China and the Impact of COVID-19 on Asian Stock Markets

By

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ABSTRACT

This paper analyzes the impact of COVID-19 across Asian markets with a particular focus on China and the implications this has on risk, diversification, and relationships between these markets. In January 2020, the emergence of COVID-19 spread globally, impacting not only the health of people but financial markets and economies. This study seeks to shed light on what's been going on in Asia especially with China as the source, as current studies are mostly focused on western countries.

The paper focuses on the period of January 2020 to December 2020 but also uses 2019 as a reference point for comparison. The markets selected for the study are: China, Japan, Hong Kong, India, Taiwan, South Korea, Singapore, Indonesia, Malaysia, Philippines, and the United States as a benchmark for the global market. Using this data, we firstly compare returns from 2019 and 2020 to analyze the relative impact of COVID on returns and volatility. Next, using RavenPack COVID-19 news indices, we use a simple regression and panel regression to investigate the impact of COVID-19 news on returns. We also explore the implications of the virus on diversification for a portfolio of Asian markets. Breaking up the periods into quarters, we study the initial impact and normalization periods of each market. Finally, this paper looks beyond the numbers by diving into factors such as politics, culture, and technology that provide insight into the results, especially regarding China. This paper finds that: 1) Asian markets are less sensitive to COVID-19 news 2) The crisis has implications on the benefits of portfolio diversification 3) China (and Hong Kong) stands out as they seem to be less sensitive to COVID news than the rest of Asian markets as despite being the source of the virus.

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1. Introduction

The World Health Organization (WHO) was notified on December 31, 2019 of cases of an acute respiratory syndrome from an unknown source in Wuhan City in China's Hubei Province. It was discovered that the cause was a novel coronavirus, which they named COVID-19. By January 15, 2020 there were 282 confirmed cases, four found in Japan, South Korea, and Thailand. Person-to-person transmissibility was confirmed on January 20, 2020 by the WHO. In response, China put Wuhan City into lockdown as other countries imposed travel bans on China. Nevertheless, COVID-19 cases spread across the globe, spanning Asia, Europe, and the United States. In order to mitigate the spread, various countries imposed quarantine and lockdown measures, which hit their economies hard as factories were shut down, unemployment increased, and panic spread. Consequently, COVID-19 has not only impacted health, but economies as well. Economies shut down as there were significant drops in GDP and increases in unemployment. By December 4, 2020, the WHO reported that globally there were 64.6 million confirmed cases and 1.5 million deaths.

Despite the fact that all countries were hit hard by COVID-19, the way these countries have handled and recovered from COVID-19 has varied significantly. Particularly, economies in Asia, especially China, have bounced back quickly from COVID-19. This is reflected in not only economic data, but stock market returns that reflect investor sentiment in light of available information on COVID-19 and the government's plans to reduce transmission and ensure stability. Hence, the situation in Asia highlights the question: *How have Asian Markets been impacted by COVID-19?* Specifically looking at the different ways in which Asian countries have experienced and handled COVID-19, not only between themselves but Western countries, particularly the U. S., sheds light on this question. This paper seeks to look into the direct impact

of the virus on specific Asian countries' economy and stock markets. Through analysis and study into past crises, such as SARS, this paper investigates why Asian countries, especially China, are impacted differently, with the U.S. as used as a benchmark for the global market.

Looking deeper into the issue of COVID-19 as not just a health problem, but also an economic, financial, and political one is imperative in order to get a more comprehensive picture of the crisis that is affecting everyone's lives. As an issue that is still currently ongoing, people's lives have been disrupted and even after the crisis is over, there will likely be lingering effects, which makes this an important study. Towards the latter half of the year, individuals and companies have adapted, albeit differently, to the "new normal," which this paper also seeks to investigate.

Using stock return data, economic data, and COVID-19 news indices (from RavenPack), this paper breaks down the relationships between movements in the stock market and economy to COVID-19 news using the RavenPack data as a proxy for relevant COVID-19 news to capture unexpected shocks about COVID-19. This is done by doing an analysis of the following markets: United States, China, Japan, Hong Kong, India, Taiwan, South Korea, Singapore, Indonesia, Malaysia, and the Philippines. This paper utilizes data from January 2020 to December 2020 and aims to provide insight on how Asian markets are impacted by COVID-19, with an emphasis on China since not only was it the source, but they handled the virus the best not only relative to other Asian countries, but the West too. Diving deeper into political relations and the integration of their markets will provide an interesting study on the larger picture of COVID-19 as not just a case of health, but politics and economics as well.

The study finds that: 1) Asian markets are less sensitive to COVID-19 news 2) The crisis has implications on the benefits of portfolio diversification 3) China (and Hong Kong) stands out

as they seem to be less sensitive to COVID news than the rest of Asian markets as despite being the source of the virus. The paper dives deeper into the numbers by identifying factors including technology, cultural, and political that explain the results.

2. COVID and the Economy

Asian economies were mostly affected in the second quarter of 2020 along with the US while China and Hong Kong were primarily affected in the first quarter. As evident in GDP data in Table 1, China and Hong Kong recovered in the second quarter while most economies were able to bounce back in the third quarter. Monetary and fiscal measures were taken by all countries to stimulate the economy in addition to lockdowns and other measures to control the spread of the virus. In both Asian countries and the US, their economies contracted as unemployment increased because measures, such as lockdowns, hindered economic activity.

Table 1: 2019-2020 GDP Data (Unit: QoQ %; seasonally adjusted)

Region	US	China	HK	Japan	Malaysia	Philippines	Singapore	S. Korea	Taiwan	India	Indonesia
Q1 2019	0.73	2.00	0.80	0.57	0.88	1.34	0.77	-0.34	0.49	6.54	-0.52
Q2 2019	0.37	1.20	-0.30	0.08	1.27	1.50	0.26	1.01	1.48	-4.16	4.20
Q3 2019	0.64	1.20	-3.00	0.18	0.78	1.77	0.30	0.38	0.71	-0.15	3.05
Q4 2019	0.59	1.20	-0.40	-1.84	0.63	1.91	0.05	1.31	1.07	1.29	-1.74
Q1 2020	-1.26	-9.70	-5.60	-0.56	-1.97	-5.60	-0.60	-1.28	-0.41	6.26	-2.41
Q2 2020	-8.99	11.60	-0.10	-8.30	-16.52	-14.89	-13.12	-3.15	-0.73	-29.64	-4.19
Q3 2020	7.48	3.00	2.70	5.28	18.22	8.02	8.97	2.14	4.34	22.35	5.05
Q4 2020	1.06	2.60	0.20	2.81	-0.26	5.57	3.76	1.23	1.43	9.77	-0.42

Source: CEIC Global Economic Monitor

In the U. S., fiscal measures involved coronavirus relief and government funding that included unemployment benefits. In March, when COVID cases significantly increased in the US and lockdown measures were imposed, direct stimulus payments were made to individuals, funding for education, and resources for vaccines (International Monetary Fund, 2021). In the same month, federal fund rates were lowered and measures to facilitate credit flows.

In early January 2020, China imposed strict containment measures to control the spread of the virus. Large-scale mobility measures were put in place as well as quarantine periods. Because of these measures, the economy contracted by 9.7 percent in Q1. However, in mid-February, the government began easing measures by removing mobility and activity restrictions, prioritizing essential sectors, specific industries, regions, and population groups based on ongoing risk assessments. Businesses and schools also reopened but social distancing was still in place as well as restriction on foreign entries. In certain areas however, restrictions were reimposed. By August, many regions lowered their emergency response level to low risk. Technological means were used to track virus spread via testing and individualized health QR codes to contain and track outbreaks. By the second quarter economic activity normalized as the economy rebounded. Fiscal and monetary measures were put in place, and the exchange rate was allowed to adjust flexibility.

In Japan, the first confirmed case was on January 16, 2020. In response, the government imposed several measures to contain spread as well as entry bans to foreigners who have visited COVID-19 affected countries and regions. Prime Minister Shinzo Abe declared the state of emergency for seven prefectures on April 7, ordering people to stay at home, order closures of schools and public facilities, build temporary medical facilities, and adopt actions to support medical and food supplies. In July, there was a second wave of infections, raising the alert level to the highest. The government requested residents to refrain from traveling outside Tokyo and karaoke venues and restaurants serving alcohol to close by 10pm. Throughout the year, as new infections increased, so did alert levels and relaxed when infections seemed to go down. Entry still limited by foreign nationals. In addition to fiscal and monetary measures, exchange rates have been allowed to adjust flexibly.

Hong Kong reported its first confirmed COVID-19 case on January 23, 2020. As the situation improved in late August to November, social distancing measures were relaxed but some containment measures remained in place including mask-weaking, entry bans, reducing partially suspending cross-border transport. However, the COVID situation worsened in late November and as such more containment measures were put in place. This included restaurants requiring to apply for a "Leave Home Safe" venue QR code to monitor visits. Fiscal and monetary measures were also implemented.

In India, the first case was reported in late January and infection rates continued to rise. The government imposed containment measures, intensity varying by county, which included travel restrictions, closing educational establishments, gyms, museums, and theatres, bans on mass gatherings, and encouraging firms to work remotely. On April 15, in order to stimulate economic activities, the government relaxed measures in non-hotspot areas. In May, the Prime Minister announced relief packages including monetary and fiscal measures. On July 29, the government issued ‘Unlock 3.0’ guidelines to initiate re-opening of activities and limiting the lockdown until August 31. On August 29, the next phase ‘Unlock 4.0’ was put into place to further reopen the economy by opening metro transportation and allowing social congregations up to 100 people. On September 30, ‘Unlock 5.0’ guidelines were issued that included the reopening of schools in a graded manner, as well as entertainment venues such as cinemas.

In South Korea, the first case was reported in late January and the number of new cases peaked in early March. The government implemented strategies to contain the spread through widespread testing, aggressive contact tracing, and prompt isolation and treatment of cases. Voluntary social distancing and the mentioned measures slowed infections and most businesses were allowed to remain open. In the summer, new cases neared zero. In the latter part of the year,

the government introduced a five-tier framework for distancing measures, with tiers set by region using multiple infection metrics, and granular restrictions tailored to the risks of various activities. However, cases increased during the latter part of the year despite tighter limits.

In Singapore, there was sharp increase in cases in April and in response, distancing measures intensified to prevent local transmission. The government also announced a three-phased approach in order to re-open activity beginning in June. As cases decreased and stabilized, Phase Two began on June 19 and Phase Three scheduled for December 28 in which there was a further relaxation of social distancing measures.

In Indonesia, they reported their first case on March 2. In response, the government implemented containment measures including bans on domestic and international travel, closing schools, and imposing restrictions on public events. The government also banned celebrations for Eid al-Fitr in May and began containment measures in June. Jakarta began a transitional phase from large-scale social restrictions on June 5th and further eased restrictions on malls and parks and recreation areas. On September 9, Jakarta's governor announced the tightening of measures to contain the spread. Reduced consumption and investment due to containment measures led to slow growth in the second quarter and led to disruptions in mobility and activity.

Malaysia was hit by another shock as in addition to COVID-19, there was a sharp decline in oil prices. The first COVID case emerged in early February but a local outbreak only emerged in March, which prompted the introduction of the Movement Control Order (MCO) which helped significantly reduce the spread of the virus. From May 4, under the Conditional Movement Control Order (CMCO), authorities began to ease restrictions to allow most businesses to reopen. On June 10, the Recovery Movement Control Order (RMCO) took effect, lifting most restrictions on domestic activities and movement, and its end date was extended

from August 31 to March 31, 2021. A new wave of infections hit Malaysia due to an outbreak because of elections in the state of Sabah, which led to the reinstatement of the CMCO until December 6 in most states. The CMCO was lifted in most states until December 20, then further extended in large cities such as Kuala Lumpur. Borders remained closed and overseas travel was announced to be restricted until at least March 31, 2021.

In the Philippines, the first case was confirmed on January 30. Beginning August 19, the government lightened restrictions by moving high-risk areas from a "modified enhanced community quarantine" to a "general community quarantine," which allowed more businesses to reopen and mass transportation to resume in phases. International travel restrictions remained, but domestic flights were allowed, though limited. As a country that heavily relies on tourism, eventually hotels in areas under general community quarantine and modified GCQ were allowed to accept guests at full capacity to allow the tourism industry to recover. Towards the latter part of the year, financial market volatility subsided, with the peso/US $ exchange rate staying stable. The government announced a 4-pillar socioeconomic strategy against COVID-19, which includes support to vulnerable groups and individuals, expanded resources for frontline medical workers, as well as fiscal and monetary measures.

3. Literature Review

3.1. Past Crises

In comparison to the SARS epidemic, according to Siu and Wong in their paper *Economic Impact of S. A. R. S.: The case of Hong Kong*, they "find no anecdotal evidence to indicate that SARS had negative effects on either domestic or global investment" (2004). Furthermore, Koo and Fu found that the "SARS epidemic appears to have had limited and temporary economic impacts in the region" (2003). Evidently, the impact of COVID-19 greatly

supasses that of SARS, truly making it a new and unpredictable situation, leading to wide scale uncertainty and panic. However, in a similar manner to COVID, as Chen, Chen, Tang, and Huang found, “SARS had a negative impact on stock prices relating to tourism, wholesale and retail sectors, but positively in stock related to biotechnology” (2009). As evident with countries that rely heavily on the tourism industry, specifically developing countries like the Philippines, this also explains their relatively hard blow by the COVID pandemic.

He et al. in *COVID-19's impact on stock prices across different sectors-an event study based on the chinese stock market* investigate how emergencies influence investor behavior by impacting investor sentiment and therefore stock prices (2020, p.2198-2212). They analyze the relationship between crises including, terrorist attacks, natural disasters, political behavior, and financial crises. However, few papers look into the impact of major public health events. Currently, there are studies on influenza and SARS, however they are limited. Goh and Law found that “the 1997 Asian financial crisis and the 1998 Hong Kong avian influenza outbreak had a significant negative impact on tourism” (2002). Mctier, Tse, and Wald studied “the impact of flu on the US stock market and found that an increase in the flu rate would reduce the enthusiasm of trading activities and stock returns” (2011). As evident, studies on an outbreak of such a scale regarding health has yet to be investigated further in past literature.

3.2. Current COVID-19 Papers

Khan, Zhao, Zhang, Yang, Shah, and Jahanger in *The Impact of COVID-19 Pandemic on Stock Markets: An Empirical Analysis of World Major Stock Indices* investigate the “impact of the COVID pandemic on stock markets” of United States, China, Japan, South Korea, Spain, Italy, Germany, France, United Kingdom, Canada, Belgium, Denmark, the Netherlands, Norway, Sweden, and Switzerland (2020). The results showed that the “the growth rate of weekly new

cases of COVID negatively predicts the return in stock market." Moreover, the results of the "t-test and mann-whitney test to compare returns reveal that investors in these countries do not react to the media news of COVID at the early stage of the pandemic." Then "once human-to-human transmissibility had been confirmed, all the stock market indices negatively reacted to the news in the short- and long-event window." A particular country that stood out was China as they noticed that the "shanghai composite index, which was severely affected during the short-event window, bounced back during the long-event window." Unlike investors in other countries, "investors in the Shanghai composite index negatively reacted to news of transmissibility in a short event window." This is explained by the "drastic measure taken by the chinese government to contain the spread of the disease regained the confidence of the investors in China which explains insignificant results in the long-event window." Unlike studies that use COVID cases, infection rates, and death rates, to predict stock market return, this paper utilizes RavenPack news indices as a proxy for unexpected shocks about COVID. The news indices provide a more holistic measure of COVID information and news shocks as it includes not just news in the media about COVID deaths, cases, and cases, but any big events, government announcements, and more.

Boon, Haugh, Pain, and Alins described three channels through which covid may affect global economy: "overall decline in the supply, demand side (travel and tourism, education and other entertainment services), increases in the uncertainty of the environment will lead to a rise in opportunity cost of investment, firm exposure to China and the share of foreign revenues resulted is associated with substantially lower cumulative abnormal returns over the study period" (2020). In an interesting study by Boudoukh, Liu, Moskowitz, and Richardson in *Risk, Return and Diversification in Times of Crisis: (How) Is COVID-19 Different?* they analyze the

impact of COVID on the risk and diversification characteristics of financial securities across major asset classes and western countries (2020). They find that "the factor structure of asset returns dramatically changes during COVID-19 times compared to both normal times, as well as other crises periods (e.g., Global Financial Crisis)." Secondly, they "identify how systematic factors become related to COVID-19 using news/shocks about the virus and epidemiological model forecast errors." Thirdly, they "investigate the implications of these findings for popular asset portfolios, with a particular focus on the volatility of these portfolios and their risk exposure." Overall, they conclude that "the benefits to diversification and the ability to hedge systematic risk are greatly reduced during the peak of COVID-19 news." As a whole, current studies suggest that COVID has had an impact on financial markets and economies across the globe, however there lacks a focus on Asian Markets.

4. Data

4.1. Economic and Stock Return Data

This paper uses data on Asian Markets and the US to look at the direct impact of the virus and how that impact is related to COVID-19 news in that market. The selected Asian markets are: China, Japan, South Korea, Hong Kong, Taiwan, India, Singapore, Philippines, Malaysia, and Indonesia. This paper utilizes weekly and daily stock return data for each of the selected markets' index from January 2019 up until December 2020. These include the following: S&P 500, SSE Composite, Nikkei 225, HK Hang Seng Index, NIFTY 50 Index, TAIEX, KOSPI, STI, JKSE, FTSE Bursa Malaysia index, and the PSEi Composite Index. Additionally, quarterly data for the 2019 and 2020 period is used on each country's GDP, Inflation, Business Confidence, and Consumer Confidence.

4.2. RavenPack Data

RavenPack is a data analytics platform that provides data on the COVID-19 pandemic by analyzing and identifying trends and patterns from the news. This paper uses the news indices developed by RavenPack that is backed out using Natural Language Processing (NLP) algorithm. Specifically, this paper uses: *The Coronavirus Panic Index, Coronavirus Hype Index, and Coronavirus Media Coverage Index*. The *Coronavirus Panic Index* "measures the level of news chatter that makes reference to panic or hysteria alongside the Coronavirus." The *Coronavirus Hype Index* "measures the percentage of news talking about the novel Coronavirus" by taking into account the distinct stories that mention the coronavirus. The *Coronavirus Media Coverage Index* "calculates the percentage of all news sources covering the topic of the novel Coronavirus," specifically looking into the number of news sources that talk about the coronavirus.

RavenPack provides daily indices for each country, as well as a Worldwide index. This paper uses the relevant indices for the markets in the study for the period of January 2020 to December 2020. Unlike most existing COVID-19 papers that use confirmed COVID-19 cases and death rates, this paper primarily uses RavenPack's news indices. These indices are used in the study not as actual measures of panic and such, but as a proxy for relevant COVID-19 news to measure unexpected shocks about COVID-19. Comparing a timeline of events to significant movements in the data points show that the indices are a good proxy for news shocks. News on spikes in COVID cases, government declarations of lockdowns, and COVID related events show a corresponding jump in the indices as well. For instance on February 27, 2020 when the Prime Minister of Japan requested the closure of schools, there was a jump in all three indices for Japan. This paper also uses one of their Topic Indices, which are "the canonical name of the

theme mentioned together with CoronaVirus keywords in the media." Specifically, the paper uses the "Vaccine" topic indicator. This study also uses weekly COVID-19 death rates to provide a contemporaneous measure how actual COVID activity affects the stock market.

5. Methodology

Pre-COVID periods (January to December 2019) and COVID periods (January 2020 to December 2020) are compared using daily returns of stock market data on each market's index. The data was adjusted for gaps due to holidays for both the daily and weekly returns. These year-long periods were also divided into quarters during the 2019 and the 2020 year to identify the specific periods during which the stock markets were affected by COVID and when they seemed to bounce back. GDP quarterly data was used to provide further support for the evidence. Descriptive statistics was run on both the pre-COVID and COVID period specifically calculating the mean, volatility, Skewness, Kurtosis, and Max Drawdown as follows:

$$Skewness = \frac{n\sum_{i=1}^{n}(x_i-\underline{x})^3}{(n-1)(n-2)s^3}$$

Where $\bar{x}$ is the mean and s is the standard deviation of sample S. The formula was used to measure and compare the skewness of the stock return data for the 2019 and 2020 period.

$$Kurtosis = \frac{n(n+1)\sum_{i=1}^{n}(x_i-\underline{x})^4}{(n-1)(n-2)(n-3)s^4} - \frac{3(n-1)^2}{(n-2)(n-3)}$$

Where $\bar{x}$ is the mean and s is the standard deviation of sample S. The formula was used to measure the extremities (tails) of the stock return data to indicate the presence of outliers in the stock return data.

The Drawdown is the cumulative loss since losses started and was calculated through the following steps:

$$Cumulative\ Return\ P_t = P_{t-1} \times (1 + R_t)$$

$$High\ Water\ Mark_t = max_{s \leq t}(P_s)$$

$$Drawdown_t = \frac{(HWM_t - P_t)}{HWM_t}$$

$$Max\ Drawdown_t = max_{t \leq T}(DD_t)$$

Specifically, looking at the change in volatilities during the periods shows whether there is a significant impact of COVID-19 on stock markets and allows a comparison between markets. A correlation matrix was also run across cross-country returns for 2019 and 2020. After getting a general snapshot of how Asian stock markets overall have been affected by COVID-19, this paper digs deeper into the different and similar ways COVID-19 impacts each market, as well as investigates significant relationships.

Before using the RavenPack data, the indices were adjusted for seasonalities to take away the movement in data that is simply due to the day of the week. For the data, we assume that the seasonality is multiplicative and accordingly, for six months of data, calculate the multiple for each day of the week. This is taken by getting the average ratio of each day's index relative to a -3/+3 day window. For the six month sample, the average for every day of the week and that multiple is used to smooth out the data throughout. We also construct a COVID News Composite of the three indices by standardizing the Panic, Media Hype, and Media Coverage Indices, then combining them into a composite with equally weighting.

After adjusting the indices, we run a simple linear regression on the stock return data and the adjusted Ravenpack data on each index individually as well as the composite. This was done using weekly data to get results over the entire year of 2020 and then again on daily data to break the data into quarters to identify the periods COVID hit these markets the strongest. Running

these regressions breaks down the change in the coefficient between stock return data and COVID news. Additionally, the changes in deaths over the week are regressed over returns as death rates as well. The Simple Linear Regression was calculated using the following formula:

$$\boldsymbol{y} = \boldsymbol{\beta}_0 + \boldsymbol{\beta}_1 \boldsymbol{X} + \boldsymbol{\varepsilon}$$

X is the independent variable, in this case the COVID-19 news indices and COVID-19 death rates. y is the predicted value of the dependent variable, the stock return data for each country. β_1 is the regression coefficient to evaluate how much the dependent variable, the COVID-19 news indices or COVID-19 death rates, influences the stock returns. ε is the error of the estimate and β_0 is the intercept, the predicted value of y when the x is 0.

Then we run a panel regression using the weekly stock returns from the entirety of 2020 of the Asian markets, the COVID news composite, and Ravenpack's vaccine news index. Firstly, we use a Hausman Test to decide between using a fixed effects model or random effects model on the panel data:

$$H = (b_1 - b_0)' \left(\mathrm{Var}(b_0) - \mathrm{Var}(b_1) \right)^{\dagger} (b_1 - b_0),$$

For the panel data, we rejected the null hypothesis, as b_1 was inconsistent and so the Random Effects Model was preferred due to higher efficiency. For the Panel Regression Random Effects Model, we began with the same unobserved effects model:

$$y_{it} = \beta_0 + \beta_1 x_{it1} + \ldots + \beta_k x_{itk} + a_i + u_{it},$$

where we explicitly include an intercept so that we can make the assumption that the unobserved effect, $\boldsymbol{a}_i$, has zero mean. The explanatory variables used were the COVID-19 composite news index, and Vaccine news index, while the independent variable was the weekly stock index

return data of each market. The equation becomes a random effects model when we assume that the unobserved effect a_i is uncorrelated with each explanatory variable:

$$\text{Cov}(x_{itj}, a_i) = 0, \quad t = 1, 2, \ldots, T; j = 1, 2, \ldots, k.$$

Additionally, a portfolio of Asian countries was constructed to compare the change in volatilities of the portfolio during 2019 and 2020 to see if and how COVID has impacted portfolio volatility and diversification. In addition to the mean, Skewness, Kurtosis, and Max Drawdown, Portfolio Variance was calculated with the following formula:

$$\textit{Portfolio Variance} = \sum_{i=1}^{n} w_i^2\sigma_i^2 + \sum_{i=1}^{n} 2w_i w_{i+1}\text{Cov}_{i,i+1}$$

where w_i is the portfolio weight of the nth asset and for the study it was set at 10% for equal weight across the 10 Asian markets. σ_i is the standard deviation of the nth asset while $\text{Cov}_{i,j}$ is the covariance of each two assets *i* and *j*, which can be expressed as $p_{(i,j)}\sigma_i\sigma_i$, where $p_{(i,j)}$ is the correlation coefficient between the two assets.

6. Results & Analysis

6.1. Pre-COVID vs. COVID Period

We ran descriptive statistics on the weekly returns of all the stock indices and divided it into two periods: pre-COVID (January to December 2019) and COVID (January 2020 to December 2020). We also broke down each period into quarters to dive deeper into identifying and segregating the 2020 periods into the COVID shock period and "new normal" period. This was also done for the pre-COVID 2019 period to compare the volatiles pre-COVID and during COVID.

Table 2: Summary Statistics of Pre-COVID vs. COVID Period

Summary Stats (Mean, Volatility, Skewness, Kurtosis, Max Drawdown)

Summary Statistics During Pre-COVID and COVID Period											
Market		**2020**	**Q1 2020**	**Q2 2020**	**Q3 2020**	**Q4 2020**	**2019**	**Q1 2019**	**Q2 2019**	**Q3 2019**	**Q4 2019**
S&P 500	*Mean*	0.11%	-0.524%	0.482%	0.153%	0.279%	0.146%	0.251%	0.115%	0.019%	0.210%
	SD	2.30%	3.755%	2.318%	1.186%	1.259%	0.865%	0.733%	1.080%	1.037%	0.460%
	Skewness	-0.42					0.30				
	Kurtosis	5.43					6.46				
	Max Drawdown	33.92%					6.389%				
SSE	*Mean*	0.08%	-0.184%	0.185%	0.172%	0.126%	0.112%	0.464%	0.000%	-0.010%	0.042%
	SD	1.65%	2.353%	0.996%	1.880%	1.033%	1.364%	1.662%	1.890%	0.907%	0.789%
	Skewness	-1.11					0.41				
	Kurtosis	13.08					3.51				
	Max Drawdown	18.24%					14.904%				
N225	*Mean*	0.10%	-0.698%	0.562%	0.084%	0.333%	0.119%	0.276%	-0.033%	0.079%	0.190%
	SD	1.84%	2.687%	2.158%	0.969%	0.888%	0.951%	0.990%	1.162%	0.974%	0.684%
	Skewness	-0.56					0.03				
	Kurtosis	4.33					0.95				
	Max Drawdown	31.22%					8.467%				
HSI	*Mean*	-0.02%	-0.593%	0.318%	-0.001%	0.233%	0.062%	0.404%	-0.072%	-0.125%	0.071%
	SD	1.80%	2.368%	1.965%	1.347%	1.378%	1.147%	0.952%	1.194%	1.236%	1.169%
	Skewness	-0.70					0.02				
	Kurtosis	5.44					0.85				
	Max Drawdown	27.99%					16.092%				
NSEI	*Mean*	0.10%	-0.559%	0.146%	0.292%	0.428%	0.081%	0.194%	0.062%	-0.113%	0.196%
	SD	2.26%	2.127%	3.597%	1.071%	1.503%	0.960%	0.708%	0.965%	0.976%	1.153%
	Skewness	-0.54					0.91				
	Kurtosis	6.67					4.99				
	Max Drawdown	38.44%					10.537%				
TSEC	*Mean*	0.12%	-0.060%	0.086%	0.195%	0.290%	0.150%	0.327%	0.039%	0.047%	0.184%
	SD	1.68%	1.441%	2.803%	0.879%	1.078%	0.757%	0.754%	0.813%	0.762%	0.709%
	Skewness	-2.13					0.17				
	Kurtosis	12.23					1.13				
	Max Drawdown	28.72%					6.686%				
KOSPI	*Mean*	0.17%	-0.013%	0.227%	0.200%	0.334%	0.058%	0.218%	-0.026%	-0.143%	0.138%
	SD	2.31%	1.766%	3.843%	1.663%	1.272%	0.930%	0.983%	1.022%	0.867%	0.919%
	Skewness	-1.71					-0.20				
	Kurtosis	12.83					1.21				
	Max Drawdown	35.23%					15.072%				
STI	*Mean*	-0.06%	-0.122%	-0.219%	-0.127%	0.272%	0.033%	0.195%	-0.081%	-0.021%	0.060%
	SD	1.78%	1.256%	2.969%	1.178%	1.204%	0.673%	0.662%	0.653%	0.771%	0.647%
	Skewness	-0.53					0.17				
	Kurtosis	4.31					0.72				
	Max Drawdown	33.95%					9.606%				

JKSE	*Mean*	0.00%	-0.187%	-0.332%	0.188%	0.197%	0.008%	0.158%	-0.192%	0.085%	-0.052%
	SD	2.19%	1.378%	3.704%	1.089%	1.698%	0.788%	0.517%	0.945%	0.812%	0.807%
	Skewness	-0.70					-0.30				
	Kurtosis	9.14					0.78				
	Max Drawdown	39.80%					10.917%				
FTSE	*Mean*	0.02%	-0.085%	-0.100%	0.136%	0.073%	-0.019%	0.134%	-0.178%	0.002%	-0.021%
	SD	1.51%	0.973%	2.343%	1.171%	1.143%	0.551%	0.522%	0.546%	0.565%	0.508%
	Skewness	-1.92					-0.07				
	Kurtosis	18.47					0.71				
	Max Drawdown	29.52%					9.808%				
PSEi	*Mean*	-0.02%	-0.158%	-0.574%	0.147%	0.466%	0.009%	0.114%	-0.109%	0.098%	-0.046%
	SD	2.56%	1.643%	4.221%	1.929%	1.506%	0.978%	1.072%	1.026%	1.028%	0.769%
	Skewness	-0.59					-0.16				
	Kurtosis	8.94					0.20				
	Max Drawdown	44.11%					7.474%				

After comparing pre-COVID and COVID periods, for both full year pre-COVID and COVID periods, there was an increase in volatility for all markets in 2020 than 2019. This is clearly driven by COVID due to economic shutdowns as well as the impact COVID has had on health. But this is also indirectly attributed to the global economy. Nevertheless, the maximum drawdowns illustrate that these countries got hit hard regardless if they were especially hit by COVID. Overall, the COVID normalization period seems to occur during the last two quarters of 2020 where volatility stabilized. However for notable countries like China, they were able to bounce back and stabilize as early as the second quarter. Breaking it down, China stabilized in the second quarter going from 2.353% to 0.996%. Following, would be Hong Kong and Japan also stabilizing in the second quarter while the others, including the US, stabilized in the third quarter. Notably, the Philippines had the biggest change in volatility in the second quarter going from 1.64% to 4.22%. Following closely is India and Indonesia. As seen, overall the COVID-19 pandemic created a lot of uncertainty and instability as markets reacted negatively. We find notable markets that were able to bounce back quickly such as China and Hong Kong despite being hit by the virus first. The results highlight an interesting divergence for how Asian markets have handled COVID, as developing countries like the Philippines were hit harder. Interestingly,

the US too, as a global benchmark and a developed country seemed to be hit harder than other developed countries in Asia including China.

The change in correlation for Asian Markers in 2020 versus 2019 is displayed in Tables 8-17. As evident, the correlations increased in 2020, which can be explained by the common global shock that is volatile. This suggests that systemic risk exposure has increased, which is consistent with what has been going on with COVID. For instance, the correlation between China (SSE) and the Philippines (PSEi) in 2019 was 0.084, but increased to 0.408 in 2020.

The results are supported by GDP data in Table 1 which tell the same story. For example, China's GDP data during the first quarter when COVID-19 first hit China was negative (-9.7%) but they recovered quickly in the second quarter to 11.6% (QoQ). Other Asian countries' GDP, including the U.S. were more negative and did not bounce back as strongly. Furthermore, both China's Consumer and Business Confidence indicators were the only ones that didn't drop to negative, thus further illustrating China's ability to maintain stability relative to other countries (Table 13). In comparison to the global market, the U. S.'s Consumer Confidence and Business Confidence are quite low.

6.2. Analyzing The Sensitivity of Asian Markets to COVID-19 News Shocks

After adjusting for seasonalities, we ran both daily and weekly regressions and created correlation matrices of each market's index and the RavenPack Panic Index, Media Hype Index, Media Coverage Index, and the composite index. Figure 1 illustrates the movement of the COVID news composite over 2020. New shocks are measured as changes in the composite index.

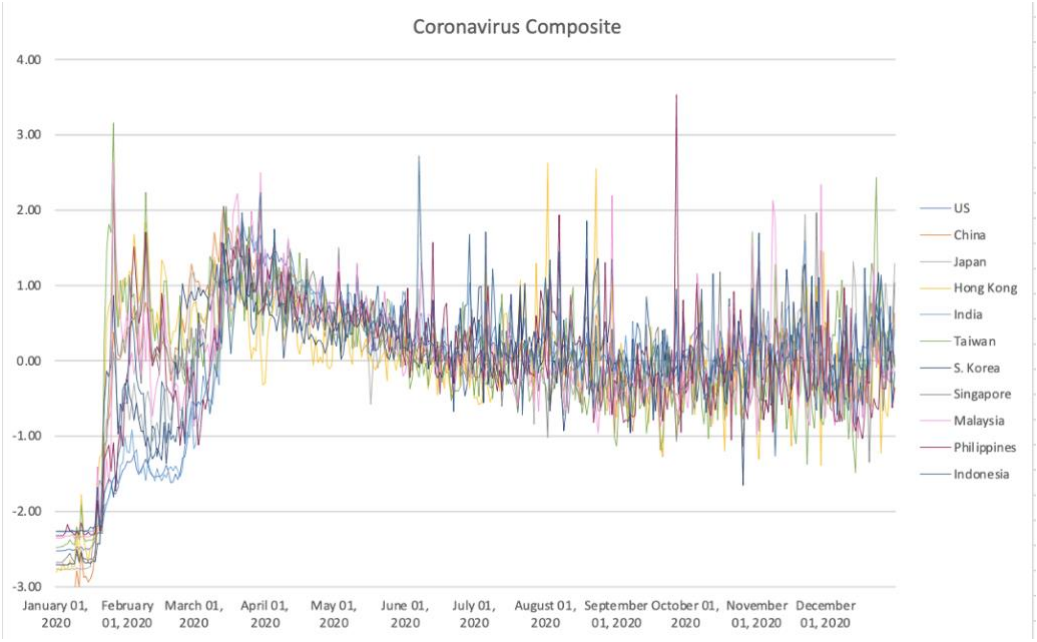

Figure 1: COVID-19 News Composite

Table 3: Regression of Stock Returns to COVID-19 News Composite Over 2020

Returns & COVID-19 News Shocks (Weekly; 2020)

	(1) US	(2) China	(3) Japan	(4) HK	(5) India	(6) Taiwan	(7) S. Korea	(8) Singapore	(9) Malaysia	(10) Philippines	(11) Indonesia
Composite	-0.0524**	0.00262	-0.00473	0.000841	-0.0257*	-0.00706	-0.00971	0.00168	-0.00448	-0.00340	-0.00171
	(-3.37)	(0.41)	(-0.43)	(0.14)	(-2.29)	(-1.47)	(-1.28)	(0.19)	(-1.11)	(-0.34)	(-0.32)
Constant	0.00512	0.00228	0.00305	-0.000458	0.00366	0.00441	0.00551	-0.00274	0.000897	-0.00117	-0.000825
	(0.85)	(0.57)	(0.44)	(-0.10)	(0.63)	(0.97)	(0.88)	(-0.52)	(0.24)	(-0.15)	(-0.15)
Observations	49	49	49	49	49	49	49	49	49	49	49
R^2	0.195	0.004	0.004	0.0003	0.100	0.044	0.034	0.001	0.026	0.002	0.002
bStdX	-0.02033	0.00161	-0.00303	-0.00370	-0.01331	-0.00672	-0.00815	0.00099	-0.00415	-0.00264	-0.00181

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3 documents results for regressions of weekly changes in the stock returns and the COVID-19 news composite index. Notably, the t-statistics are -3.37 and -2.29 for the U. S. and India respectively. For other Asian countries, the t-statistics have a lower magnitude as seen with China and Hong Kong with 0.41 and 0.14 respectively. Interestingly, the U. S. stock market is

strongly correlated with COVID-19 news with an R squared of 19.5%. In contrast, the results for the Asian markets are not that strong. This is interesting especially since China was the source of the virus, yet even China and Hong Kong's markets don't seem to be strongly correlated with COVID-19 news.

Table 4: Panel Regression Random Effects Model

	(1) Asian Returns	(2) Asian Returns	(3) Asian Returns
Composite	-0.00445*	-0.00479*	-0.00467*
	(-2.00)	(-2.16)	(-2.11)
Vaccine		0.00135*	0.00125*
		(2.36)	(2.17)
Elections			-0.000863
			(-1.42)
Constant	0.00142	0.000701	0.000836
	(0.82)	(0.40)	(0.48)
r2_w	0.00823	0.0197	0.0237
r2_o	0.00815	0.0194	0.0234
r2_b	0.109	0.0562	0.0633
N	490	490	490

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Based on the Hausman Test, a Random Effects model was selected for the panel regression for all ten Asian markets. The panel regression was run on weekly returns, COVID news composite, vaccine news index, and US election news index as illustrated in Table 5. The p-values are less than 5% for COVID news and vaccines. The coefficients suggest that there is a negative relationship between returns and COVID news but a positive one with vaccine which makes sense. Other news indices were used, such as Election news, however the results were not significant. As seen comparing the results in Table 5 and Table 3, we find that the coefficient is higher (more negative) for the U. S. compared to the average Asian country. The results go in the right direction and are significant, but in a much smaller magnitude compared to the US. This suggests that Asian markets are less correlated and therefore less sensitive to COVID news.

As we can see, COVID news has had a negative impact for Asian markets albeit not a strong one. It is important to note as we break down the composite, only the Panic Index is directional as it captures negative news. However, the other two components, Media Hype and Media Coverage index are two directional as they also capture good news. Hence, the change in correlation with the composite during the latter quarters can be explained by positive news about COVID. Nevertheless, we can also see as we enter the normalization period there is some level of normalcy regarding COVID in addition to not just positive news on vaccines but people and businesses adapting to COVID.

Table 5 breaks down the regression into quarters using daily data and it demonstrates similar results with the yearly results. Despite being noisy as daily returns, they allow us to break the results down into quarters. In line with the GDP data and conclusions from the Pre-COVID vs. COVID analysis in the previous sections, we find that in the first quarter, China has a relatively stronger relationship with COVID news but overall is still weak. China's R squared is 13.5% and a t-statistic of -2.49 for the first quarter. However the correlation weakens significantly throughout the following periods. Nevertheless, overall the results for Asian markets are not significant. The last two quarters of 2020 can be identified as the "new normal" period where all the countries seem to be less sensitive to COVID-19 news. It is also important to note other external news factors such as the progress for a COVID vaccine as well as the U. S. elections in the latter part of 2020 could explain the results. While these markets had big drawdowns, it may have been less about COVID news and more about the global economy, the exceptions being the US and China which are a major part of the global economy.

6.3. Changes in Death

The results from the regression run on weekly returns against weekly changes in COVID death rates showcases similar results to the COVID news data. The key distinction is that these results provide a contemporaneous understanding of COVID, as deaths provide information on the actual effects of COVID. However, it is more one dimensional as it doesn't capture the more multidimensional factors of COVID that COVID news captures. COVID news captures elements such as policy announcements and COVID events.

Table 6: Regression of Stock Returns to COVID-19 Deaths Over 2020

Returns & COVID-19 Deaths (Weekly; 2020)

	(1) US	(2) China	(3) Japan	(4) HK	(5) India	(6) Taiwan	(7) S. Korea	(8) Singapore	(9) Malaysia	(10) Philippines	(11) Indonesia
Deaths	1.81E-06	-1.0E-05	9.35E-05	0.00013	2.62E-06	0.0029	9.88E-05	0.0061	0.00087	3.80E-05	3.80E-05
	(1.49)	(-0.67)	(1.04)	(0.14)	(.24)	(0.32)	(0.42)	(1.27)	(2.08)	(0.89)	(0.78)
Constant	-0.0089	0.0033	-0.003	-0.0012	-0.0048	0.0034	0.0037	-0.0059	-0.0087	-0.0084	-0.003
	(-0.89)	(0.80)	(-0.35)	(-0.24)	(-0.59)	(0.74)	(0.52)	(-1.07)	(1.39)	(-0.82)	(-0.56)
Observations	52	51	51	52	52	52	52	52	52	52	52
R^2	0.043	0.0091	0.022	0.0004	0.0299	0.002	0.0035	0.031	0.079	0.016	0.012
bStdX	0.0092	-0.0026	0.0069	0.0006	0.0071	0.0014	0.0025	0.0062	0.011	0.0064	0.0028

t statistics in parentheses
$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

Table 6 documents results for regressions of weekly changes in the returns to the change in weekly deaths. Overall the relationship is not significant and the model is weak.

6.4. Portfolio of Asian Markets

A construction of a portfolio of Asian markets, equally weighted, illuminates how volatility changes from 2019 to 2020. The portfolio also divides the periods into quarters to understand the changes during each quarter. As evident in Table 7, holding a portfolio of Asian countries in 2019 provided benefits through diversification compared to holding the countries individually (as seen in a comparison between Table 2 and Table 7). However we find that this changes in 2020 where we see that the volatiles have increased significantly. The benefits of

diversification during the crisis period decreases as holding a portfolio of Asian markets in 2020 provides less benefit. This is in line with the findings using the correlations that show that systematic risk exposure increased during the COVID period.

Table 7: Portfolio of Asian Markets Pre-COVID vs COVID

Portfolio of Asian Markets (Equal weighting)

		2020	Q1 2020	Q2 2020	Q3 2020	Q4 2020	2019	Q1 2019	Q2 2019	Q3 2019	Q4 2019
Portfolio of Asian Markets	*Return*	0.054%	-0.545%	0.304%	0.065%	0.352%	0.058%	0.162%	0.028%	-0.063%	0.125%
	Variance	0.024%	0.065%	0.020%	0.006%	0.006%	0.003%	0.003%	0.004%	0.004%	0.002%
	SD	1.540%	2.542%	1.403%	0.804%	0.791%	0.582%	0.589%	0.641%	0.603%	0.475%
	Skewness	-1.38					-0.39				
	Kurtosis	7.72					0.63				
	Max Drawdown	27.981%					7.911%				

7. Going Beyond the Numbers

7.1. **Asia vs. The West**: Population & Culture

This paper looks beyond the numbers to dig deeper into why the Asian Markets have responded relatively well to the COVID pandemic. *Why are Asian countries outperforming the Western world in controlling COVID-19 pandemic?* by Landoni et al. explores why Asian countries are outperforming Western countries during the COVID pandemic. Notable differences include "the Asian population is younger in comparison to the European and North American ones" (2020). For instance, the "median population age in Asia is 31 years old, as compared to 42 years old in Europe and 35 in North America." Therefore this would influence the severity of COVID as older people are more susceptible to COVID. This also provides an explanation for Italy which was severely hit by COVID as they have a "median population age is 45.5 years old, one of the highest in the world. As elderly are more susceptible to infectious diseases "differences in mean population age may partially explain the mortality rates." Another interesting thing they noticed was that "the SARS outbreak of 2003 may have given some Asian

countries (notably China and Hong Kong) a few advantages in fighting COVID-19." They also argue that, because "Asians already knew how to face an epidemic, and took early actions as soon as the first cases were reported, enforcing travel limitations, lockdowns and deploying modern technology to track and trace the infection." Hence this provides some insight into results on the Asian markets, especially China and Hong Kong.

Moreover, they suggest that culture is another factor that has affected how COVID was handled. The paper explains that in the West "when restrictions were finally enforced, the population was less willing to collaborate, as the critical importance of these limitations was not understood." In contrast, "in the Asian culture, the maintenance of interpersonal distance and the use of facemasks are more common, pandemic or not." Hence, in European countries and the U.S. "these measures were hardly understood and adopted by Western populations at first." Consequently, this made it difficult for authorities to enforce. In fact, anti-lockdown protests emerged in these Western countries. In the U.S., President Trump said that COVID was a hoax (Dyere, 2020). This spurred protests of a few hundred people wearing Trump merchandise and carrying rifles and body armour, all over states such as Pennsylvania, Virginia, Minnesota, Ohio, Kentucky, California, Colorado, Wisconsin, Texas, and Michigan. Banners even included "Social distancing is communism" and "Covid-19 is a lie" on them. Later on, protests started to emerge in Europe (Gul Kayhan). This included Amsterdam, Austria, Belgium, Denmark, Bulgaria, Slovenia, Hungary, the Czech Republic. This was in response to extended lockdown measures due to the more contagious and apparently deadlier strain of the virus.

7.2. **The Case of China**: Politics, Technology, and Policy Response

To investigate further into the Chinese market, in *COVID–19's Impact on Stock Prices Across Different Sectors—An Event Study Based on the Chinese Stock Market* by He, Sun, and

Zhang they use an "event study approach to empirically study the market performance and response trends of Chinese industries to the COVID-19 pandemic" (2020). They found that "the study found that transportation, mining, electricity & heating, and environment industries have been adversely impacted by the pandemic" however "manufacturing, information technology, education and health-care industries have been resilient to the pandemic." When COVID-19 was announced, China's government imposed greater macro-policy adjustment, active fiscal and taxation policy (Li, Zhang, and Zhao 2020). Yang, Chen, and Zhang found that "the outbreak of the pandemic caused a sharp rise in risks in the financial sector, which transmitted to other industries" (2020). However, the degree to which they are affected differed and their responsiveness also varied. The paper's empirical results found that the pandemic had a large impact on China's traditional industries, which include transportation, mining, electricity and heating, and environment. Conversely, the pandemic "created opportunities for the development of high-tech fields." Given China's "large economy, complete infrastructure and industrial chain, and strong supporting capabilities" along with the opportunities for technology fields "helped the country to quickly overcome the adverse effects of COVID-19." Thus they found that "the outbreak of COVID-19 had a serious negative impact on China's traditional industries, but created opportunities for the development of high-tech industries."

Additionally, through a political lens, China's authoritarian government and strict measures provides another dimension in which to understand how China has been able to maintain stability. Existing COVID papers have also noted that the "drastic measure taken by the chinese government to contain the spread of the disease regained the confidence of the investors in China which explains insignificant results in the long-event window" (Khan et al. 2020). Yuen's paper *When COVID-19 Meets Centralized, Personalized Power* discusses the

implications of China's authoritarian regime in light of COVID. Notably, they explain how the political climate in China enabled mass mobilization of people to abide by strict measures and the rapid creation of new hospitals to contain the virus. These different lenses provided us a more holistic view to understand the discrepancies between not only Asia and the West, but China and other Asian countries.

From the lens of technology, it also explains howChina especially was able to combat COVID differently. In *Applications of digital technology in COVID-19 pandemic planning and response* by Whitelaw, Mamas, Topol et al. they found that "countries that have maintained low COVID-19 per-capita mortality rates appear to share strategies that include early surveillance, testing, contact tracing, and strict quarantine." These successful countries have "relied on adopting digital technology and integrating it into policy and health care." Such tools like "migration maps, which use mobile phones, mobile payment applications, and social media to collect real-time data on the location of people, allowed Chinese authorities to track the movement of people who had visited the Wuhan market, the pandemic's epicentre." China is an interesting case in which technology used by the government and firms allowed them to respond to COVID successfully. China uses "free, web-based and cloud-based tools to screen and direct individuals to appropriate resources." The data is used to track and identify emerging hot spots and clusters of infection where testing could be initiated.

In addition to technology used by the government, firms in China using technology to adapt has also helped stimulate economic activity. In *Marketing innovations during a global crisis: A study of China firms' response to COVID-19* by Wang, Hong, Li, and Gao, they explore "how firms in China are innovating their marketing strategies by critically identifying the typology of firms' marketing innovations using two dimensions, namely, motivation for

innovations and the level of collaborative innovations." They find that "practices of firms in China provide sufficient evidence of marketing innovation strategies that are significant contributing factors for firms' survival during the COVID-19 crisis." Unlike other Asian countries like the Philippines who are more dependent on their tourism industry and are not as technologically advanced, companies in China were able to adapt to COVID measures by using technology to keep their businesses running. Specifically, they find that "among the surviving firms in China, a majority perform fairly well in marketing innovations to adapt quickly to turbulent, uncertain, and ambiguous environments." Despite the fact that "weak consumer demand is one of the greatest challenges in the COVID-19 crisis," these Chinese companies used "deep insight into the changes in consumers' psychology and behaviors during home isolation" from digital means to sustain consumer demand and accommodate their needs. For example, "many retailers and even some leading manufacturers choose to use e-commerce live streaming as a new channel that can be adapted to the policy of home quarantine and makes it more convenient for consumers to obtain access to the products or services they need."

8. Conclusion

As a whole, the unprecedented COVID-19 pandemic demonstrates the impact of public health crises on financial markets and economies. With a focus on Asian markets, this paper finds that: 1) Asian markets are less sensitive to COVID-19 news 2) The crisis has implications on the benefits of portfolio diversification 3) China (and Hong Kong) are interesting cases as they seem to be less sensitive to COVID news despite being the source of the virus. Through digging deeper beyond the numbers, factors such as population age explain the varying impact of COVID on Asian countries versus the West. Moreover, the lens of culture provides insight on how Asia as a whole has performed differently from the West, notably regarding the

effectiveness of containment measures. Culture seems to play a role in that people in Asian countries are less resistant to abiding by strict government policies unlike the West. The lens of technology explains the numerical results on why Asian markets have been impacted by COVID differently, specifically highlighting China. Technology has been significant in countries like China as it was not just used by the government to directly combat COVID but for firms as well in order to adapt to the strict measures. Hence, Asian countries like the Philippines whose economy relies on tourism and lacks technological resources, have had more difficulty handling COVID. Additionally, as we investigate further into China, the strict measures and policies of their authoritarian government contributed to their ability to combat the virus, as it provided the government more control, especially over mobilization of resources.

As seen overall, the COVID crisis is not just a problem of health, but economics, politics, technology, and even culture. Hence, it naturally leads to questions regarding the implications of these conclusions on potential solutions to COVID. This interesting integration of health, economics, politics, and more provides a more holistic view of the relationship between markets through different dimensions. As a currently ongoing crisis, it would be interesting to further investigate the effects of COVID and the current attempts at finding a solution. Especially expanding the scope to include other regions will provide a more holistic view of the global crises. Moreover, it would be worthwhile to investigate how this crisis will have lingering effects not just on health and behavior in the future, but relationships between markets.

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Appendices

Table 5: Regression of Stock Returns to COVID-19 News Composite Over In Quarters

Returns & COVID-19 News Shocks (Daily; Q1)

	(1) US	(2) China	(3) Japan	(4) HK	(5) India	(6) Taiwan	(7) S. Korea	(8) Singapore	(9) Malaysia	(10) Philippines	(11) Indonesia
Composite	-0.0248	-0.0180*	-0.0128	-0.00452	0.0162	-0.00837	-0.0102	-0.0152	-0.00469	-0.00627	-0.00864
	(-0.91)	(-2.49)	(-0.98)	(-0.56)	(0.80)	(-1.58)	(-0.59)	(-1.57)	(-1.15)	(-0.59)	(-1.20)
Constant	-0.00360	-0.00107	-0.00480	-0.00377	-0.00898	-0.00465	-0.00502	-0.00572	-0.00308	-0.00793	-0.00650
	(-0.56)	(-0.36)	(-1.19)	(-1.14)	(-1.62)	(-1.29)	(-1.10)	(-1.37)	(-1.07)	(-1.42)	(-1.58)
R^2	0.018	0.135	0.022	0.007	0.015	0.057	0.008	0.055	0.029	0.008	0.032
bStdX	-0.00568	-0.007443	-0.00393	-0.00184	0.00434	-0.00573	-0.00268	-0.00661	-0.00329	-0.00331	-0.00504

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Returns & COVID-19 News Shocks (Daily; Q2)

	(1) US	(2) China	(3) Japan	(4) HK	(5) India	(6) Taiwan	(7) S. Korea	(8) Singapore	(9) Malaysia	(10) Philippines	(11) Indonesia
Composite	0.0306	0.00838	-0.00163	0.00913	-0.00127	-0.00756	0.00157	0.0112	-0.00129	-0.0128	0.00460
	(1.51)	(1.49)	(-0.18)	(1.66)	(-0.12)	(-1.61)	(0.16)	(1.23)	(-0.26)	(-1.74)	(1.03)
Constant	0.00345	0.00148	0.00265	0.000533	0.00300	0.00294*	0.00299	0.000312	0.00177	0.00256	0.00145
	(1.36)	(1.46)	(1.15)	(0.27)	(1.07)	(2.10)	(1.37)	(0.13)	(1.21)	(0.93)	(0.69)
R^2	0.036	0.038	0.001	0.045	0.0002	0.043	0.0007	0.039	0.001	0.050	0.018
bStdX	0.003784	0.001522	-0.00035	0.00332	-0.00030	-0.00227	0.000448	0.00369	-0.00036	-0.00482	0.00215

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Returns & COVID-19 News Shocks (Daily; Q3)

	(1) US	(2) China	(3) Japan	(4) HK	(5) India	(6) Taiwan	(7) S. Korea	(8) Singapore	(9) Malaysia	(10) Philippines	(11) Indonesia
Composite	-0.00205	-0.00399	-0.00198	0.00648**	0.00755*	0.00313	0.00234	-0.00217	-0.00213	-0.00171	-0.00211
	(-0.25)	(-0.82)	(-0.67)	(2.72)	(2.26)	(1.22)	(0.61)	(-0.91)	(-0.63)	(-0.78)	(-0.93)
Constant	0.00129	0.00111	0.000623	-0.000564	0.00129	0.00115	0.00158	-0.000849	0.0000511	-0.000894	-0.0000718
	(0.96)	(0.59)	(0.48)	(-0.39)	(1.04)	(0.94)	(1.09)	(-0.89)	(0.05)	(-0.61)	(-0.05)
R^2	0.001	0.010	0.008	0.105	0.074	0.023	0.006	0.013	0.007	0.010	0.014
bStdX	-0.00034	-0.001604	-0.00088	0.00390	0.002868	0.001506	0.000956	-0.00093	-0.00069	-0.00116	-0.00143

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Returns & COVID-19 News Shocks (Daily; Q4)

	(1) US	(2) China	(3) Japan	(4) HK	(5) India	(6) Taiwan	(7) S. Korea	(8) Singapore	(9) Malaysia	(10) Philippines	(11) Indonesia
Composite	-0.00538	-0.000125	-0.00123	-0.00150	-0.00340	-0.000921	-0.00105	0.00138	-0.00184	-0.00400	-0.000746
	(-0.86)	(-0.05)	(-0.59)	(-0.83)	(-1.41)	(-0.77)	(-0.04)	(0.81)	(-0.96)	(-1.63)	(-0.42)
Constant	0.00178	0.00127	0.00274*	0.00252	0.00347**	0.00260**	0.00345**	0.00238*	0.00124	0.00329	0.00374**
	(1.37)	(1.10)	(2.42)	(1.99)	(2.97)	(2.67)	(2.65)	(2.01)	(0.92)	(1.89)	(2.67)
R^2	0.012	0.00004	0.006	0.012	0.032	0.010	0.00002	0.011	0.015	0.045	0.003
bStdX	-0.00109	-5.657E-05	-0.00067	-0.0009	-0.00168	-0.0007	4.913E-05	0.000934	-0.0012	-0.00286	-0.00064

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8: Correlation Matrices Across Asia (2020)

Full Year 2020

	SSE	*N225*	*HSI*	*NSEI*	*TSEC*	*KOSPI*	*STI*	*JKSE*	*FTSE*	*PSEi*
SSE	1.000									
N225	0.428	1.000								
HSI	0.724	0.634	1.000							
NSEI	0.451	0.570	0.677	1.000						
TSEC	0.563	0.705	0.741	0.716	1.000					
KOSPI	0.498	0.773	0.754	0.709	0.863	1.000				
STI	0.556	0.698	0.807	0.759	0.762	0.797	1.000			
JKSE	0.475	0.562	0.632	0.729	0.698	0.714	0.712	1.000		
FTSE	0.489	0.644	0.652	0.521	0.686	0.671	0.690	0.581	1.000	
PSEi	0.408	0.502	0.605	0.667	0.690	0.675	0.673	0.710	0.633	1.000

Table 9: Correlation Matrices Across Asia (Q1 2020)

Q1 2020

	SSE	*N225*	*HSI*	*NSEI*	*TSEC*	*KOSPI*	*STI*	*JKSE*	*FTSE*	*PSEi*
SSE	1.000									
N225	0.580	1.000								
HSI	0.863	0.805	1.000							
NSEI	0.546	0.600	0.738	1.000						
TSEC	0.664	0.772	0.883	0.760	1.000					
KOSPI	0.600	0.793	0.862	0.757	0.953	1.000				
STI	0.685	0.787	0.868	0.881	0.839	0.851	1.000			
JKSE	0.590	0.593	0.728	0.878	0.788	0.783	0.816	1.000		
FTSE	0.666	0.787	0.799	0.542	0.806	0.766	0.772	0.651	1.000	
PSEi	0.598	0.653	0.787	0.838	0.872	0.825	0.798	0.871	0.735	1.000

Table 10: Correlation Matrices Across Asia (Q2 2020)

Q2 2020

	SSE	*N225*	*HSI*	*NSEI*	*TSEC*	*KOSPI*	*STI*	*JKSE*	*FTSE*	*PSEi*
SSE	1.000									
N225	0.545	1.000								
HSI	0.709	0.542	1.000							
NSEI	0.443	0.606	0.562	1.000						
TSEC	0.670	0.755	0.615	0.615	1.000					
KOSPI	0.621	0.815	0.705	0.650	0.761	1.000				
STI	0.739	0.636	0.840	0.563	0.787	0.797	1.000			
JKSE	0.629	0.674	0.538	0.521	0.517	0.699	0.567	1.000		
FTSE	0.591	0.709	0.620	0.618	0.748	0.832	0.766	0.593	1.000	
PSEi	0.466	0.398	0.496	0.422	0.503	0.536	0.534	0.549	0.658	1.000

Table 11: Correlation Matrices Across Asia (Q3 2020)

Q3 2020

	SSE	*N225*	*HSI*	*NSEI*	*TSEC*	*KOSPI*	*STI*	*JKSE*	*FTSE*	*PSEi*
SSE	1.000									
N225	0.156	1.000								
HSI	0.643	0.399	1.000							
NSEI	0.290	0.298	0.591	1.000						
TSEC	0.367	0.440	0.557	0.607	1.000					
KOSPI	0.257	0.581	0.562	0.541	0.596	1.000				
STI	0.347	0.462	0.638	0.511	0.490	0.538	1.000			
JKSE	0.183	0.157	0.422	0.294	0.372	0.322	0.338	1.000		
FTSE	0.399	0.214	0.449	0.393	0.441	0.271	0.403	0.384	1.000	
PSEi	0.104	0.095	0.287	0.282	0.240	0.301	0.322	0.392	0.334	1.000

Table 12: Correlation Matrices Across Asia (Q4 2020)

Q4 2020

	SSE	*N225*	*HSI*	*NSEI*	*TSEC*	*KOSPI*	*STI*	*JKSE*	*FTSE*	*PSEi*
SSE	1.000									
N225	0.248	1.000								
HSI	0.628	0.284	1.000							
NSEI	0.527	0.289	0.741	1.000						
TSEC	0.584	0.336	0.562	0.587	1.000					
KOSPI	0.635	0.530	0.620	0.595	0.735	1.000				
STI	0.447	0.399	0.696	0.589	0.451	0.609	1.000			
JKSE	0.519	0.283	0.589	0.531	0.647	0.631	0.643	1.000		
FTSE	-0.048	0.120	0.352	0.235	0.149	0.152	0.388	0.317	1.000	
PSEi	0.075	-0.129	0.261	0.243	0.015	0.104	0.366	0.126	0.281	1.000

Table 13: Correlation Matrices Across Asia (2019)

Full Year 2019

	SSE	*N225*	*HSI*	*NSEI*	*TSEC*	*KOSPI*	*STI*	*JKSE*	*FTSE*	*PSEi*
SSE	1.000									
N225	0.485	1.000								
HSI	0.600	0.619	1.000							
NSEI	0.234	0.165	0.244	1.000						
TSEC	0.430	0.565	0.657	0.135	1.000					
KOSPI	0.357	0.610	0.628	0.134	0.638	1.000				
STI	0.390	0.601	0.684	0.152	0.473	0.560	1.000			
JKSE	0.207	0.250	0.349	0.217	0.409	0.377	0.318	1.000		
FTSE	0.079	0.296	0.387	0.158	0.472	0.379	0.363	0.409	1.000	
PSEi	0.084	0.260	0.361	0.154	0.502	0.458	0.354	0.505	0.489	1.000

Table 14: Correlation Matrices Across Asia (Q1 2019)

Q1 2019

	SSE	*N225*	*HSI*	*NSEI*	*TSEC*	*KOSPI*	*STI*	*JKSE*	*FTSE*	*PSEi*
SSE	1.000									
N225	0.582	1.000								
HSI	0.651	0.759	1.000							
NSEI	0.260	0.292	0.337	1.000						
TSEC	0.440	0.646	0.664	0.310	1.000					
KOSPI	0.181	0.552	0.609	-0.138	0.576	1.000				
STI	0.326	0.598	0.668	0.136	0.501	0.573	1.000			
JKSE	0.180	0.416	0.368	-0.018	0.565	0.570	0.387	1.000		
FTSE	0.041	0.284	0.304	0.009	0.546	0.412	0.372	0.613	1.000	
PSEi	0.071	0.163	0.259	0.129	0.593	0.484	0.328	0.486	0.433	1.000

Table 15: Correlation Matrices Across Asia (Q2 2019)

Q2 2019

	SSE	*N225*	*HSI*	*NSEI*	*TSEC*	*KOSPI*	*STI*	*JKSE*	*FTSE*	*PSEi*
SSE	1.000									
N225	0.406	1.000								
HSI	0.628	0.710	1.000							
NSEI	0.369	0.236	0.144	1.000						
TSEC	0.366	0.410	0.597	0.053	1.000					
KOSPI	0.408	0.620	0.742	0.134	0.662	1.000				
STI	0.481	0.683	0.788	0.134	0.443	0.530	1.000			
JKSE	0.194	0.110	0.253	0.397	0.466	0.404	0.282	1.000		
FTSE	0.069	0.048	0.216	0.104	0.507	0.347	0.060	0.374	1.000	
PSEi	-0.063	0.022	0.099	0.164	0.500	0.442	0.029	0.570	0.507	1.000

Table 16: Correlation Matrices Across Asia (Q3 2019)

Q3 2019

	SSE	*N225*	*HSI*	*NSEI*	*TSEC*	*KOSPI*	*STI*	*JKSE*	*FTSE*	*PSEi*
SSE	1.000									
N225	0.518	1.000								
HSI	0.579	0.466	1.000							
NSEI	0.202	0.080	0.254	1.000						
TSEC	0.415	0.687	0.626	0.139	1.000					
KOSPI	0.461	0.655	0.514	0.225	0.631	1.000				
STI	0.492	0.646	0.723	0.170	0.582	0.616	1.000			
JKSE	0.297	0.265	0.485	0.239	0.357	0.364	0.407	1.000		
FTSE	0.235	0.617	0.580	0.214	0.715	0.399	0.526	0.410	1.000	
PSEi	0.259	0.419	0.543	0.140	0.544	0.471	0.647	0.490	0.552	1.000

Table 17: Correlation Matrices Across Asia (Q4 2018)

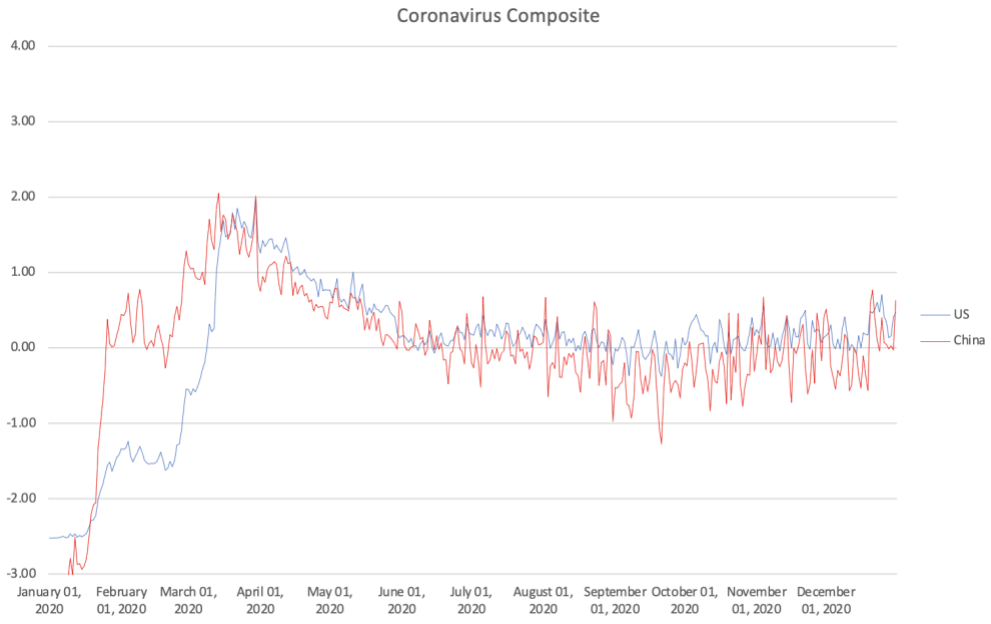
Q4 2019

	SSE	*N225*	*HSI*	*NSEI*	*TSEC*	*KOSPI*	*STI*	*JKSE*	*FTSE*	*PSEi*
SSE	1.000									
N225	0.546	1.000								
HSI	0.744	0.663	1.000							
NSEI	0.035	0.127	0.272	1.000						
TSEC	0.685	0.561	0.735	0.066	1.000					
KOSPI	0.552	0.634	0.665	0.176	0.665	1.000				
STI	0.206	0.426	0.501	0.108	0.345	0.497	1.000			
JKSE	0.191	0.273	0.246	0.009	0.259	0.166	0.132	1.000		
FTSE	0.031	0.173	0.402	0.318	0.129	0.345	0.529	0.300	1.000	
PSEi	0.202	0.489	0.481	0.263	0.402	0.437	0.347	0.525	0.470	1.000

Table 18: Consumer & Business Confidence

Region		US	China	HK	Japan	Malaysia	Philippines	Singapore	S. Korea	Taiwan	India	Indonesia
Q1 2019	*Business Confidence*	10.60	1.00	-	11.00	-5.70	50.20	1.60	-24.00	-	16.20	5.30
	Consumer Confidence	-2.20	24.10	-	-19.20	-14.40	10.70	-	0.50	-15.64	33.40	24.54
Q2 2019	*Business Confidence*	2.60	-1.20	-	2.00	-5.80	45.00	-0.80	-25.00	-	13.50	5.33
	Consumer Confidence	-2.20	25.90	-	-22.40	-7.00	9.70	-	-1.60	-20.20	28.40	26.38
Q3 2019	*Business Confidence*	-3.40	-0.40	-	-1.00	-31.00	46.90	-1.00	-28.00	-	12.80	4.09
	Consumer Confidence	-6.65	24.10	-	-28.40	-16.00	15.80	-	-2.10	-19.14	18.00	21.84
Q4 2019	*Business Confidence*	-4.60	0.40	-	-4.00	-11.70	36.50	0.20	-29.00	-	2.20	2.99
	Consumer Confidence	1.26	26.60	-	-22.00	-17.70	15.70	-	1.30	-15.72	14.50	26.37
Q1 2020	*Business Confidence*	-0.60	4.00	-	-7.00	-17.00	35.60	-9.20	-31.00	-	5.00	-8.72
	Consumer Confidence	-4.35	22.20	-	-37.60	-48.90	9.20	-	-19.60	-21.49	15.20	13.78
Q2 2020	*Business Confidence*	4.40	1.80	-	-22.00	-39.00	-	-4.00	-51.00	-	8.80	-42.91
	Consumer Confidence	-20.92	12.60	-	-41.60	-9.90	-	-	-16.30	-31.23	-2.10	-16.22
Q3 2020	*Business Confidence*	11.40	3.00	-	-40.00	-13.70	13.50	0.60	-32.00	-	-0.50	-10.19
	Consumer Confidence	-19.79	20.50	-	-33.80	-8.50	-4.10	-	-18.60	-28.40	15.90	-16.64
Q4 2020	*Business Confidence*	21.00	3.80	-	-31.00	15.40	30.80	1.00	-19.00	-	11.40	-5.41
	Consumer Confidence	-32.06	22.10	-	-35.80	-14.80	4.30	-	-8.80	-29.10	15.90	-3.50

Figure 2: COVID Composite of China and the U. S.


Coronavirus Composite
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
January 01, 2020
February 01, 2020
March 01, 2020
April 01, 2020
May 01, 2020
June 01, 2020
July 01, 2020
August 01, 2020
September 01, 2020
October 01, 2020
November 01, 2020
December 01, 2020
US
China