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Dynamics of Volatility Spillover and Connectedness Among Sectors of Indian Stock Market

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Abstract

This paper investigates the dynamic volatility spillover and connectedness among sectors of Indian stock market during Covid-19. The study considered 19 sectors which are listed in National Stock Exchange and used Diebold Yilmaz Volatility spillover model and Baunik and Krehlik frequency connectedness methodology to investigate the time varying dynamics of the spillover during the turbulence period of Covid-19. Daily market prices of 19 sectors from 15 March 2019 to 28/02/2022 was considered in the present study. From the results it is found that the spillover from sector Infra, Commodities, Services, MNC, Oil & Gas, Financial Services, Private Bank, Energy, and PSE is more and this clearly indicates that during the pandemic these sectors have mostly spillover their effect to other sectors.

Keywords: Spillover, Covid-19, Frequency Connectedness

1. Introduction

Onset of Covid-19 pandamic crippled down every aspect of life. Infact Covid has increased the need for an effective operating model by different sectors to meet the changing patterns during the turbulence period and to remain agile and productive. This type of turbulence situations requires robust and resilient strategies by the sectors to ensure compliance to address the complexities and to strengthen their resilience for their long-term sustenance. Economic booms, cyclical stocks become an appealing destination given their high price sensitivity to business cycle fluctuations. In this regard, a good understanding of the origins and magnitude of shocks across equity sectors is essential to enhance the ability of market participants to achieve their main financial goals while minimizing risk. As such, informed investors can optimize their decision-making regarding portfolio diversification while considering the information transmission among equity sectors and the effect of the disaster risk related to COVID-19 (Shahzad et al., 2021).

A study by (Nayak et al., 2022) highlighted about the impact of COVID-19 epidemic on various industrial sectors such as automobile, energy and power, agriculture, education, travel and tourism and consumer electronics. During the pandemic period many industries were affected. This is clearly evident from findings of many researchers. According to one of the study by(Gandhi & Gandhi, 2020) that even though the pharmaceutical sector had some problems they are still growing and television and online media and

entertainment are growing in the entertainment sector. The aviation sector had been hit very badly. The tourism and hospitality sector has been hit the worst.

The current pandemic of COVID-19 has disrupted every aspect of life from groceries to medicines, travel to events, sports to funerals, economics to politics and religion to social rights. (Baber, n.d.) examined the effect of this crisis on the financial market, banking, hospitality, and health care. Their findings shows that the pandemic has shown a substantial and extended negative impact on the global economy, especially on the financial and hospitality industry. (Sahoo, 2021) highlights key policy measures to control the possible fallout in the economy. (Anguera-Torrell et al., 2021)estimate how the 20 world-largest and publicly listed hotel companies' stock market returns reacted to the pandemic evolution and to the different public sector economic measures across the different countries they operate using regression techniques. The main contribution of(Gandhi & Gandhi, 2020) is to analyze the impact of COVID-19 on the Indian Economy and these 4 sectors. (Allan et al., 2021)utilize timely proprietary data to examine the contemporary impact of the COVID-19 pandemic on commercial property rent dynamics in the Asia–Pacific region. (Mizik, 2021) analyze the performance of the Hungarian agri-food sector during the last three crises based on international and Hungarian datasets. (Damara UTOMO & Hanggraeni, 2021) use fixed-effects panel-data regression method to evaluate the impact of the growth in COVID-19 total confirmed cases and death as well as the lockdown policies on daily stock returns of 272 firms that are listed on the Indonesia Stock Exchange's main board and operate in the real sector from 2 March 2020 to 27 November 2020. (Fu & Shen, 2020) find that COVID-19 has had a significant negative effect on the performance of energy companies. (Sansa, 2020) apply a Simple regression model to investigate the impact of the COVID - 19 on the Financial Markets during the period from dated 1st March 2020 to 25th March 2020 in China and the USA. The research provides some urgent and prominent insights to help investors and policymakers avoid the risks in the crude oil and stock markets because of the COVID-19 pandemic and reestablish economic development policy strategies (Zhang et al., 2021). (Anguera-Torrell et al., 2021) estimate how the 20 world-largest and publicly listed hotel companies' stock market returns reacted to the pandemic evolution and to the different public sector economic measures across the different countries they operate using regression techniques. (Arslan et al., 2021) aim to synthesize the findings of the studies that have explored the impact of the COVID-19 pandemic on stock markets to identify the research progress and the research trends in this contemporary literature through a bibliometric and systematic review. (Hasan et al., 2021)examine the effect of the COVID-19 pandemic on global economic activity, the stock market, and the energy sector considering the sizable damaging impacts in these crucial aspects. (Tan et al., 2022) investigate the effect of different categories of essential COVID-19 data from 2020 to 2021 towards stock price dynamics and options markets.

(Qarni et al., 2019) investigate the volatility spillover dynamics between U.S. Bitcoin and financial markets from July 19, 2010 to December 29, 2017. (Nakajima & Toyoshima, 2019) examine spillovers among the North American, European, and Asia–Pacific natural gas markets based on daily data. (Trabelsi, 2019) aim to investigate the connectedness of Islamic Stock Markets in five regional financial systems, namely, the United States, the United Kingdom, Europe (EU), GCC (Gulf Cooperation Council) and APAC (Asia-Pacific Countries), and across different asset classes (i.e. bonds, gold and crude oil). (Li et al., 2020) examine the risk connectedness across seven cryptocurrencies, Bitcoin, Ethereum, Ripple, Litecoin, Stellar, Monero, and Dash, which have large capitalizations in the cryptocurrency market. (Geng et al., 2020) explore dynamic information connectedness effects between natural gas markets, uncertainties and stock markets in the North American and European regions for high- and low-frequency bands using the time-frequency connectedness network model.

Without an efficient financial risk management, it may cause massive consequences to a financial institution as well as individual. Therefore, developing a methodology which gives precise estimates to reduce the exposure of risk to a minimum is of great importance. (Baruník & Křehlík, 2018) proposed a new framework for measuring connectedness among financial variables that arise due to heterogeneous frequency responses to shocks. To estimate connectedness in short-, medium-, and long-term financial cycles, they introduced a framework based on the spectral representation of variance decompositions. Their study used an asymmetric BEKK-GARCH model to examine the return and volatility linkages between the FTSE Bursa Malaysia Emas Shariah(FBMS)index and the sectoral indices under a normal market.(Yahya et al., 2019) investigate the temporal and frequency domain connectedness between the price of crude oil and ten major agricultural commodities. Their findings suggested that the FBMS plays a leading role in the mean return spillover effect. There is a strong evidence of significant transmission of past shocks, volatilities and leverage effects are observed on the current conditional variance-covariance in all the pair-wise models. (Ng et al., 2017). Research studies have also investigated the impact of COVID-19 on the volatility of stock prices in India with the help of a generalized autoregressive conditional heteroscedasticity model. The study attempted to make a comparison of stock price return in pre-COVID-19 and during COVID-19 situation. Findings reveal that the stock market in India has experienced volatility during the pandemic period. While comparing the result during COVID period with that of the pre-COVID, they found that the return on the indices is higher in the pre-COVID-19 period than during COVID-19.(Bora & Basistha, 2021).

A study by the Song examined the return and volatility connectedness between the rare earth stock market and clean energy markets, world equity, base metals, gold, and crude oil, a Time-Varying Parameter Vector Auto Regression (TVP-VAR) approach to connectedness was applied to uncover the dynamics of connectedness during the entire period and the COVID-19 pandemic period. (Song et al., 2021). A study (Toyoshima & Hamori, 2018) analyzed return and volatility spillovers across global crude oil markets using an empirical technique from the time and frequency domains to capture the effect of major events during the Asian currency crisis (1997-1998) and the global financial crisis (2007-2008) which has caused a rise in the total connectedness of returns and volatility. The empirical literature largely finds that stock market volatility responds more to negative shocks ("bad news") than to positive shocks ("good news"). Thus, both operating and financial leverages cause firms to be riskier and to have higher volatility when stock prices decline(Gajurel, 2021).

A study conducted by Ahmed found that apart from automobiles and cement, all other sectors listed on the KSE provide good diversification opportunities. From their study the Granger causality test proved that cement, chemical and banking cause most other sectors uni-directionally, while oil and gas, biotechnology and pharmasceutical, textiles and electricity are caused by most other sectors.(Ahmed et al., 2017). To study the market risk evaluation between Malaysian Islamic stock index and sectoral indices used the daily closing price indices of FTSE Bursa Malaysia Emas Shariah Index(FBMS), Kuala Lumpur Composite Index (KLCI) and ten Malaysian financial sectoral indices, namely construction(CON), consumer product (CSU), finance (FIN), industrial(IND), plantation (PLN), product (PRO), properties (PRP),trade and service (SER), technology (TEC) and tin and mining(TIN) markets in Bursa Malaysia. (Ng et al., 2017). (Cui et al., 2020) study underlined and emphasized that besides, the major international crisis events, such as the global financial crisis, oil price collapse, and the COVID-19 pandemic have greatly intensified the risk spillover magnitude. They investigated the time-frequency dependence and risk connectedness among oil and stock markets in oil-importing and oil-exporting countries using the wavelet coherence and BK frequency connectedness method. With the help of these two methods they captured the dynamics of the dependence and risk connectedness over time as well as across different frequency bands (i.e. 1∼5 days, 5∼22 days, and more than 22 days). A study conducted by(Hasan

et al., 2021) examined the effect of the COVID-19 pandemic on global economic activity, the stock market, and the energy sector considering the sizable damaging impacts in these crucial aspects. Their findings enhanced the understanding of the spillover impacts of the global health crisis on economic activity, the stock market, and the energy sector. Another study conducted by (Xia et al., 2020) examined the dynamic characteristics of information spillover effect among economic policy uncertainty (EPU), stock and housing markets in China's first-, second- and third-tier cities. To measure return and volatility spillovers over time and across frequencies simultaneously, the researchers utilize the time-frequency connectedness network approach developed by Barunik and Křehlik (2018). The empirical findings suggest that return and volatility spillovers are stronger in the longer period (more than 3months) than in the shorter period (1 to 3months). In the short term, second and third-tier cities are net transmitters of information spillovers, while in the long term, first-tier cities, EPU, and stock markets are the net information transmitters.

(Kouki et al., 2011) in their study investigated volatility spillover for five sectors name Bankin,financial service, Industrial, real estate and oil between international stock markets using VAR-BEKK model. The study found a strong integration of the industrial sector of the markets in terms of volatility. Therefore investors have to take account of information risk from all markets in their portfolio decision. (Naeem & Suleman, 2021) studied the assymetric and time frequency spillover among commodities using high frequency data. (Shahzad et al., 2021, p. 19) studied volatility spillover among Chinees sectors during covid-19 found that the bad volatility spillover shocks dominate good volatility spillover shocks and helps their study for investors and portfolio managers constructing risk hedging portfolios across sectors and for Chinees policy makers maintaining and crafting stimulating policies for the stock market at the sectoral level.

2. Need for the study

The above literature provided a comprehensive body of knowledge on how different markets interact over time and with the different methodologies adopted at different periods. However, most of the studies have not covered wide range of works how different sectors within the markets interact during the turbulence/crisis periods instead focused on the entire markets. Further, existing research has not widely touched upon more recent period particularly the COVID pandemic period. Hence, in the present study the researcher covered 18 sectors along with Nifty-50 index within the Indian market during the COVID pandemic period from 15th March 2019 to 15th February 2022 covering almost the entire Pandemic Phase. Thus the study provides an opportunity to examine dynamics of spillover and connectedness among sectors during the pandemic crisis period. The study employed DCC-GARCH and Diebold Yelmaz for spillover and frequency connectedness and used further the Barunik and Krehlik(2018) time frequency connectedness network approach to find out the spillover effect in short, medium and long term under different frequency bands.

3. Data and Methodology

The present study analyses the impact of Covid-19 on Nifty -50stcok index which is a proxy for Indian stock market and different sector indexes of 19 sectors i.e., Bank, Private Bank, Pharma, Financial Services, Oil &Gas, PSE, Auto, MNC, Reality, Media, Commodities, Metal, Infra, Energy, Services and FMCG Sector indexes. Daily closing prices of these indexes from 15/03/2019 to 28/02/2022 were considered and log returns from this calculated and used for the present study. Accordingly 730 observations collected from investing.com were used in the study. Descriptive statistics and statistical properties of the daily logarithmic returns of the sector indexes under the study are presented in Table No.1. The average returns of all the sector indexes are negative except the Media Index. The highest standard deviation is reported in the Sectors Commodities, Public Sector Banks, Metal, Reality, Media and Private Bank during the study period. Excess Kurtosis is seen in almost all the sectors, while positive skewness ranging from 0.004 to 1.647 is observed in the study. Jarque- Bera Test

results are significant at one per cent level for all the series and Augmented Dicky Fuller test results shown that all the return series are stationary.

4. Results and Discussion

Table No.2 Depicts the results of Dynamic Conditional Correlation among the different sectors of Indian stock market during the pandemic period. The study applied DCC GARCH to evaluate the volatility and co-volatility dynamics between the Nifty 50 and Sector Indexes of Indian Stock market. The table shows clearly the interaction among the sectors. From the table 'mu' indicates the overall mean while 'omega' is the intercept term. Alpha in the table measures the volatility impact for short term and Beta measures the long term impact of the shock on conditional correlation. From the table it is crystal clear that both short and long term volatility impact is observed in all the sectors.

ARCH-LM test confirms the clustering effect in the volatility of sample series in the study, hence the Asymmetric Dynamic Conditional Correlation (DCC-GARCH) model is used to find out the association between the sectors and Nifty-50. ARCH and GARCH terms of all the stock indexes are significant. Hence it indicates the persistence in volatility. The sum of ARCH and GARCH coefficients is less than one for all the sectors. It indicates that there is a decay in volatility persistence over time. It is also observed from the results that the volatility decay is slower in all the sectors, as the sum of ARCH and GARCH co-efficient of sectors of Bank (0.97), Private Bank (0.97), Financial Services (0.97), Oil& Gas (0.97), PSE (0.93), Auto (0.95), MNC (0.95), Public Sector Bank (0.937), IT (0.948), Reality (0.91), Commodities (0.96), Metal (0.96), Infra (0.935), Energy (0.929), Services (0.97), FMCG (0.95) while the decay is fast in the sectors Pharma and Media as the sum of the co-efficient is 0.88. and 0.89 respectively.

Further the table explains the combined ARCH and GARCH through DCC-GARCH model. The combined effect is reflected in the dcca1 and dccb1 in the same table. It is clear that both the values are positive and significant. From this results, it is clearly inferred that there is an integration and asymmetry affect from NIFTY50 to all the sectors. However, to find out the frequency connectedness among sectors the study used the Diebold Yelmaz model.

The study measured the connectedness of different sectors during the pandemic using the Diebold Yelmaz frequency connectedness. Table No.3 shows the results of the returns connectedness of Nifty50 with other sector indexes and vice-versa. The connectedness is also studied using the Generalized Forecast Error Variance Decomposition(GFEVD) model. GFEVD generated a 19X19 matrix which as shown in the Table no.3. The numbers in each row of the matrix 19X19 reflects the total variation in returns in per cent for each Sector Index explained by its own variance and the variances of the other 19 sector indexes selected in the present study during the pandemic period. Similarly, the number of each column shows the contribution of each sector on the other 19 sectors including its own variance.

From the table it is very clear that the overall connectedness among sectors during the study period(pandemic) is 87.51. It clearly indicates the returns among the different sectors are more closely connected with other. The table further depicts that the spillover received by the different sectors from other sectors is noticeably more or less ranging in between 4.13 to 4.94 across the sectors, while spillover to the other sectors are different across the sectors. Spillover to other sectors from sectors Commodities (6.55), Infra (6.55), Services (6.51), MNC (5.98), Oil A&Gas (5.95), Financial Services(5.68), Private Bank(5.55), PSE(5.09) is comparatively high. It is

also supported from the net spillover results from the table. This clearly indicates that during the pandemic these sectors have mostly spillover their effect to other sectors and are termed as dominant sectors.

While the pair-wise connectedness shows clearly that Services Sector is closely connected with Financial Services (10.32%)than its own connected per cent of 10.11%, while the financial sector to service sector the per cent of connectedness is (9.32%) . Energy Sector is connected highly with PSE (9.14%) while PSE to Energy is(8.81%). Commodities Sector is highly connected with Metal Sector (10.17% than its own connected per cent of (9.79%), while the Metal Sector to Commodities sector connectivity is(7.8%). The sector MNC is highly connected with FMCG (10.23%) while FMCG is connected with MNC with7.72%. Financial sector with Private Bank is connected with 10.61% while PVT bank connected with Financial Services with 10.36% in the study.

Many changes took place during the period from 2019March 15 to February 2022. Frequency connectedness table has explained about the (strong and weak) connectedness among the different sectors during the period. Though spillover index provided useful insights about the connectivity among the different sectors during the study period, it has missed out some potential movements (Gain/Fall) in spillover. In order to capture this, the present study further used 100 day rolling window plot which is shown in the Figure.No:1.

From the Figure No.1 it is clear that the volatility spillover plot started falling from 85% from March 15 2019 due to exit polls and their results of 2019 General Elections. With several cycles the spillover plot reached to bottom low of 70% by September 2019 due to FPI surcharge roll back and relief measures undertaken to ease the US-China trade. Then slowly gained and reached to 83% with news driven by Union Budget for the Financial year 2020 followed by the news of global breakdown due to corona Virus Pandemic a day before the budget. Upto this period of time the volatility spillover plot fluctuated between 75 to 85% but however, the spillover far exceeded the 95% mark by the end of March 2020 and up to June second week due to the COVID-19 pandemic .Then immediately with the positive news about the Union Budget announcement by the Finance Minister, the plot had sudden fall from 95% to 78% by February 2021. Then once again the plot started slowly climbed upto 88% due to the global breakdown and rise in COVID cases, however with cyclical fluctuations from then reached to almost 88% high due to the New corona virus strain by the end of November 2021. From then there was a continuous rise in the spillover plot due to rise in daily COVID-19 cases, speculation of complete lockdown in the State of Maharashtra, inflation concerns and increasing geographical tensions and rising of the inflations by the second week of February 2022. Then with the news of withdrawal of troops from Ukraine boarder, the spillover plot reached to 80% and once again reached to almost 94%with the Russian Invasion of Ukraine by 24thFebrauray 2022.

Overall spillover table indicates the time frequency spill over results for returns across the different sectors. However, Short term, medium term and long term spillover results based on Barunik and Krehlik are placed in Table Nos.4,5,6 to understand the frequency connectedness at different time spans among the sectors of Indian Stock market during the pandemic period.

Table No.4 indicates the frequency connectedness roughly corresponds to a time frame of 1 to 4 days(short term), Table No.5 indicates time frame from 4 to 10 days (medium term) and Table No.6 shows the results corresponds to 10 to infinity (long term). Values in the 'FROM' and 'TO' in the able indicates the strength of spillover effect from the sectors to that specific sector, and 'to' indicated to spillover to other sectors from that specific sector. Values under 'ABS' and 'WITH' indicates the 'absolute' and 'within' from the table.

From 'abs' is the measure of frequency connectedness in absolute sense and From 'with' is the measure of within connectedness. From the tables, it is found that the overall spillover ranges from 87.39 to 88.01% at different frequency bands. It is also observed that as the frequency band increases, the total connectedness strengthened in the study period.

Overall spillover table shows clearly that the sectors Commodities, Infra were the high spillover sectors to others followed by Serices, MNC and Oil&Gas sectors. Almost the Sector Infra continued to give the spillover in the small term followed by Commodities, Services and MNC. However in the medium and long term OIL&Gas Sector which was almost in fourth and sixth position in giving the spillover effect to others has become the highest spillover giving sector in both medium and long term (10days to Infinity days). Interestingly, the Service Sector retained its position and almost continued as second highest sector throughout the different frequency brands.

Commodities sector changed its position in Short, Medium, Long term as second, fourth and third positions respectively. Surprisingly though the Infra sector was the highest spillover to other sectors in the overall spillover and in the short term periods, it become the third highest in the medium term period but its position has been replaced by Commodities sector in the long term period , hence it become the fourth highest sector in spreading the spillover in the long term period.

From the above discussion it is very evident that the Infra, Oil&Gas, Services and Commodities are the sectors contributed highly the spillover to other sectors during the study period. Very interesting results are found from the study that generally, the sectors own spillover per cent will be high compared to the spillover effect received from other sectors. However, the sectors, Commodities own connectedness is (9.79%), while connectedness with Metal Sectors is (10.17%) in overall connected spillover, as well in short, medium and long term spillover bands. Its connectedness with sector Metal is high in overall spillover, medium term, long term and short term respectively. Similarly, Service Sectors own connectedness is lower than its pairwise connectedness with Financial Services in overll, small,medium and long term periods. In the same way results in medium and long term spillover band table results shows that the sectors Financial Services and Private Banks own connectedness is less than their pairwise connectedness with Sector 'Bank'. Throughout the analysis 'Pharma' Sector results shown that it is the sector which has highest in its own per cent connectedness compared to other sectors in the study.

Pair wise connectedness clearly shows that in the short term Commodities sector is highly connected with metal, and PSE with (7.56%) and (7.19%) respectively. Almost their pair wise connected scores are same in short, medium and long term. Similarly, the Metal Sector is highly connected with the Commodities Sector in short, medium and long term. However, the PSE is connected highly with Energy, Metal in short and medium respectively but highly connected with Metal Sector in the long run. Infra and Commodities sectors are highly connected in short and energy in the medium and long term. Oil & Gas are highly connected with Financial Services in the short and medium term but highly connected with Bank sector in the long term. The sector Services is well connected with the Financial Services, Private Bank in the short and medium while highly connected with sector Bank in the long term. Sector Commodities is highly connected with Metal and PSE in short, medium and long term during the study, where as MNC sector is highly connected with FMCG in short, medium and long term as well. In a nutshell, it is found out that these are the sectors highly in spillover the effect to other sectors during the pandemic period in the study.

5. Conclusion

Impact of Covid-19 had not left any industry, however the intensity of impact of covid-19 varies from industry to industry. Some industries were directly impacted while some were indirectly impacted. Majority of the

literature explored about the impact of Covid on different sectors. Review of literature explored had highlighted the spill over from one market to the other market so as to understand the diversification of investors portfolios. However, there were no studies explored the spillover among the different sectors with in the market during the crisis periods like the Pandemic. Hence the present study considered it as a gap and attempted to explore the spillover among the different sectors in Indian capital market during the pandemic time. The study focuss to identify the sectors which are more resilient during the turbulence time and will guide the investors and the decision makers to adopt different strategies to sustain in such turbulence perods.

Study found that all the observations considered for the study shown the ARCH effect and were further tested with Standardized GARCH model. Then results shown clearly that volatility decay is slower in all the sectors considered for the study where as the volatility decay is fast in the sector Media. Further the results show that there is an integration and asymmetry found in the short as well as long run as the results of dcca1 and dccb1 are significant at one percent level.

The study attempted even to find out the frequency connectedness with the help of Dibol Yelmaz overall spillover index. From the results it is found that the spillover from sector Infra, Commodities, Services, MNC,Oil&Gas, Financial Services, Private Bank, Eenergy, and PSE is more and this clearly indicates that during the pandemic these sectors have mostly spillover their effect to other sectors.

As infrastructure sector in India remained as a growth driver, due to labour exodus, liquidity problems and stalling the projects, paranoia among human stakeholders affected more during the study period, however slowly it has regained from the problems. The same has been found from our study where the Infrastructure Sector had remained the dominant sector in terms of giving the spillover effect in overall spillover, however it has changed its positions from one to fourth in different. From the study, it is found that the financial services and energy sectors are one of the dominant sectors in spreading the spillover to other sectors in the Indian context during our study period. These findings are also in line with the work done by(Hasan et al., 2021) where the study found that compared to economic activity, the financial markets and energy sectors are more sensitive to the Covid-19 crisis. Similarly the service sector was another sector which was effected as stated by (Gandhi & Gandhi, 2020)the same has been found from the study that the service sector is also one of the dominant sector in spreading its effects to other sectors during the study period. Furthermore the Financial Sector turned out to be dominant sector by giving its effect to other sectors in the study. The same is observed from the net spillover percentages in the short term, while in the medium term Financial services sectors had higher connectedness while the Private Bank net spillover is high in long term. The same is found out from the works of (Rao et al., 2021).

References

Ahmed, A., Malik, M. N., Awan, O. A., & Muzaffar, A. (2017). Sectoral Integration and Domestic Portfolio Diversification in the Karachi Stock Exchange. In *The Lahore Journal of Business* (Vol. 5, Issue 2, pp. 23–44).

Allan, R., Liusman, E., Lu, T., & Tsang, D. (2021). The COVID-19 Pandemic and Commercial Property Rent Dynamics. *Journal of Risk and Financial Management*, *14*(8), 360. https://doi.org/10.3390/jrfm14080360

Anguera-Torrell, O., Aznar-Alarcón, J. P., & Vives-Perez, J. (2021). COVID-19: Hotel industry response to the pandemic evolution and to the public sector economic measures. *Tourism Recreation Research*, *46*(2), 148–157. https://doi.org/10.1080/02508281.2020.1826225

Arslan, H., Bilal, & Bashir, M. (2021). *Contemporary research on spillover effects of COVID-19 in stock markets. A systematic and bibliometric review.* 9103. https://doi.org/10.3390/ecerph-3-09103

Baber, H. (n.d.). Spillover effect of COVID19 on the Global Economy-A review. In *Transnational Marketing Journal (TMJ)* (Vol. 8, Issue 2, pp. 177–196). https://www.bbc.com/news/world-asia-china-51403795

Baruník, J., & Křehlík, T. (2018). Measuring the frequency dynamics of financial connectedness and systemic risk. *Journal of Financial Econometrics*, *16*(2), 271–296. https://doi.org/10.1093/jjfinec/nby001

Bora, D., & Basistha, D. (2021). The outbreak of COVID-19 pandemic and its impact on stock market volatility: Evidence from a worst-affected economy. *Journal of Public Affairs*, *21*(4). https://doi.org/10.1002/pa.2623

Cui, J., Goh, M., Li, B., & Zou, H. (2020). Dynamic dependence and risk connectedness among oil and stock markets: New evidence from time-frequency domain perspectives. *Energy*. https://doi.org/10.1016/j.energy.2020.119302

Damara UTOMO, C., & Hanggraeni, D. (2021). The Impact of COVID-19 Pandemic on Stock Market Performance in Indonesia. *Journal of Asian Finance*, *8*(5), 777–0784. https://doi.org/10.13106/jafeb.2021.vol8.no5.0777

Fu, M., & Shen, H. (2020). COVID-19 and Corporate Performance in the Energy Industry. *Energy RESEARCH LETTERS*, *1*(1), 1–5. https://doi.org/10.46557/001c.12967

Gajurel, D. (2021). Asymmetric Volatility in the Nepalese Stock Market. *Journal of Comparative International Management*, *22*(1), 41–59. https://doi.org/10.7202/1075637ar

Gandhi, R., & Gandhi, S. (2020). Economic Impact of COVID-19 on Different Sectors in India. In *AIJR Preprints* (Vol. 122, Issue 1).

Geng, J.-B., Geng, J.-B., Xu, X.-Y., & Ji, Q. (2020). The time-frequency impacts of natural gas prices on US economic activity. *Energy*. https://doi.org/10.1016/j.energy.2020.118005

Hasan, M. B., Mahi, M., Sarker, T., & Amin, M. R. (2021). Spillovers of the COVID-19 Pandemic: Impact on Global Economic Activity, the Stock Market, and the Energy Sector. *Journal of Risk and Financial Management*, *14*(5), 200. https://doi.org/10.3390/jrfm14050200

Kouki, I., Harrathi, N., & Haque, M. (2011). A volatility spillover among sector index of international stock markets. *Journal of Money, Investment and Banking*, *22*, 32–45. Scopus.

Li, Z., Wang, Y., & Huang, Z. (2020). Risk Connectedness Heterogeneity in the Cryptocurrency Markets. *Frontiers in Physics*, *8*(July), 1–13. https://doi.org/10.3389/fphy.2020.00243

Mizik, T. (2021). The Performance of the Agri-food Sector in the Recent Economic Crisis and during Covid-19 Pandemic. *HighTech and Innovation Journal*, *2*(3), 168–178. https://doi.org/10.28991/hij-2021-02-03-02

Naeem, M., & Suleman, M. T. (2021). Quantifying the asymmetric spillovers in sustainable investments. *Journal of International Financial Markets, Institutions and Money*. https://doi.org/10.1016/j.intfin.2021.101480

Nakajima, T., & Toyoshima, Y. (2019). Measurement of connectedness and frequency dynamics in global natural gas markets. *Energies*, *12*(20), 1–15. https://doi.org/10.3390/en12203927

Nayak, J., Mishra, M., Naik, B., Swapnarekha, H., Cengiz, K., & Shanmuganathan, V. (2022). An impact study of COVID -19 on six different industries: Automobile, energy and power, agriculture, education, travel and tourism and consumer electronics. *Expert Systems*, *39*(3). https://doi.org/10.1111/exsy.12677

Ng, S. L., Chin, W. C., & Chong, L. L. (2017). Multivariate market risk evaluation between Malaysian Islamic stock index and sectoral indices. *Borsa Istanbul Review*, *17*(1), 49–61. https://doi.org/10.1016/j.bir.2016.09.002

Qarni, M. O., Gulzar, S., Fatima, S. T., Khan, M. J., & Shafi, K. (2019). Inter-markets volatility spillover in u.S. bitcoin and financial markets. *Journal of Business Economics and Management*, *20*(4), 694–714. https://doi.org/10.3846/jbem.2019.8316

Rao, P., Goyal, N., Kumar, S., Hassan, M. K., & Shahimi, S. (2021). Vulnerability of financial markets in India: The contagious effect of COVID-19. *Research in International Business and Finance*, *58*(April), 101462. https://doi.org/10.1016/j.ribaf.2021.101462

Sahoo, M. (2021). COVID -19 impact on stock market: Evidence from the Indian stock market. *Journal of Public Affairs*, *21*(4). https://doi.org/10.1002/pa.2621

Sansa, N. A. (2020). The Impact of the COVID-19 on the Financial Markets: Evidence from China and USA. *SSRN Electronic Journal*, *march 2020*. https://doi.org/10.2139/ssrn.3567901

Shahzad, S. J. H., Bouri, E., Kristoufek, L., & Saeed, T. (2021). Impact of the COVID-19 outbreak on the US equity sectors: Evidence from quantile return spillovers. *Financial Innovation*, *7*(1). https://doi.org/10.1186/s40854-021-00228-2

Song, Y., Bouri, E., Ghosh, S., & Kanjilal, K. (2021). Rare earth and financial markets: Dynamics of return and volatility connectedness around the COVID-19 outbreak. *Resources Policy*, *74*. https://doi.org/10.1016/j.resourpol.2021.102379

Tan, L. P., Sadiq, M., Aldeehani, T. M., Ehsanullah, S., Mutira, P., & Vu, H. M. (2022). How COVID-19 induced panic on stock price and green finance markets: Global economic recovery nexus from volatility dynamics. *Environmental Science and Pollution Research*, *29*(18), 26322–26335. https://doi.org/10.1007/s11356-021-17774-y

Toyoshima, Y., & Hamori, S. (2018). Measuring the time-frequency dynamics of return and volatility connectedness in global crude oil markets. *Energies*, *11*(11). https://doi.org/10.3390/en11112893

Trabelsi, N. (2019). Dynamic and frequency connectedness across Islamic stock indexes, bonds, crude oil and gold. *International Journal of Islamic and Middle Eastern Finance and Management*, *12*(3), 306–321. https://doi.org/10.1108/IMEFM-02-2018-0043

Xia, T., Yao, C.-X., & Geng, J.-B. (2020). Dynamic and frequency-domain spillover among economic policy uncertainty, stock and housing markets in China. *International Review of Financial Analysis*. https://doi.org/10.1016/j.irfa.2019.101427

Yahya, M., Oglend, A., & Dahl, R. E. (2019). Temporal and spectral dependence between crude oil and agricultural commodities: A wavelet-based copula approach. *ENERGY ECONOMICS*, *80*, 277–296. https://doi.org/10.1016/j.eneco.2019.01.011

Zhang, Q., Di, P., & Farnoosh, A. (2021). Study on the impacts of Shanghai crude oil futures on global oil market and oil industry based on VECM and DAG models. *ENERGY*, *223*. https://doi.org/10.1016/j.energy.2021.120050

Annexure
Table-1

Descriptive of the Sectoral Indices in the Present Study

	NIFTY	BANK	PVTBANK	PHARMA	FINSERVIC	OIL&GAS	PSE	AUTO	MNC	PSUBANK	IT	REALITY	MEDIA	COMMODITIES	METAL	INFRA	ENERGY	SERVICES	FMCG
MAN	-0.0005149	-0.0002682	-1.270e-04	-4.627e-04	-0.000044486	-0.0000527 5	-0.0001527	-0.0002913	-0.0004411	2.053e-04	-0.000 1066	-0.0007544	0.000030 06	-0.000 06467	-0.000 0922	-0.0000566 6	-0.0000563 5	-0.0000534 8	-0.0002333
MEDIAN	-0.0013421	-0.0000704 7	1.270e-05	-3.873e-05	-0.000128 18	-0.0001283 5	-0.0008559	-0.0005462	-0.0011140	-8.795e-05	-0.0014 65	-0.0021949	-0.000026 09	-0.000 17780	-0.000 1629	-0.0001501 6	-0.0001096 9	-0.0001073 9	-0.0007193
MIN	-0.0840029	-0.0002682	-1.049e-01	-9.865e-02	-0.089 1067	-0.0840030	-0.0742363	-0.0989966	-0.0754615	-1.020e-01	-0.0864 08	-0.0830252	-0.134 5096	-0.0. 327257	-0.0759 92	-0.0692837	-0.0828181	-0.0791265	-0.0799060
MAX	0.1390375	0.1831300	1.970e-01	9.351e-02	0.173 6226	0.1390376	0.1065763	0.1490552	0.1283727	1.411e-01	0.1006 54	0.1205235	0.108 9732	0.13 066603	0.1233 18	0.1283 60	0.1021 668	0.1467 593	0.1119 978
Std.dev	0.0142 6786	0.0199 389	0.0204 5166	0.0188 7905	0.0187 9055	0.0145 6997	0.0162 8386	0.0183 1414	0.0122 4085	0.0239 9917	0.0156 7036	0.0216 7024	0.021 5298	107 1.046	0.0217 175	0.0146 522	0.0156 626	0.0157 354	0.0120 2804
	1.4267 86	1.9938 9	2.0451 66	1.8879 05	1.8879 05	1.4569 97	1.6283 86	1.8314 14	1.2240 85	2.3999 17	1.5670 36	2.1670 24	2.152 98	107 104.6	2.1717 5	1.4652 2	1.5662 6	1.5735 4	1.2028 04

ADF	-8.3700	-8.13115	-8.11167	-8.49334	-8.19199	-8.33338	-8.00069	-7.48496	-8.7055	-7.81797	-8.58999	-8.27295	-7.78882	-8.24254	-8.5441	-8.22263	-7.79717	-8.16554	-9.37758
ARCH	220.74	152.59	148.75	109.84	169.2	220.77	172.46	120.15	163.98	83.368	232.5	71.176	80.463	191.76	125.54	228.18	288.48	208.66	208.15
SKEWNESS	1.6478895	1.1736404	1.2971986	0.0195 0846	1.3255 5592	1.6446 35	0.7020 838	0.5941 566	1.4770 22	0.4912 7	0.7016 832	0.6221 949	0.0048 8345	1.18038 2	0.6521 993	1.2283 44	0.6226 953	1.6620 59	0.5974 918
KURTOSIS*	18.458 81	13.148 72	15.245 19	6.555 4595	13.581 69	18.447 07	4.829 7707	9.923 9352	22.523 07	3.733 8892	7.517 7415	3.546 7798	5.5189 979	9.85338 3	3.1689 96	12.282 64	7.1619 3	15.364 81	18.404 9
JARQUE-BERA*	10762	5462.5	7321.4	1317.7	5863.1	10747	776.05	3060.2	15793	457.76	1792.3	433.82	934.34	3144.5	360.7	4804.5	1619.7	7565.4	10413

Table -2

Results of Dynamic Conditional Correlation

Variables	Estimate	Std.Error	t value	Pr(>|t|)
[rnifty].mu	-0.000743	0.000366	-2.03176	0.042178
[rnifty].omega	0.000004	0.000014	0.31933	0.749478
[rnifty].alpha1	0.166508	0.061282	2.71707	0.006586
[rnifty].beta1	0.814408	0.121171	6.72115	0.000000
[rbank].mu	-0.000287	0.000540	-0.53206	0.594684
[rbank].omega	0.000013	0.000009	1.39455	0.163152
[rbank].alpha1	0.180070	0.045131	3.98996	0.000066
[rbank].beta1	0.790178	0.053400	14.79747	0.000000
[rpvtbank].mu	-0.000147	0.000542	-0.27231	0.785380
[rpvtbank].omega	0.000011	0.000016	0.69303	0.488288
[rpvtbank].alpha1	0.170906	0.063478	2.69238	0.007094
[rpvtbank].beta1	0.805400	0.061160	13.16877	0.000000
[rpharma].mu	-0.000192	0.000464	-0.41332	0.679370
[rpharma].omega	0.000024	0.000011	2.10429	0.035353

[rpharma].alpha1	0.213842	0.084836	2.52065	0.011714
[rpharma].beta1	0.673039	0.113534	5.92807	0.000000
[rfinservices].mu	-0.000748	0.000520	-1.43633	0.150909
[rfinservices].omega	0.000011	0.000010	1.06173	0.288358
[rfinservices].alpha1	0.185975	0.043952	4.23137	0.000023
[rfinservices].beta1	0.785936	0.074064	10.61161	0.000000
[roil].mu	-0.000747	0.000428	-1.74514	0.080960
[roil].omega	0.000005	0.000024	0.19783	0.843182
[roil].alpha1	0.167666	0.047104	3.55948	0.000372
[roil].beta1	0.809808	0.168540	4.80486	0.000002
[rpse].mu	0.000079	0.000616	0.12784	0.898273
[rpse].omega	0.000018	0.000022	0.84473	0.398264
[rpse].alpha1	0.136756	0.084544	1.61756	0.105757
[rpse].beta1	0.792937	0.161873	4.89852	0.000001
[rauto].mu	-0.000550	0.000943	-0.58325	0.559728
[rauto].omega	0.000014	0.000009	1.53972	0.123630
[rauto].alpha1	0.123511	0.037941	3.25531	0.001133
[rauto].beta1	0.831476	0.042924	19.37077	0.000000
[rmnc].mu	-0.000739	0.000328	-2.25361	0.024221
[rmnc].omega	0.000008	0.000003	2.40738	0.016068
[rmnc].alpha1	0.286242	0.066861	4.28115	0.000019
[rmnc].beta1	0.673145	0.071773	9.37885	0.000000
[rpsubank].mu	0.000166	0.000888	0.18638	0.852148
[rpsubank].omega	0.000035	0.000021	1.67474	0.093984
[rpsubank].alpha1	0.068700	0.029446	2.33312	0.019642
[rpsubank].beta1	0.869165	0.054973	15.81085	0.000000
[rit].mu	-0.001121	0.000488	-2.29761	0.021584
[rit].omega	0.000011	0.000002	6.54271	0.000000
[rit].alpha1	0.124383	0.016481	7.54696	0.000000
[rit].beta1	0.823732	0.018298	45.01728	0.000000
[rreality].mu	-0.000953	0.000815	-1.17020	0.241922
[rreality].omega	0.000046	0.000028	1.61423	0.106478
[rreality].alpha1	0.167573	0.089723	1.86767	0.061807
[rreality].beta1	0.743576	0.117890	6.30735	0.000000
[rmedia].mu	0.000159	0.000866	0.18316	0.854675
[rmedia].omega	0.000053	0.000030	1.79368	0.072864
[rmedia].alpha1	0.157766	0.058154	2.71289	0.006670
[rmedia].beta1	0.737996	0.088339	8.35412	0.000000
[rCommodities].mu	-0.000715	0.000495	-1.44666	0.147992
[rCommodities].omega	0.000009	0.000003	2.95290	0.003148
[rCommodities].alpha1	0.120832	0.021296	5.67393	0.000000
[rCommodities].beta1	0.841296	0.021795	38.60008	0.000000

[rmetal].mu	-0.001093	0.000755	-1.44760	0.147728
[rmetal].omega	0.000016	0.000004	3.93909	0.000082
[rmetal].alpha1	0.063901	0.008805	7.25762	0.000000
[rmetal].beta1	0.899937	0.009636	93.39107	0.000000
[rinfra].mu	-0.000577	0.000422	-1.36716	0.171576
[rinfra].omega	0.000015	0.000023	0.66407	0.506643
[rinfra].alpha1	0.256567	0.097236	2.63862	0.008324
[rinfra].beta1	0.678475	0.180797	3.75268	0.000175
renergy].mu	-0.000659	0.000520	-1.26731	0.205044
[renergy].omega	0.000015	0.000003	4.78029	0.000002
[renergy].alpha1	0.116513	0.013659	8.53034	0.000000
[renergy].beta1	0.813273	0.027723	29.33521	0.000000
[rservices].mu	-0.000785	0.000417	-1.88449	0.059499
[rservices].omega	0.000007	0.000024	0.27895	0.780286
[rservices].alpha1	0.177668	0.057793	3.07422	0.002111
[rservices].beta1	0.793776	0.162735	4.87773	0.000001
[rfmcg].mu	-0.000361	0.000332	-1.08822	0.276497
[rfmcg].omega	0.000006	0.000004	1.26105	0.207292
[rfmcg].alpha1	0.157131	0.024550	6.40058	0.000000
[rfmcg].beta1	0.798622	0.038753	20.60794	0.000000
[Joint]dcca1	0.019975	0.001804	11.07246	0.000000
[Joint]dccb1	0.973650	0.007052	138.06299	0.000000

Table-3

The Standard Diebold & Yilmaz Spillover

	NIFTY	BANK	PVTBANK	PHARMA	FINSERVIC	OIL&GAS	PSE	AUTO	MNC	PSUBANK	IT	REALITY	MEDIA	COMMODITIES	METAL	INFRA	ENERGY	SERVICES	FMCG	FROM
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
NIFTY	6.15	4.65	6.61	2.80	7.02	7.24	4.15	5.30	6.23	3.15	4.84	3.66	2.92	5.99	4.04	6.67	5.57	8.08	4.92	4.94
BANK	5.74	7.52	9.32	1.76	8.90	6.91	4.07	4.91	5.04	4.37	2.99	3.91	2.82	5.31	3.75	5.85	4.64	8.72	3.47	4.87

PVT BANK	1.56	2.00	11.51	1.63	10.61	7.83	4.15	5.55	5.61	5.03	2.40	4.68	3.12	5.63	4.08	6.42	4.41	9.93	3.85	4.66
PHARMA	1.53	0.69	2.87	21.56	2.90	4.80	5.11	4.61	7.12	2.86	4.68	3.54	3.79	6.74	5.31	6.21	5.18	4.44	6.06	4.13
FIN SERVIC	1.67	1.93	10.36	1.59	11.20	8.18	4.12	5.46	5.50	4.67	2.59	4.74	2.78	5.69	4.06	6.56	4.50	10.32	4.07	4.67
OIL &GAS	1.88	1.52	7.22	2.54	7.78	10.79	4.43	5.47	6.30	3.47	4.37	4.25	2.86	6.23	4.31	7.20	5.54	8.52	5.34	4.70
PSE	1.42	1.09	4.28	2.96	4.39	4.83	11.94	5.09	5.52	5.50	2.59	4.41	3.85	9.27	7.09	7.94	9.14	5.15	3.85	4.63
AUTO	1.61	1.18	5.80	2.66	5.82	6.19	5.09	12.04	7.81	3.89	3.19	4.76	4.15	6.99	5.33	7.25	5.32	6.43	4.47	4.63
MNC	1.41	0.82	5.27	3.73	5.26	6.25	4.95	6.99	10.85	3.26	4.29	4.08	3.68	7.36	5.22	7.31	5.29	6.26	7.72	4.69
PSU BANK	1.78	2.29	6.67	2.08	6.37	5.06	6.61	4.85	4.65	15.32	1.40	5.48	4.42	6.52	5.30	6.45	5.65	6.15	2.98	4.46
IT	2.02	0.64	3.89	4.00	4.28	7.35	4.00	4.84	7.21	1.82	18.07	3.02	2.87	6.15	4.46	6.02	4.80	8.67	5.89	4.31
REALITY	2.15	1.75	5.81	2.44	6.00	5.79	5.29	5.74	5.41	5.18	2.41	14.52	4.70	6.46	4.87	6.73	4.83	6.25	3.69	4.50

MEDIA	1.50	1.18	4.74	3.05	4.32	4.88	5.63	5.99	5.88	5.15	2.86	5.91	17.07	6.39	4.70	6.40	5.46	5.17	3.73	4.36
COMMODITIES	1.55	1.09	4.76	3.18	4.95	5.55	7.53	5.68	6.70	4.15	3.31	4.43	3.59	9.79	7.81	8.07	7.62	5.82	4.43	4.75
METAL	1.72	1.22	4.46	3.32	4.58	5.04	7.57	5.63	6.20	4.38	3.05	4.39	3.48	10.17	12.63	6.92	6.13	5.42	3.70	4.60
INFRA	1.69	1.15	5.45	2.94	5.73	6.44	6.43	5.91	6.64	4.11	3.28	4.62	3.61	8.07	5.34	9.84	7.43	6.61	4.71	4.75
ENERGY	1.49	1.03	4.46	2.94	4.68	5.86	8.81	5.16	5.75	4.31	3.02	3.91	3.60	9.07	5.63	8.85	11.60	5.58	4.25	4.65
SERVICES	1.76	1.56	8.75	2.15	9.32	8.03	4.33	5.42	5.86	4.07	4.80	4.45	2.99	6.00	4.33	6.80	4.82	10.11	4.47	4.73
FMCG	1.39	0.68	4.74	4.33	5.08	6.78	4.51	5.09	10.23	2.67	4.50	3.64	3.06	6.34	3.98	6.88	5.13	6.22	14.77	4.49
TO	1.78	1.39	5.55	2.64	5.68	5.95	5.09	5.14	5.98	3.78	3.19	4.10	3.28	6.55	4.72	6.55	5.34	6.51	4.29	87.51
Net	-3.16	-3.48	0.89	-1.49	1.01	1.25	0.46	0.51	1.29	-0.68	-1.12	-0.4	-1.08	1.8	0.12	1.8	0.69	1.78	-0.2	

Table-4

The Spillover Table for Band: 3.14 to 0.79 Roughly Corresponds to 1 Days to 4 Days.

	NIFTY	BANK	PVTBANK	PHARMA	FINSERVIC	OIL&GAS	PSE	AUTO	MNC	PSUBANK	IT	REALITY	MEDIA	COMMODITIES	METAL	INFRA	ENERGY	SERVICES	FMCG	FROM_ABS	FROM_WITH
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
NIFTY	4.10	3.08	4.11	1.90	4.51	4.59	2.52	3.15	4.07	1.72	3.40	1.95	1.70	3.90	2.61	4.38	3.67	5.27	3.48	3.16	4.30
BANK	3.77	4.98	5.48	1.27	5.40	4.19	2.36	2.89	3.27	2.10	2.31	2.01	1.67	3.40	2.36	3.73	3.00	5.52	2.48	3.01	4.10
PVTBANK	1.60	1.37	8.49	1.30	7.98	5.54	2.92	4.13	4.30	3.51	1.93	3.23	2.29	4.30	3.13	4.89	3.31	7.53	3.08	3.46	4.71
PHARMA	1.03	0.50	2.19	15.61	2.31	3.29	3.86	3.11	5.08	2.02	3.37	2.54	2.54	5.11	4.09	4.85	4.01	3.42	4.34	3.03	4.13
FINSERVIC	1.15	1.33	7.70	1.25	8.52	5.84	2.94	4.03	4.19	3.30	2.06	3.28	2.03	4.38	3.13	5.02	3.41	7.88	3.27	3.48	4.74
OIL&GAS	1.27	1.05	5.48	1.94	6.06	8.33	3.27	4.12	4.94	2.57	3.34	3.01	2.04	4.87	3.40	5.65	4.28	6.59	4.35	3.59	4.89
PSE	0.99	0.76	3.32	2.29	3.47	3.46	8.83	3.86	4.26	3.64	2.80	3.07	2.75	7.19	5.59	6.22	6.87	4.08	2.98	3.52	4.79
AUTO	1.10	0.79	4.26	2.07	4.43	4.29	3.78	9.07	5.97	2.60	2.51	3.39	3.03	5.48	4.29	5.68	4.17	4.90	3.53	3.49	4.75

MNC	0.92	0.52	3.79	2.83	3.90	4.26	3.59	5.14	8.22	2.30	3.36	2.79	2.56	5.67	4.08	5.68	4.11	4.70	5.98	3.48	4.74
PSUBANK	1.27	1.65	5.09	1.70	4.95	3.51	4.89	3.76	3.60	11.18	1.14	3.92	3.20	5.03	4.16	4.96	4.28	4.80	2.31	3.38	4.60
IT	1.37	0.44	2.92	3.04	3.23	5.50	3.20	3.61	5.59	1.45	13.75	2.12	2.07	4.92	3.58	4.77	3.94	6.58	4.75	3.32	4.52
REALITY	1.44	1.19	4.16	1.76	4.41	3.88	3.75	4.12	3.96	3.47	1.79	10.07	3.24	4.88	3.71	5.04	3.60	4.60	2.87	3.26	4.43
MEDIA	0.99	0.78	3.25	2.30	3.00	3.03	3.82	4.23	4.26	3.33	1.89	3.62	12.37	4.60	3400	4.61	3.80	3.55	2.86	3.02	4.10
COMMODITIES	1.09	0.76	3.62	2.42	3.86	3.95	5.52	4.26	5.19	2.94	2.63	3.02	2.55	7.55	6.08	6.31	5.84	4.55	3.54	3.59	4.88
METAL	1.17	0.85	3.39	2.33	3.55	3.44	5.22	4.16	4.64	2.98	2.31	2.90	2.38	7.56	9.50	5.19	4.49	4.17	2.86	3.35	4.55
INFRA	1.18	0.81	4.16	2.26	4.49	4.64	4.75	4.41	5.07	2.97	2.57	3.21	2.62	6.30	4.26	7.72	5.75	5.16	3.73	3.60	4.89
ENERGY	1.04	0.72	3.45	2.35	3.68	4.25	6.69	3.91	4.50	3.16	2.40	2.74	2.61	7.17	4.58	6.98	8.87	4.39	3.43	3.58	4.87
SERVICES	1.22	1.08	6.54	1.66	7.12	5.78	3.17	4.03	4.49	2.92	3.75	3.10	2.18	4.65	3.37	5.25	3.71	7.74	3.58	3.56	4.84
FMCG	0.85	0.	3.59	3.30	3.90	4.80	3.	3.	7.	2.02	3.	2.56	2.11	4.89	3.08	5.45	3.93	4.75	11.	3.37	4.58

		42					33	77	85		36								26		
TO_ABS	1.21	0.95	4.03	2.00	4.22	4.12	3.66	3.72	4.49	2.58	2.43	2.76	2.29	4.96	3.63	4.98	4.01	4.87	3.34	64.24	
TO_WITH	1.64	1.30	5.48	2.72	5.74	5.56	4.98	5.06	6.10	3.51	3.31	3.76	3.1	6.75	4.93	6.78	5.45	6.62	4.54		87.39

Table-5

The Spillover Table for Band: 0.79 to 0.31
Roughly Corresponds to 4 Days to 10 Days.

	NIFTY	BANK	PVTBANK	PHARMA	FINSERVIC	OIL&GAS	PSE	AUTO	MNC	PSUBANK	IT	REALITY	MEDIA	COMMODITIES	METAL	INFRA	ENERGY	SERVICES	FMCG	FROM_ABS	FROM_WITH
NIFTY	1.27	0.97	1.59	0.56	1.60	1.66	1.00	1.36	1.36	0.86	0.92	1.05	0.75	1.30	0.89	1.45	1.18	1.79	0.89	1.11	6.72
BANK	1.23	1.58	2.49	0.31	2.28	1.74	1.06	1.30	1.14	1.39	0.46	1.19	0.72	1.21	0.88	1.36	1.03	2.09	0.62	1.18	7.13
PVTBANK	0.32	0.40	1.96	0.21	1.72	1.48	0.76	0.91	0.85	0.94	0.32	0.91	0.52	0.84	0.59	0.98	0.69	1.57	0.48	0.76	4.59
PHARMA	0.30	0.11	0.41	3.66	0.36	0.92	0.76	0.90	1.24	0.49	0.80	0.61	0.75	0.99	0.73	0.84	0.73	0.62	1.03	0.66	4.00
FINSE	0.33	0.	1.73	0.21	1.75	1.51	0.	0.	0.	0.85	0.	0.92	0.47	0.83	0.59	0.99	0.68	1.59	0.	0.76	4.57

RVIC		38					73	92	83		35								50		
OIL &GAS	0.38	0.29	1.10	0.37	1.10	1.56	0.71	0.84	0.85	0.54	0.65	0.77	0.50	0.85	0.57	0.98	0.78	1.23	0.61	0.69	4.16
PSE	0.27	0.20	0.61	0.42	0.58	0.86	1.96	0.77	0.79	0.96	0.32	0.84	0.67	1.32	0.96	1.09	1.41	0.67	0.53	0.70	4.20
AUTO	0.32	0.25	1.00	0.38	0.91	1.22	0.82	1.93	1.19	0.79	0.45	0.87	0.70	0.95	0.66	1.01	0.73	0.99	0.59	0.73	4.39
MNC	0.30	0.18	0.92	0.55	0.85	1.24	0.82	1.16	1.65	0.57	0.58	0.79	0.68	1.04	0.69	1.02	0.73	0.98	1.07	0.74	4.49
PSUBANK	0.33	0.41	1.05	0.25	0.95	1.01	1.08	0.72	0.68	2.65	0.18	0.99	0.77	0.95	0.73	0.95	0.86	0.90	0.41	0.70	4.19
IT	0.40	0.12	0.58	0.60	0.63	1.13	0.48	0.75	0.99	0.20	2.77	0.54	0.48	0.76	0.53	0.78	0.53	1.29	0.69	0.60	3.64
REALITY	0.44	0.35	1.06	0.42	1.02	1.20	0.96	1.01	0.90	1.05	0.38	2.79	0.89	0.99	0.73	1.07	0.76	1.05	0.50	0.78	4.69
MEDIA	0.31	0.24	0.93	0.49	0.83	1.16	1.11	1.11	1.02	1.10	0.62	1.41	2.95	1.13	0.82	1.12	1.03	1.02	0.54	0.84	5.06
COMMODITIES	0.29	0.20	0.72	0.47	0.70	1.01	1.25	0.89	0.96	0.74	0.44	0.88	0.64	1.40	1.09	1.12	1.11	0.81	0.55	0.73	4.39
METAL	0.34	0.23	0.68	0.60	0.66	1.00	1.44	0.91	0.97	0.86	0.47	0.93	0.68	1.62	1.97	1.08	1.01	0.80	0.50	0.78	4.68

INFRA	0.31	0.21	0.82	0.43	0.80	1.14	1.04	0.95	0.98	0.70	0.44	0.88	0.61	1.12	0.69	1.35	1.06	0.92	0.61	0.72	4.34
ENERGY	0.28	0.19	0.64	0.38	0.63	1.01	1.33	0.78	0.79	0.70	0.39	0.73	0.60	1.21	0.68	1.18	1.72	0.75	0.51	0.67	4.05
SERVICES	0.34	0.30	1.42	0.30	1.42	1.43	0.72	0.88	0.87	0.70	0.68	0.84	0.50	0.85	0.60	0.99	0.69	1.52	0.55	0.74	4.47
FMCG	0.32	0.15	0.69	0.60	0.71	1.19	0.69	0.78	1.44	0.37	0.67	0.63	0.55	0.86	0.53	0.86	0.70	0.88	2.13	0.66	4.00
TO_ABS	0.36	0.27	0.97	0.40	0.93	1.15	0.88	0.89	0.94	0.73	0.48	0.83	0.60	0.99	0.68	0.99	0.83	1.05	0.59	14.57	
TO_WITH	2.16	1.65	5.84	2.40	5.63	6.94	5.31	5.37	5.66	4.38	2.89	5.01	3.64	5.96	4.11	5.98	4.98	6.32	3.54		87.77

Table-6

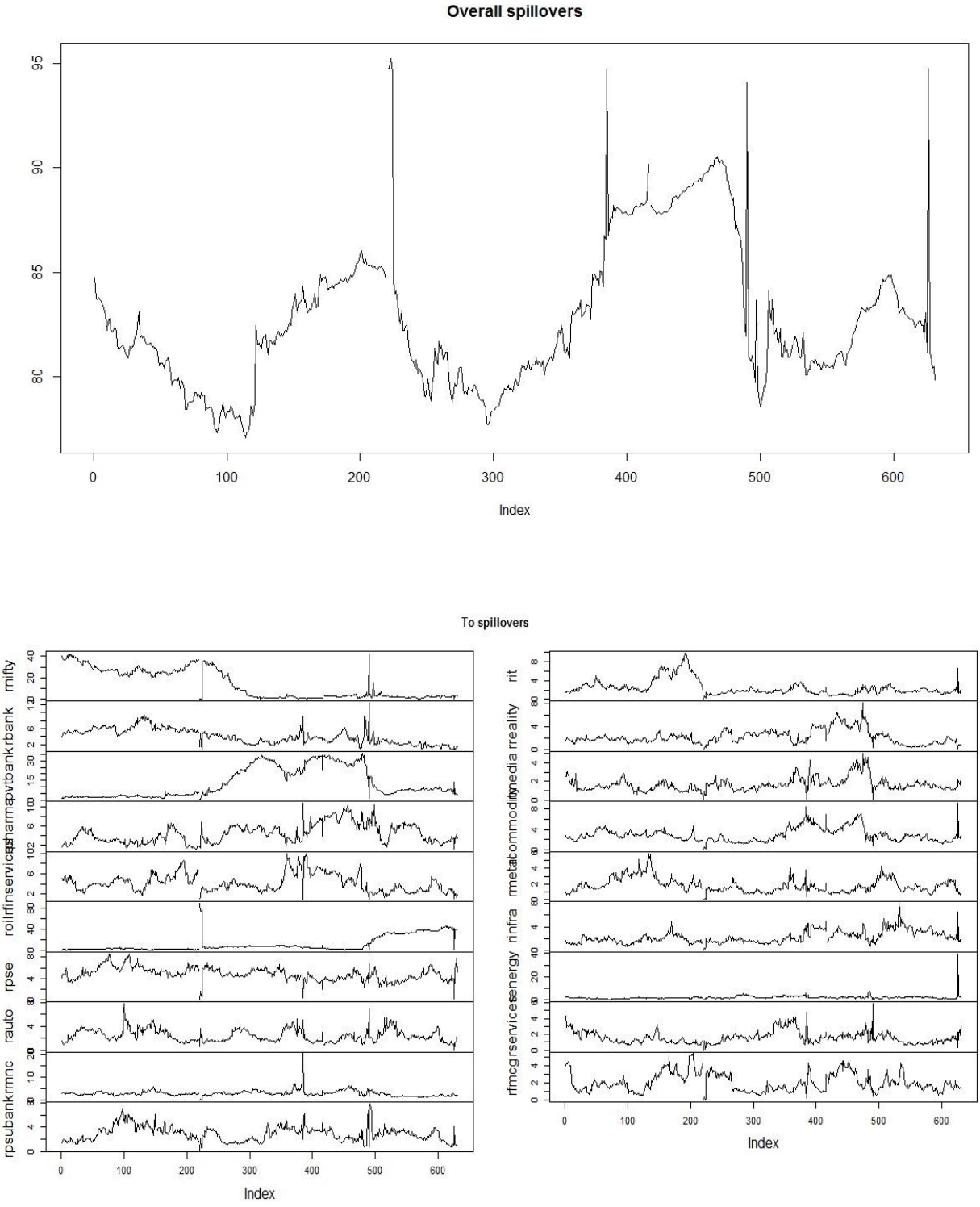
The Spillover Table for Band: 0.31 to 0.00
Roughly Corresponds to 10 Days to Inf Days

	NIFTY	BANK	PVTBANK	PHARMA	FINSERVIC	OIL&GAS	PSE	AUTO	MNC	PSUBANK	IT	REALITY	MEDIA	COMMODITIES	METAL	INFRA	ENERGY	SERVICES	FMCG	FROM_ABS	FROM_WITH
NIFTY	0.78	0.60	0.91	0.34	0.90	0.99	0.63	0.80	0.80	0.57	0.52	0.66	0.48	0.78	0.54	0.84	0.71	1.02	0.55	0.67	6.73

BANK	0.73	0.95	1.35	0.18	1.22	0.98	0.65	0.72	0.64	0.88	0.22	0.71	0.43	0.70	0.51	0.76	0.61	1.11	0.37	0.67	6.82
PVTBANK	0.18	0.23	1.05	0.13	0.91	0.81	0.47	0.51	0.47	0.58	0.16	0.54	0.31	0.49	0.35	0.55	0.41	0.83	0.29	0.43	4.37
PHARMA	0.20	0.08	0.27	2.28	0.23	0.60	0.49	0.59	0.79	0.35	0.52	0.39	0.51	0.64	0.49	0.52	0.45	0.40	0.69	0.43	4.36
FINSERVIC	0.19	0.22	0.94	0.13	0.93	0.83	0.45	0.51	0.47	0.53	0.18	0.54	0.28	0.48	0.34	0.56	0.41	0.85	0.30	0.43	4.38
OIL&GAS	0.23	0.18	0.64	0.23	0.62	0.90	0.45	0.50	0.50	0.36	0.37	0.47	0.31	0.51	0.34	0.57	0.48	0.70	0.38	0.41	4.18
PSE	0.17	0.12	0.35	0.25	0.33	0.51	1.15	0.46	0.47	0.60	0.19	0.51	0.43	0.77	0.54	0.64	0.86	0.39	0.34	0.42	4.22
AUTO	0.18	0.15	0.54	0.21	0.48	0.67	0.49	1.05	0.65	0.50	0.24	0.50	0.42	0.56	0.39	0.55	0.42	0.53	0.35	0.41	4.17
MNC	0.19	0.12	0.56	0.35	0.50	0.75	0.54	0.70	0.98	0.39	0.35	0.50	0.45	0.65	0.44	0.61	0.46	0.59	0.67	0.46	4.69
PSUBANK	0.18	0.22	0.53	0.13	0.47	0.54	0.63	0.37	0.37	1.50	0.09	0.57	0.45	0.53	0.41	0.53	0.50	0.45	0.25	0.38	3.84
IT	0.25	0.09	0.40	0.37	0.42	0.72	0.33	0.48	0.63	0.16	1.55	0.36	0.31	0.48	0.34	0.47	0.33	0.80	0.45	0.39	3.92
REALITY	0.27	0.21	0.60	0.26	0.57	0.70	0.59	0.61	0.54	0.66	0.23	1.66	0.57	0.59	0.43	0.62	0.46	0.60	0.31	0.46	4.69

MEDIA	0.19	0.16	0.56	0.26	0.49	0.69	0.70	0.65	0.59	0.73	0.35	0.88	1.75	0.67	0.48	0.67	0.64	0.60	0.33	0.51	5.13
COMMODITIES	0.18	0.12	0.41	0.29	0.39	0.59	0.76	0.53	0.56	0.46	0.25	0.53	0.40	0.83	0.64	0.65	0.66	0.46	0.34	0.43	4.37
METAL	0.21	0.14	0.39	0.39	0.37	0.60	0.90	0.56	0.60	0.54	0.28	0.56	0.43	0.99	1.16	0.65	0.62	0.46	0.34	0.48	4.81
INFRA	0.19	0.13	0.47	0.26	0.45	0.66	0.63	0.56	0.58	0.44	0.26	0.53	0.38	0.65	0.39	0.77	0.63	0.62	0.53	0.38	4.33
ENERGY	0.17	0.12	0.37	0.22	0.36	0.60	0.79	0.47	0.46	0.45	0.23	0.45	0.39	0.70	0.38	0.69	1.02	0.44	0.31	0.40	4.04
SERVICES	0.20	0.18	0.79	0.19	0.78	0.81	0.45	0.50	0.50	0.45	0.37	0.51	0.31	0.50	0.36	0.56	0.41	0.84	0.34	0.43	4.37
FMCG	0.22	0.10	0.46	0.43	0.46	0.79	0.49	0.54	0.94	0.27	0.47	0.44	0.40	0.59	0.37	0.57	0.50	0.59	1.37	0.45	4.59
TO_ABS	0.22	0.17	0.55	0.24	0.53	0.68	0.55	0.53	0.56	0.47	0.28	0.51	0.38	0.60	0.41	0.58	0.50	0.60	0.37	8.70	
TO_WITH	2.20	1.68	5.61	2.46	5.31	6.48	5.55	5.34	5.62	4.75	2.80	5.13	3.85	6.02	4.12	5.87	5.09	6.04	3.73		88.01

Figure -1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300
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500
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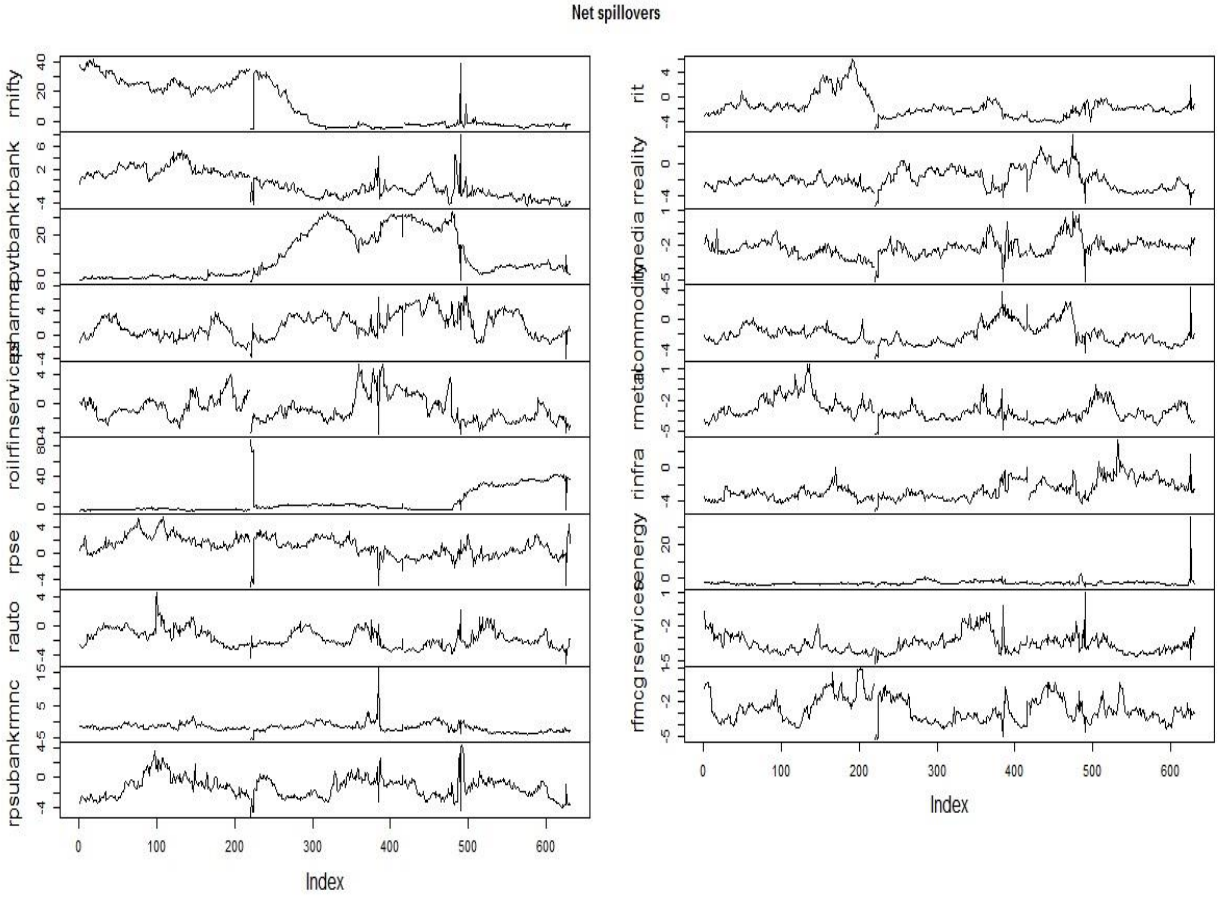
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rcommodity
rmetal
rinfra
renergy
rservices
rfmcg
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