of the INR is impacted by the COVID-19 which leads towards a change in the return of the INR in the pre-covid and during the COVID-19 time period. Based on the reported results the positive coefficient shows that during COVID-19 returns of the INR are more than the before COVID-19 and vice-versa. In order to provide IV and DV links, an interactive dummy is computed between COVID-19 and SENSEX(-1) with INR. The empirical results show that the existence of impact of slope dummy at lower quartile 0.1, 02 and upper quartiles 0.9 and the magnitude of slope dummy relationship with INR is negligible but still statistically significant which means that during COVID-19 change in the return of SENSEX(-1) caused an increase in the INR returns.

TABLE 4.4.8: Lead lag Relationship between Equity and Currencies markets across Quantile in India

					SENSEX					
	C	**t-Stat**	**INR(-1)**	**t-Stat**	**SENSEX(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR***	**t-Stat**
10%	-0.014	-29.910	-0.119	-1.603	-0.215	-7.117	-0.146	-1.450	0.001	1.269
20%	-0.008	-29.615	-0.017	-0.346	-0.184	-5.890	0.052	0.600	0.001	-0.065
30%	-0.004	-18.665	0.007	0.178	-0.154	-7.073	-0.015	-0.241	0.001	0.222
40%	-0.001	-9.569	0.043	1.213	-0.143	-9.247	-0.115	-2.080	0.001	2.054
50%	0.001	1.695	0.062	1.854	-0.141	-8.363	-0.173	-4.275	0.002	4.252
60%	0.002	13.231	0.059	2.025	-0.157	-7.873	-0.211	-5.029	0.002	5.042
70%	0.005	24.356	0.073	2.937	-0.186	-8.963	-0.227	-6.517	0.003	6.567
80%	0.008	32.367	0.125	3.439	-0.211	-9.669	-0.284	-4.673	0.003	4.741
90%	0.014	35.018	0.169	6.767	-0.239	-12.052	-0.470	-8.925	0.006	8.999
					INR					
	C	**t-Stat**	**SENSEX(-1)**	**t-Stat**	**INR(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR****	**t-Stat**
10%	-0.006	-31.656	-0.261	-9.129	-0.084	-7.859	-0.020	-3.829	5.73E	4.103
20%	-0.003	-28.510	-0.228	-9.054	-0.077	-6.984	-0.077	-2.048	3.66E	2.031
30%	-0.002	-20.937	-0.221	-9.753	-0.075	-9.361	-0.004	-0.926	1.27E	0.831
40%	0.000	-10.246	-0.201	-9.332	-0.065	-8.534	-0.003	-0.802	1.09E	0.872
50%	9.72E	1.156	-0.190	-9.898	-0.069	-8.412	-0.001	-0.390	6.09E	0.595
60%	0.001	12.336	-0.204	-11.655	-0.073	-9.336	0.001	0.392	-3.64E	-0.341
70%	0.002	21.780	-0.208	-10.997	-0.070	-8.560	0.008	1.846	-2.040	-1.684
80%	0.004	29.397	-0.233	-10.078	-0.086	-8.443	0.006	1.099	-1.51E	-0.924
90%	0.006	36.734	-0.203	-6.680	-0.086	-6.038	0.023	5.570	-6.17E	-5.429

In Table 4.4.9 empirical results of TWI and TWD are reported in order to explain the impact of COVID-19 on the stock exchange market and exchange rate market. Firstly, computed results of all exogenous variables on the dependent variable are reported which is TWI and the next section of the Table contains information

related to the estimated results of the TWD along with its predictors. According to the computed results of Table 4.4.9 TWD (-1) shows a statistically significant relationship with TWI at the only 0.1 quartile, for the rest of quartiles relationship between TWD (-1) and TWI becomes statistically insignificant. The coefficient of TWD (-1) is positive and shows increasing trend because at 0.1 the value of TWD(-1) coefficient is 0.004 which provides information between the dependencies of the TWD(-1) and TWI. Therefore, lag returns of the TWD(-1) impact the current return of the stock exchange (TWI) returns. In Table TWI(-1) represent the lag return of the which is statistically significant for all quartiles. The coefficient of the TWD(-1) are negative but shows increasing trend which means that lag return of TWD(-1) causes decrease with increasing trend in the return of the TWD.

COVID represents the intercept dummy and captures the impact of COVID on the TWI returns that whether pre-covid and during covid how much change in the returns of TWI occur due to the COVID-19 pandemic. On the basis of results reported in Table 4.4.9 impact of intercept dummy (COVID) is statistically in significant at 0.2, 0.4, and 0.8 with positive for 2nd and 4th quartile and negative for 0.8 quartile which means during Covid-19 returns of TWI are effected. INTR* represents the slope dummy between the Covid and TWD(-1) with TWI. INTR* is computed in order to estimate the IV and DV link before COVID and during the COVID-19 pandemic. The coefficient value of the interactive dummy is statistically significant at 0.2, 0.4, and 0.8 quartile.

In the next section of the table computed results of TWI(-1), TWD(-1), COVID, and INTR** with respect to TWD are reported in order to explain the impact of all exogenous variables at the exchange rate market represented by TWD. In Table 4.4.9 the coefficient value of TWI(-1) is statistically in-significant for all quartiles. Moreover, according to the estimated results TWD(-1) is statistically significant at 0.4, 0.5 and 07 with a negative coefficient. COVID represents the intercept dummy of the COVID -19 and TWD in order to compute the difference in the return of the TWD predicted by the COVID-19 dummy. The value of COVID is statistically in-significant at all quartiles which mean COVID does not impact the TWD. INTR** represents the slope dummy in order to estimate the dependencies

between the exogenous and endogenous variables. According to the represented results in Table 4.4.9 INTR** is statistically insignificant for all quartiles.

TABLE 4.4.9: Lead lag Relationship between Equity and Currencies markets across Quantile in Taiwan

					TWI					
	C	**t-Stat**	**TWD(-1)**	**t-Stat**	**TWI(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR***	**t-Stat**
10%	-0.011	-33.930	0.004	7.296	-0.190	-5.905	0.369	0.797	-0.012	-0.799
20%	-0.006	-28.255	-0.002	-3.239	-0.218	-9.164	0.233	2.745	-0.007	-2.770
30%	-0.003	-18.544	-0.001	-1.162	-0.213	-8.028	0.057	0.700	-0.001	-0.707
40%	-0.001	-7.792	0.001	-0.390	-0.207	-8.544	0.168	2.573	-0.005	-2.563
50%	0.001	3.852	0.001	1.138	-0.216	-9.614	0.107	0.890	-0.003	-0.878
60%	0.002	15.864	0.001	1.210	-0.227	-13.388	-0.057	-0.701	0.001	0.724
70%	0.004	26.986	0.001	0.265	-0.248	-13.510	-0.116	-1.050	0.004	1.070
80%	0.007	35.270	0.001	-0.695	-0.281	-12.483	-0.216	-1.284	0.007	1.317
90%	0.011	36.775	0.001	-0.004	-0.287	-6.280	-0.343	-2.738	0.011	2.782
					TWD					
	C	**t-Stat**	**TWI(-1)**	**t-Stat**	**TWD(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR****	**t-Stat**
10%	-0.005	-6.099	-0.654	-0.797	-0.043	-0.637	-0.011	-1.236	1.04E	1.244
20%	-0.002	-20.168	-0.325	-0.919	-0.040	-1.946	-0.010	-1.396	8.73E	1.387
30%	-0.001	-9.430	-0.316	-1.034	-0.044	-1.653	-0.003	-0.283	2.40E	0.218
40%	0.000	-5.700	-0.296	-0.988	-0.037	-2.319	-0.001	-0.422	1.13E	0.312
50%	7.12E	1.305	-0.289	-0.933	-0.039	-2.684	0.001	0.151	-9.16E	-0.188
60%	0.001	6.265	-0.311	-0.604	-0.041	-1.768	0.001	-0.035	1.44E	0.053
70%	0.001	17.487	-0.312	-0.565	-0.051	-2.348	-0.001	-0.149	1.14E	0.128
80%	0.002	12.475	-0.339	-0.680	-0.044	-0.843	0.006	0.786	-6.01E	-0.734
90%	0.006	9.398	-0.387	-0.837	-0.034	-0.515	0.001	0.141	-3.05E	-0.291

Table 4.4.10 represents the estimated results of the impact of COVID-19 on the Kuala Lumpur Stock Exchange (KLSE) and Malaysian exchange rate (MYR). On the basis of the Table, 4.4.10 it is deduced that the quantile regression model is able to describe and estimate describe and the dependencies between exogenous and endogenous variables appropriately. The estimated results show that the MYR (-1) impact on the KLSE is statistically significant at the lower and upper quartiles and negative which means that the previous day's return of MYR (-1) causes a change in the current return of the KLSE. At conditional quartiles the coefficient of MYR(-1) is negative which means that increase in the lag return of the MYR(-1) causes decrease in the KLSE return. In Table KLSE(-1) represent the lag return of the Kuala Lumpur Stock Exchange which is statistically significant at 0.1 and 0.6 quartiles.

The coefficient of the KLSE(-1) is positive for first quartile and negative for sixth quartile but shows decreasing trend which means that lag return of KLSE(-1) causes increase and decrease respectively in the return of the KLSE. The coefficient

of COVID-19 is statistically significant at lower quartile (0.1 and 0.3) and Upper quartile with negative coefficient values which shows that the return of KLSE is decreased during COVID-19 as compare to the pre COVID-19.

In Table 4.4.10 INTR* represent the interactive dummy of COVID-19 and MYR(-1) associated with KLSE. On the basis of reported results INTR* is statistically significant at 0.3,0.7,0.8, and 0.9 quantile with a positive coefficient which denotes that during and before COVID-19 returns of KLSE are the change that is predicted due to MYR(-1) or this provides information that during COVID-19 MYR(-1) cause the change in the returns of the KLSE differently (increase or decrease) as compare to pre-COVID-19 period.

Table 4.4.10 of KLSE also contains the results of all exogenous variables with respect to MYR. KLSE (-1) shows the significant negative impact on the return of the MYR at all conditional quartiles. However, the estimated results of MYR(-1) in Table shows that the existence significant positive and significant negative association between MYR(-1) and MYR at 0.1 and 0.6 quartiles which means that the previous day return of MYR (-1) impact the MYR returns. COVID provides information related to the impact of COVID-19 on the returns of the MYR and the impact of COVID is statistically significant at all 9 conditional quartiles except 0.2 and 0.3, along with the negative coefficient at 0.1 quartile and negative coefficient for rest of quartiles.

The significant value of COVID shows that the return of the MYR is impacted by the COVID-19 which leads towards a change in the return of the MYR in the pre-covid and during the COVID-19 time period. Based on the reported results the positive coefficient shows that during COVID-19 returns of the MYR are more than the before COVID-19 and vice-versa.

In order to provide IV and DV links, an interactive dummy is computed between COVID-19 and KLSE(-1) with MYR. The empirical results show that the existence of impact of slope dummy at all quartiles except 0.2 and 0.3, the magnitude of slope dummy relationship with MYR is negligible but still statistically significant which means that during COVID-19 change in the return of KLSE(-1) caused an decrease in the MYR returns.

TABLE 4.4.10: Lead lag Relationship between Equity and Currencies markets across Quantile in Malaysia

					KLSE					
	C	**t-Stat**	**MYR(-1)**	**t-Stat**	**KLSE(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR***	**t-Stat**
10%	-0.004	-30.841	-0.090	-6.899	0.133	5.273	-0.045	-2.055	0.009	1.771
20%	-0.002	-15.311	-0.071	-5.640	0.057	1..618	-0.045	-0.633	0.010	0.593
30%	0.001	-12.142	-0.020	-4.274	0.002	0.295	-0.047	-3.394	0.011	3.413
40%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
50%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
60%	8.89E	4.877	-1.11E	-5.133	-3.33E	-7.400	-0.001	-0.500	0.000	0.518
70%	0.001	8.278	-0.042	-4.705	0.007	0.315	-0.076	-3.558	0.018	3.524
80%	0.002	19.630	-0.068	-6.594	0.001	0.065	-0.151	-7.417	0.036	7.324
90%	0.005	24.531	-0.070	-3.145	-0.016	-0.635	-0.225	-9.469	0.054	9.396
					MYR					
	C	**t-Stat**	**KLSE(-1)**	**t-Stat**	**MYR(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR****	**t-Stat**
10%	-0.006	-28.970	-0.232	-6.528	-0.033	-0.719	-0.061	-3.201	4.13E	3.314
20%	-0.003	-26.171	-0.213	-10.448	-0.054	-1.795	-0.009	-1.132	6.62E	1.269
30%	-0.001	-18.493	-0.190	-9.592	-0.048	-2.095	0.003	0.241	-1.51E	-0.182
40%	0.000	-9.444	-0.177	-11.576	-0.042	-2.497	0.013	2.433	-8.55E	-2.377
50%	8.88E	1.240	-0.178	-11.373	-0.036	-2.151	0.012	2.629	-8.45E	-2.590
60%	0.001	12.351	-0.195	-12.053	-0.046	-2.288	0.015	2.624	-1.06E	-2.658
70%	0.002	20.069	-0.217	-12.385	-0.048	-1.884	0.026	4.145	-1.80E	-4.272
80%	0.003	28.353	-0.259	-15.655	-0.059	-2.512	0.035	5.625	-2.37E	-5.852
90%	0.007	26.460	-0.336	-17.112	-0.068	-1.059	0.050	2.038	-3.46E	-2.151

In Table 4.4.11 empirical results of TAWADAL and SAR are reported in order to explain the impact of COVID-19 on the stock exchange market and exchange rate market. According to the computed results of Table 4.4.11 SAR (-1) shows a statistically significant relationship with TAWADAL at 0.4 quartile only, the rest of quartiles show the relationship between SAR (-1) and TAWADAL statistically insignificant. The coefficient of SAR (-1) is negative and shows decreasing trend because the value of SAR(-1) coefficient is -0.001 provides information between the dependencies of the SAR(-1) and TAWADAL. Therefore, lag returns of the SAR(-1) impact the current return of the stock exchange (TAWADAL) returns. TAWADAL(-1) have a statistically significant coefficient with TAWADAL at lower quartiles and the coefficient value of TAWADAL(-1) are positive which means that previous return of stock exchange market (TAWADAL) cause an increase in the today's return of TAWADAL.

On the basis of results reported in Table 4.4.11 impact of intercept dummy (COVID) is statistically in significant at lower and upper quartiles where negative coefficient has been recorded for lower and positive coefficients for upper quartiles. INTR* represents the slope dummy between the Covid and SAR(-1) with TAWADAL.

INTR* is computed in order to estimate the IV and DV link before COVID and during the COVID-19 pandemic. The coefficient value of the interactive dummy are statistically significant at lower and upper quantiles, which means that during COVID-19 change in the return of KLSE(-1) caused an increase initially and then decrease in the TAWADAL returns

TABLE 4.4.11: Lead lag Relationship between Equity and Currencies markets across Quantile in Saudi Arabia

	C	**t-Stat**	**SAR(-1)**	**t-Stat**	**TAW(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR***	**t-Stat**
10%	-0.007	-25.206	-0.001	-0.586	0.208	7.298	-0.037	-2.449	0.007	2.796
20%	-0.003	-15.191	-0.001	-0.635	0.107	5.648	-0.015	-3.154	0.002	3.697
30%	0.001	-12.107	-0.001	-2.485	0.020	2.218	0.000	-1.321	0.000	1.570
40%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
50%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
60%	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.983	0.000	-0.803
70%	0.001	8.791	-0.002	-1.232	0.001	0.075	0.015	3.269	-0.002	-3.218
80%	0.004	19.246	0.002	1.264	0.015	0.487	0.024	3.111	-0.004	-3.215
90%	0.008	27.160	-0.002	-0.715	-0.016	-0.524	0.037	4.526	-0.006	-3.984
	C	**t-Stat**	**TAW(-1)**	**t-Stat**	**SAR SAR(-1)**	**t-Stat**	**COVID**	**t-Stat**	**INTR****	**t-Stat**
10%	-0.067	-27.277	-0.316	-12.733	-0.296	-2.058	-0.303	-1.365	3.72E	1.103
20%	-0.036	-26.730	-0.235	-10.081	-0.103	-0.803	-0.233	-1.253	3.29E	1.275
30%	-0.020	-21.552	-0.203	-9.181	0.058	0.599	-0.057	-0.556	8.26E	0.570
40%	-0.010	-12.132	-0.189	-8.685	0.001	-0.004	0.022	0.190	-2.93E	-0.179
50%	0.001	0.001	-0.204	-8.588	0.001	0.001	0.043	0.337	-5.84E	-0.322
60%	0.011	11.525	-0.227	-10.379	-0.052	-0.623	-0.026	-0.236	5.20E	0.321
70%	0.024	22.408	-0.251	-12.156	-0.079	-0.636	0.100	0.558	-1.29E	-0.512
80%	0.040	29.443	-0.280	-11.888	0.030	0.173	0.245	1.407	-3.22E	-1.319
90%	0.068	35.915	-0.317	-12.356	-0.061	-0.311	0.528	4.608	-7.02E	-4.452

In the next section of the table computed results of TAWADAL(-1), SAR(-1), COVID, and INTR** with respect to SAR are reported in order to explain the impact of all exogenous variables at the exchange rate market represented by SAR. In Table 4.4.11 the coefficient value of TAWADAL(-1), shows the significant negative impact on the return of the SAR at all conditional quartiles. However, the estimated results of SAR(-1) in Table shows that the existence significant negative association between SAR(-1) and SAR at 0.1 quartile which means that the previous day return of MYR (-1) impact the MYR returns. The value of COVID is statistically significant at the uppermost quartile which is 0.9 with a positive coefficient. The values of the coefficient of COVID are 0.528 at 0.9 conditional quartile provide the information related to the magnitude of the increase in the return of SAR which is caused by the COVID-19. According to the represented results of slop dummy in Table 4.4.11 INTR** is statistically significant at the 0.9

quartile which tell us that during COVID-19 returns of the SAR decrease due to the change in the returns of the TAWADAL(-1) because the coefficient of INTR** is -7,02E at 0.9.

Chapter 5

Conclusion

5.1 Conclusion

The stock exchange and currency market are the most important parts of the country's financial system. The stock exchange market and currency market is considered as a barometer used for measuring the economic health of the country although major other economic indicators are also used for measuring the economic health of the country (Singh, 2015). Based upon the classical economic theory, prices of the stock market and exchange rate market interact with each other, and movement in the exchange rate cause movement in the stock price because appreciation and depreciation of currency impact the country's firm at all levels whether they are at domestic level or international level. Because, if the currency of the country is depreciated then it makes the products of the country more competitive in the international market and increase the sales of the country and increase the profitability of the firm's while simultaneously depreciation of the currency lead towards an increase in the cost of imported goods and increase the cost of goods sold of the firm (Luqman & Kouser, 2018).

Therefore, whether a firm becomes profitable due to depreciation of the currency or a decrease in the company's profit due to appreciation of currency this information and appreciation or depreciation of currency also impact other macroeconomic and investors factors which jointly impact are the prices and overall performance of the

stock market. On the other hand, empirical research also supports the Portfolio balanced approach that change in the stock prices/market leads towards change in the exchange rate market. Hence in the Asian financial crisis, 1997-1998 provides a strong under arching argument in order to explore and describe the relationship between stock prices and exchange rate due to significant sudden decrease in the intrinsic values of the currency or exchange rate and prices of the stock in the stock market.

Similarly, in the US sub-prime crisis the contagion impact of the stock exchange market on the capital markets or in the currency market and another example of the impact of exchange rate market on the stock market is related to the appreciation of the Indian Rupee which leads towards the decrease in the stock prices of the export-oriented firms listed on the stock exchange. Based upon the empirical results information technology and textile sectors firms are the major sectors whose stock prices are decreased due to exchange rate appreciation (Singh, 2015). Therefore, the relationship between the exchange market and the stock market is still not concluded due to the mixed results of the previous studies as they support both arguments that exchange rate market impact or lead the stock market or stock market lead /impact the exchange rate market (Akram, Malik, Imtiaz, & Aftab, 2020). In this backdrop, the objective of the study is to estimate the lead and lag relationship between the stock market and currency market and to provide insight into the behavior of the lead-lag relationship across multiple quartiles.

Moreover, the objective of the study also includes estimating the impact of COVID -19 on the stock market and currency market along with the impact of COVID-19 on the link between the stock market and currency market. To achieve the objective of the study the sample of this study consist of eleven Asian emerging and developing countries which are India, Pakistan, Malaysia, Indonesia, South Korea, Philippines, Saudi Arabia, Thailand, Turkey, China, and Taiwan. However, This study uses daily prices of equity markets and currencies of these countries for the period 1 January 2010, to 30 July 2020 for employing the empirical methodologies which are Johansen Cointegration and Quantile regression. In order to achieve the objective of the study, the analysis of this study is divided into two stages.

The first stage of the study is based on the first and second objectives of the study which is to estimate the lead-lag connection between currency and the stock market and provides insight into the lead-lag relation across quantiles. Johansen Cointegration test is used in order to achieve these two objectives. Therefore, for applying the Johansen Cointegration test firstly data ADF and PP test is applied on the data set of eleven Asian emerging countries which are India, Pakistan, Malaysia, Indonesia, South Korea, Philippines, Saudi Arabia, Thailand, Turkey, China, and Taiwan and estimated results are reported in the Table 4.2.1.

In pursuit of estimated results presented in Table 4.2.1 all series of the stock market and currency market becomes stationer at first-order difference except the series of the stock market and currency market of India, Turkey, and Taiwan therefore these series are dropped from the sample for estimating the relationship between the stock market and currency market. After, establishing the normality of Trace statistic and Max Eigenvalue is implemented in order to find out the presence of cointegration vectors. Table 4.2.3 and 4.2.4 shows the presence of the two cointegrating vectors between the series of stock market and exchange rate market of Pakistan, Japan, Thailand, South Korea, Indonesia, China, Malaysia, and Saudi Arabia which further leads towards estimation of the lead/lag relationship between the stock market and currency market by Granger Causality.

Table 4.2.3 represent the empirical results of pairwise Granger Causality between the stock market and currency market of Pakistan, Japan, Thailand, South Korea, Indonesia, China, Malaysia, and Saudi Arabia and conclude that a unidirectional relationship between the stock market and currency market exists in Pakistan which means PKR does not follow the PSX in long run. Moreover, a bidirectional relationship exists between the stock market and currency market of Japan, Thailand, Indonesia, South Korea, and Malaysia, and no unidirectional or bidirectional relationship exists between the stock and currency market of China and Saudi Arabia. Therefore, the stock and currency markets of China and Saudi Arabia are independent of each other.

The second stage of the study includes the estimation of the impact of COVID-19 on the stock market and exchange rate market. Quantile regression is used in order

to compute the impact of COVID-19 on the stock market and currency market and to find out the impact of COVID-19 on the link between the stock market and currency market. Therefore, for estimating the appropriate and accurate understanding of the impact on the relationship between the stock market and currency market intercept dummy and slope dummy is estimated of the stock market and currency market of Pakistan, Turkey, Japan, Thailand, South Korea, Indonesia, China, India, Taiwan, Malaysia, and Saudi Arabia. Based upon the estimated results of Quantile regression each table is divided into two sections.

The first section consists of the estimated results with respect to the stock market of the selected country and the second section of the table consist of the results of the impact of all exogenous variables on the currency market.Based upon the estimated results of Quantile regression lag of currency market impact the current stock market returns of the country Turkey, Japan, Indonesia, India, Malaysia, and Thailand at upper lower and upper higher quartiles except Pakistan, Taiwan, South Korea, China and Saudi Arabia. Lag returns of the stock market impact the current period return of currency market in Pakistan, Turkey, Japan, Thailand, South Korea China, Indonesia, Malaysia and India at lower and upper quartiles except for Pakistan, Taiwan, South Korea, China and Saudi Arabia.

On the basis of computed results intercept dummy COVID for Pakistan, Thailand, China, India, Taiwan, Malaysia, and Saudi Riyal is statistically significant mostly at the lower and upper quartiles which means that during COVID-19 returns of the stock market and exchange rate market of all seven Asian countries are different as compared to the returns earned by the investors in the currency market and stock market before COVID-19. Interactive dummy INTR* is statistically significant for Pakistan, Turkey, Thailand, South Korea, Indonesia, China, India, Malaysia, and Saudi riyal in lower and upper quartiles.

5.2 Recommendations

Based on the current study on revisiting quantiles granger causality between stock price indices and exchange rate in Asian countries following recommendations are

concluding which are related to its implication in multiple dimensions such as an investors, policymaker, and for the academic researcher.

1. Based upon the results of Granger Causality which confirms that no long-run cointegration exists between China and Saudi Arabia because both series are independent in long run. So, it is recommended based on the results of Johansen Cointegration that Investors can invest in the stock market and currency market to exploit investment opportunities. Moreover, a unidirectional relationship exists between PSX and PKR in which PKR does not follow PSX. So, it is recommended that investors can construct their portfolio by allocating their resources to PSX and PKR simultaneously because PKR is not impacted by the shock in the PSX.

2. However, empirical findings presented in Table 4.3 shows that long-run bi-directional relationship significantly exists between the stock market and currency market of Japan, Thailand, Indonesia, South Korea, and Malaysia. So, it is recommended based upon the results of Granger Causality that investors should carefully allocate resources by considering the macro environment and microenvironment factors in the stock market and currency market of Japan, Thailand, Indonesia, South Korea, and Malaysia simultaneously.

3. Empirical results of Intercept dummy COVID and interactive show that during COVID-19 returns of the stock market and currency market is less than the returns of the stock and currency markets at lower and upper quartiles of the Quantile regression in Pakistan, Turkey, Japan, Thailand, South Korea, Indonesia, China, India, Taiwan, and Malaysia and Saudi Arabia. So, it is recommended, based upon the results of Quantile regression investors can earn more profits by designing their investment and trading strategies more efficiently and effectively.

4. Finally, regulatory authorities of Japan, Thailand, Indonesia, South Korea, and Malaysia can also use the outcomes of the study for attracting foreign

investors, designing the strategies of macro stabilization and monetary policies. Moreover, the academic researcher can extend the time frame of the sample of the study in order to find out the impact of COVID-19 on the stock market and currency market more accurately.

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