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How do equity markets react to COVID-19? Evidence from emerging and developed countries

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ABSTRACT

Based on the supply of stock market returns hypothesis, we argue that the unprecedented adverse shock of COVID-19 on the countries' economic growth translates into a negative shock to the stock markets. According to the institutional theory, we also argue that the impact of COVID-19 in emerging countries is different from developed countries. Based on the overreaction hypothesis, we expect that the market reaction during the stabilizing period of COVID-19 spread is different from the market reaction during the infection period. Using high-frequency daily data across 53 emerging and 23 developed countries from January 14 to August 20, 2020, we find that COVID-19 cases and deaths adversely affect stock returns and increase volatility and trading volume. Cases and deaths affected stock returns and volatility in the emerging markets, while only cases of COVID-19 affected stock returns, volatility, and trading volume in the developed markets. COVID-19 cases and deaths are related to returns, volatility, and trading volume for emerging countries during the rising infection of COVID-19 (pre-April 2020), while cases and mortality rates are related to returns, volatility, and trading volume in developed countries during the stabilizing spread (post-April 2020). Therefore, the emerging markets' investors seem to react to COVID-19 cases and mortality rates differently from those in the developed markets across two different periods of COVID-19 infection.

1. Introduction

The world is experiencing an unprecedented shock due to the novel coronavirus outbreak, also known as COVID-19. Initially found in December 2019 in Wuhan city in China, COVID-19 has spread across 216 countries and territories (World Health Organization (WHO), 2020b). While prior pandemic diseases such as bird flu, SARS, swine flu, Ebola, and MERS have brought a significant increase of volatility in the equity market, COVID-19 brings the most forceful impact to the equity market history (Baker et al., 2020; Baker, Bloom, Davis, & Terry, 2020). Barro, Ursua, and Weng (2020) compare the COVID-19 with the Great Influenza Pandemic (Spanish Flu) from 1918 to 1920 across 48 countries and conclude that COVID-19 has brought significantly larger impacts to the gross domestic products (GDPs), consumption, and stock markets than any past pandemics. Fernandez (2020) examines the impact of COVID-19 on the GDPs across 30 different countries and finds that, on average, the 2020 GDPs for these countries is expected to decline by at least

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2.8 %. Yilmazkuday (2020a) examines the impact of COVID-19 on global economic activities, measured by crude oil prices, and finds that rising COVID-19 cases have a significant adverse effect on the global economies.

In this study, we examine the impact of COVID-19 on stock market returns, volatility, and trading volume during the rising infection period (January until the end of March or pre-April) and the stabilizing infection period (April until August or post-April) of COVID-19 infection. We also examine the impact of COVID-19 on the emerging countries' equity markets and compare it with the developed countries' equity markets. Our main objective is to extend the existing literature by examining the impact of COVID-19 across a broader number of countries across two distinctly different markets (emerging and developed countries) and two extended periods of infection rate.

Based on the supply of stock market returns hypothesis (Diermier, Ibbotson, & Siegel, 1984; Ibbotson & Chen, 2003), we argue that businesses' productivity determines the stock market return. Since countries worldwide have instituted lockdowns and stay-at-home orders, the COVID-19 outbreak brought significant global disruptions to real economic activities, such as supply chains, productions, and consumptions (Eichenbaum, Rebelo, & Trabandt, 2020; McKibbin & Fernando, 2020). Investors translated these disruptions on real economic activities by at once withdrawing their investments in the equity markets, which created negative returns, greater volatility, and higher trading volume. Based on the institutional theory (North, 1990, 1991, 2005; Khanna & Palepu, 1997, 2011), we also hypothesize that the impact of COVID-19 in the emerging markets is different from the developed markets. Research has found different investment behaviors between emerging and developed markets, such as risk and return framework, and we believe the impact of COVID-19 will differ between these two markets (Salomons & Grootveld, 2003). Furthermore, according to the overreaction hypothesis (De Bondt & Thaler, 1985, 1987; Phan & Narayan, 2020), we argue that the impact of COVID-19 on equity markets during the rising infection period (pre-April) is different from its impact during the stabilizing period (post-April). The market tends to overreact about COVID-19 and then resettle itself as it learns more about the pandemic.

Recent studies have examined the impact of COVID-19 on the stock market returns and volatility (e.g., Ashraf, 2020; Harjoto, Rossi, & Paglia, 2020; Narayan, Phan, & Liu, 2020; Shehzad, Xiaoxing, & Kazouz, 2020). Our study extends this existing literature by empirically examining the impact of COVID-19 on stock markets for an extended period from January to August 2020. While extant studies have examined the impact of COVID-19 on the stock markets in developed countries or emerging countries separately, our study also directly compares the COVID-19 impact on stock markets in the emerging and the developed markets. Finally, we answer the call for an empirical examination of the equity markets' overreaction hypothesis that has been proposed by Phan and Narayan (2020) across 76 different countries.

Using a sample of 53 emerging markets and 23 developed market equity indices from the Morgan Stanley Capital International (MSCI) and the daily cases and mortality rates from the World Health Organization (WHO) situation reports, we find strong evidence that an increase in daily cases and mortality rates adversely affect the daily stock markets' return. The daily cases and mortality rate also increase the daily volatility and the daily trading volume. We find that these impacts are both statistically and economically significant. We also find that daily cases and death rates affect the daily return, volatility, and trading volume in emerging countries. In contrast, only daily cases affect the daily return, volatility, and trading volume in developed countries. We find that COVID-19 cases and mortality rates significantly affect the daily stock return, volatility, and trading volume during the rising infection period. The cases and mortality rates only affect the volatility during the stabilizing infection period. This latter finding supports the overreaction hypothesis (Phan & Narayan, 2020) and indicates that the stock markets seem to overreact during the rising infection period.

The World Health Organization (WHO), government agencies, and news publish the new cases and deaths from COVID-19 daily, which directly reflects the speed of transmission (cases) and the mortality (deaths) from this pandemic throughout the rising (pre-April) and the stabilizing (post-April) infection periods. To the best of our knowledge, no study has examined how the stock market indices worldwide react to the daily cases and mortality rates during these two different periods of the COVID-19 spread. Furthermore, no study has examined the differing impacts of COVID-19 of new cases and death rates on developed and emerging equity markets. Our study offers new insights into how the equity markets in emerging countries reacted differently than developed countries to the cases and death rates during the rising and the stabilizing infection periods of COVID-19. Our results are robust even after we exclude the equity markets in the U.S. and China. Our results are also robust under the fixed-effects and random-effect estimation methods.

2. Literature review and hypotheses

Studies that examine the impact of COVID-19 on economic growth and stock markets are emerging rapidly. Yilmazkuday (2020a) examines the impact of COVID-19 daily cases on global economic activities based on commodities' daily shipping (transportation). He finds that daily cases adversely affect the global economic activity and argues that COVID-19 has brought significant disruptions on global economic activity through disrupted transportations among the supply chains. Yilmazkuday (2020c) finds that COVID-19 has also increased the U.S.'s unemployment rate, especially in March 2020. Furthermore, Yilmazkuday (2020b) finds that a one percent increase in the cumulative daily COVID-19 cases in the U.S. resulted in 0.01 percent negative daily return in the S&P 500 index. Onali (2020) finds that COVID-19 significantly affects the U.S. equity market toward the end of February 2020. Using daily data from China, India, Japan and Korea, Prabheesh, Padhan, and Garg (2020) examine the relationship between oil price returns and stock returns and find that falling oil prices brings a negative signal to the stock markets.

Recent studies have also examined the impact of COVID-19 on the equity markets' volatility and trading volume. Baek, Mohantry, and Glambosky (2020) find a significant increase in absolute risk for the US equity market due to the COVID-19 deaths. Salisu and Akanni (2020) construct a global fear index (GFI) based on the cases and deaths from the COVID-19. They find that GFI is a good predictor of stock returns in the OECD and the BRICS countries during the pandemic. Zhang, Hu, and Ji (2020) examine the impact of COVID-19 on stock market volatility across 11 developed countries and China and find that the volatility has increased substantially

from February to March 2020.

COVID-19 studies have also examined the impact on the commodity markets, specifically crude oil (energy) markets. Narayan (2020b) examines the effect of the threshold of the COVID-19 case on oil prices and finds that news on oil prices has a limited effect on price when conditioned on COVID-19 cases. Under the oil price volatility threshold, both COVID-19 cases and negative news on the oil process significantly affect oil prices. Using hourly data, Devpura and Narayan (2020) show that COVID-19 cases and deaths led to a significantly greater daily volatility in the oil process. Salisu and Adediran (2020) find that the equity market volatility tracker of COVID-19 (Baker, Bloom, Davis, Terry et al., 2020) is a good predictor for energy market volatility. Qin, Zhang, and Su (2020) find that the COVID-19 pandemic index negatively affects the oil prices due to lower demand during the infection period of 2019 and early 2020.

Albulescu (2020) examines the impact of COVID-19 on the stock market volatility in the US and finds that the global new cases and fatality ratio increase the volatility. Espinosa-Méndez and Arias (2020) find evidence that COVID-19 has increased herding behavior in returns, volatility, and trading volumes among five major European equity markets. Chiah and Zhong (2020) examine the impact of COVID-19 on the trading volumes across 37 international equity markets and find a massive increase in trading volume attributable to the national culture and institutional environment in each country.

Our study extends this literature by conducting a broader examination of the impact of COVID-19 on equity markets' returns, volatility, and trading volumes across 76 different countries. While the literature has empirically examined the adverse impact of COVID-19 on the global equity markets, most studies did not derive their mechanisms on how COVID-19 could adversely affect the stock markets. Our first hypothesis is based on the supply of stock market returns hypothesis (Diermier et al., 1984; Ibbotson & Chen, 2003). We argue that the stock market return is determined by the productivity of businesses in the real economy. Studies have shown that many countries have instituted various forms of lockdowns and quarantines during the COVID-19 outbreak to reduce the virus's spread (Abouk & Heydari, 2020; Alvarez, Argente, & Lippi, 2020; Hsiang et al., 2020). We argue that these lockdowns, stay-at-home orders, and quarantines have disrupted real economic activities, supply chains, productions, and consumptions (Eichenbaum et al., 2020). According to the supply of stock market returns hypothesis, the country's economic growth influences the returns, volatility, and trading volume in the equity market. Therefore, the unprecedented adverse effect of COVID-19 on the real economic activities translates into a significant adverse effect on the equity markets (Baker et al., 2020; Baker, Bloom, Davis, Terry et al., 2020; Barro et al., 2020; Fernandez, 2020).

Empirical studies have also demonstrated that the stock markets reacted negatively to widespread adverse economic shocks. Given our focus is to examine the unprecedented impact of COVID-19 on the financial markets across different countries, we follow the current study (Baker et al., 2020; Baker, Bloom, Davis, Terry et al., 2020; Fernandez, 2020; Shehzad et al., 2020) and focus our comparison with the most recent 2007–2008 global financial crisis. Fernando, May, and Megginson (2012) prove that the stock markets experienced 5% losses during the Lehman collapse as the culminating event of the 2007–2008 global stock market collapse. The Lehman collapse's shockwave has also been documented across different financial institutions (Dumontaux & Pop, 2013; Johnson & Mamun, 2012) and different countries (Mensi, Hammoudeh, Nguyen, & Kang, 2016). Existing studies also documented that the 2007–2008 global stock market collapse was also accompanied by greater stock market volatility and trading volumes (Anand, Irvine, Puckett, & Venkataraman, 2013; Hoffman, Post, & Pennings, 2013).

We base our first hypothesis on the supply of equity market returns hypothesis and the extant empirical studies that examine the impact of COVID-19 on stock markets. We argue that COVID-19's negative effect of disrupting real economic activities will lead to a significant adverse effect on stock market returns, volatility, and trading volume. We form our first hypothesis as follow:

H1. Daily cases and mortality rates from COVID-19 adversely affect the stock markets, indicated by lower daily returns and higher volatility and trading volume.

Recent studies examine the impact of COVID-19 on the emerging stock markets. Mishra, Rath, and Dash (2020) find that all Indian stock indices react negatively to the COVID-19 outbreak. Salisu and Akanni (2020) also demonstrate that the global fear index (GFI) based on the cases and deaths from the COVID-19 is a good predictor of stock returns in the BRICS countries during the pandemic. Examining 23 emerging markets across three regions (i.e., Americas, Europe, the Middle East, and Asia), Haroon and Rizvi (2020) find that a decreasing number of confirmed coronavirus cases is associated with improving liquidity in the equity markets and vice versa. They also find that policy interventions (stringency index) are associated with improved liquidity. They conclude that flattening coronavirus infections help reduce uncertainty among emerging countries' equity markets investors.

Studies have also examined the impact COVID-19 across different sectors on emerging markets, specifically in China. He, Sun, Zhang, and Li (2020) find the pandemic adversely impacted Chinese firms that operate in transportation, mining, electricity and heating, and environment industries while those that operate in manufacturing, information technology, education, and healthcare industries have been more resilient against the COVID-19. Fu and Shen (2020) find the negative effect of COVID-19 on China energy companies' performance and indicate that the impact of COVID-19 varies across different sectors. Gu, Ying, Zhang, and Tao (2020) examine the impact of COVID-19 across different sectors based on electricity use in China. They find that the impact of COVID-19 varies across different industries, ownership structure, and firm size. Shen, Fu, Pan, Yu, and Chen (2020) and Xiong, Wu, Hou, and Zhang (2020) examine the reaction of Chinese listed stocks to the lockdown in Wuhan due to the COVID-19 outbreak and find that the impact varies across different industries, firm size, profitability, growth opportunity, leverage, and fixed assets. They also find that the negative impact of COVID-19 on firm performance is more pronounced in China's regions with high confirmed cases of COVID-19 and specific industries that were adversely affected by COVID-19.

While COVID-19 also adversely affects the emerging countries' equity markets, recent studies argue that the impact of COVID-19 in emerging countries is different from the developed countries. Liu, Sun, and Zhang (2020) find that the Chinese business and financial

cycles were already close to the contraction phase right before the COVID-19 outbreak. They suggest that China may be better positioned than other emerging economies to recover from the COVID-19 economic shockwave. Salisu and Sikiru (2020) demonstrate that although Islamic stocks' effectiveness in Asia-Pacific as a hedging strategy has declined, they still provide superior performance relative to the conventional stocks during the COVID-19.

Although existing studies have examined the impact of COVID-19 on emerging countries, to the best of our knowledge, none of these studies compare the impact of COVID-19 on the emerging countries' equity markets with the impact of COVID-19 on the developed countries' equity markets. We derive our second hypothesis based on the institutional theory (North, 1990, 1991). North (1990) argues that the institution consists of formal and informal constraints that are necessary to facilitate economic activities because they provide enforcement mechanisms that reduce the transaction costs, increase capital mobility, and diversify risk among market participants, especially when the markets and exchanges become more complex, competitive, and impersonal. The strengths of formal and informal constraints influence the magnitudes of the impact of a catastrophic disaster on the economic and financial systems (North, 2005).

Khanna and Palepu (1997) characterize the emerging markets as having weak institutional contexts in a product, capital, labor markets, regulatory system, and lack of mechanisms for enforcing contracts. They indicate that these weak institutional contexts as institutional voids (Khanna & Palepu, 2011). Several studies have also indicated that the emerging markets generally have lower capacity and less advanced fiscal and monetary policies infrastructure to weather the adverse impact of COVID-19 (Arellano, Bai, & Mihalache, 2020; Topcu & Gulal, 2020). More specifically, the emerging countries have been identified to have a weaker healthcare infrastructure (Hsiang et al., 2020; McKibbin & Fernando, 2020). Furthermore, the capital markets in emerging countries generally have lower liquidity and more significant information asymmetry than the developed markets (Bhagat, Malhotra, & Zhu, 2011; ElBannan, 2017; Khanna, Palepu, & Sinha, 2005). Therefore, any unexpected global economic shockwave to the emerging markets significantly increases the uncertainties and adversely affects their financial markets (Tran, Hoang, & Tran, 2018).

Existing empirical studies also demonstrate that the impact of a global financial shockwave on emerging markets is different from the developed markets (Batten & Szilagyi, 2011; Normazia, Hassan, Ariff, & Shamsher, 2013). Girard and Biswas (2007) examine the volatility and trading volume in 22 developed countries and 27 emerging markets and find that emerging markets exhibit greater unexpected volatility and trading volume. Dooley and Hutchinson (2009) examine 14 different emerging markets and find that the impact of 2007 crisis on the emerging markets was quite significant. Berkmen, Gelos, Rennhack, and Walsh (2012) find that the 2007 financial crisis affected emerging markets through financial channels. Tran et al. (2018) find that the ownership structure influences the impact of 2007 crisis on Vietnam's stock markets.

Based on the institutional theory and these existing literature that indicate the financial markets' reactions to financial shocks vary across emerging and developed markets, we form our second hypothesis that daily cases and deaths from COVID-19 bring differing effects on emerging and developed equity markets. In other words, investors of the emerging equity markets are expected to react to daily cases and deaths from COVID-19 differently from investors of the developed equity markets. Our second hypothesis can be stated as the following:

H2. The impacts of daily cases and mortality rates from COVID-19 on the emerging equity markets are different from the impacts on the developed markets.

Equity markets also showed different behavior and reactions during the pre- and post-financial crisis (Jebran, Chen, Ullah, & Mirza, 2017; Majid & Kassim, 2009). Celebi and Hönig (2019) find that the regional (OECD) leading indicator plays an important role in stock returns during the pre-2007 financial crisis while macroeconomics factors in each country play a more important role post-2007 crisis. Roni, Abbas, and Wang (2018) examine Asian emerging stock markets and find that volatility and stock returns behave differently during the post-2007 crisis compared to the pre-2007 crisis.

Recent studies that examine the impact of COVID-19 on stock markets across distinct phases of infections have documented a time-varying impact of COVID-19 on equity markets. Ramelli and Wagner (2020) find that the stock markets' reactions to COVID-19 change during the incubation (early January 2020), outbreak (January to February), and feverish (February to March) periods of the COVID-19. Phan and Narayan (2020) examine the impact of COVID-19 across 25 countries and argue that the stock markets tend to overreact as the number of deaths and cases from COVID-19 increases and are more likely to self-correct as the time lapses. Narayan, Devpura, and Wang (2020) examine the impact of COVID-19 on the exchange rates between Yen and US Dollar and find that the depreciation in Yen during the COVID-19 generates significant positive returns on the equity markets. However, Narayan (2020a) finds the impact of COVID-19 on the Japanese Yen exchange rates is transitory and indicates the time-varying effect of COVID-19. Gil-Alana and Monge (2020) find that the oil market's shock during the COVID-19 pandemic is only transitory, and therefore, it exhibits a mean-reverting pattern. Huang and Zheng (2020) find a structural change in the relationship between investor sentiment and crude oil futures during the pre-versus-post COVID-19 pandemic. Liu, Wang, and Lee (2020) find a negative relation between crude oil returns and stock returns. More importantly, they demonstrate a time-varying effect of COVID-19 cases in both crude oil and equity markets. Rizwan, Ahmad, and Ashraf (2020) examine the impact of COVID-19 on the banking industry's systemic risk and find that the systemic risk has changed during the post-period relative to the rising period of COVID-19 cases. Debelle (2020) finds that the central bank and the government's monetary and fiscal policies in Australia have successfully reversed the adverse impact of COVID-19 in the economy.

Topcu and Gulal (2020) investigate the impact of COVID-19 in 26 emerging equity markets and find that the pandemic's negative impact has decreased by mid-April. Bissoondoyal-Bheenick, Do, Hu, and Zhong (2020) examine the connectedness between stock returns and volatility and find that the connectedness is more pronounced when the severity of the COVID-19 pandemic was rising, indicating that there is a time-varying effect of COVID-19 on the stock return and volatility. El-Khatib and Samet (2020) find that COVID-19 adversely affects the emerging market index and increases volatility and premiums on their sovereign credit default swaps.

Ahmed, Hoek., Kamin, Smith, and Yoldas (2020) examine the impact of COVID-19 on emerging market economies and lower-income developing countries and find that strengthening restrictions to reduce the spread leads to tighter financial conditions that adversely affect economic activity, but continuing to ease restrictions to support activity increases the risk of spread. Therefore, requiring more stringent restrictions with greater financial repercussions in the future. Thus, monetary, fiscal, and health policies to address the COVID-19 have created moral, ethical, and economic dilemmas (Tisdell, 2020), especially in emerging countries.

Most of these existing studies examine the impact of COVID-19 during the period when COVID-19 cases and deaths were surging; our study extends the literature by examining the time-varying impact of COVID-19 on equity markets during the periods of rising cases and deaths (pre-April 2020) and the period of stabilizing cases and deaths (post-April 2020). Phan and Narayan (2020) hypothesize that the stock markets tend to overreact to COVID-19 and expect that the markets will self-correct as information becomes more available, and investors can gauge the real impact of COVID-19 on stock markets. We answer the call for an empirical examination of the overreaction hypothesis. The overreaction hypothesis explains that the equity markets tend to overreact, especially to a negative shock (De Bondt & Thaler, 1985, 1987). The overreaction hypothesis also predicts that the equity markets tend to exhibit the mean-reverting, and therefore, every overreaction is accompanied by a reversal. We argue that the equity markets tend to overreact to the negative impact of COVID-19 on the economies, especially during the rising cases and deaths from COVID-19 (pre-April 2020). Therefore, we expect that the market reactions during the stabilizing infection period (post-April, 2020) will be different from the market reactions during the rising cases and mortality rates of COVID-19 (pre-April 2020).

Based on the overreaction hypothesis and these existing studies, we form our third hypothesis that there is a different time-varying impact of COVID-19 cases and deaths on stock markets during the rising infection period (pre-April) than the stabilizing period of infection (post-April). Our third hypothesis can be stated as the following:

H3. The impacts of daily cases and mortality rates from COVID-19 on the equity markets during the rising infection (pre-April) period are different from the impacts during the stabilizing infection (post-April) period.

3. Data and sample statistics

We start our data compilation from the daily numbers of new and cumulative cases and deaths from the World Health Organization Situation Report website (World Health Organization (WHO), 2020a, 2020b) starting from January 14, 2020, until August 20, 2020. After web searches and research across different countries, we found 78 countries out of 216 countries and territories listed in the WHO Situation Report have stock indices. We downloaded daily data for 77 countries' major stock indices (e.g., S&P500 for the USA) from the Bloomberg terminal. We retrieved the Iran stock market index (TEDPIX) from the Tehran Stock Exchange website (https://tse.ir/en/archive.html). Two countries (i.e., Bangladesh and Kuwait) have missing information on stock indices, trading volume, or volatility and were excluded from our sample.

We merge the WHO data with the stock indices data based on the country names and dates. After deleting missing observations, our final sample consists of 8,985 total observations across 76 countries. As far as our knowledge, our sample represents the most comprehensive sample that examines the impacts of COVID-19 cases and deaths on the equity markets around the globe. We also split our sample into 5,940 observations across 53 emerging countries and 3,045 observations across 23 developed markets based on the MSCI market classification (https://www.msci.com/market-classification). The 76 countries, their major indices, and emerging and developed markets classifications are listed in the Appendix A.

We also explore the two subsample periods: the rising COVID-19 infection period between January 14 through March 31, 2020

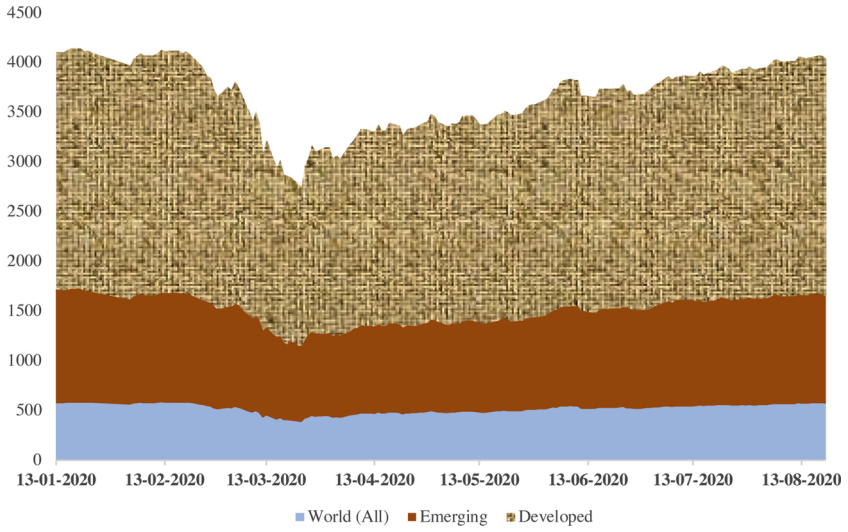

Fig. 1. World, Emerging and Developed Market Equity Indices.

(pre-April), where the infection rates were increasing rapidly, and the stabilizing infection period from April 1, 2020, through August 20, 2020 (post-April) where the infection rates started to decline and become more stable. We selected March 31, 2020, as our cutoff date based on the existing studies (Baker et al., 2020; Baker, Bloom, Davis, Terry et al., 2020; Ramelli & Wagner, 2020; Yilmazkuday, 2020b).

To account for variations in cases and deaths across different countries, we calculate the percentage of daily increase in the percentage of new cases (%CASES) as the daily new cases divided by the cumulative cases to measure the transmission speed. We calculate the percentage of new deaths (%DEATHS) as the daily new deaths divided by the cumulative cases as our daily mortality rate measure. We calculate the percentage of daily stock index returns (RET) in each country. Following the mixture of distribution hypothesis (Clark, 1973; Darolles, Foi, & Mero, 2017; Epps & Epps, 1976), we use the daily trading volume (TVOLUME) and 30-day volatility (VOLAT) as our two measures of stock markets volatility. We take a natural log of daily trading volume (natural log of TVOLUME or VOLUM) to reduce daily trading volume skewness.

Fig. 1 shows the daily movements of the world (All), the emerging (Emerging), and the developed (Developed) equity market indices during the entire period of our sample. It shows that all equity indices were experiencing a sharp downward trend, especially in March 2020. By April 2020, the indices were experiencing a rebound. This evidence is consistent with the overreaction hypothesis (Phan & Narayan, 2020).

Fig. 2 provides daily stock indices returns across all countries (RET All), emerging (RET EM), and developed (RET DEV). We find that the stock indices return for the emerging countries were experiencing the most volatile daily returns, especially during the rising infection (pre-April) period. Both emerging and developed countries' stock indices returns become less volatile during the stabilizing infection (post-April) period. Fig. 3 indicates that 30-day volatility peaked during the rising infection (pre-April) period, especially for the developed countries. Fig. 4 shows that the trading volumes, especially for the developed countries, continue to fluctuate during the rising infection (pre-April) and stabilize infection (post-April) periods.

Table 1 presents the summary statistics. The average daily returns during our sample period are 0.011 %. The averages of 30-day volatility and daily trading volume are 30.613 % and 1.845 billion shares, respectively. The daily averages in the percentages of new cases and new deaths due to COVID-19 during our sample period are 4.4 % and 0.3 %, respectively. Slightly over a third of our sample represents the 23 developed countries, while a two-third of our sample represents 53 emerging markets. Our sample consists of 1.1 %, 5.7 %, 16.1 %, 16.1 %, 15 %, 17.3 %, 17.9 %, and 10.8 % observations in January, February, March, April, May, June, July, and August, respectively.

4. Empirical method and regression results

We conduct multivariate regressions to examine the impact of daily percentages increase in the number of cases and deaths due to COVID-19 on daily return (RET), volatility (VOLAT), and the natural log of trading volume (VOLUM). We include the one-day lag of RET, VOLAT, and VOLUM to control autocorrelation and mean-reverting characteristics of stock return, volatility, and trading volume. We also include monthly dummy variables with August as the excluded dummy and 75 country dummy variables with United States (USA) as the excluded dummy to control differences in stock market characteristics across different months and countries. Following Petersen (2009), we use the two-way clustering of standard errors based on country and day in all regressions. The standard errors are reported in parenthesis below the slope coefficient.

Table 2 shows that a one percent increase in daily new cases, and deaths from COVID-19 adversely affects daily stock returns by 0.013 % and 0.122 %. Given the average of daily returns (RET) is 0.011 %, the magnitudes of the impacts of daily new cases and mortality rates from COVID-19 on daily stock returns are economically significant. We find that a one percent increase in daily new cases and deaths from COVID-19 increases the volatility by 2.24 % and 10.34 %, respectively. We also find that a one percent increase in daily new cases and deaths increases the daily trading volume by 2.8 % and 18.87 %, respectively. Since the averages of the volatility

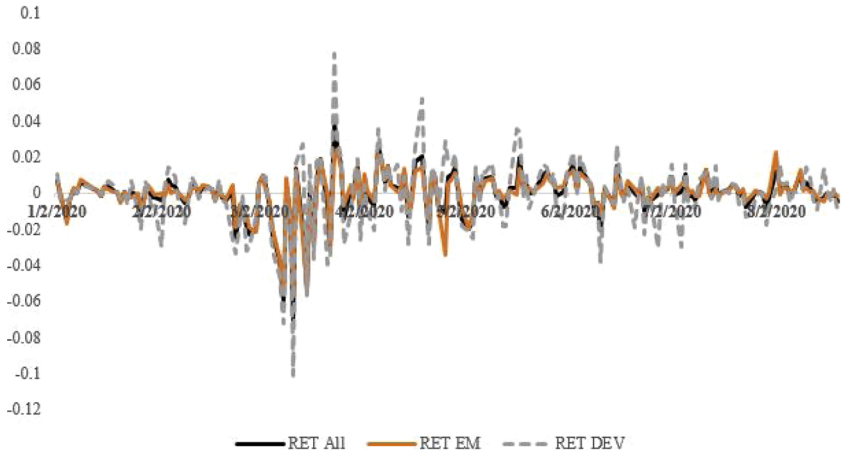

Fig. 2. World, Emerging and Developed Market Equity Daily Returns.

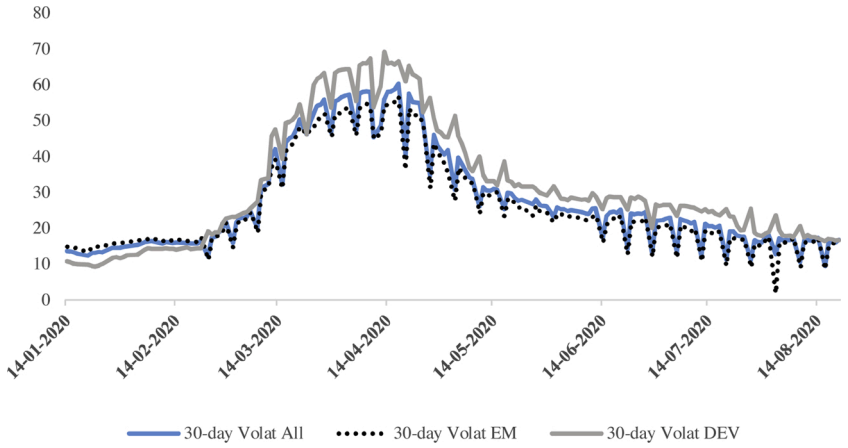

Fig. 3. World, Emerging and Developed Market Equity 30-Day Volatility.

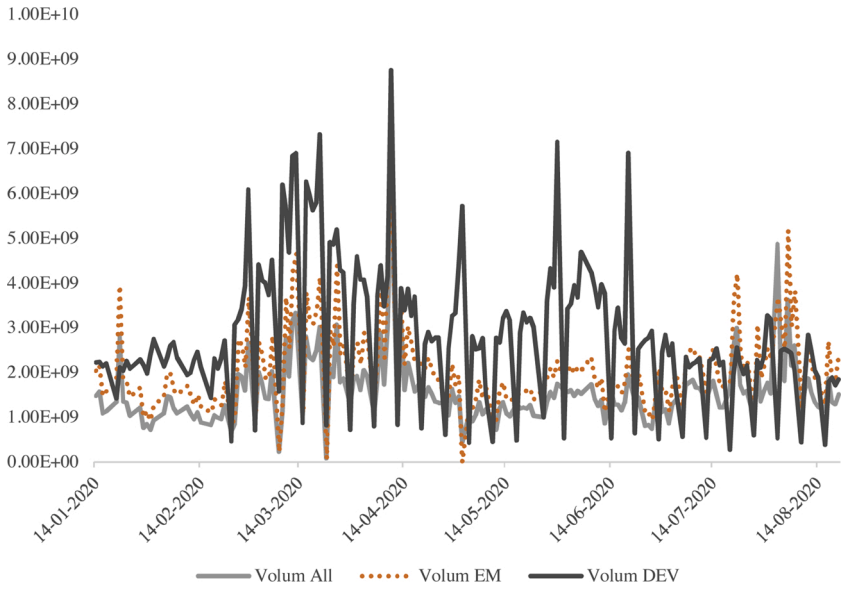

Fig. 4. World, Emerging and Developed Market Equity Trading Volume.

and trading volume are 30.61 % and 1.85 %, respectively, the impacts of COVID-19 cases and mortality rates on stock volatility and trading volume are also economically significant. Overall, we find evidence to support our first hypothesis (H1) that indicates the stock markets from January through August 2020 responded poorly to the percentage increase in daily cases and mortality rates from COVID-19. Consistent with Yilmazkuday (2020b) and Ramelli and Wagner (2020), we also find evidence that the returns are significantly lower during January, February, and especially March compared to August. Consistent with Phan and Narayan's (2020) overreaction hypothesis, we find that April is the mean-reverting (higher returns, lower volatility, and lower trading volume) than the three months before April.

Next, we examine the differing impacts of cases and deaths from COVID-19 on emerging and developed markets. Table 3 presents the regression results. We find that both daily cases and deaths rates significantly affect daily returns (-0.013 % and -0.12 %) and volatility (2.37 % and 14.94 %) in the emerging markets. Again, the magnitudes of these impacts relative to their means are economically significant. We find that in the developed markets, the daily cases of COVID-19 that significantly affect daily returns (-0.018 %), volatility (1.62 %), and trading volume (5.34 %). The daily deaths do not significantly affect the stock markets in developed countries. This provides evidence to support our second hypothesis (H2) that there are differing impacts of cases and deaths on stock markets in the emerging countries versus the developed countries. This finding also indicates that while the emerging equity markets reacted negatively to daily mortality rates, the developed countries' equity markets ignored the daily death rates. We also find that the daily mortality rate and daily cases are more closely correlated (0.614) in emerging countries than the developed countries (0.328). We believe that emerging countries have greater challenges with their healthcare infrastructure than developed countries (). Hence, investors in emerging equity markets react negatively to both daily cases and mortality rates, while investors in developed

Table 1
Descriptive Statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
RET	8,985	0.00011	0.023	−0.169	0.185
VOLAT	8,985	30.613	20.050	1.596	114.48
TVOLUME	8,985	1.845	0.883	0.00012	19.1
%CASE	8,985	0.044	0.087	0	0.947
%DEATH	8,985	0.003	0.011	0	0.5
DEV	8,985	0.339	0.473	0	1
JAN	8,985	0.011	0.102	0	1
FEB	8,985	0.057	0.232	0	1
MAR	8,985	0.161	0.368	0	1
APR	8,985	0.161	0.368	0	1
MAY	8,985	0.150	0.358	0	1
JUN	8,985	0.173	0.378	0	1
JUL	8,985	0.179	0.384	0	1
AUG	8,985	0.108	0.310	0	1

RET represents a daily percentage stock return. VOLAT represents 30-days moving average volatility (in %). TVOLUME represents the daily trading volume (in billion shares). %CASE represents daily new cases divided by cumulative cases of COVID-19 (%). % DEATH represents daily new death divided by cumulative cases of COVID-19 (%). DEV is a dummy variable equals to one if countries are classified by the MSCI market classification as a Developed country or zero otherwise. JAN, FEB, MAR, APR, MAY, JUN, JUL, and AUG represent dummy variables for each month from January 14, 2020, through August 20, 2020.

Table 2
Multivariate Regression for All Countries.

	RET	RET	VOLAT	VOLAT	VOLUM	VOLUM
RET(t-1)	−0.00876	−0.00877				
	(0.03523)	(0.03545)				
VOLAT(t-1)			0.98944***	0.99019***		
			(0.00129)	(0.00123)		
VOLUM(t-1)					0.99985***	0.99988***
					(0.00028)	(0.00028)
%CASE	−0.01304**		2.24092***		0.02799**	
	(0.00563)		(0.45746)		(0.01067)	
%DEATH		−0.12192**		10.33673**		0.18874**
		(0.05065)		(4.11330)		(0.07402)
JAN	−0.00479***	−0.00488***	0.18032	0.27047***	0.00291	0.00350
	(0.00094)	(0.00092)	(0.10883)	(0.09933)	(0.00525)	(0.00525)
FEB	−0.00495***	−0.00485***	0.42067***	0.46350***	0.00693	0.00706
	(0.00067)	(0.00063)	(0.07553)	(0.07145)	(0.00467)	(0.00469)
MAR	−0.00675***	−0.00711***	1.63226***	1.80113***	0.01673***	0.01834***
	(0.00089)	(0.00080)	(0.14834)	(0.13542)	(0.00477)	(0.00467)
APR	0.00413***	0.00399***	−0.38833***	−0.36434***	−0.01727***	−0.01678***
	(0.00059)	(0.00059)	(0.09656)	(0.08857)	(0.00454)	(0.00454)
MAY	0.00144	0.00143	−0.56730***	−0.56922***	0.00183	0.00191
	(0.00107)	(0.00107)	(0.08097)	(0.08281)	(0.00465)	(0.00465)
JUN	0.00035	0.00033	−0.02237	−0.02460	−0.00232	−0.00229
	(0.00069)	(0.00069)	(0.05224)	(0.05112)	(0.00416)	(0.00416)
JUL	−0.00049	−0.00049	−0.14121***	−0.14263***	−0.00813	−0.00812
	(0.00053)	(0.00053)	(0.04217)	(0.04201)	(0.00619)	(0.00619)
Intercept	0.00125**	0.00117**	0.10050***	0.10811***	0.00340	0.00311
	(0.00050)	(0.00049)	(0.02933)	(0.03087)	(0.00683)	(0.00690)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8985	8985	8985	8985	8985	8985
R-squared	0.0305	0.0319	0.9888	0.9888	0.9994	0.9994

RET represents a daily percentage stock return. VOLAT represents 30-days moving average volatility (in %). VOLUM represents the natural log of daily trading volume (in billion shares). %CASE represents daily new cases divided by cumulative cases of COVID-19 (%). % DEATH represents daily new death divided by cumulative cases of COVID-19 (%).JAN, FEB, MAR, APR, MAY, JUN, JUL, and AUG represent dummy variables for each month from January 14, 2020, through August 20, 2020. Country dummy variables are included in the multivariate regression but not reported to conserve space. Robust and clustered by country and day standard errors are reported in parenthesis below the slope coefficient. ***, ** and * represent statistically significant at 1%, 5% and 10 % respectively.

equity markets are more concerned with rising cases as the mortality rates remain relatively low in the developed countries.

We further examine the differing effects of COVID-19 cases and mortality rates across two different periods: the rising infection (pre-April) period and the stabilizing infection (post-April) period. Panel A of Table 4 shows that daily cases and death rates significantly affect stock returns, volatility, and trading volume during the rising infection (pre-April) period. In contrast, panel B of Table 4

Table 3
Multivariate Regressions for Emerging and Developed Countries.

	RET	RET	VOLAT	VOLAT	VOLUM	VOLUM
Panel A. Emerging Markets						
RET(t-1)	0.02332	0.02249				
	(0.04628)	(0.04692)				
VOLAT(t-1)			0.99051***	0.99132***		
			(0.00154)	(0.00142)		
VOLUM(t-1)					1.00007***	1.00009***
					(0.00028)	(0.00029)
%CASE	−0.01320*		2.37310***		0.00213	
	(0.00695)		(0.63576)		(0.01525)	
%DEATH		−0.11663*		14.93623**		0.15865
		(0.06560)		(6.97460)		(0.09843)
JAN	−0.00434***	−0.00454***	0.21916	0.28663*	−0.00217	−0.00288
	(0.00142)	(0.00136)	(0.16383)	(0.14814)	(0.00869)	(0.00854)
FEB	−0.00393***	−0.00400***	0.31948**	0.34996***	−0.00255	−0.00297
	(0.00095)	(0.00095)	(0.13210)	(0.12596)	(0.00711)	(0.00706)
MAR	−0.00649***	−0.00673***	1.43640***	1.53101***	0.01151	0.00990
	(0.00104)	(0.00099)	(0.18378)	(0.15366)	(0.00687)	(0.00661)
APR	0.00481***	0.00460***	−0.43854***	−0.41389***	−0.01559**	−0.01591**
	(0.00084)	(0.00082)	(0.12805)	(0.11480)	(0.00656)	(0.00658)
MAY	0.00218	0.00212	−0.62505***	−0.62137***	−0.00152	−0.00163
	(0.00151)	(0.00152)	(0.11325)	(0.11625)	(0.00681)	(0.00680)
JUN	0.00085	0.00081	−0.10559	−0.10233	−0.00608	−0.00610
	(0.00096)	(0.00097)	(0.06801)	(0.06701)	(0.00596)	(0.00597)
JUL	0.00014	0.00013	−0.15945***	−0.15889***	−0.00823	−0.00822
	(0.00073)	(0.00073)	(0.05677)	(0.05652)	(0.00915)	(0.00916)
Intercept	0.00092	0.00082	0.12243***	0.13172***	0.00414	0.00378
	(0.00072)	(0.00069)	(0.03799)	(0.04094)	(0.00822)	(0.00833)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,940	5,940	5,940	5,940	5,940	5,940
R-squared	0.034	0.035	0.990	0.989	0.999	0.999
VARIABLES	RET	RET	VOLAT	VOLAT	VOLUM	VOLUM
Panel B. Developed Markets						
RET(t-1)	−0.08595**	−0.08215**				
	(0.03134)	(0.03081)				
VOLAT(t-1)			0.98211***	0.98213***		
			(0.00160)	(0.00189)		
VOLUM(t-1)					0.99936***	0.99937***
					(0.00030)	(0.00029)
%CASE	−0.01757*		1.62062**		0.05341***	
	(0.00923)		(0.72219)		(0.01027)	
%DEATH		−0.13387		3.02321		0.21541
		(0.08434)		(3.57721)		(0.13696)
JAN	−0.00541***	−0.00568***	0.18133	0.29224**	0.01115**	0.01374***
	(0.00104)	(0.00121)	(0.14552)	(0.12642)	(0.00440)	(0.00445)
FEB	−0.00629***	−0.00621***	0.56947***	0.63772***	0.01914***	0.02047***
	(0.00094)	(0.00065)	(0.07583)	(0.06858)	(0.00367)	(0.00370)
MAR	−0.00673***	−0.00807***	2.22820***	2.46655***	0.02862***	0.03510***
	(0.00172)	(0.00126)	(0.21827)	(0.18773)	(0.00304)	(0.00289)
APR	0.00284***	0.00270***	−0.03600	0.00471	−0.01975***	−0.01876***
	(0.00042)	(0.00050)	(0.11180)	(0.11108)	(0.00338)	(0.00330)
MAY	−0.00023	−0.00016	−0.35639***	−0.35881***	0.00933***	0.00920***
	(0.00026)	(0.00026)	(0.10054)	(0.10601)	(0.00266)	(0.00267)
JUN	−0.00088**	−0.00082**	0.21094***	0.20549***	0.00574*	0.00555
	(0.00040)	(0.00039)	(0.05333)	(0.05409)	(0.00327)	(0.00327)
JUL	−0.00194***	−0.00192***	−0.06922	−0.07041	−0.00795**	−0.00799**
	(0.00038)	(0.00037)	(0.05521)	(0.05650)	(0.00301)	(0.00302)
Intercept	0.00206***	0.00196***	0.15226***	0.16317***	0.00441	0.00444
	(0.00027)	(0.00025)	(0.04196)	(0.04674)	(0.00498)	(0.00483)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,045	3,045	3,045	3,045	3,045	3,045
R-squared	0.033	0.035	0.987	0.987	0.999	0.999

RET represents a daily percentage stock return. VOLAT represents 30-days moving average volatility (in %). VOLUM represents the natural log of daily trading volume (in billion shares). %CASE represents daily new cases divided by cumulative cases of COVID-19 (%). % DEATH represents daily new death divided by cumulative cases of COVID-19 (%). DEV is a dummy variable equals to one if countries are classified by the MSCI market classification as a Developed country or zero otherwise. JAN, FEB, MAR, APR, MAY, JUN, JUL, and AUG represent dummy variables for each month from January 14, 2020, through August 20, 2020. Country dummy variables are included in the multivariate regression but not reported to conserve

space. Robust and clustered by country and day standard errors are reported in parenthesis below the slope coefficient. ***, ** and * represent statistically significant at 1%, 5% and 10 % respectively.

shows that the daily cases and death rates during the stabilizing infection (post-April) period only significantly affect the volatility (VOLAT). However, they do not affect the stock returns and trading volume. This provides evidence to support our third hypothesis (H3) that there are different effects of cases and death rates during the period when COVID-19 infection was rising versus the period when COVID-19 infection become more stable.

Furthermore, this finding also implies that the equity markets tend to overreact during the rising infection (pre-April). The markets seem to be less affected by COVID-19 cases and mortality rates during the stabilizing infection period. Thus, our finding supports Phan and Narayan (2020), who propose that the markets tend to overreact to the rising cases and deaths of COVID-19 in the first quarter of 2020. As information becomes more available, investors began to understand the ramification and real impacts of COVID-19 on the equity markets (Phan & Narayan, 2020).

We analyze the differing impacts of COVID-19 on emerging and developed markets during the two subsamples: the rising and the stabilizing periods. Panel A of Table 5 shows the results for emerging markets during these two subsamples. We find that daily cases and death rates significantly affect stock returns, volatility, and trading volume during the rising infection (pre-April) period. In contrast, the daily cases and death rates during the stabilizing infection (post-April) period only significantly affect the volatility (VOLAT), but they do not significantly affect stock returns and trading volume. Thus, we find evidence to support our third hypothesis (H3) that there are different effects of cases and mortality rates during the rising infection versus the stabilizing infection.

Panel B of Table 5 shows that the impacts of daily cases and deaths from COVID-19 were mostly insignificant during the rising infection rates (pre-April) period, except for the daily cases on trading volume (5.49 %). In contrast, the daily cases and deaths from COVID-19 were significantly affecting daily returns, volatility, and trading volume during the period when infection rates become

Table 4
Multivariate Regression during Rising and Stabilizing Infection Periods.

VARIABLES	RET	RET	VOLAT	VOLAT	VOLUM	VOLUM
Panel A. Pre-April 1, 2020						
RET(t-1)	−0.08609***	−0.08548***				
	(0.03037)	(0.02986)				
VOLAT(t-1)			0.99416***	0.99546***		
			(0.00514)	(0.00541)		
VOLUM(t-1)					1.00111***	1.00122***
					(0.00077)	(0.00077)
%CASE	−0.01612***		1.82979***		0.03399***	
	(0.00588)		(0.50443)		(0.01050)	
%DEATH		−0.14216**		8.91630**		0.23573***
		(0.05398)		(4.16787)		(0.08013)
Intercept	−0.00378***	−0.00382***	0.25707**	0.32518**	−0.01388	−0.01541
	(0.00060)	(0.00054)	(0.11680)	(0.12384)	(0.01557)	(0.01558)
Month dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,058	2,058	2,058	2,058	2,058	2,058
R-squared	0.012	0.015	0.980	0.980	1.000	1.000
VARIABLES	RET	RET	VOLAT	VOLAT	VOLUM	VOLUM
Panel B. Post-April 1, 2020						
RET(t-1)	0.05945	0.05938				
	(0.05290)	(0.05288)				
VOLAT(t-1)			0.98694***	0.98781***		
			(0.00268)	(0.00275)		
VOLUM(t-1)					0.99955***	0.99952***
					(0.00049)	(0.00050)
%CASE	−0.00380		5.32243***		−0.01986	
	(0.01411)		(1.13111)		(0.04688)	
%DEATH		0.09703		37.90276***		−0.48546
		(0.13626)		(9.67011)		(0.43154)
Intercept	0.00107*	0.00098**	0.10759***	0.13487***	0.00918	0.00964
	(0.00057)	(0.00048)	(0.03844)	(0.03447)	(0.01014)	(0.01032)
Month dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,927	6,927	6,927	6,927	6,927	6,927
R-squared	0.012	0.013	0.992	0.992	0.999	0.999

RET represents a daily percentage stock return. VOLAT represents 30-days moving average volatility (in %). VOLUM represents the natural log of daily trading volume (in billion shares). %CASE represents daily new cases divided by cumulative cases of COVID-19 (%). % DEATH represents daily new death divided by cumulative cases of COVID-19 (%). Month and Country dummy variables are included in the regression but not reported to conserve space. Robust and clustered by country and day standard errors are reported in parenthesis below the slope coefficient. ***, ** and * represent statistically significant at 1%, 5% and 10 % respectively.

Table 5
Multivariate Regression during Rising and Stabilizing Infection Periods for Emerging and Developed Countries.

VARIABLES	RET	RET	VOLAT	VOLAT	VOLUM	VOLUM
Panel A. Emerging Markets						
(1) Pre-April 1, 2020						
RET(t-1)	−0.08104*	−0.08328**				
	(0.04132)	(0.04095)				
VOLAT(t-1)			0.99625***	0.99735***		
			(0.00716)	(0.00739)		
VOLUM(t-1)					1.00104***	1.00111***
					(0.00078)	(0.00076)
%CASE	−0.01703**		2.02138***		0.01139**	
	(0.00771)		(0.71784)		(0.00539)	
%DEATH		−0.15011**		13.34268*		0.21854**
		(0.06963)		(7.04443)		(0.08839)
Intercept	−0.00314***	−0.00337***	0.35753**	0.38173**	−0.01711	−0.01866
	(0.00087)	(0.00089)	(0.16525)	(0.18330)	(0.01696)	(0.01660)
Month dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies						
Observations	1,246	1,246	1,246	1,246	1,246	1,246
R-squared	0.013	0.016	0.979	0.979	1.000	1.000
(2) Post-April 1, 2020						
RET(t-1)	0.09391	0.09365				
	(0.06990)	(0.06970)				
VOLAT(t-1)			0.98820***	0.98922***		
			(0.00324)	(0.00319)		
VOLUM(t-1)					0.99985***	0.99980***
					(0.00049)	(0.00050)
%CASE	0.00026		4.05886***		−0.04468	
	(0.01518)		(1.20522)		(0.05264)	
%DEATH		0.14529		31.24933***		−0.43382
		(0.12526)		(8.73566)		(0.47534)
Intercept	0.00069	0.00061	0.13739***	0.15574***	0.00826	0.00878
	(0.00078)	(0.00066)	(0.04166)	(0.03835)	(0.01105)	(0.01137)
Month dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,694	4,694	4,694	4,694	4,694	4,694
R-squared	0.022	0.023	0.992	0.992	0.999	0.999
VARIABLES	RET	RET	VOLAT	VOLAT	VOLUM	VOLUM
Panel B. Developed Markets						
(1) Pre-April 1, 2020						
RET(t-1)	−0.09388**	−0.08877*				
	(0.04435)	(0.04347)				
VOLAT(t-1)			0.98434***	0.98410***		
			(0.00374)	(0.00422)		
VOLUM(t-1)					0.99721***	0.99697***
					(0.00090)	(0.00096)
%CASE	−0.01590		1.12178		0.05485***	
	(0.00956)		(0.78041)		(0.01046)	
%DEATH		−0.13056		1.84942		0.22020
		(0.08369)		(3.63314)		(0.14146)
Intercept	−0.00436***	−0.00431***	2.37133***	2.55819***	0.06454***	0.07074***
	(0.00101)	(0.00066)	(0.31248)	(0.28439)	(0.01722)	(0.01876)
Month dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies						
Observations	812	812	812	812	812	812
R-squared	0.011	0.014	0.982	0.982	0.999	0.999
(2) Post-April 1, 2020						
RET(t-1)	−0.07349***	−0.07268***				
	(0.01477)	(0.01533)				
VOLAT(t-1)			0.97535***	0.97725***		
			(0.00424)	(0.00344)		
VOLUM(t-1)					1.00029***	1.00031***
					(0.00022)	(0.00021)
%CASE	−0.07101***		15.77771***		0.04868*	
	(0.01558)		(2.78057)		(0.02886)	
%DEATH		−0.38626***		90.74347***		0.92145***
		(0.12277)		(27.50109)		(0.29883)
Intercept	0.00243***	0.00199***	0.16760**	0.23021***	−0.01201***	−0.01243***
	(0.00029)	(0.00024)	(0.07767)	(0.07391)	(0.00395)	(0.00377)

(*continued on next page*)

Table 5 (*continued*)

VARIABLES	RET	RET	VOLAT	VOLAT	VOLUM	VOLUM
Month dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,233	2,233	2,233	2,233	2,233	2,233
R-squared	0.016	0.012	0.989	0.989	0.999	0.999

RET represents a daily percentage stock return. VOLAT represents 30-days moving average volatility (in %). VOLUM represents the natural log of daily trading volume (in billion shares). %CASE represents daily new cases divided by cumulative cases of COVID-19 (%). % DEATH represents daily new death divided by cumulative cases of COVID-19 (%). Month and Country dummy variables are included in the regression but not reported to conserve space. Robust and clustered by country and day standard errors are reported in parenthesis below the slope coefficient. ***, ** and * represent statistically significant at 1%, 5% and 10 % respectively.

more stable (post-April). These findings indicate that (1) the impacts of cases and mortality rates on the emerging countries are indeed different from the developed countries, and (2) the impacts of cases and mortality rates vary between the rising infection and the stabilizing periods.

Overall, our findings from Table 5 provide further evidence to support our second and third hypotheses (H2 and H3) that there are different effects of cases and death rates for emerging versus developed markets and during the period when COVID-19 infection rates were rising versus the period when COVID-19 infection rates become more stable. Thus, we find evidence that the emerging markets' investors reacted to the COVID-19 cases and deaths differently from the developed markets. The investors also changed their perspective on COVID-19 cases and deaths during the stabilizing period (post-April) relative to the rising infection period (pre-April).

Since the USA represents staggering numbers of cases and deaths from COVID-19 and the fact that COVID-19 was initially identified in China, we exclude the USA from the developed markets, and we exclude China from the emerging markets. Our untabulated results from excluding the USA and China are consistent with the reported results. We also re-estimate the developed and emerging markets by excluding the USA and China, and the untabulated results are consistent with our reported results. We re-estimate our regressions using the fixed-effects and the random-effects, and our untabulated results are consistent with this paper's results using the ordinary least square method. Overall, we believe that our results are robust.

5. Conclusions

The spread of COVID-19, measured by the number of cases and deaths, has brought an unprecedented adverse shock to the stock markets (Baker et al., 2020; Baker, Bloom, Davis, Terry et al., 2020; Narayan, Phan et al., 2020; Phan & Narayan, 2020; Ramelli & Wagner, 2020; Yilmazkuday, 2020b). As the World Health Organization (WHO), news media, and other non-profit organizations continue to provide the daily number of cases and deaths from COVID-19, our study contributes to the literature by exploring whether and how the stock market returns, volatility, and trading volume were affected by the percentages of daily cases and deaths from COVID-19 throughout 76 countries stock indices. Our study also extends current literature that mostly focuses on either developed countries (i.e., Baek et al., 2020; Salisu & Akanni, 2020; Zhang et al., 2020) or emerging countries (i.e., Haroon & Rizvi, 2020; Mishra et al., 2020) by conducting a direct comparison of the impact of COVID-19 on 53 emerging countries and 23 developed countries.

Our findings show that the global equity markets across 76 countries reacted negatively to the COVID-19 spreads, measured by the percentage of daily new cases and the mortality rate from the COVID-19. Our findings also imply that investors withdrew their equity investments as they witnessed an increasing transmission (cases) of COVID-19 and deaths from COVID-19, which resulted in lower returns, higher volatility, and higher trading volume.

We also find that cases and mortality rates from COVID-19 affect the emerging markets differently from the developed markets during the rising infection and the stabilizing infection periods. While daily cases and death rates from COVID-19 have increased uncertainties among investors, they have increased volatility in both developed and emerging countries' equity markets. Our findings also extend the existing emerging studies (Baker et al., 2020; Baker, Bloom, Davis, Terry et al., 2020; Fernandez, 2020; Narayan, Phan et al., 2020; Onali, 2020; Ramelli & Wagner, 2020; Yilmazkuday, 2020b; Zhang et al., 2020) by examining the impact of COVID-19 on broader measures of equity markets (i.e., stock returns, volatility, and trading volume), across broader countries (76 different countries), and during a more extended period (January 14, 2020 through August 20, 2020).

Our study also extends recent literature that hypothesizes the market overreaction to COVID-19 (Narayan, 2020a; Phan & Narayan, 2020) by demonstrating that there is a time-varying effect of COVID-19 cases and mortality rates on the equity markets during the rising infection period (pre-April) and the stabilizing infection period (post-April). We find that the market reactions are less during the stabilizing period. This finding supports evidence that the investors can discern relevant information on the real impacts of COVID-19 and the ramifications of lockdowns on the economy and companies' business activities.

As the COVID-19 pandemic continues to unravel, we expect that our study will stimulate further examinations on how the global equity markets react to the progression of infection and mortality rates from COVID-19. Besides, our study provides insight into how the emerging and developed markets may react if either a second or a third wave of COVID-19 appears, or the vaccines are proven to be effective to curb the spread of COVID-19.

Declaration of Competing Interest

The authors report no declarations of interest.

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Appendix A. Sample Distribution across 76 Countries

Country	Stock Index	Freq.	Pct(%)	Country	Stock Index	Freq.	Pct(%)
Argentina	MERVAL	110	1.22	Luxembourg*	LUXXX	120	1.34
Australia*	ASX	142	1.58	Malaysia	FMBKLCI	139	1.55
Austria*	ATX	122	1.36	Malta	MALTEX	105	1.17
Bahrain	BHSEASI	115	1.28	Mauritius	SEMDEX	98	1.09
Belgium*	BEL20	139	1.55	Mexico	MEXBOL	119	1.32
Brazil	IBOVESPA	121	1.35	Mongolia	MSETOP	102	1.14
Bulgaria	SOFIX	109	1.21	Morocco	MASI	117	1.3
Cambodia	CSX	133	1.48	Netherlands*	AEX	121	1.35
Canada*	TSX	142	1.58	New Zealand*	NZSE	120	1.34
Chile	IPSA	116	1.29	Nigeria	NGSEINDX	116	1.29
China	SSE	151	1.68	Norway*	OBX	120	1.34
Colombia	COLCAP	105	1.17	Pakistan	KSE100	118	1.31
Croatia	CRO	118	1.31	Philippines	PCOMP	136	1.51
Cyprus	CYSMMAPA	84	0.93	Poland	WIG	117	1.3
Czechia	PX	118	1.31	Portugal*	PSI20	120	1.34
Denmark*	KFX	117	1.3	Puerto Rico	BPRSX	109	1.21
Egypt	EGX30	119	1.32	Qatar	DSM	114	1.27
Estonia	TALSE	116	1.29	Republic of Korea	KOSPI	146	1.62
Finland*	HEX	139	1.55	Romania	BET	121	1.35
France*	CAC	146	1.62	Russia	IMOEX	137	1.52
Germany*	DAX	143	1.59	Saudi Arabia	TASI	114	1.27
Ghana	GGSECI	103	1.15	Serbia	BELEXLIN	116	1.29
Greece	ASE	117	1.3	Singapore*	STI	142	1.58
Hungary	BUX	115	1.28	South Africa	JALSH	114	1.27
Iceland	ICEXI	114	1.27	Spain*	IBEX	140	1.56
India	NIFTY	138	1.54	Sri Lanka	CSEALL	31	0.35
Indonesia	JCI	112	1.25	Sweden*	OMX	139	1.55
Iran	TEDPIX	115	1.28	Switzerland*	SMI	123	1.37
Iraq	ISXGI	49	0.55	Thailand	SET	148	1.65
Ireland*	ISEQ	120	1.34	United Kingdom*	FTSE350	137	1.52
Israel*	TA-125	116	1.29	Tunisia	TUNINDEX	115	1.28
Italy*	FTSEMIB	143	1.59	Turkey	XU100	108	1.2
Japan*	NKY	147	1.63	Ukraine	PFTS	118	1.31
Jordan	JOSMGNFF	10	0.11	United Arab Emirates	ADSMI	141	1.57
Kazakhstan	KZKAK	106	1.18	USA*	S&P500	147	1.64
Latvia	RIGSE	111	1.24	Venezuela	IBVC	103	1.15
Lebanon	BLOM	106	1.18	Viet Nam	VNINDEX	142	1.58
Lithuania	VILSE	115	1.28	Zimbabwe	MXZWIM	70	0.78

* represents Developed countries (source: MSCI market classification https://www.msci.com/market-classification)

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