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The Role of News Sentiments in the Connectedness of GCC Equity Markets

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ABSTRACT

This study examines the role of news sentiments in the GCC equity markets' connectedness. We collected news titles for the period from 22nd June 2006 until 31st December 2020 from Gulf News, which is the most widely read English newspaper in the Arab World. We filter these news titles using a carefully designed list of keywords that capture public sentiment on matters related to financial markets. Next, we classify the news titles to compute the geographically distinguished sentiment indexes that allow for a detailed analysis of the source of news sentiment spillovers to compare the impact of domestic versus regional sentiments on the equity markets of GCC countries. Our quantile regression results reveal that equity markets in the GCC are most sensitive to news sentiments when underperforming. Moreover, our results from the connectedness approach suggest that the UAE equity markets are most influenced by domestic sentiments, whilst the KSA equity market is most influenced by regional sentiments from the other GCC countries. Mixed results are found for other countries. The time-varying component of this study also shows that the influence of news spillovers intensified during the major crises events, including the COVID-19 outbreak.

KEYWORDS

Econometrics; international finance; Gulf Cooperation Council; spillover effects; crises handling; macroeconomics; news spillovers; sentiments analysis

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1. Introduction

Financial connectedness across equity markets has become an increasingly important topic due to the need for continuous improvements in macroprudential policies in crises handling situations. In today's world, financial markets can be highly integrated, such that an idiosyncratic shock to one market can impact other markets most connected to it. In the long term, macroeconomic variables such as the interest rates, exchange rates, money supply, as well as the oil prices could affect equity markets (Alshihab, 2021). Whilst greater international financial integration could be viewed as a symbol of globalization, higher connectedness could also expose equity markets to greater financial risk during crises events. Moreover, the market value of equities could exceed their fundamental value due to speculations, that can continually inflate equity prices until the bubble bursts, as it has been the case for the GCC countries (Manap and Omar, 2014). These speculators frequently follow related markets and news trends to not only to find arbitrage opportunities, but also to predict the performance of their own investments. Therefore, an underperforming equity market in a region could signal concerns and pessimism for its neighbors almost immediately. In the short term, an idiosyncratic shock could also occur due to a drastic change in the overall market sentiment (Smales, 2016; Dong et al, 2020; Wei et al, 2017; Hsu et al, 2021). However, depending on the intra-regional financial connectedness levels, a news sentiment that relates to other countries within the region may or may not affect the domestic equity markets.

Connectedness studies in financial research, aim to examine the flow of spillovers from one market to another, by examining the direction and magnitude of shocks. These shocks could be due to various unexplainable factors that impact returns and volatilities. Depending on various economic and geopolitical factors, markets may be net recipients or net transmitters of shocks at a certain point in time. Hence, the level of financial integration between equity markets may not remain static over-time and could significantly fluctuate across the different global and regional geopolitical events. Methods such as the one proposed by Diebold and Yilmaz (2014), allow us to examine the dynamic connectedness of financial markets and examine how the financial integration levels between certain markets have evolved over time. Therefore, although control variables for the source of shocks to these markets are not usually included in these studies, it may be possible to trace the source of the contagion by locating the major events that occurred at specific points on the timeframe.

Our study examines the role of news sentiments in the connectedness of GCC equity markets. Whilst the impact of news sentiments on equity markets has been examined by various authors, such as Smales (2016) Dong et al (2020); Wei et al (2017); Hsu et al (2021), our study is distinct as it compares between the impact of regional versus domestic news sentiments using a connectedness approach. In addition to examining the impact of news sentiments on equity market returns, our study would also examine the dynamic connectedness of GCC equity markets from a sentimental perspective. More specifically, our study would examine whether news sentiments from other countries within the region could influence the domestic equity markets, whilst also considering the impact of news sentiments relating to the individual country. Hence, for every GCC country, we shall construct two different types of sentiment indexes; a domestic index representing news sentiments relevant to that country, and a regional index representing news relevant to any of the other five countries within the region (excluding itself). Many researchers including Allen et al (2019) have shown that financial markets may be vulnerable to sentiments, differently across the different levels of returns. Hence, we would first consider the asymmetric impact of news sentiments on equity market returns, by applying quantile regressions. Subsequently, we shall apply the Diebold and Yilmaz (2014) dynamic connectedness approach that uses forecast error variance decompositions from vector autoregressive (VAR) models to examine the extent to which each GCC equity market is influenced by domestic and regional news sentiments.

Our study focuses of the GCC equity markets specifically since the GCC economies are an underexplored region in comparison with other emerging economies. Secondly, the GCC represents a well-defined cluster of six countries

that form an economic bloc, that could be seen as a version of the European Union within the Middle East. This prevents us from arbitrarily drawing a border around a cluster of countries for a study on regional connectedness. Thirdly, the GCC itself is a region of high economic growth, and an ever-changing environment that makes it interesting to explore. The region has one of the fastest-growing populations in the world, largely supported by global migration into the region. Over the past two decades, the populations of UAE, Kuwait, Qatar, and Bahrain have at least doubled due to the large inflow of migrants that represent more than half of the total population in each of these four GCC countries. Moreover, the GCC countries are now listed as "emerging economies" by major analyst groups such as the FTSE, MSCI, and S&P. These are the growing economies that fall between the status of developing and developed economies, classified by their newly industrialized status and a high economic potential.

Our study contributes to the growing literature on sentiment analysis and the connectedness of financial markets. To the best of our knowledge, this is the first study that explores the impact of news sentiments on the GCC equity markets, by distinguishing between regional and domestic news sentiments. Hence, our study provides an innovative approach to examining the regional connectedness of equity markets by using news sentiments. Empirical findings from our research provide useful insights on how domestic or regional news sentiments could influence equity market returns for each of the GCC countries. From our results, we could identify equity markets that are most susceptible to spillovers from news sentiment relating to other countries within the region, as well as their own. Moreover, we would learn more about how the influence of news sentiments could asymmetrically differ across the different quantiles of equity returns. Our dynamic connectedness study would also provide insights regarding the time varying impact of sentiments on equity markets throughout the major crises events that occurred over the 2006 – 2020 period. Our findings would aid policy makers in developing macro-prudential policies by learning more about the influence of regional and domestic news sentiments during crises events. Learning more about how equity markets respond to regional news sentiments would also assist investors in hedging and diversification across regional assets.

2. Literature Review

Recent literature has explored the topic of sentiment analysis in relation to equity markets and found varying results. Many researchers have argued that there is a strongly positive relationship between the news sentiments and stock market behavior (Smales, 2016; Dong et al, 2020; Wei et al, 2017; Hsu et al, 2021). Hsu et al (2021) further demonstrated that market news sentiments could be used to partially predict stock market behavior. They applied GARCH models and distinguished between the aggregate news sentiment and the sentiment of macroeconomic classified news. They found a strong association between the aggregate news sentiment and stock market volatilities. Furthermore, they applied the GJR-GARCH model to account for asymmetries and find that stock market volatilities are relatively more sensitive to negative aggregate news sentiments, especially during crises events. Meanwhile, Audrino et al (2020) found that although the sentiment variables are a significant contributor of volatility shocks, the magnitude of its impact, after controlling for other economic and financial variables, is relatively small. In another research, Calomiris and Mamaysky (2019) examined the impact of market news on equity returns for 51 developed and emerging economies and concluded that the effects of market news differ across and countries and over time.

Amongst many researchers, Ho et al (2013), Smales (2016) and Hsu et al (2021) demonstrate that negative sentiments have a stronger effect on the stock market behaviour compared to positive sentiments. Ho et al (2013) explored the inter-temporal relationship between news sentiments and return volatility of 65 firms listed on the Dow Jones Composite Average (DJN 65). The utilize two different GARCH models and differentiate their sentiments by the general macro-economic sentiments and the firm-specific sentiments and conclude that the impact of firm-specific sentiments on volatilities is relatively more persistent. They concluded that negative sentiments have a

greater impact on volatilities, compared to positive sentiments, indicating asymmetries and risk aversion amongst investors. In another research, Smales (2016) examined the relationship between news sentiments, implied volatility and stock returns using the news sentiments as an exogenous variable in a VAR framework. They found that sentiments have a positive relationship with returns and a negative relationship with implied volatilities. This means that a negative news sentiment could decrease stock returns and increase the implied volatilities. He also found asymmetries regarding the effect of sentiments on volatilities, such that negative sentiments had stronger impact on volatilities compared with positive sentiments.

Seok et al (2019) investigated how the impact of earnings news on stock prices varies with the firm-specific investor sentiment. They concluded that a positive earnings news has a stronger impact on stock prices of firms that have a high sentiment, compared to those that have a low sentiment, suggesting that investors are more optimistic towards the positive earnings news. On the contrary, the impact of a negative earnings news on stock prices does not significantly vary across firms with high or low sentiments. Another study on this topic was conducted by Mian and Sankaraguruswamy (2012) who also found that the impact of earnings on stock prices amplified during periods of high sentiment. However, their study showed that negative earnings had a greater impact during periods of low sentiment. They also added that the impact of sentiments was stronger for growth stocks, start-ups, non-dividend paying stocks, volatile and distressed stocks.

Another type of asymmetry found in the research was regarding the effect of news sentiments on stock market returns that differed across the different levels of returns. Allen et al (2019) used Quantile Regression (QR) to investigate the effect of daily news sentiments during periods of relatively high or low returns. Their results show that the coefficient of sentiment scores is significant across all DJIA stock returns when the returns are low, measured as 5% and 25% quantiles, however, this is not the case for when the returns are high, measured as 75% and 95% quantiles. Therefore, their research show that market sentiments could become more significant during times of financial distress, where investors follow the news more so than they normally would. Hence, future research on the topic should consider the possibility of such non-linearities. Allen et al (2019) analyzed the impact of daily aggregated market news sentiments on returns of stocks that are traded in the Dow Jones Industrial Average (DJIA). They use OLS regressions with the inclusion of up to 5 lags of the sentiment score, as well as the squared sentiment score. The squared term is particularly insightful since the sentiment score is structured as a value between -1 and +1, to capture negative and positive polarities. Therefore, the squared term would be higher for extreme values, capturing the magnitude of the sentiment score. Additionally, they also included the Fama-French factors to capture the market effects and concluded that despite the inclusion of other factors, market sentiments were still frequently significant and captured nearly 5% of the variation in returns, in addition to the 50 – 60 % of the variations that were captured by other market factors.

The causal relationship between sentiments and their effect on stock market returns and volatilities was confirmed by Wei et al (2017), who constructed daily, weekly, and monthly aggregate news sentiment indexes to examine against the equity market responses in Taiwan. By conducting Granger causality tests, they conclude that market sentiments influence stock market behavior with a lag. Therefore, the investors could take advantage of the delayed response by keeping track of the publicly available information that influences stock market returns and volatilities. To test for the robustness of their results over time, they separated their sample into sub-periods and found that the effect of news sentiments on stock markets was also consistent across the time periods. Lee (2020) also found that markets, generally react to certain sentiments with a lag, hence there are arbitrage opportunities that could be exploited through predictions from sentiment analysis. He explored the effect of sentiments on stock markets during the initial outbreak of the COVID-19 pandemic in the United States. He examined five terms using the frequencies from Google search: “coronavirus’, “laid-off”, “unemployment”, “recession” and “vaccine”, each of which, were compared against separate industries. Research by Wei et al (2017) and Lee (2020), both support the

existence of arbitrage opportunities and their results point towards the benefits of carefully examining market sentiments that could be used as a tool to partially predict stock market behavior.

The effect of sentiments on stock markets may differ during a global pandemic. Valle-Cruz et al (2022) examined the relationship between Twitter sentiments and stock market behaviour of major global indexes, during two of the global pandemics (COVID-19 and H1N1). They found that the impact of Twitter sentiments on the financial indexes was more significant during the COVID-19 pandemic, compared to the H1N1 pandemic, potentially due to a relatively greater number of speculations, rumors and negative news during the COVID-19 pandemic. Amongst the most influential Twitter accounts that presented a very high correlation of their sentiments with stock market behaviour, were renowned news sources such as the New York Times and CNN, in addition to Bloomberg and Investing.com. This raises the importance of the news sentiments as potential determinants of regional stock market behaviour.

In a discussion on the source of market sentiments that could affect stock market behavior, the research by Dong et al (2020) would be a worthy mention as they compared two major sources of sentiments: news and blogs. They analyzed the impact of news sentiments and microblog sentiments on two major stock exchanges in China; Shanghai and Shenzhen. In their analysis, they conducted a series of Granger causality tests, and found a bi-directional causal relationship between news sentiments and stock market behavior. On the contrary, a unidirectional causal relationship was found for microblog sentiments, flowing from stock markets to the microblogs. The results make intuitive sense, due to the higher authority of news over microblogs, such that investors may follow the news more closely that influences their investing decisions, whilst microblogs would subsequently explain anomalies in stock markets after they have occurred. Their findings suggest that it would be a better idea to consider the news as a potential predictor of stock market behavior compared to other text-based content such as blogs.

Existing research on sentiment analysis also includes research on the real estate market in the United States, utilizing news elements filtered using a keyword “real estate”, which was used to extract relevant content for compilation of pessimism and optimism indicators (Hausler et al, 2018). Given that each period is likely to have a different number of headlines relating to “real estate”, the “pessimism indicator” was computed by dividing the number of negative headlines during each period, by the number of total headlines for the respective period. Accordingly, the “optimism indicator” was computed by dividing the number of optimistic headlines by the number of total headlines. In addition to these two indicators, they also computed a “sentiment quotient” that represented the level of optimism for each period by dividing the number of positive headlines, by the number of positive and negative headlines, both. This quotient is therefore, not impacted by the number of neutral headlines that may be published during each period. The methodology used in their econometric analysis involved Vector Autoregressive (VAR) models applied on stationary variables. Results showed that the relevant news headlines can significantly influence the real estate markets. This is also verified in their analysis by application of Granger causality tests.

One of the factors that are important to consider when reviewing the existing literature, is that many researchers have used specialized newspapers that cover a particular sector, yet do not represent the general public sentiment. For instance, Hausler et al (2018) gathered their headlines from the S&P Global Market Intelligence platform. Meanwhile, another research by Bourezk et al (2020) gathered their data from six different online news websites, that specifically provide financial and economic information that is read by a limited proportion of the population. They’ve suggested that future research could benefit from covering headlines from a newspaper source that is widely read across the region. Moreover, the neuro-linguistic programming software are not as developed for languages other than English, providing a natural preference to choose English newspapers (if the option is available). As mentioned by Bourezk et al (2020), who covered the news content for Morocco, the “subtleties” and “diversity” of the French language, could add another layer of complexity when computing sentiments from text-

based data. Hence, to better capture the overall market segment, our research would gather data from Gulf News, which is the most widely read English newspaper in the Middle East (Forbes Middle East, 2012).

Whilst most research in the field of sentiment analysis in relation to financial markets is relatively recent, the amount of research conducted on this topic with regards to the COVID-19 is relatively scarce. Amongst these research works is a working paper published by Costola et al (2020), that evaluates the impact of COVID-19 related sentiments on the S&P 500 Index. Doing so, they gather data from three different sources; Market Watch, NY Times, and Reuters. The inclusion of three major news sources, allows them to extract a large number of articles, precisely 203,886 online articles that are related to the pandemic. The amount of optimism or pessimism offered by these online news resources is found to be very significantly related to equity market performance in the short run, such that positive news is likely to positively impact the S&P 500 Index, and vice versa. Moreover, the authors have also indicated that increase variance in the news sentiments, representing uncertainty in the news, may also be linked with negative performance in the equity markets. Our research would explore the interconnectedness between these sentiments and the equity performance of the GCC stock markets by using forecast error variance decompositions, effectively involving volatilities, to explore this issue for the GCC region.

In general, researchers have adopted a wide variety of ways to explore the impact of sentiments on equity markets. This is due to the largely heterogenous text-based datasets that are available to different researchers. There are also many packages available that rate sentiment scores on a different scale. Due to the lack of a universal standard for research on this topic, it could be challenging to make the most suitable choices arbitrarily. Nonetheless, this provides us the opportunity to be creative in devising a suitable methodology that best contributes towards achieving the aim of this research.Text.

3. Data Collection and Description

We use daily news titles that are published with varying frequencies every day, to compute the weekly sentiment indexes for our study. We extract these news titles for the period from 26th June 2006 to 31st December 2020, from “Gulf News”, which is the most widely read English-based newspaper in the Arab World (Forbes Middle East, 2012). Moreover, Gulf News is the only English newspaper on the list of “Top 10 Newspapers in the Arab World” by Forbes Middle East, ranking 3rd whereby the first two; “Al-Ahram” and “Al-Youm Al-Sabe’a” are not based in the GCC. In terms of readership, the source further cites 77.11 annual online visits to Gulf News, which is larger than the combined total visits of the next two largest English newspapers; The National and Khaleej Times. Due to its large audience and exposure, Gulf News titles can serve as a proxy for news in the GCC, since the newspaper covers relevant news items from across the Gulf. Launched in Dubai during 1978, Gulf News gained popularity across the Gulf and began distribution to other GCC countries starting with Bahrain in 1987 (Gulf News, 2015).

Another reason why Gulf News is advantageous is due to being accessible in the English language, since it is simpler to apply neuro linguistic programming packages that are specifically designed for text based in English. Hence, these packages can be applied directly to the text without the need for translation (resultantly avoiding any translation errors). In total, we gather 309,534 news titles from the ProQuest online database[1], where Gulf News titles are updated on a daily basis. Over the sample period, the news titles are unevenly distributed, such that the average number of news titles published per day is 58, whilst this number varies with a standard deviation of 29. Moreover, the frequency is higher over the recent years. We address this problem by computing sentiment scores that are not impacted by the frequency of news titles published; by computing the weekly average scores. Figure 1 exhibits the daily frequency distribution of news titles over the timeframe of our study.

[1] https://www.proquest.com/.

We collect the data for the GCC equity markets from the MSCI online database[2] for country-level indexes, covering the same time period as the news titles, from 26th June 2006 to 31st December 2020. The equity index for each country represents its primary stock market, except for the UAE's equity index, which represents its two major stock markets; Dubai Financial Market (DFM) and the Abu Dhabi's Financial Market (ADX). These indexes are plotted in Figure 2.

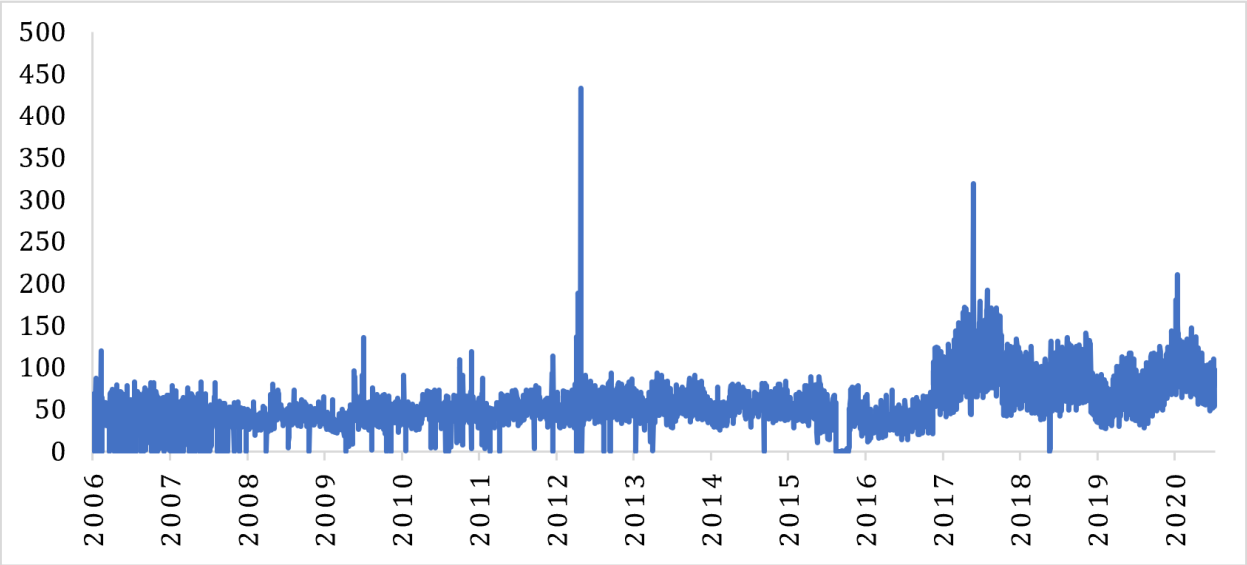

Figure 1. Daily frequency of news items.

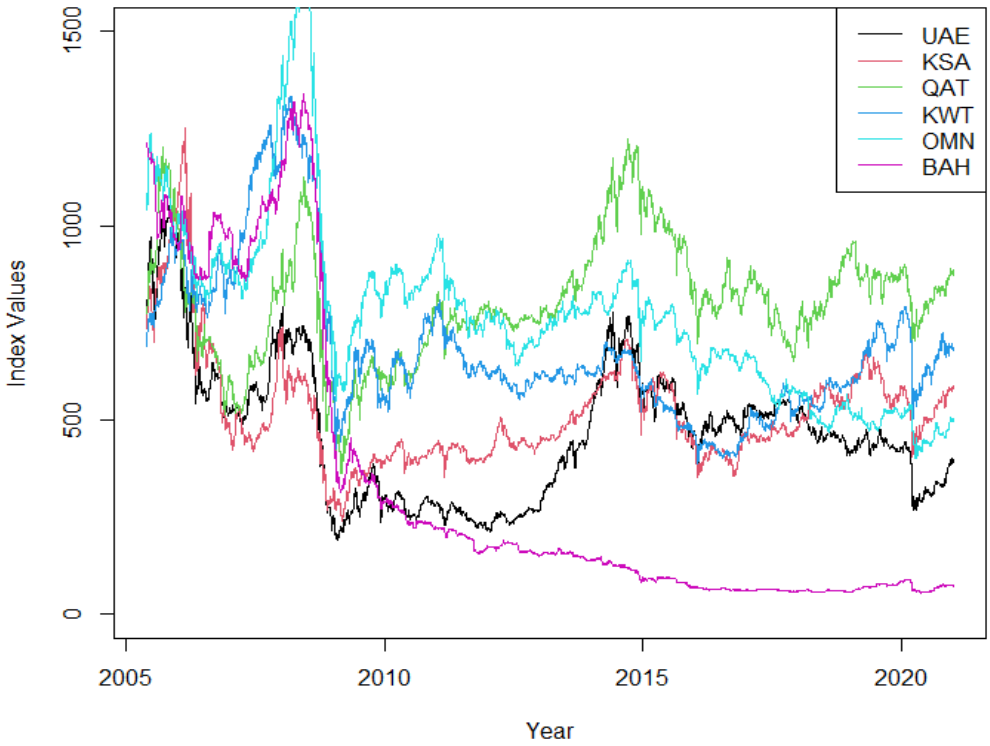

Figure 2. MSCI Equity Indexes for GCC Countries.

In order to extract the return on these indexes, we compute the daily geometric growth rate by taking the first

[2] https://www.msci.com/end-of-day-data-search.

difference for each index variable P_it and dividing it by P_it in order to generate the series: $r_{it} = (P_{it} - P_{it-1})/P_{it}$. We utilize resultant series as the country-wise equity market returns in our study. The descriptive statistics of these indexes are provided in Table 1, followed by the plots in Figure 3.

Table 1. Descriptive Statistics for the Daily Returns of the GCC Countries' Equity Indexes.

	UAE	KSA	QAT	KWT	OMN	BAH
Mean	-0.0003	-0.0002	-0.0001	-0.0001	-0.0003	-0.0008
Median	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	0.1675	0.1498	0.1066	0.0838	0.1030	0.1086
Minimum	-0.1783	-0.1853	-0.1431	-0.2576	-0.1930	-0.1971
Std. Dev.	0.0169	0.0156	0.0139	0.0132	0.0116	0.0128
Skewness	-1.1549	-1.8734	-1.2033	-2.9424	-2.1866	-2.5444
Kurtosis	19.0683	25.5412	19.3965	50.6565	43.0232	40.8569

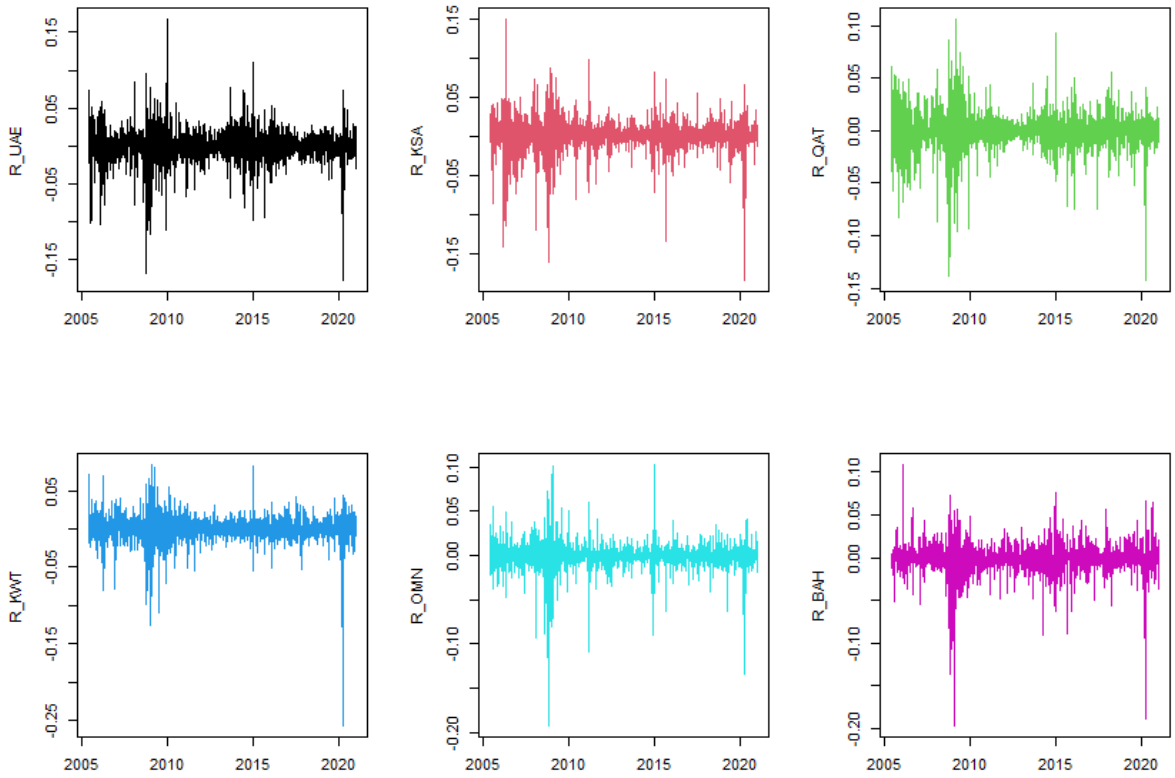

Figure 3. Daily Returns of the GCC Countries' Equity Indexes.

4. Methodology

The methodology in this research involves a number of processes that are implemented to extract sentiment indexes that are relevant and robust. The sequential flow of these processes is summarized as a methodology flowchart in Figure 4. Subsequently, the methodology is further detailed in three sub-section: Section 4.1 details the filtration process utilized to extract relevant news titles in preparation of our dataset for the construction of the geographically distinguished sentiment indexes. Section 4.2 details the construction of domestic and regional weekly sentiment indexes. Finally, Section 4.3 details our econometric methods for the data analysis. This analysis is based on weekly indexes, due to the following:

- Whilst the daily sentiment index could provide us with a large number of observations, there could be many

missing values during time periods with lower daily frequencies.

- The sentiment index could be disproportionately impacted by individual news items based on the daily frequencies.
- The daily sentiment index would include data from 7 days a week, whilst the daily equity market indexes include data from 5 days a week, resulting into a mixed frequency problem. Weekly sentiments solve the mixed frequency problem, whilst providing a greater frequency of observations compared to monthly indexes.

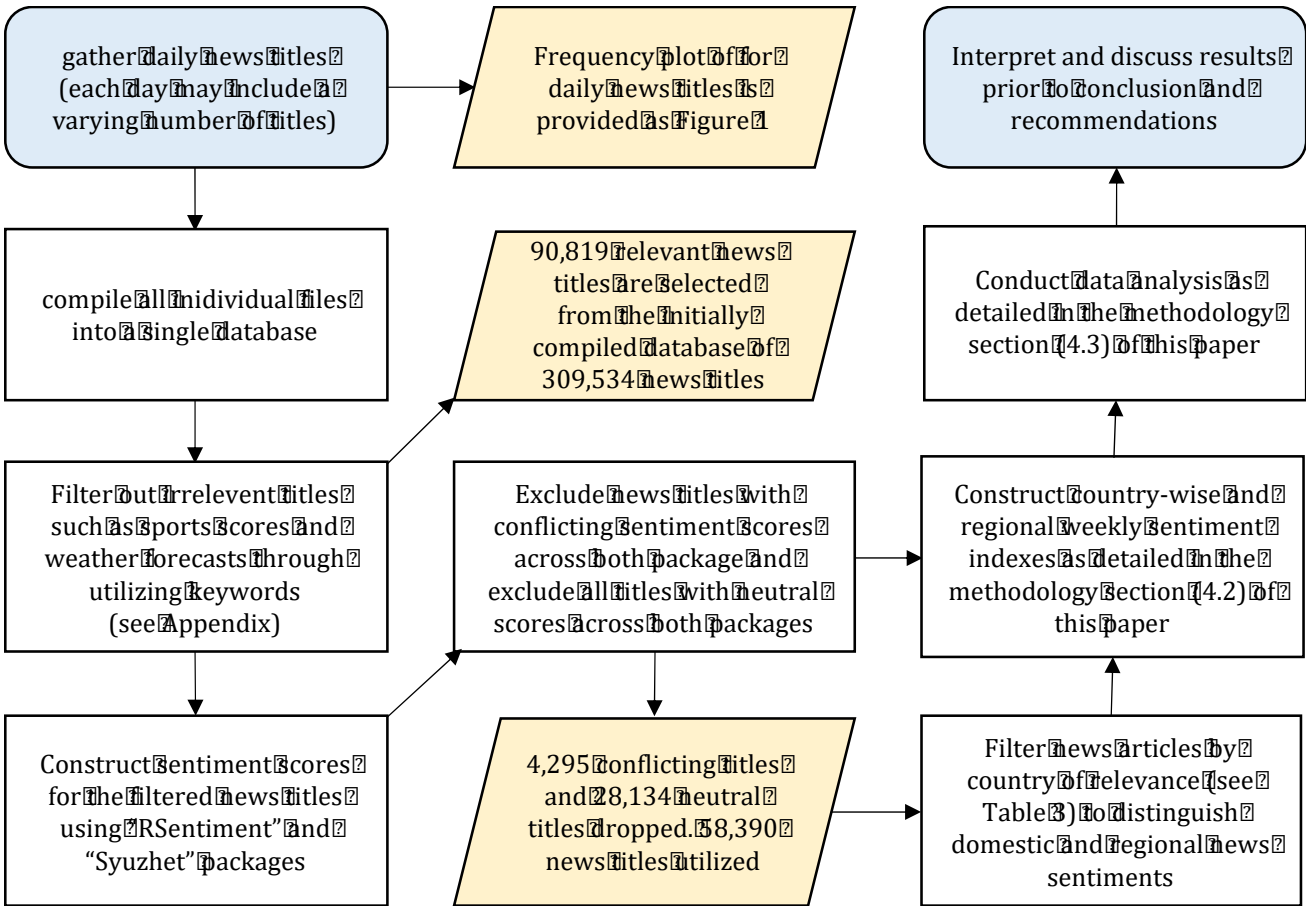

Figure 4. Methodology Flowchart.

4.1. Filtration of News Titles for Sentiment Indexes

Mittal and Goel (2012) used keywords in their study, filter and consider terms that represented feelings, such as "feel", "makes me", "I'm", or "I am". Whilst this process reduced the number of observations, it helps extract the most relevant sentiments to eliminate noise from the data series. By filtering our news titles, we are subsequently able to construct sentiment indexes that best reflect the investor's sentiment. Hence, we first aim to drop irrelevant titles that may carry sentiment scores, yet not impact the equity market behaviour in any way, such as the titles on: food recipes, horoscopes, sport match performance updates, and so on. Therefore, our goal is to extract a subset of the total number of news titles, that are best related economics, business and finance. Accordingly, we devise a list of 100 keywords with the help of finding synonymous terms from thesauras.com that would help us filter topics in economics, business and finance. We search for the presence of these keywords across the news titles, as well as the "subject terms" column, provided by the ProQuest online database that categorizes each news item by subjects. Searching for the keywords across both columns helps prevent any relevant news items from being excluded from our analysis. Table 2 exhibits the list of the top ten keywords and their occurrences across both columns. An

extensive list of the 100 keywords chosen for the filtration process, is shown in the Appendix.

Table 2. Frequency of top keywords in the "title" and "subject terms" columns.

Top keywords in the "title" column			Top keywords in the "subject terms" column		
Rank	Keyword	Frequency	Rank	Keyword	Frequency
1	bank	4111	1	industr	8065
2	market	3744	2	econom	6850
3	invest	3688	3	bank	6771
4	business	2719	4	financ	6448
5	profit	2330	5	market	6192
6	price	2150	6	employ	4614
7	econom	2109	7	invest	4546
8	pay	2023	8	product	4008
9	fund	1864	9	stock	3977
10	trade	1863	10	pandemic	3933

After the above process, we are left with a total of 90,819 potentially relevant news items. These filtered entries are used to compute the sentiment scores in our study. These scores would reflect the level of optimism, neutrality or pessimism for each individual news item. Next, these news items would be filtered based on their geographic relevance, by using keywords including the country's name, abbreviation, names of its largest cities and the name of its capital city (refer to Table 3). Similar to the previous filtration process, we search for these keyword matches across both, the news title column and the subject terms' column.

Table 3. Keywords used in filtering country-wise news items.

Country	Keywords
UAE	UAE; United Arab Emirates; Dubai; Abu Dhabi; Sharjah; Ajman; Fujeirah; Ras Al Khaimah; Umm Al Quwein; Al Ain
KSA	KSA; Saudi; Riyadh; Jeddah
Qatar	Qatar; Doha
Kuwait	Kuwait
Bahrain	Bahrain; Manama
Oman	Oman; Muscat

So far, we have summarized the raw data, collected from "Gulf News" for over a decade and a half, and detailed the filtration process to extract relevant news items and categorized them by country as well. Next, we shall detail our approach to the construction of sentiment indexes.

4.2. Construction of Sentiment Indexes

For each news item, we initially compute the sentiment scores using two different packages: "Syuzhet" and "RSentiment". After a manual review of a sample of a hundred news items, "RSentiment" seemed to provide more accurate sentiment scores. Moreover, "RSentiment" is a specialized package that reviews polarity (positive or negative) of sentiments and returns the value of zero for neutral sentiments. Additionally, "RSentiment" filters out news items that provide an unclear message such as those ending with question marks are marked as sarcasm and not ranked by polarity. This helps us avoid Type I and Type II errors in the context of positive or negative sentiments. Nonetheless, scores from both packages show a high correlation (75%), indicating that one could be effectively used as a proxy for another. The reason for not having a perfect correlation could be largely explained by news items marked polar (positive or negative) by one package and neutral by another. Accordingly, we found some news to be marked with opposing polarities by the two packages. When manually reviewing these titles, it was apparent that

most of these news items offered mixed messages with both positive and negative polarities, causing conflicting results across both packages as they adopt differing approaches to sentiment scoring. Therefore, it was considered best to exclude these titles for robustness of our study. After doing so, our number of observations fell from 90,819 to 86,524 (a decline of 4.7%). Moreover, we also excluded the news titles with neutral sentiments. This is since frequencies of news titles have changes over time and neutral news items may create unnecessary noise in the sentiment indexes. After dropping the neutral news titles, we are left with 58,390 news items that we use to compute the sentiment indexes.

To compute the weekly sentiment indexes, we first proceed with computation of the daily sentiment indexes by taking the daily arithmetic means of all relevant sentiment scores for each day. The process is repeated six times for the country-wise filtered sentiment scores representing each of the six GCC countries. We then use the resultant series for the general daily sentiment index and the country-wise daily sentiment indexes to construct weekly sentiment indexes by taking weekly arithmetic means. Regional sentiment indexes are computed separately for each GCC country such that the inclusion criteria for every news sentiment excludes the country itself. For instance, the regional index for Kuwait, would include sentiments relevant to the other five GCC countries; UAE, KSA, Qatar, Bahrain and Oman. This approach allows us to compare between the inflow of sentiment spillovers from within a country and the inflow of sentiment spillovers from other countries within the region. Accordingly, countries that are highly connected intra-regionally, could be expected to exhibit evidence of sentiment spillovers from other countries within the region. Figure 5 exhibits our general weekly sentiment index spanning over the 759 weeks of our study.

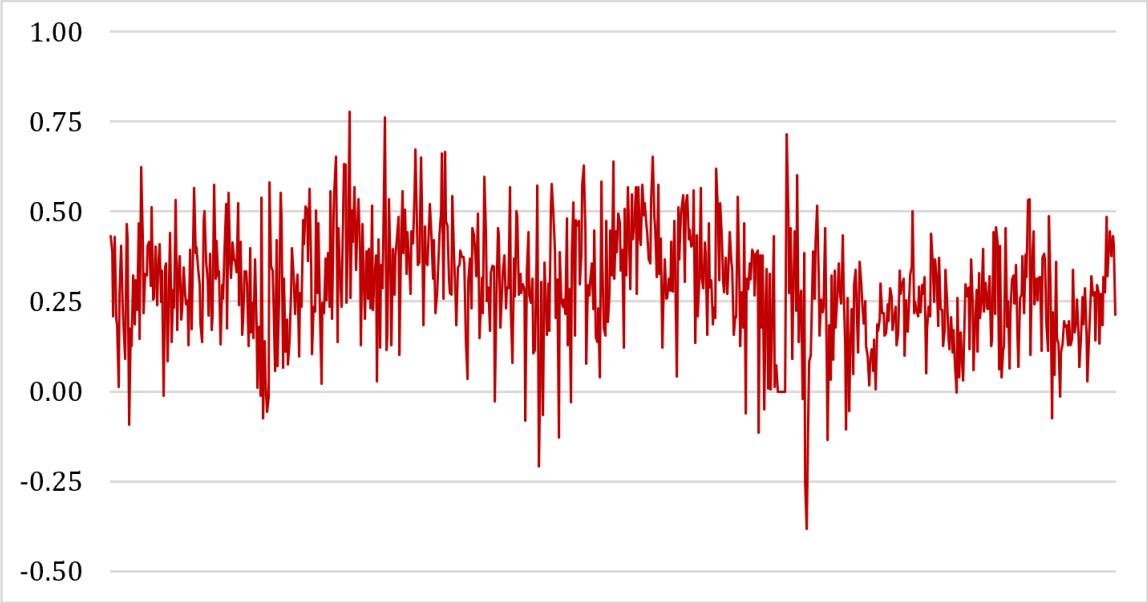

Figure 5. General Weekly Sentiment Index.

4.3. Data Analysis

Two different econometric approaches would be applied for the data analysis in this paper. First, we estimate quantile regression (QR) models, to examine the overall relationship between equity market returns and sentiment indexes, whilst accounting for asymmetries. Second, we use forecast error variation decompositions generated from VAR models, to extract the proportion of forecast errors, explainable by news sentiments, based on the Diebold and Yilmaz (2014) approach. This would provide insights on the intra-regional connectedness of the GCC equity markets

through domestic and regional news sentiment spillovers.

Quantile regressions are of particular importance in this study, since they provide the benefits of the linear regression models, whilst also enabling us to consider the asymmetries that could be prevalent in studies involving sentiment analysis. As suggested by Allen et al (2019), we apply quantile regression models to examine the asymmetric impact of news sentiments for the 10th, 25th, 50th, 75th, and 90th quantiles of equity market returns. The quantile regressions are also computed as linear regression models, generating a new class of statistics labelled "regression quantiles", introduced by Koenker and Bassett Jr (1978). Similar to simple linear regression models, which minimizes the sum of squared errors $\sum_i {e_i}^2$, the quantile regression model minimizes the following, where q is defined as the quantile being estimated. Hence, the minimization problem, penalizes for underprediction, using the term $q|e_i|$ and for overprediction, using the term $(1-q)|e_i|$.

$$\sum_i q|e_i| + \sum_i (1-q)|e_i| \,; 0 < q < 1 \tag{1}$$

By implementing the above, into a quantile regression model, defined as $y_i = x_i'\beta_q + e_i$, where β_q the coefficient estimator for the quantile "q", we obtain the following minimization problem:

$$\sum_{i:y_i \geq x_i'\beta} q\left|y_i - x_i'\beta_q\right| + \sum_{i:y_i < x_i'\beta} (1-q)\left|x_i'\beta_q\right| \tag{2}$$

The quantile regression coefficients β_q for each of the five selected quantiles across the six countries, are of particular importance as they would provide insights on how the impact of domestic and regional sentiments varies across the different quantiles of domestic returns.

Subsequently, we apply the Diebold & Yilmaz (2014) approach to examine the connectedness between equity market returns, domestic sentiments, and regional sentiments, for each of the six GCC countries (repeating the approach six times). The Diebold and Yilmaz (2014) approach, uses forecast error variance decompositions (FEVD) from Vector Autoregression (VAR) models to examine the dynamic connectedness between time series variables. This method adopts VAR models with a moving average (MA) component that helps capture the persistence of shocks. This MA component is given by $X_t = \varphi(L) * \varepsilon_t$, Where $\varphi(L) = (I - AL)^{-1}$. Furthermore, we denote the unique lower triangular Cholesky factor of the covariance matrix of ε_t by ${Q_t}^{-1}$. Based on these formulations, we can rewrite the equation for X_t as:

$$X_t = \varphi(L){Q_t}^{-1} * Q_t\varepsilon_t \tag{3}$$

Moreover, by introducing $K(L) = \varphi(L){Q_t}^{-1}$ and $u_t = Q_t\,\varepsilon_t$, Equation 3 can be rewritten as $X_t = K(L) * u_t$. Now, we consider a one-step ahead forecast for a three variable vector that is represented by $\hat{X}_{t+1} = A * X_t$. The forecast error $\epsilon_{t+1,t}$ would be given by:

$$\epsilon_{t+1,t} = X_{t-1} - \hat{X}_{t+1} = K_0 * u_{t+1} = \begin{bmatrix} a_{1,1} & a_{1,2} & a_{1,3} \\ a_{2,1} & a_{2,2} & a_{2,3} \\ a_{3,1} & a_{3,2} & a_{3,3} \end{bmatrix}_0 \begin{bmatrix} u_{1,t+1} \\ u_{2,t+1} \\ u_{3,t+1} \end{bmatrix} \tag{4}$$

The coefficient matrix in Equation 4 can explain the extent to which, the errors are explainable by shocks occurring to other variables. More specifically, $a_{i,j}$ would represent the proportion of variations in variable i, that could be explained by variations in variable j (where $i \neq j$). Hence, the non-diagonal row sums representing the total inflow of spillover overs from others, whilst the non-diagonal column sums would represent the total outflow of spillovers to others. Furthermore, the diagonal elements of the matrix would each, represent the proportion of

forecast error variations within a particular series resulting occurring due to unexplained idiosyncratic factors. And since $E(u_t u_t') = I$, the covariance matrix of $\epsilon_{t+1,t}$ is given by $E(\epsilon_{t+1,t}\epsilon'_{t+1,t}) = K_0 K'_0$. This suggests that the sum of elements in K_0 equals to $trace(K_0 K'_0)$, and therefore, the one-step ahead total spillover index for a certain number of N variables is given by:

$$S = \frac{\sum_{i,j=1}^{N} a_{0,ij}}{trace(K_0 K'_0)} * 100, where\ i \neq j \quad (5)$$

For an H-step ahead forecast, the index would be:

$$S = \frac{\sum_{h=0}^{H-1}(\sum_{i,j=1}^{N} a_{h,ij})}{\sum_{h=0}^{H-1} trace(K_h K'_h)} * 100, where\ i \neq j \quad (6)$$

The total spillover index is a dynamic series that is expected to vary over time throughout the major geopolitical events. Therefore, the spillover index could be estimated repeatedly on a rolling sampling basis for an equal sample width of t, to forecast H number of weeks, repeated after every H weeks, as illustrated in Figure 6. After reviewing the literature by Diebold and Yilmaz (2009) covering weekly data, and considering various combinations of the forecast horizons and sample widths, we carefully select the parameters at $H = 4$ and $t = 50$. These parameters for weekly data ensure sufficient variability to capture short term impacts whilst maintaining accuracy of the forecasts.

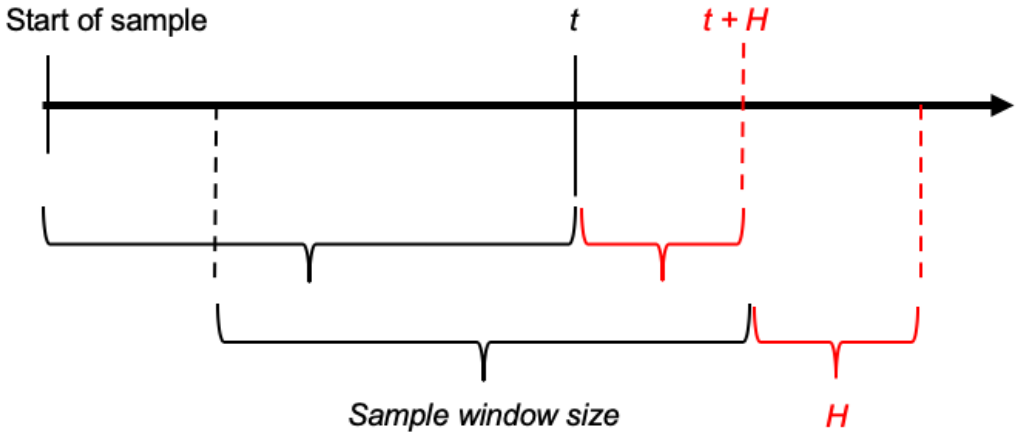

Figure 6. An illustration of the rolling sample analysis.

5. Results and Discussion

Existing research has shown that news sentiments could play a vital role in predicting equity market behaviour (Smales, 2016; Dong et al, 2020; Wei et al, 2017; Hsu et al, 2021). In an interconnected environment, it would be fair to hypothesize that not only the domestic news sentiments but the regional news sentiments could also impact the domestic equity market behaviour. Accordingly, when exploring the impact of sentiment spillovers on equity markets in this paper, we also consider the potential impact of sentiment spillovers from other countries within the region. Doing so, we explore the topic using two different econometric methods. First, we construct quantile regression models that examine the impact of domestic or regional news sentiments whilst taking asymmetries into account by use of different regression quantiles. Second, we apply the Diebold and Yilmaz (2014) approach that helps us to explore the dynamic connectedness of GCC equity markets through news sentiments, and compare between the time-varying inflow of spillovers from domestic versus regional sentiments.

5.1. Quantile Regression Models

To examine the asymmetric effects as suggested by Allen et al (2019), we apply the quantile regression approach to explore how news sentiments impact equity market returns at the 10th, 25th, 50th, 75th, and 90th quantiles. Hypothetically, investors may be likely to react to the same news, differently, based on the current performance of the market. If the market is performing poorly, the investors' decisions may naturally become more susceptible to news sentiments. Our results from the quantile regression models for each of the GCC countries, are summarized in Table 4, followed by the quantile regression plots shown in Figure 7. The quantile regression plots graphically illustrate how the coefficient estimators for the quantile regressions vary across the different quantiles for each of the six GCC countries. The quantile regression output also enables us to compare between the asymmetric effects of domestic versus regional sentiment indexes. This helps us better understand precisely which of the domestic or regional sentiment indexes significantly impact the equity markets across the different quantiles examined.

Table 4. Quantile Regression Output.

Dependent Variable: Equity Return							
Method: Least Squares							
Sample: 6/26/2006 to 12/28/2020							
Included observations: 758							
Variable	Quantile	UAE	KSA	QAT	KWT	BAH	OMN
Constant	0.10	-0.0075	-0.0075	-0.0065	-0.0053	-0.0066	-0.0049
	l t-Stat. l	14.213***	14.562***	13.609***	16.078***	15.654***	15.030***
	0.25	-0.0035	-0.0027	-0.0027	-0.0026	-0.0027	-0.0021
	l t-Stat. l	11.324***	8.885***	10.719***	12.302***	13.476***	11.540***
	0.50	0.0001	0.0005	0.0002	0.0001	-0.0002	0.0000
	l t-Stat. l	0.491	2.559**	0.9801	0.645	1.386	0.468
	0.75	0.0040	0.0032	0.0032	0.0028	0.0021	0.0023
	l t-Stat. l	12.976***	13.660***	13.860***	13.409***	10.109***	10.776***
	0.90	0.0081	0.0064	0.0068	0.0059	0.0050	0.0053
	l t-Stat. l	18.328***	16.380***	14.653***	15.412***	14.848***	18.062***
Sentiment	0.10	0.0014	0.0012	0.0010	0.0000	0.0012	0.0000
	l t-Stat. l	2.771***	3.295***	2.472**	0.181	2.839***	0.087
	0.25	0.0007	0.0001	0.0006	0.0000	0.0000	0.0000
	l t-Stat. l	2.355**	0.451	2.594***	0.136	0.004	0.165
	0.50	0.0005	0.0000	0.0003	0.0000	0.0000	0.0000
	l t-Stat. l	1.846**	0.112	1.821*	0.428	0.154	0.230
	0.75	0.0012	0.0000	0.0002	0.0004	0.0001	0.0000
	l t-Stat. l	3.860***	0.022	0.745	1.948*	0.811	0.251
	0.90	0.0012	-0.0001	0.0006	-0.0001	0.0000	0.0005
	l t-Stat. l	3.373***	0.348	1.671*	0.521	0.090	1.611
GCC Sent.	0.10	0.0005	0.0012	0.0006	0.0009	0.0008	0.0010
	l t-Stat. l	1.231	2.114**	1.263	2.460**	1.635*	3.418***
	0.25	0.0005	0.0009	0.0003	0.0004	0.0003	0.0000
	l t-Stat. l	1.795**	2.681***	0.977	1.727*	1.813*	0.458
	0.50	0.0000	0.0005	0.0002	0.0003	0.0004	0.0000
	l t-Stat. l	0.329	2.828***	0.837	2.212**	2.099**	0.256
	0.75	0.0000	0.0002	0.0002	0.0005	0.0005	0.0000
	l t-Stat. l	0.322	0.955	0.765	2.459**	2.560**	0.420
	0.90	-0.0005	0.0001	0.0002	0.0004	0.0006	0.0004
	l t-Stat. l	1.229	0.330	0.510	0.919	1.742*	1.979**

*Notes: ***, **, and * represent statistical significance levels at 1%, 5% and 10%, respectively.*

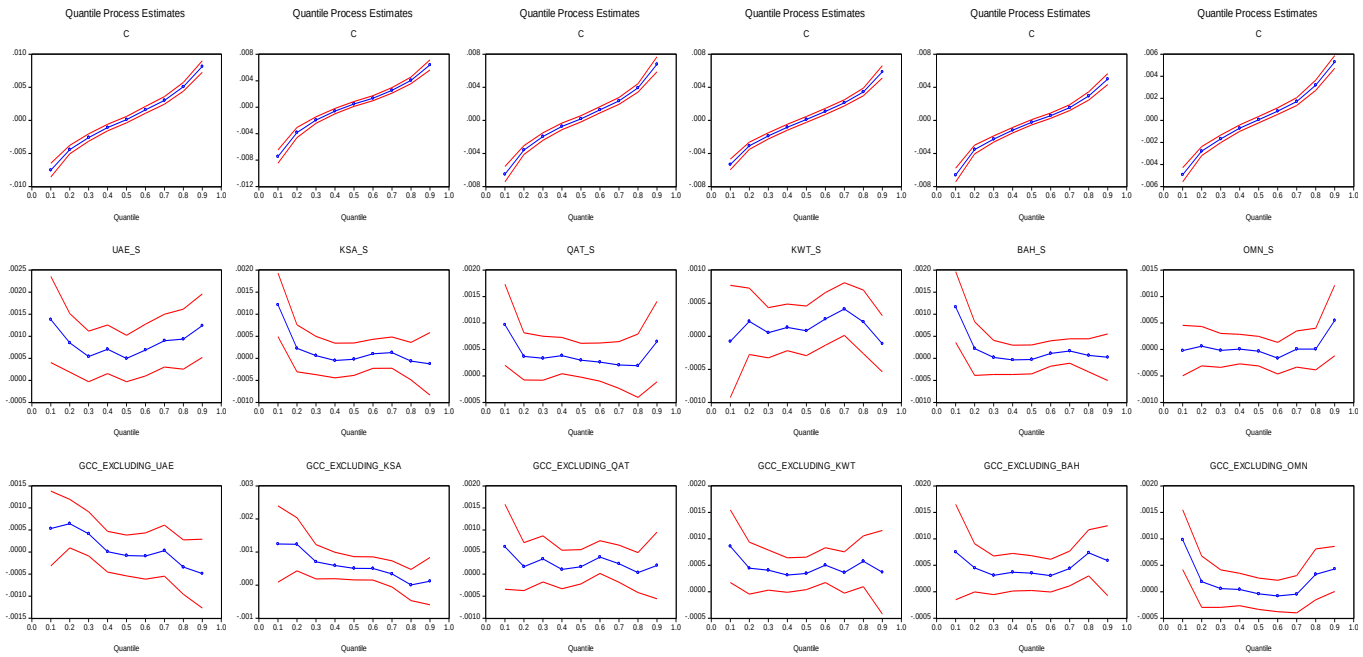

Figure 7. Quantile Regression Plots.

The quantile regression plots are illustrated for each of the six GCC countries. Confidence intervals at computed at the 95% confidence level.

Based on our results, the UAE equity markets are statistically significantly impacted by domestic sentiments across all quantiles, although the magnitude of the impact is highest for extremely high and low values of equity market returns. This indicates that investors in the UAE pay closest attention to the market news, when the market is performing away from average. Moreover, the UAE equity markets respond to domestic news sentiments across all quantiles, whilst the regional news sentiments become relevant only where the equity market performs below average. The impact of news sentiment spillovers when the market is performing below average, is also found to be stronger, compared to the impact when the market is performing above average, for all GCC countries. For the Saudi equity market, the impact of regional spillovers however, is statistically significant across the 10th, 25th, and 50th percentiles, suggesting that investors in Saudi Arabia are more cautious of the regional news when the market is either performing poorly, or at average, and not so much, when the market is performing better than average. Moreover, the Saudi equity market is most significantly affected by the domestic sentiment spillovers, when the market is performing very poorly, at the 10th percentile.

Results for Qatar, reveal that the Qatar stock exchange is most significantly affected by domestic sentiment spillovers, when compared to regional spillovers. The Qatar's equity market reacts to domestic news sentiments at the 10th, 25th, 50th, and 90th percentile, suggesting that whilst the investors would closely follow the domestic news when the market is performing at average or below, they may also react to news sentiments, when the market is performing excellent (at the 90th percentile). Hence, this indicates that news may not only impact the "buy or sell" decisions of investors when the market is performing poorly, but also influence the investor in their decisions when the market is performing at its best. On the other hand, whilst no statistically significant results are found for the impact of regional sentiments on Qatar's equity market, the correlation coefficient across all quantiles has been consistently positive. For Boursa Kuwait however, the situation is different. The Kuwaiti stock market has responded to regional spillovers across all quantiles except for the highest (90th) quantile. Meanwhile, the stock exchange in Kuwait has not been significantly affected by domestic news sentiments, except for when the market has been performing above average. Accordingly, it could be inferred that whenever Boursa Kuwait performs poorly, or below

average, investors tend to pay closer attention to the regional news from the other GCC countries.

Similar to KSA, results for Bahrain, also reveal that their stock market most strongly reacts to domestic news sentiments, when the equity market is performing poorly (at the 10th percentile). The impact of domestic news sentiments on Bahrain's equity market is found to be statistically insignificant across the other four quantiles reported in the results. On the other hand, Bourse Bahrain has been impacted by regional news sentiments across all quantiles examined. In fact, Bahrain is the only GCC country where this is found to be the case for all quantiles. The intuitive explanation behind this finding could be due to the size of its economy and the influence of the region on its markets. Lastly, Oman's equity market shows no statistically significant influence of domestic news sentiments on the domestic equity market. On the other hand, regional sentiment spillovers are found to significantly impact the Muscat Securities Market as the results for Oman are statistically significant at the highest and the lowest quantiles examined (10th and 90th percentiles, respectively). Moreover, whilst the Oman's equity market is excepted to respond to regional spillovers under both extreme circumstances, the magnitude of the impact is higher for when the market is performing very poorly (at the 10th percentile), compared to when the market is performing excellent (at the 90th percentile).

Such asymmetric results are also found for other regions by other researchers including Seok et al (2019), Mian and Sankaraguruswamy (2012), and Allen et al (2019), who have indicated that the impact of sentiments on stock market returns could greatly vary depending on the current market performance, making the stock markets specifically vulnerable for certain levels of stock market returns. Allen et al (2019) explored these asymmetries using quantile regressions, and have also argued that investors may carefully follow the news during low returns compared to days where the stock market is performing well. A common observation from applying the quantile regression approach across all the GCC countries reveals that all the statistically significant coefficients for news sentiments (both domestic and regional), are positive. This implies that in addition to a positive domestic news being associated with higher equity returns, positive news from other countries within the region are also likely to be positively associated with higher equity returns, and vice versa. Such an observation indicates stronger connectedness across the GCC equity markets, limiting the opportunity for intra-regional diversification as news sentiments are likely to spillover across borders within the GCC.

5.2. Diebold and Yilmaz (2014) Approach

In this part of our study, we apply the Diebold and Yilmaz (2014) approach for a detailed analysis of the interconnectedness of GCC equity markets through regional news sentiments. This approach not only helps us understand the differences between domestic and regional spillovers for different countries, but also helps explore how these spillovers have evolved over the timeline of our study. The analysis is conducted separately for each country and our results for the connectedness tables are illustrated in Table 5. As we would expect, the net spillovers for each of the GCC equity markets, against news sentiments are negative, suggesting that overall, equity markets are impacted by news sentiments, and not vice versa. From these connectedness tables, it is also evident that the GCC countries differ in how they respond to news sentiment spillovers from domestic and regional sources. For example, the UAE equity markets are affected by spillovers from the domestic sentiments, whilst spillovers from sentiments relating to other countries within the region are not as significant. More specifically, approximately 2.32 percent of variations in the UAE equity markets could be explained by the domestic news sentiments, whilst only 0.14 percent of variations could be attributed to regional sentiments corresponding to the other five GCC countries. Meanwhile, the opposite could be true for KSA, which is impacted by news sentiments relating to other countries within the region. Approximately 1.82 percent of variations in the Saudi equity markets could be attributed to regional sentiment spillovers from the other five GCC countries, whilst only 0.25% of variations could be attributed to domestic sentiments.

To better illustrate the inflow of domestic and regional sentiment spillovers for each of the GCC countries, we have summarized the critical values from the connectedness tables in Figure 8. Based on these results, Bahrain's equity markets are found most sensitive to news sentiments from both sources. Approximately, over 2% of all fluctuations in Bahrain's equity market returns could be explained by domestic sentiment spillovers, and another 2% could be explained by regional sentiment spillovers. Overall, the GCC countries' equity markets are not as highly impacted by sentiment spillovers as other regions (Allen et al, 2019; Costola et al, 2020; Hausler et al, 2018; Smales, 2016; Dong et al, 2020; Wei et al, 2017; Hsu et al, 2021). This could be partially due to the relatively large proportion of government holdings in equity markets found in GCC countries, when compared with other regions globally. Governments, unlike private investors, are unlikely to react to short term sentiments as they tend to hold their investments in the long run. As highlighted in a report by Tomlinson and Chalhoub (2010), a majority of the ownership in GCC equity markets is solely limited to local market participants. For most of these markets, foreign market participants cannot hold more than 49% of equity in a joint stock company, whilst no foreign ownership is permitted for certain markets, with a few exceptions. Governments hold significant stakes in many publicly listed corporations and since the governments aim to maintain stability, they may do the very opposite of selling their shares as a result of a short-term panic.

So far, these results represent the average picture over the past decade and a half. Next, we explore whether the picture has changed over time in the dynamic part of our analysis. The total connectedness plots for each study, are exhibited in Figure 9. From the total connectedness plots, it is evident that the connectedness index for all countries increased during the COVID-19 outbreak, with the exception of Oman. Moreover, hikes in the connectedness indexes can be observed during the global financial crises of 2007 – 2008, as well as the oil price crash of mid-2010s. Over the timeframe of our study, the connectedness index for the UAE and KSA have trended upwards, suggesting that in these countries, news sentiments are becoming increasingly important as predictors of equity market behaviour. On the other hand, the connectedness has dropped for Oman during the same period. Oman has been a relatively isolated economy compared to the rest of the GCC countries and this could explain why Oman's connectedness index has been the lowest of all, peaking at 20% for a very short period following the global financial crisis of 2007 – 2008. The total connectedness index represents the overall dynamic flow of connectedness without segregating the impact from regional versus domestic sentiment spillovers. In order to look at the segregated effects, we next examine the net pairwise connectedness plots between each country and its sentiment indexes; domestic and regional (illustrated in Figure 10).

The net pairwise dynamic connectedness plots provide a more detailed picture of the time-varying spillovers from domestic and regional sentiments to the GCC equity markets. Starting with the first plot for the UAE, it is evident that the COVID-19 outbreak was a period when the impact of news sentiments was the greatest, and stronger for domestic sentiments. On the other hand, whilst sentiment spillovers were stronger for other countries during the same time, the source was identified as regional spillovers and the plots on the right side of Figure 10 dropped significantly below zero during the pandemic. Due to having the largest proportion of expats and being an international hub, the UAE showed some of the early COVID-19 cases that may have caused its equity markets to be impacted by its own domestic sentiments first, and then causing financial spillovers to others. Our results also reveal that connectedness generally accelerates during times of uncertainty as markets look towards each other for a sense of direction, more so, than they otherwise would. The UAE, KSA and Qatar also exhibited sentiment spillovers during the oil price crash of mid-2010s. This makes intuitive sense as the UAE and KSA are net exporters of crude oil, whilst Qatar largely exports natural gas, the price of which is highly correlated with crude oil.

Our results on time-varying spillovers enable a comparison between the impact of three crises events that occurred during the time-frame of this study. For each total connectedness plot in Figure 9, we see a rise in spillovers during the global financial crisis of 2008 – 2009. For four GCC countries; UAE, KSA, Kuwait, and Bahrain, this rise is

comparable to yet smaller than the rise in connectedness corresponding to the COVID-19 outbreak. This complements prior research findings on the financial interconnectedness of global equity markets and the GCC, where the total connectedness index peaked during the COVID-19 outbreak (Yousuf and Zhai, 2022). These results suggest that the COVID-19 outbreak accelerated the flow of spillovers across global financial markets, regional news sentiments, and the GCC equity markets. Hence, regional investors followed regional news sentiments as well as changes in global markets for a sense of direction, especially during times of high uncertainty. Finally, the total connectedness plots also indicated hikes during mid-2010s for all GCC countries. This was a period of significant decline in oil prices, which raised the levels of uncertainty in the GCC equity markets. However, whilst mid-2010s illustrated high spillovers between news sentiments and regional equity markets, Bahrain was the only regional market to reach peak connectedness during this time. Evaluating the net dynamic pairwise spillovers in Figure 10, we also observe that the oil price crash of mid-2010s and the COVID-19 outbreak differently affected the direction flow of spillovers across news sentiments and equity markets. During the oil price crash of mid-2010s, there were short periods of positive net spillovers from equity markets to news sentiments, suggesting the possibility of an influence of financial markets on the wider news sentiments. On the contrary, the COVID-19 outbreak predominantly indicated negative net spillovers from equity markets to news sentiments, suggesting a strong influence of news sentiments on regional financial markets. These results indicate that news sentiments had a strong role to play in determining the direction of regional equity markets. Moreover, this role has been more significant during the global pandemic when compared to the other two crises events that occurred during the time frame of our study.

6. Conclusion

Our results provide insights on how news sentiments play their part in not only influencing the equity market returns, but also the connectedness of regional equity markets in the GCC. As countries became more and more isolated due to the recent COVID-19 outbreak, their financial markets have become more connected than they have ever been in over a decade. Our research includes sentiment data for the period 2006 – 2020, and applies two distinct econometric approaches. Results from the quantile regression approach suggest that equity markets in the GCC are most vulnerable to news sentiment spillovers when the markets are under-performing. Moreover, our results also reveal that the GCC countries have responded differently to shocks from domestic and regional news sentiments. The UAE equity markets are most influenced by domestic sentiments, whilst the KSA equity market is influenced by regional sentiments. Bahrain's equity market on the other hand, is relatively highly influenced by both, domestic and regional sentiments. Overall, the magnitude of the inflow of spillovers from news sentiments across the GCC countries has been low, when compared to other regions. A reasonable explanation for that could be the large proportion of government stake in public limited companies found in the GCC. Governments are least likely to react to short term sentiments, since they aim to invest in the long term and maintain stability in the markets.

Our results from the Diebold and Yilmaz (2014) approach also reveal that the UAE's equity market is most affected by its own domestic sentiment spillovers, whilst Bahrain has been the highest recipient of sentiment spillovers from both domestic and regional sources. Nonetheless, the magnitude of these effects has been low, averaging below 2%. This is except for times of greater uncertainty such as the recent global pandemic or the oil price crash of mid-2010s, when sentiments became stronger predictors of equity market behaviour. Hence, we could infer that whilst domestic and regional news sentiments influence equity market returns of GCC countries, the magnitude of this impact is usually low, except for when the individual markets are underperforming, or if the region is undergoing a major crisis event. Moreover, we also found that whilst the flow of spillovers across news sentiments and equity markets accelerates during crises events, the magnitude of this effect could vary across different crises events and countries, as illustrated by the results of our study.

Our results contribute to a new realm of literature that explores the connectedness of regional equity markets through regional sentiment spillovers. The results provide regulators and policy makers with insights on how the news sentiments could affect equity markets across the different levels of returns and during crises events. Our findings provide useful insights for policy makers, investors and researchers. Policy makers could benefit by learning how sentiments regarding neighboring countries could spillovers to domestic financial markets and set macroprudential policies accordingly. Through anticipating how regional sentiments could impact domestic markets, policy makers and regulators could play a proactive role in timely dealing with potential equity market risks. Moreover, by understanding the impact of news sentiments, especially during crises events, regulators and policy makers could help ensure that investors get reliable information, preventing unnecessary panics resulting from negative news sentiments. Moreover, investors could follow the news sentiments to partially predict stock market behavior and intra-regionally diversify in countries least effected by regional spillovers. Future researchers could apply our approach across other regions or add industrial indexes for the GCC countries to examine how sentiments affect each industry differently. Future research could also incorporate sentiment valence by including emotions such as anger, fear, and joy. This would provide further insights on the role of sentiments in financial markets. Other useful techniques such as the different variants of GARCH models could also be applied in future studies examining the impact of domestic and regional news sentiments on financial markets.

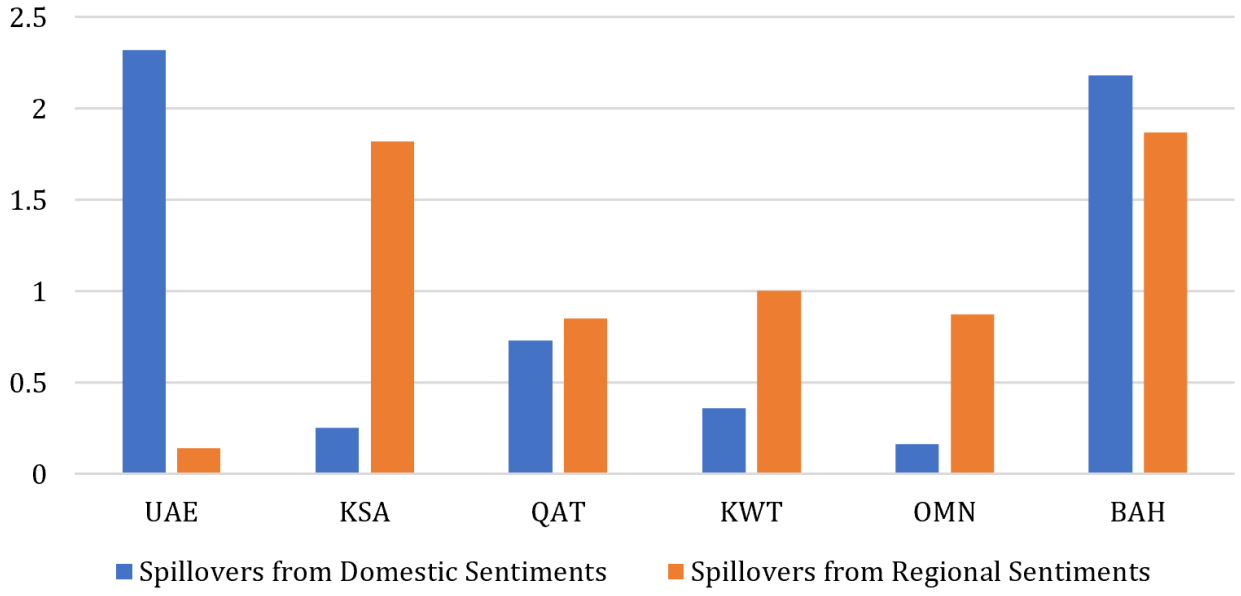

Figure 8. Domestic and Regional Sentiment Spillovers to the GCC Equity Markets.

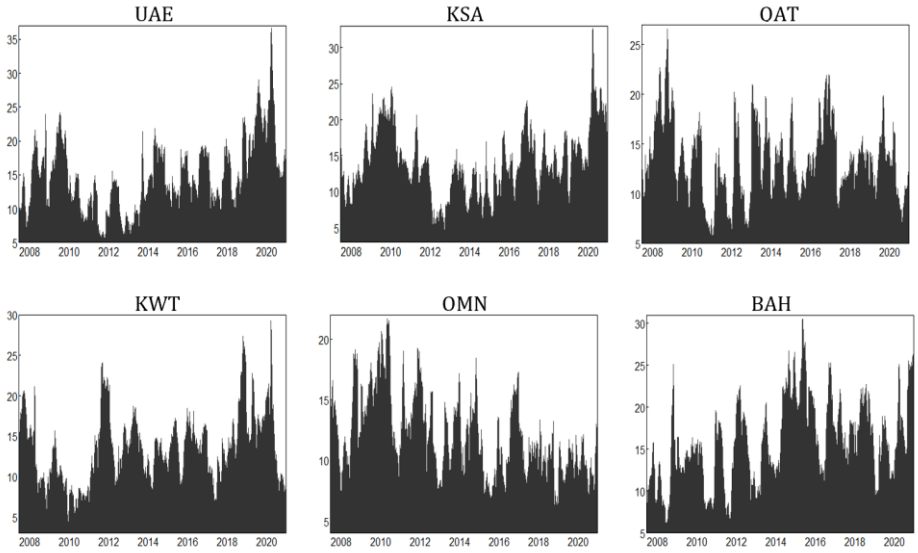

Figure 9. Total Connectedness Indexes for Individual Connectedness Studies.

Table 5. Connectedness Tables for Sentiment Spillovers.

		EQUITY INDEX	DOMESTIC	GCC_EXCL_OWN	FROM OTHERS
UAE	UAE	97.54	2.32	0.14	2.46
	DOMESTIC	1.45	97.96	0.59	2.04
	GCC_EXCL_OWN	0.23	0.91	98.86	1.14
	TO OTHERS	1.68	3.23	0.73	TCI
	NET DIRECTIONAL	-0.78	1.19	-0.41	1.88
KSA	KSA	97.92	0.25	1.82	2.08
	DOMESTIC	0.57	97.88	1.56	2.12
	GCC_EXCL_OWN	0.65	1.64	97.70	2.30
	TO OTHERS	1.22	1.90	3.38	TCI
	NET DIRECTIONAL	-0.85	-0.23	1.08	2.17
QAT	QAT	98.41	0.73	0.85	1.59
	DOMESTIC	0.36	99.18	0.47	0.82
	GCC_EXCL_OWN	0.45	0.59	98.96	1.04
	TO OTHERS	1.68	3.23	0.73	TCI
	NET DIRECTIONAL	-0.78	0.50	0.28	1.15
KWT	KWT	98.64	0.36	1.00	1.36
	DOMESTIC	0.26	98.36	1.38	1.64
	GCC_EXCL_OWN	0.94	1.52	97.54	2.46
	TO OTHERS	1.21	1.88	2.38	5.47
	NET DIRECTIONAL	-0.16	0.24	-0.08	1.82
OMN	OMN	98.98	0.16	0.87	1.02
	DOMESTIC	0.18	99.72	0.10	0.28
	GCC_EXCL_OWN	0.78	0.26	98.96	1.04
	TO OTHERS	0.97	0.42	0.97	TCI
	NET DIRECTIONAL	-0.06	0.13	-0.08	0.78
BAH	BAH	95.95	2.18	1.87	4.05
	DOMESTIC	0.88	97.78	1.33	2.22
	GCC_EXCL_OWN	0.88	1.20	97.93	2.07
	TO OTHERS	1.76	3.38	3.21	TCI
	NET DIRECTIONAL	-2.30	1.16	1.14	2.78

Notes: The inflows of news sentiment spillovers to each of the GCC countries are shown as a split between spillovers from domestic news sentiments versus news sentiments relating to the other countries within the GCC region (labeled as "DOMESTIC" and "GCC_EXCLUDING_OWN", respectively). Country labels represent the MSCI country-level equity market

indexes, whilst the rows representing net directional connectedness are computed as the difference between the outflow of spillovers to other variables and the inflow of spillovers from other variables.

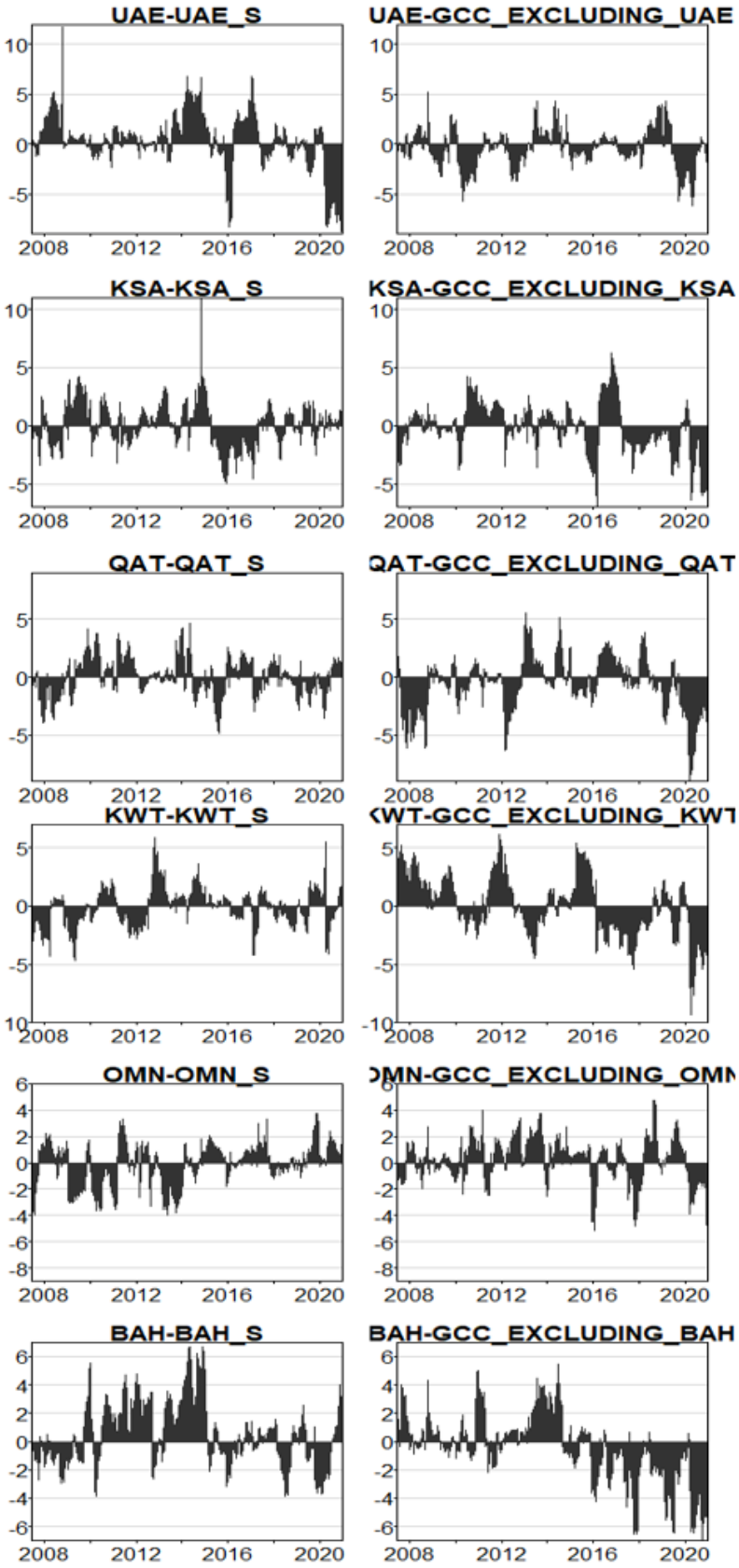

Figure 10. Net Pairwise Dynamic Spillovers for Individual Sentiment Connectedness Studies.

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Conflict of interest

The author claims that the manuscript is completely original. The author also declares no conflict of interest.

Appendix

A1. List of Keywords Used in Filtration of Relevant News Titles.

account	dollar	interest rate	purchases	demand
acquisition	duties	invest	real estate	develop
agriculture	earnings	livelihood	retail	dinar
airport	econom	loan	revenue	dirham
bank	employ	loss	riyal	dividend
budget	equity	management	salaries	import
business	establish	manufactur	salary	income
career	exchange	market	sales	industr
cash	export	merchan	security	inflation
commerc	factories	merger	shipment	institution
commission	factory	monetary	shipping	price
commodit	fdi	money	shop	pricing
compensat	financ	monopol	stock	product
corporation	fiscal	occupation	store	profit
corporation	fund	pandemic	supply	propert
crises	gdp	partnership	sustain	transaction
crisis	goods	pay	tax	ventur
currenc	goodwill	policy	technolog	wage
debt	harvest	policy	tourism	wealth
deflation	imf	politic	trade	wholesal

The above list of keywords has been devised through carefully and individually selecting relevant terms that include and are synonymous to economics, business and finance. Certain words are truncated to include possible variations, such as “econom” would include titles with words economy, economic, economical, and economist. Synonyms for related terms have been drawn from thesauras.com. The filtration process is not case-sensitive.

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