Impact of COVID-19 Spawned Factors on Emerging Markets' Reaction: A Case of Pakistan Stock Exchange

Dr. Ameena Arshad[1], Dr. Shagufta Parveen[1], Dr. Faisal Nawaz Mir[1], and Dr. Zoya Wajid Satti[1]

[1]Department of Management Science, Comsats University, Attock Campus, Pakistan

*ameena.arshad@gmail.com**

**Corresponding Author*

ABSTRACT

The outbreak of COVID-19 has affected stock markets worldwide and caused considerable losses to investors and economies. Pakistan's stock exchange was also impacted by this pandemic and remained volatile from January 2020 till September 2020. Many different factors spurred during this time and influenced the trade volume of the stock market. We have applied the LDA topic modeling technique to find out those factors. The results demonstrated that international stock markets news, announcements from the government, the World health organization's announcements, and COVID-19 vaccine progress were the main factors that caused the Pakistani stock market volatility.

Keywords: Stock Market, COVID-19, Latent Dirichlet Allocation (LDA).

INTRODUCTION

The outbreak of Covid-19 has seriously affected people's lives and their productivity. World economies are facing severe challenges because of this disease. According to traditional economic development, the influence of COVID-19 is not a recurring instability. Examining and studying its financial impact on stock market reactions has become an important issue. This study aims to evaluate the impact of COVID-19 and its generated factors on Pakistan stock market reaction using e-news articles of different newspapers.

Traditional finance states that the market and company-based factors determine stock prices. According to behavioral finance, uncertain situations impact the psychology of investors and their behaviors. The prices of stocks are affected by investors' emotions, moods, and behaviors in certain situations (crashes, bubbles, financial crises). The pessimism and optimism of investors bring volatility in earnings and stock trade volume (Frugier, 2016). Therefore, the sudden occurrence of COVID-19 impacts investors' sentiments and stock market reaction. Investors who are trading in a stock

market constitute or represent the whole market. If investors are affected by any event, their investment decisions automatically create volatility in the stock market. Pakistan stock exchange (PSX) is an emerging stock exchange, and the impact of this outbreak can be seen from January 2020 till today. There were fluctuations in stock market volume due to investors' sentiments.

Pakistan Stock market went through different phases of the volatility after receiving news and announcements on COVID-19, government policies on lockdown, budget, relief packages, oil prices, lower inflation rates, and world health organization. The investors faced mixed results on their investments from January to March 2020 (Shehzad, 2020). Figure 1 illustrates the case of the Pakistan Stock Exchange (PSX) from January until June 2020.

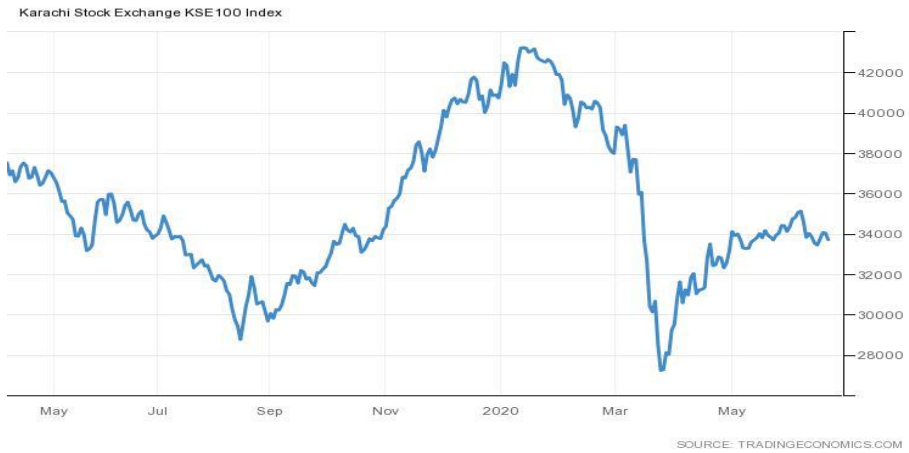


Figure 1: PSX's performance during COVID-19

The month of April brought negative returns for investors as stock prices of the oil and gas sectors decreased. News on new China cases and increasing political noise in the country created fear and uncertainty among investors and caused stock market volatility (The Express Tribune, June 21, 2020). Despite all these problems, PSX managed to keep working correctly. The stock market of Pakistan was not closed as the Securities and Exchange Commission of Pakistan (SECP) provided guidance and assistance in formulating Standard Operating Procedures (SOPs), which has helped ensure measures to keep the stock market operational successively. The situation from February 2020 until June 2020 demonstrated volatility in PSX trade volume and changes in sentiments of investors during COVID-19. It indicated the tendency of the Pakistani stock market and its investors affected by current news, past information, and global announcements. Pakistani investors live in a collective culture and are influenced by their family and friends' suggestions and recommendations by displaying 'herd behavior' (Bashir et al., 2013). There is a need to examine the Pakistani stock

market reaction due to investors' sentiments during COVID-19 as there was a state of confusion, fear, and uncertainty.

Stock market studies with LDA topic modeling are in process in developed countries. The results of these studies are not generalizable to the stock markets of developing countries like Pakistan because of different policies, financial market infrastructure, government support, financial literacy level, and psychology of investors trading in the Pakistan stock exchange. The contribution of the present study is that it has used e-news articles from websites of different well-known newspapers, discussions and examined them using LDA topic modeling in python. It will add to the literature on the impact of COVID-19 on stock market reaction due to investors' sentiments (the result of different factors) using machine learning in developing countries like Pakistan. It is a novelty of the present study.

LITERATURE REVIEW

According to various international organizations, the recent COVID-19 will severely influence the global economy, which will be more dangerous than the 2007 economic crisis (Sansa,2020). Experts believe that the financial markets have swiftly reacted to the COVID-19, and the spreading of this pandemic might lead to a world recession (Ramelli & Wagner,2020; Baret et al.,2020). Xinhuan (2020) also found that COVID-19 had a significant global effect on the financial markets. This pandemic gave birth to different factors that created volatility in the world's financial markets and affected the investors too.

Okorie & Boqiang (2020) conducted a study in 32 economies to check the fractal contagion effects of COVID-19 on the stock markets and volatility. They used Detrended Moving Cross-Correlation Analysis (DMCA) and Detrended Cross-Correlation Analysis (DCCA) techniques to analyze the impact of COVID-19 on stock market returns. They found a significant but short-lived influence on the stock markets because of the COVID-19 pandemic. Awadhi et al. (2020) conducted a study on the effect of COVID-19 on the stock market returns of China. The results showed that the daily increase in total confirmed cases and total death cases due to COVID-19 negatively influenced the stock returns of all companies.

Sansa (2020) researched the USA and China's financial markets, and his findings suggest that COVID-19 has adverse effects on stock market returns. The study revealed a significant positive relationship between the COVID-19 cases and financial markets. Ashraf (2020) analyzed the stock market's reaction to the COVID-19 confirmed cases and death cases across 64 countries. The results indicated that the stock market returns decrease as the number of cases increases. The study provided evidence that there is a negative effect on the stock market returns as confirmed cases increase.

A study was conducted by Topcu & Serkan (2020) to explore the effect of COVID-19 on developing stock markets from period March 10th-April 30, 2020. The study findings suggest a negative impact of COVID-19 on the emerging stock markets. The outbreak in Europe markets is more minor than Asian emerging markets. Ding et al. (2020) conducted a study to check corporate immunity during the COVID-19 pandemic. They used more than 6000 organizations from 56 countries to evaluate the effect of COVID-19 cases on stock prices and corporate characteristics. They found that organizations with stronger pre-2020 finances, less exposure to the pandemic, less entrenched executives, and higher social responsibility activities faced a minor pandemic that induced a drop in the stock price.

Furthermore, they found that the corporations with large corporate ownership performed well and corporations were badly affected and had more ownership in hedge funds. Alfaro et al. (2020) attempted to describe the unpredicted changes taking place in the COVID-19 and are forecasting the returns of the US stock market. They took a sample of 4070 companies that were listed in the United States, and they found that if COVID-19 infections are doubled, it will decrease the US market returns and vice-versa.

Corbet et al. (2020) inspected the influence of the COVID-19 on the Chinese stock market. They proposed that the Chinese financial markets were exposed to infection since the start of the COVID-19 pandemic. Schoenfeld (2020) evaluated the uncertainty in the context of financial markets and pandemics. He found that the managers undervalue the pandemic uncertainty that ultimately resulted in a decline in the value of a firm. The results also propose that the performance of the financial markets is critical in novel pandemics. Ashraf et al. (2020) investigated the effect of Islamic Equity Investments (IEIs) in the COVID-19 pandemic. S&P Down Jones found that the IEIs performed very well due to the rigorous handling of the IEIs in the first quarter of 2020. The results indicated that hedging profits are provided by IEIs when there was market downfall, and their research also indicated that hedging profits come at an additional cost. According to Xinhuan (2020), China's financial market remained stable contrary to various world financial markets, even in the present COVID - 19 pandemic.

Summarizing the literature review, it has been observed that Covid-19 has generated many factors like recession in economies, bearish trend, government policies, lockdown, increase in oil prices, announcements related to COVID-19 vaccine, and news on the second wave, etc. The present study has tried to find out the factors that have influenced the Pakistani stock market and its investors during COVID-19 using Latent Dirichlet Allocation (LDA) techniques used for topic modeling in python. The hypothesis of our study is.

H_1: Covid-19 has significantly impacted the Pakistan stock exchange and its investors.

METHODOLOGY

We have collected online newspaper articles from Dawn, Business Recorder, and the Frontier Post. The total number of news articles taken was 100, and the study time was January 1, 2020, to September 30, 2020. Python language was used to code and analyze the text of these articles. It is called natural language processing, which is used to understand human language and its sentiments through text. Latent Dirichlet Allocation (LDA) was applied for topic modeling.

This model is a generative probabilistic model, which assumes that each topic is a mixture of different words and each article is a mixture of different topics in each document. α and β are parameters of LDA, and α demonstrates document topic density (Saxton, 2018). The higher value of α indicates more topics in a document, and the β value illustrates topic word density. The higher value of β indicates more specific words relating to the topic (Porter, 2018).

We have implemented the LDA model in the following steps:

- Data loading in CSV file
- Cleaning of data
- Analysis of processed data
- Transforming data for LDA analysis
- LDA model training for result visualization
- Analyzing results of LDA model

After loading the CSV file, punctuations and lowercase the text (metadata) as the purpose of topic modeling is to emphasize text-only for reliable and accurate results. It is called tokenization or clean-up text. After that, stop words, bigram and lemmatization were done. Bigram removes the two words frequently occurring within a document. Stop words were removed, and lemmatize was used to convert the word to its primary form. Stemming was also used to remove the last word. After this cleaning of data techniques, a corpus and dictionary were created, which are two main elements of LDA modeling.

After that, we have built a model with topics included in it. Each topic is made up of keywords, and each keyword has weightage within a specific topic. After building the LDA model, we examined the produced topics and liked words.

DATA ANALYSIS

After applying the LDA model, we have visualized the topics using the visualization package "pyLDAvis," which is designed to understand and

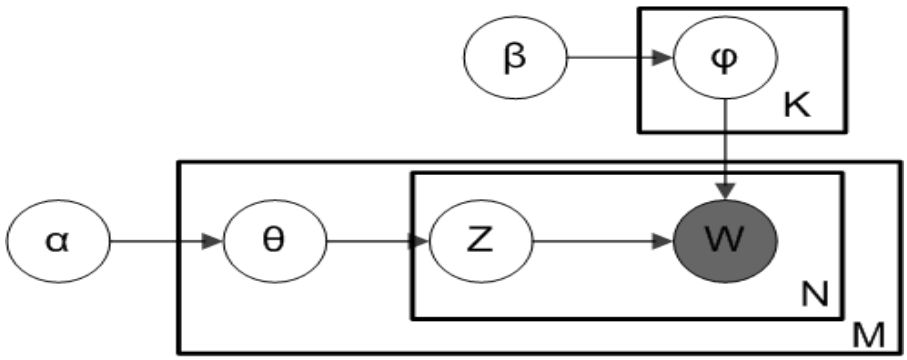
interpret individual topics and connections between these topics. It also reveals the most relevant terms of the topic. Chaung et al. (2012) explain term distinctiveness of the term "w" as follows:

$$distinctiveness(w) = \sum_{T} P(T|w) \log \frac{P(T|w)}{P(T)}$$

This equation tells us how informative a particular term "w" explains a specific topic. The product demonstrates the saliency of the term:

$$Saliency\ (w) = P(w) \times distinctiveness\ (w)$$

Topic modeling is used to identify topics in different sets of documents. LDA views all documents as a "bag of words," and it works by first selecting the topics from the document and then choosing a set of words from it (Maier et al., 2018).



Source: https://en.wikipedia.org/wiki/Latent_Dirichlet_allocation

Figure 2: Plate Diagram of LDA Model

α= topic distribution in each document
β= word distribution in each topic
θ= topic distribution for article m
φ= distribution of words for topic k
z= topic for nth word in document m and w is specific word.
W= observable variable

LDA topic modeling generates visualization, containing bar charts and circles, indicating topics and terms relevant (Jelodar et al., 2019). The bar chart shows a bar with grey and red color at the same time when you click on a circle, whether small or larger. The gray bar demonstrates the corpus-wide frequencies of each term, and the red bar illustrates each term's topic-specific frequencies.

In our visualization, we get two types of information. On the left side, inter-topic differences are displayed. The area of circles shows the prevalence of topics in the corpus. The bar chart shows the most valuable terms in interpreting the selected topic on the left. The left and right sides of our visualization are connected because when we choose a topic from the left, it reflects the most useful term on the right (bar chart) for interpretation of the topic. Selecting a term from the bar chart (on right) displays the distribution of topics for the chosen term from the left side. This association helps researchers to evaluate many relationships between terms and topics. Terms are ranked according to their frequency of appearance in the topic. The most frequently appear term is ranked on top and so on. We have explained the most influential factors during COVID-19, which are demonstrated by the size of the circle and bar charts. We have placed the figure 4 terms-topic link in the text, and the rest of the figures are placed in Annexure for reference. Discussion on all the generated visualization is as below:

If you look at figure 3, when we moved the cursor on circle 1, salient keywords from the topic appeared, and 23% of the words were relevant to the current topic. The red bar shows the estimated frequency of the word "market" related to the selected topic and gray bar shows this term's overall frequency in an article. The intersection of circles indicates the presence of terms in other articles too. Other words in figure 4 are "Pakistan", "Index", "points", "stock", "investors" and so on. This relationship indicates that the COVID-19 impacted the stock market of Pakistan from January 2020 till September 2020. This term-topic relationship indicates that most articles discussed the stock market volatility due to investors' reactions to COVID-19.

The stock market of Pakistan was no different from other international stock markets. It faced losses from January to April, especially as the wave of the corona was strong in Pakistan and the Pakistani government, along with Pakistan stock exchange management, was deciding what to do in such an uncertain situation. Investors were watching international markets and were influenced by negative results. They started selling stocks of the oil and gas sector after receiving news of international oil price fluctuations. The size of the circle indicates investors' decision-making and trade volume volatility of the Pakistan stock exchange, which COVID-19 significantly influenced from January 2020 till September 2020. Bar charts indicate words like "loss," "foreign," "price," "global," "markets," etc., which illustrates the loss of investors in March and April when corona cases were increasing locally and internationally.

Next, we have discussed the topic-term relationships of figure 4 to figure 11 (See Annexure). Here you can see the words like "exchange," "market," "stock," "SECP," "trade," "China," "lockdown," "loan," "sukuk," "petroleum

price," etc. which highlights the role of these factors on impacting the stock market volatility and investors in Pakistan. Figure 4 demonstrates the impact of SECP's decisions during COVID-19, and this topic had 20.2% token related to impact on stock market reaction. It indicates how significant was the role of SECP during COVID-19 in managing the Pakistan stock exchange. Its leading role was to guide investors and decision-makers of the stock exchange in designing strategies and SOPs to handle this pandemic successfully.

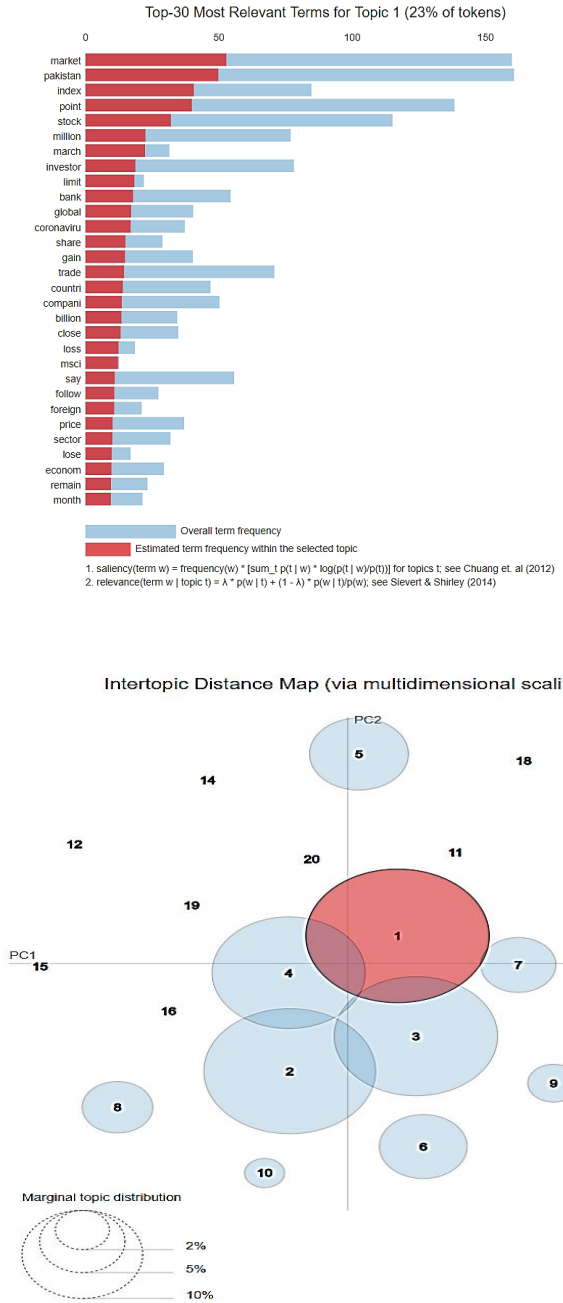


Figure 3: Impact of international stock markets' fall on Pakistan stock exchange

Figure 4 to 12 indicates news, announcements, and progress on the COVID-19 vaccine. These figures also reveal the role of the Pakistani government in handling this situation like lockdown, smart lockdown, domestic price increase of different products, budget cuts for industries, and oil prices. The sentiments of investors were affected by such announcements, which created volatility in the Pakistan stock exchange. International news on the corona death rate, global stock exchange losses, and second-wave created hopelessness among stock market participants. Investors were expecting a budget that would help stock trading and industries. Still, it was otherwise, and the stock market was severely impacted after the announcement of the budget from the federal government. After the increase in oil prices in the international market, shares of the oil and gas sector started losing their value, and investors were under pressure to sell these stocks. It caused trade volume to drop in April as investors were hopeless. The size of the circle indicates the significance of these factors is impacting the trade volume of the Pakistan stock exchange and the investors.

These figures indicate the tendency of Pakistani investors affected by current news, past information, and global announcements. The role of SECP remained positive during COVID-19 for investors and the stock market. Previous studies conducted on LDA topic modeling on stock market reaction also showed investors' sentiments and their impact on stock market volatility. Chen et al. (2018) found that LDA topic modeling helped in topic generation for Chinese stock market. Liu (2020) used LDA topic modeling for finding the relationship between hot news and stock market reaction. Glasserman et al. (2020) utilized LDA topic modeling technique to find the return and volatility association. Atkins et al. (2018) used financial news to find out about the volatility in stock markets. Xu et al. (2020) used topic modeling to find out the link between stock market performance and social media discussion. Feuerriegel and Prollochs (2018) find out the relationship between stock market reaction and financial news disclosure. Hence, it is evident that LDA topic modeling can be used to study stock market reaction due to investors. The findings of our study have also proved it and found that Covid-19 has generated many factors which have influenced the stocks markets and its investors.

CONCLUSION

LDA topic modeling is a new way to explain the topic and the relevance of words contained in it. We have modeled the topic of the current study and found that COVID-19 has generated different factors and influenced the Pakistan stock exchange and its investors. Different words highlighted in all the figures derived from LDA modeling indicate the significance of different factors that contributed a lot in creating disturbance among the market participants and the Pakistan stock exchange. Such topic modeling can help policymakers like SECP find out the main causes of the increase or decrease

in trade volume and future strategy making. Academicians can use the LDA model to form new theories from analysis of the current situations on stock markets. Researchers can utilize the current study's findings to understand the impact of this pandemic and its generated factors on stock markets.

Future research can be done using LDA topic modeling on the manufacturing and education sectors, as it was also badly affected during this pandemic. A comparison can be made using this topic with Asian countries to see the difference and similarities in results.

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Annexure

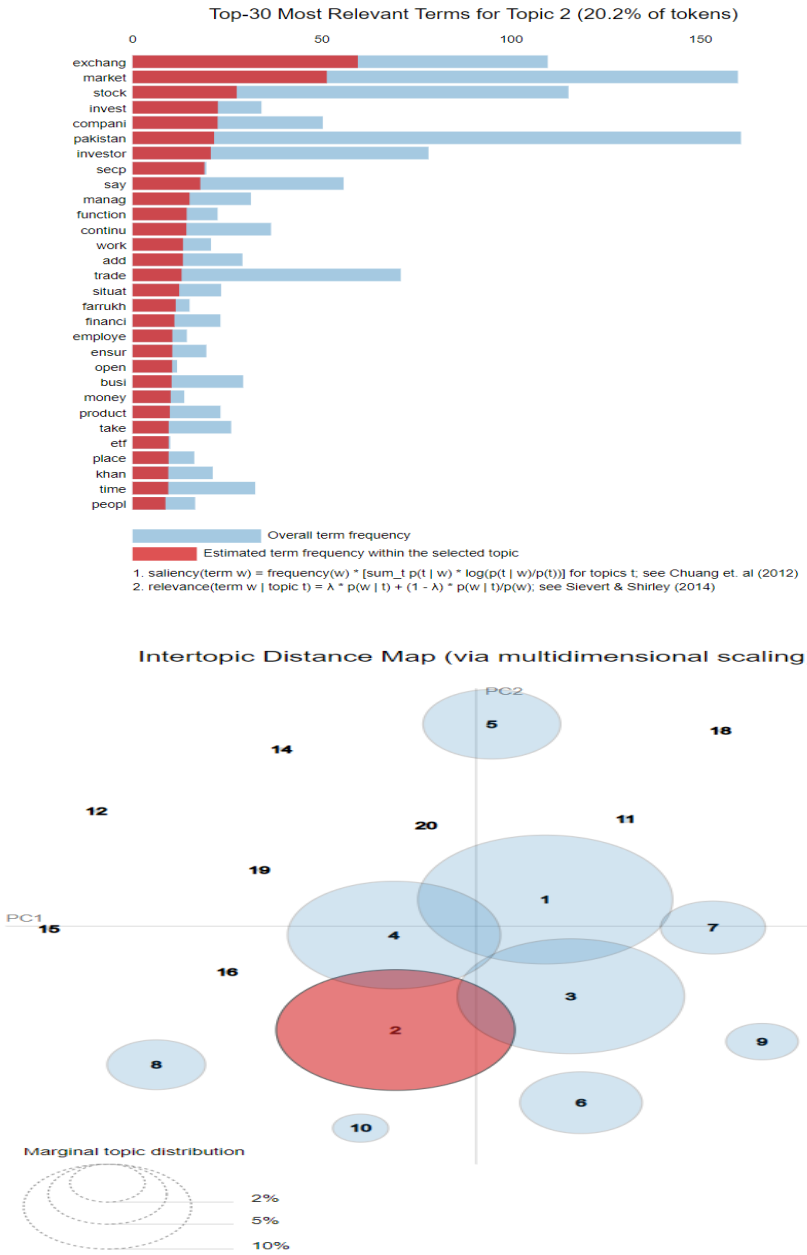


Figure 4: Role of SECP during Covid 19

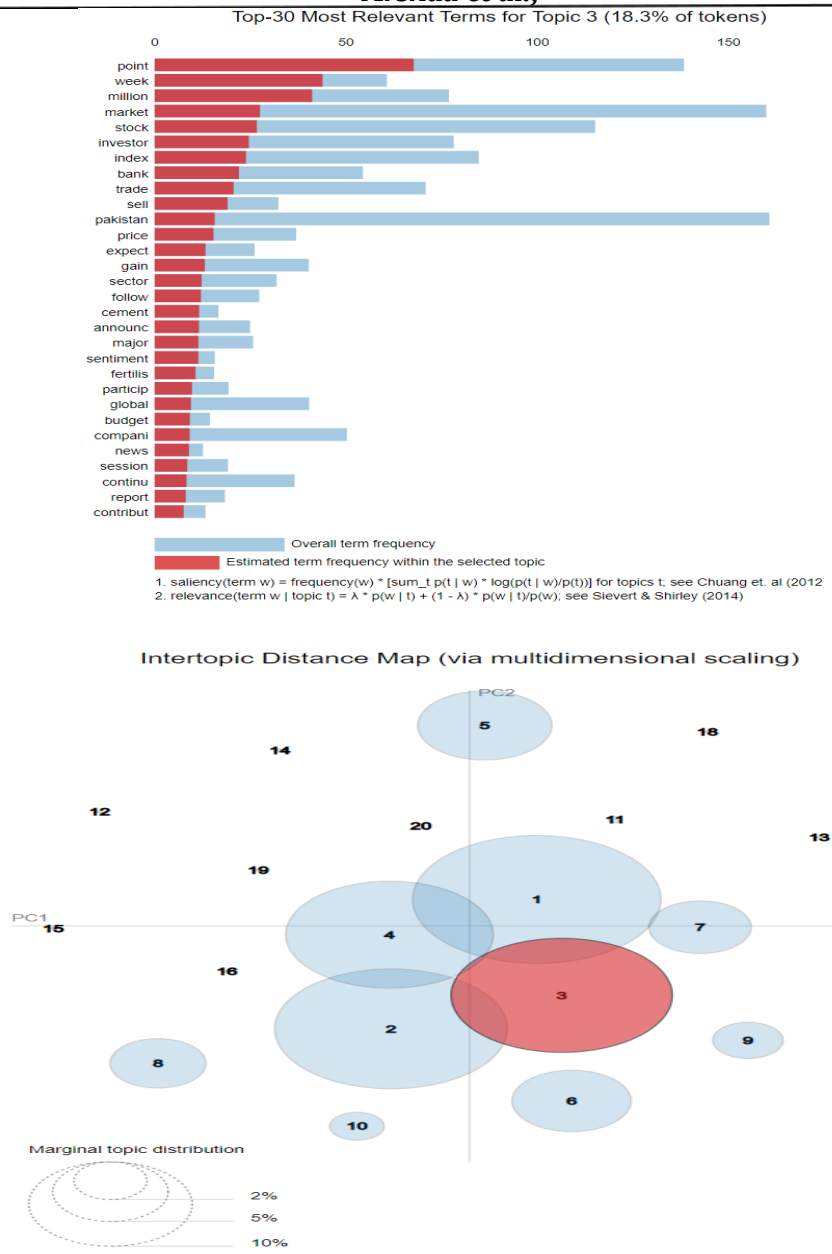


Figure 5: Impact of announcement form WHO and government on stock market reaction

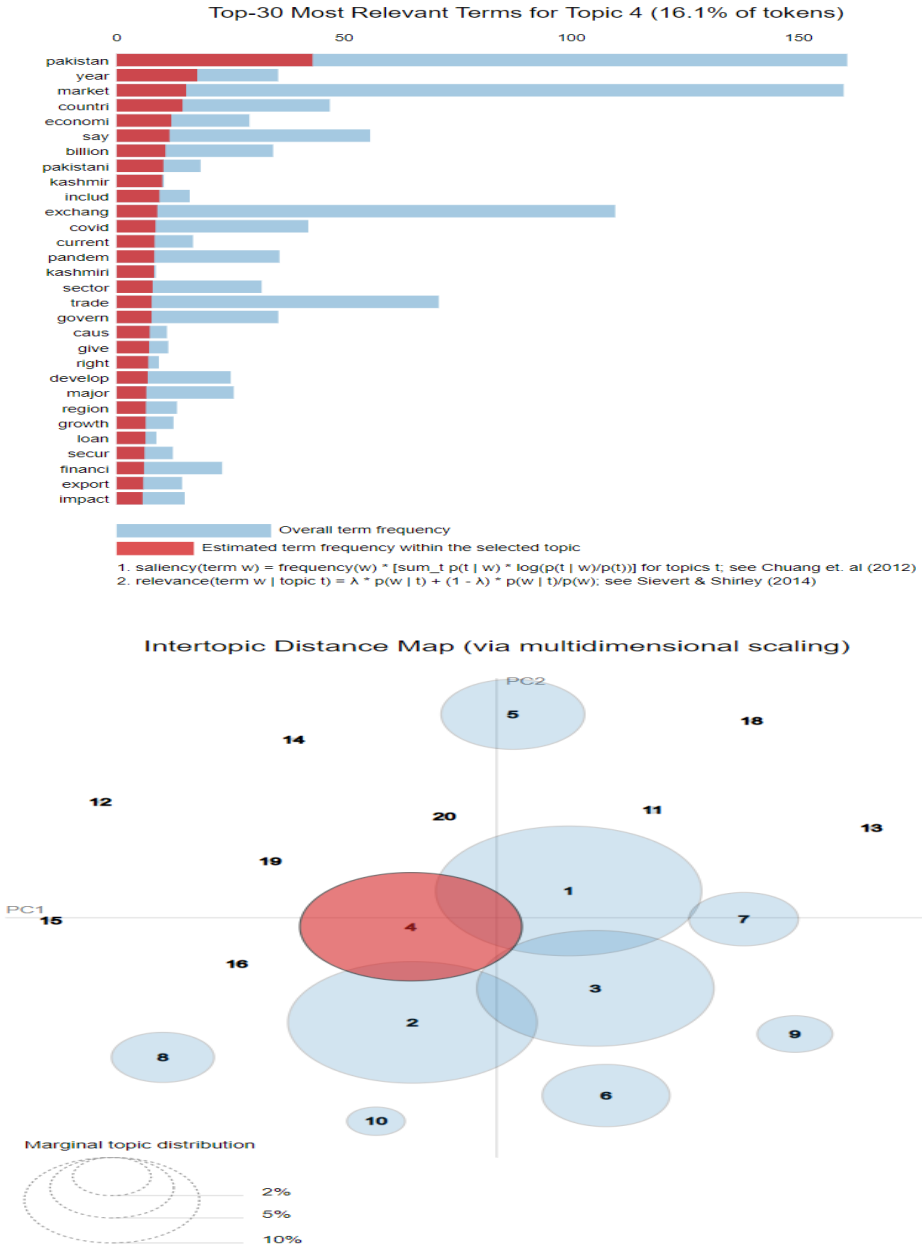


Figure 6: Impact of Kashmir issue, export and international loans on stock market reaction

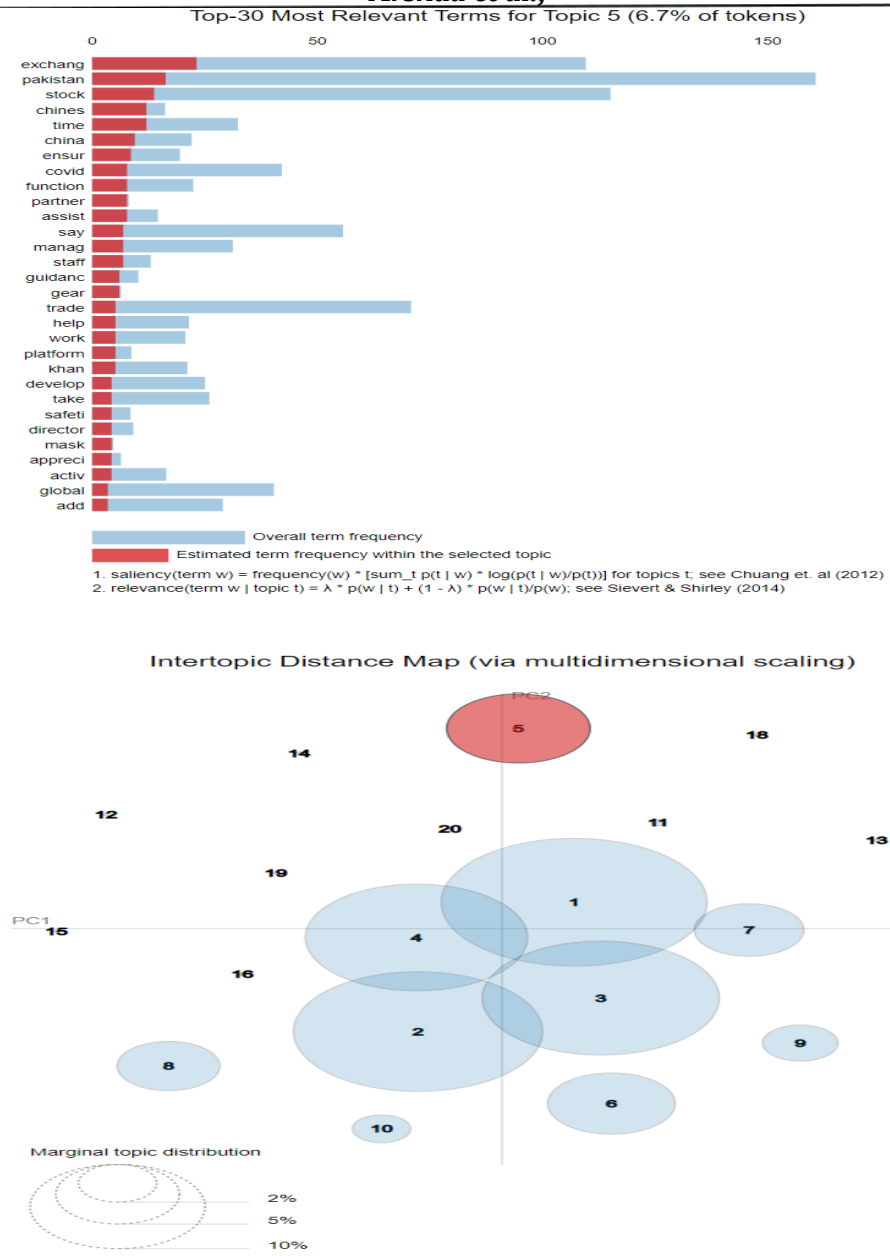


Figure 7: Impact of China's support on stock market reaction

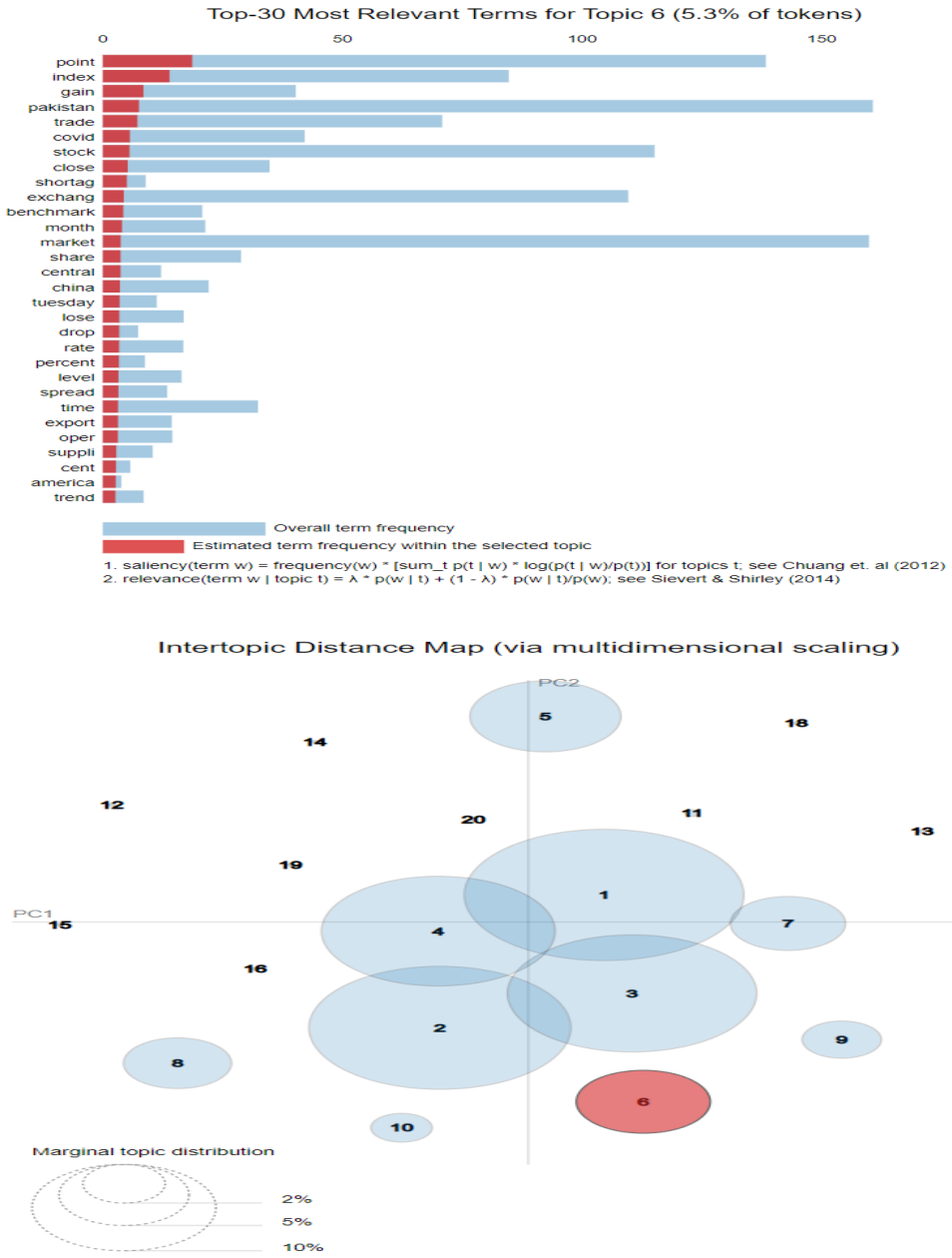
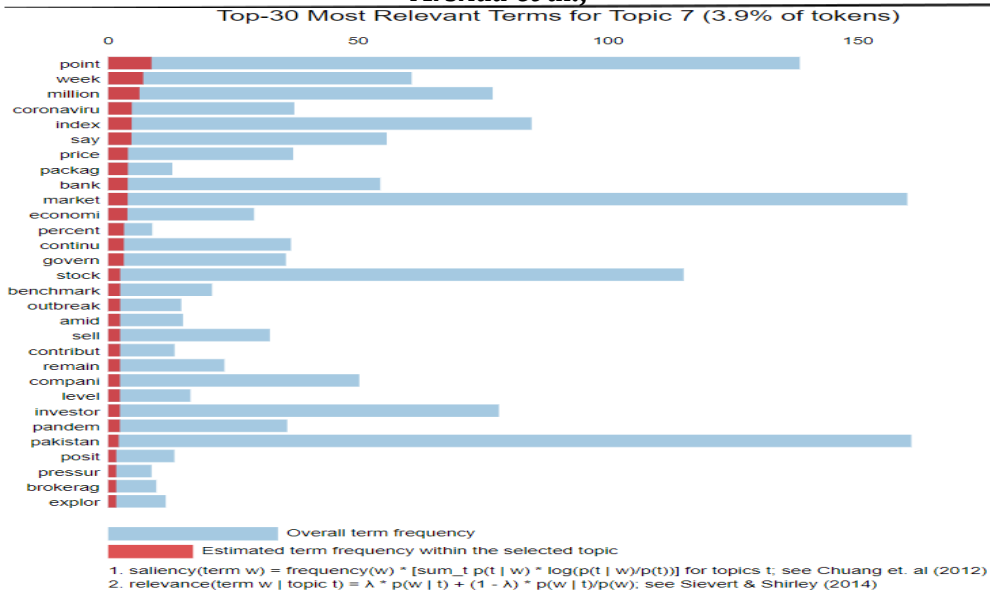


Figure 8: Impact of role of America and China on Pakistan stock exchange



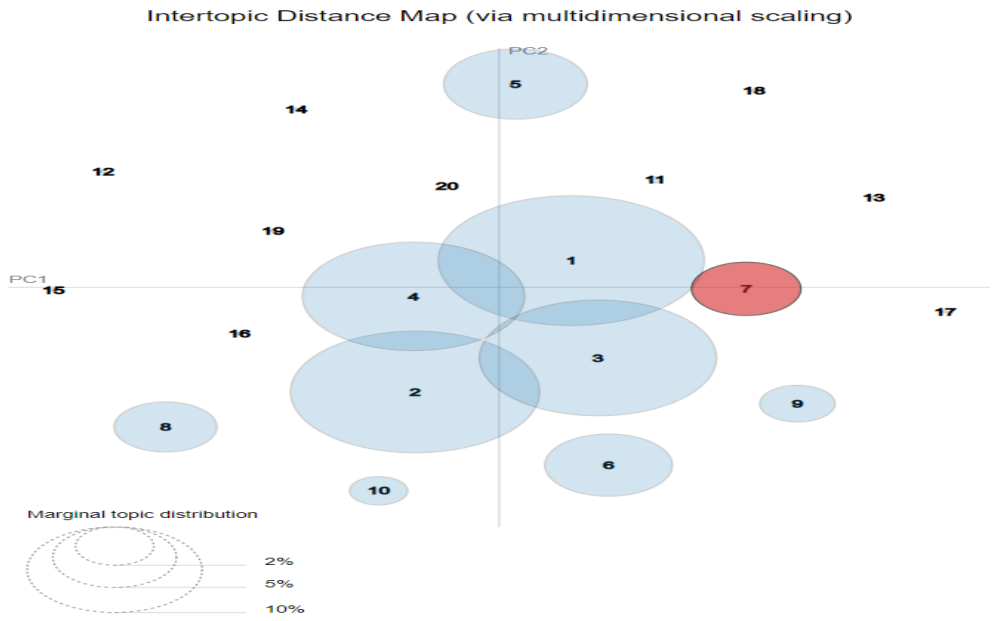


Figure 9: Impact of Corona virus vaccine development on stock market reaction

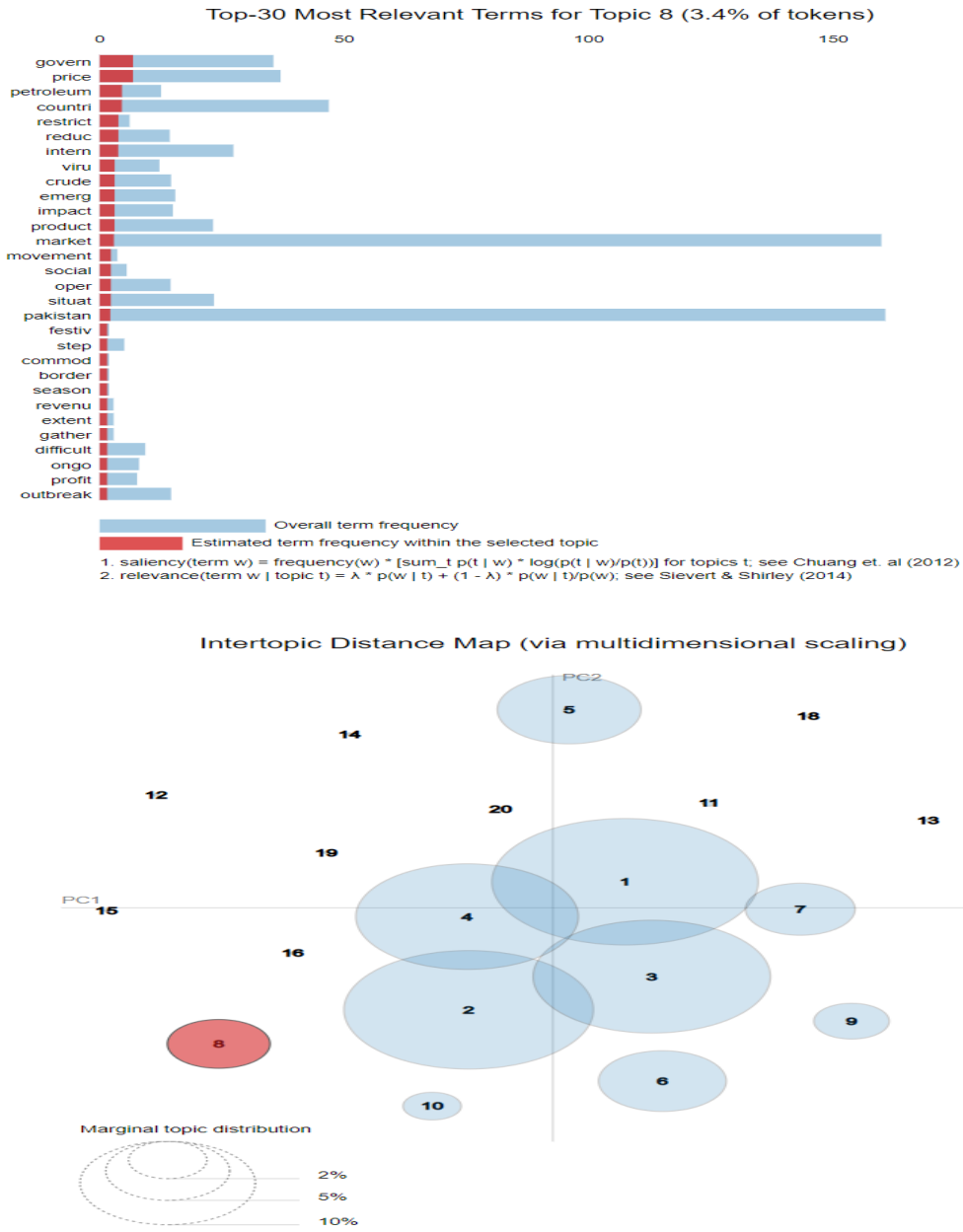
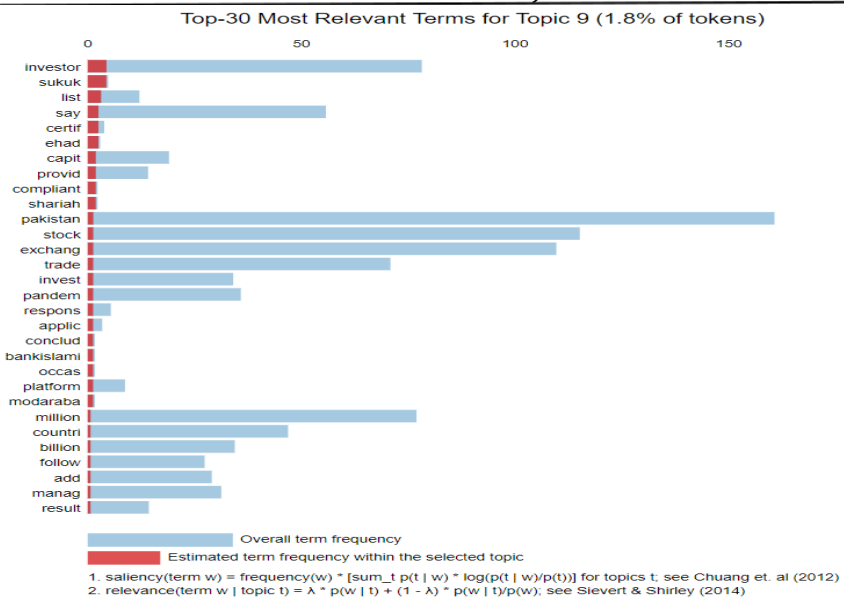


Figure 10: Impact of international petroleum and crude oil prices on stock market reaction



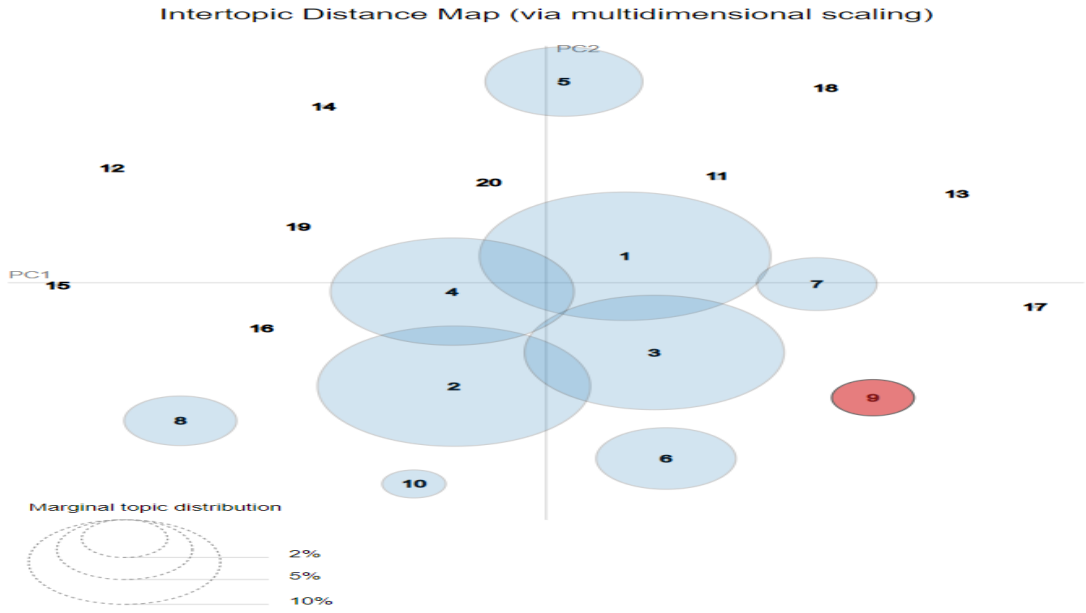


Figure 11: Impact of issuance of sukuk bonds on stock market reaction

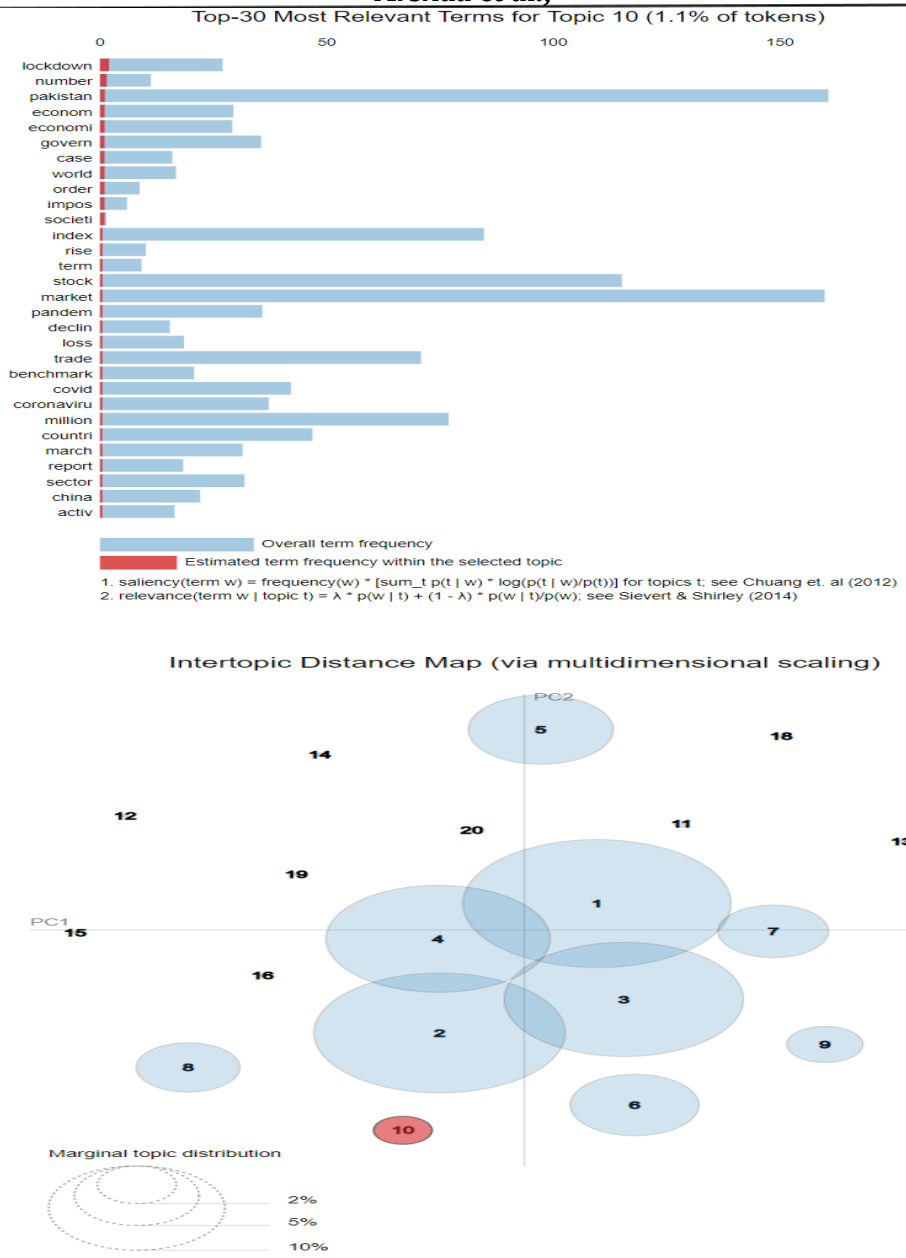


Figure 12: Impact of rise in international corona cases and international lock down on stock market reaction