COVID-19 Disclosures and Market Uncertainty: Evidence from 10-Q Filings

Jie Hao & Viet T. Pham, Susquehanna University, USA (E-mail: phamtuanvietvn@gmail.com)

We examine whether the quarterly filing COVID-19 disclosures reduce uncertainty for investors and analysts. We find a negative relationship between COVID-19 disclosure and return volatility, suggesting COVID-19 disclosure reduces investor uncertainty. This reduction effect concentrates mainly during the short window following 10-Q releases and phases out over time. We then detect that industry-wide COVID-19 disclosure dispersion is positively associated with return volatility, suggesting high variation of industry-wide COVID-19 disclosures reduces information comparability across firms, resulting in increased investor uncertainty. Moreover, we find that COVID-19 disclosures are positively associated with analysts’ downward earnings forecast revisions and negatively associated with analyst forecast dispersion after 10-Q releases, suggesting the disclosures reduce information risk even for sophisticated market participants. Further analyses show that COVID-19 disclosures are negatively associated with future financial and operational performances (i.e., sales, operating cash flow, operating income and ROA). Lastly, we find that the low readability of COVID-19 disclosure attenuates the negative relation between COVID-19 disclosure and market volatility. Collectively, our findings suggest that 10-Q COVID-19 disclosures contain value-relevant information that temporarily assists market participants in evaluating the changes in firms’ values in the time of a crisis.

The COVID-19 pandemic presents a situation of extreme uncertainty and panic in the market. In response to the changing nature of COVID-19 and high information demand, the SEC issued the Disclosure Guidance-Topic No. 9 to encourage United States (US) companies to increase COVID-19 related disclosure in public filings. Although multiple studies have captured evidence of the increased market volatility in both the US and foreign countries during the COVID-19 pandemic (Mazur et al. 2020; Zhang et al. 2020; Albulescu 2021), there is little evidence of how financial disclosure affects market volatility during the pandemic. As it is very important to know whether corporate disclosure can provide value-relevant information to the market during a time of crisis (Healy and Palepu 2001; Lee et al. 2015), in this paper we aim to provide evidence of whether COVID-19 disclosures can reduce uncertainty for market participants.

Theoretically, Verrecchia (1983) suggests that more frequent disclosure with precision greater than zero can reduce uncertainty about firm value. In a highly uncertain market during COVID-19, disclosure about the impact of the pandemic on the firms’ operation and cash flow should assist market participants in decoding future value changes. Thus, it is reasonable to expect that COVID-19 disclosures can provide timely and value-relevant information that reduces the uncertainty of market participants.

We measure the amount of COVID-19 information by capturing the frequency of COVID-19 related keywords in 10-Q filings. We focus on 10-Qs because the quarterly filing allows management to provide an extensive and detailed discussion of the impact of COVID-19 on the firm’s values in a timely fashion. We measure investor uncertainty by first calculating the daily abnormal return volatility following Landsman and Maydew (2002). Adopting the economic intuition in Roger et al. (2009), we compare daily abnormal volatilities measured three days before and three days after the 10-Q releases to capture the short-term effect of the COVID disclosure on investor uncertainty. We then measure the change in volatility between three days before and 30 days after the 10-Q releases to capture the long-run effect of COVID disclosure.

Consistent with the theoretical prediction, we find that the extent of COVID-19 disclosure is negatively as-
associated with investor uncertainty. Specifically, we find that the mitigating effect of COVID-19 disclosure on investor uncertainty concentrates mainly during the short window following the disclosure of the information and phases out gradually over time. Overall, our findings confirm that COVID-19 disclosure provides value-relevant information to investors, which is consistent with the SEC’s motivation in calling for more disclosure on COVID-19.

To broaden our understanding of COVID-19 disclosure, we further examine the impact of industry-wide COVID-19 disclosure practice on investor uncertainty. Firms in the same industry with similar operational and financial risks should have a similar disclosure extent and format when disclosing information about the COVID-19 outbreak. However, we observe firms make significantly different disclosure choices within the same industry. This industry disclosure dispersion can greatly impair financial comparability within the industry, leading to high information processing costs, high variation in pricing expectations and consequently investor uncertainty. Consistently, we find that high industry-wide COVID-19 disclosure dispersion increases investor uncertainty after 10-Q releases. This finding confirms the notion that high disclosure variation within the same industry confuses investors and reduces information comparability, in turn, increasing uncertainty.

We further investigate the distance between each firm’s COVID disclosure level to its industry median. This measure enables us to separate firms with high levels of COVID disclosures from those with low ones. Our results show that only firms with above-industry-median COVID-19 disclosure experience have a decrease in investor uncertainty, while firms with below-industry-median do not. This finding further confirms the value relevance of COVID-19 disclosure.

As COVID-19 disclosure may be relevant to multiple groups of users, we investigate how financial analysts, who are sophisticated market participants, react to COVID-19 information. Prior literature suggests that analysts are efficient in incorporating new information into their forecasts and would make revisions to their forecasts when there is new information available (Zhang 2006; Yezeig 2015). If COVID-19 disclosure provides analysts with new value-relevant information, we expect analysts to revise their future forecasts upon the release of the information. Consistently, we find that COVID-19 disclosure is positively associated with the number of analyst revisions (of next quarter earnings forecasts) after 10-Q releases. This finding suggests that firms disclose new and valuable COVID information that can trigger analyst revisions. Further, when separating upward revisions from downward revisions, we find that COVID-19 disclosure is only associated with downward revisions, not upward revisions. Perhaps, COVID-19 disclosure provides information about the negative impact of the pandemic on firms’ value, based on which analysts revise their expectations for the next quarter’s earnings downward.

We next examine how the disclosure assists analysts in achieving better consensus in future earnings forecasts. Barron and Stuerke (1998) find that analyst earnings forecast dispersion is a good indicator of uncertainty among analysts. Prior studies also suggest that firms with less public disclosure experience higher levels of analyst forecast dispersions (Lang and Lundholm 1996; Ali et al. 2019). When less public information is available, analysts have to rely more on their own private channels to acquire information, which results in less consistent forecast numbers (Ali et al. 2019). And vice versa, this information risk can be reduced if firms start to disclose more information. Therefore, firms that disclose more COVID-19 information would be associated with lower information risk and may have lower analyst earnings forecast dispersion. Consistent with this conjecture, we find a significantly negative association between COVID-19 disclosure and analyst forecast dispersion. This finding again confirms that COVID-19 disclosure reduced the information risk and uncertainty of market participants.

To triangulate our findings thus far, we investigate whether COVID-19 disclosure reflects actual financial and operational risks in the near future. If COVID-19 disclosure is indeed value relevant to market participants, we expect to find an association between COVID-19 disclosure and firms’ future performance. Consistently, we find a negative association between COVID-19 disclosure and future operational performance measures including future sales, future operating cash flows, future operating income and future return on assets. This finding suggests that COVID-19 disclosure reflects the real risk of operational disruption caused by the pandemic.

Finally, we study how characteristics of COVID-19 disclosure moderate the relationship between COVID disclosure and investor uncertainty. Prior studies suggest that the readability and the sentiment of the disclosure narratives affect how the audience processes information (Loughran and McDonald 2016; Allee et al. 2021). Due to limited cognitive ability, investors would be subject to higher information processing costs when presented with difficult to read financial texts, and thus, prevented from incorporating the information fully (Bloomfield 2002; Lee 2012). As for disclosure sentiment, prior studies show that the negativity of management disclosure can be interpreted as a negative indication of the firm’s future. Increases in negative sentiments are associated with increases in investor uncertainty (Druz et al. 2020). We, therefore, predict that low readability and negative tone attenuate the mitigating effect of COVID-19 disclosure on investor uncertainty.
We find supporting evidence that the effect of COVID-19 disclosure on investor uncertainty is weakened when the disclosure texts are more difficult to read. However, we do not find supporting evidence for the modifying effect of disclosure tone.

Our study makes several contributions. First, we contribute to the literature that examines the effect of disclosure on market uncertainty (e.g., Tetlock 2007; Kaplanski and Levy 2010; Su et al. 2017; Zaremba et al. 2020) by showing that increased disclosure reduces uncertainty for both investors and financial analysts during the COVID-19 pandemic. This paper confirms the value-relevance of public financial disclosure and reveals that all market participants (both naïve and sophisticated) need timely and credible information to decode uncertainty, especially in times of a global health crisis. We also extend the COVID-19 corporate disclosure literature (e.g., Larcker et al. 2020; Loughran and McDonald 2020) by investigating the modification effects of disclosure characteristics (i.e., readability and tone) on the relationship between COVID-19 disclosure and investor uncertainty. In doing so, we add new elements into the discussion and hope to inspire future research to consider the importance of disclosure characteristics when conducting market research.

Second, although the SEC issued Disclosure Guidance in response to the changing nature of the pandemic and high investor information demand, the reality of high industry-wide disclosure variation suggests a voluntary and loosely complied with disclosure guidance is not strong enough to protect and guide investors during a time of crisis. This finding complements the concern about investors’ vulnerability during the pandemic raised by extant studies (e.g., Al-Awadhi et al. 2020; Zhang et al. 2020; Haroon and Rizivi 2020; Akhtaruzzaman et al. 2021). The COVID-19 pandemic informs us that we need to have a set of mandatory and comprehensive emergency financial reporting guidelines to guard us against the next black swan event.

Lastly, as our world becomes more connected than ever, the catastrophic impact of COVID-19 has spread rapidly around the world and caused multiple market crashes in short periods. This reminds us that no crisis is one country’s crisis, but the whole world’s. From the perspective of financial disclosure, we know investors need both domestic and international information to assist their pricing decisions (DeFond et al. 2011; Neel 2017; Hao and Dong 2022). This means that more COVID information from international markets would further resolve the tremendous uncertainty caused by the global pandemic. Hence, this paper urges and informs regulators in other markets to take action to provide more timely and credible information to global investors. To achieve such a goal, global standard-setters need to work together to find a comprehensive solution to mitigate the negative impact of COVID-19.

The rest of the paper is organised as follows. Section 2 describes empirical models. Section 3 describes data. Section 4 summarises the regression results. Section 5 concludes.

**Research Design**

**COVID-19 disclosure and investor uncertainty**

To test whether COVID-19 disclosure affects investor uncertainty about the firm value, we use the following equation (1):

\[
\ln \left( \frac{\text{AVAR}_{\text{post}}}{\text{AVAR}_{\text{pre}}} \right)_{t,i} = \alpha_0 + \alpha_1 \text{COVID}_{-19} + \alpha_2 \text{SIZE}_{t,i} + \alpha_3 \text{BTM}_{t,i} + \alpha_4 \text{LEV}_{t,i} + \alpha_5 \text{QUICK}_{t,i} + \alpha_6 \text{SUP}_{-EPS}_{t,i} + \alpha_7 \text{CAR}_{t,i} + \alpha_8 \text{N}_{-ANALYST}_{t,i} + \alpha_9 \text{PCT}_{-CASE}_{t,i} + \alpha_{10} \text{PCT}_{-DEATH}_{t,i} + \alpha_{11} \text{HOSP}_{-PERPPL}_{t,i} + \alpha_{12} \text{STAFF}_{-PERPPL}_{t,i} + \epsilon_{t,i}\]

In equation (1), the independent variable COVID₁₉ measures the COVID-19 disclosure level. Following prior literature, we use the count of COVID-19 related keywords to proxy for the amount of COVID-19 information disclosed in forms 10-Q. Keyword count is a common approach utilised in financial disclosure literature. For example, Li et al. (2013) use the word counts of competition-related keywords to capture the level of firms’ competition. Similarly, Chen and Li (2013) use the word counts of estimation-related keywords to measure the level of estimation used in the accruals generating process. The keyword count method is also used in several other studies, such as Shalev (2009), Bradbury and Shröder (2012), Cao et al. (2018), and so on. Moreover, Li et al. (2013) suggest that this approach takes disclosure in public filings at face value, which is a simple and effective way to capture the extent of disclosure. They stress that this approach is more efficient than other complex computational linguistic methods that often provide minimal improvement at considerable higher costs. To obtain the COVID-19 disclosure data, we perform a keyword search in forms 10-Q and 10-Q/A issued between January to December 2020. We programmatically scan each 10-Q filing and count the number of occurrences of the COVID-19 keywords.¹

The dependent variable \( \ln \left( \frac{\text{AVAR}_{\text{post}}}{\text{AVAR}_{\text{pre}}} \right)_{t,i} \) measures the overall change in uncertainty due to the firm’s 10-Q COVID-19 disclosure. We first calculate firm’s daily abnormal return volatility following Beaver (1968) and Landsman and Maydew (2002) as follows:

\[
\text{AVAR}_{t,i} = \frac{\mu^2_{t,i}}{\sigma^2_{t,i}},
\]
where \( R_{it} = \mu_{it} + \epsilon_{it} \). This measure evaluates the short-run effect of COVID-19 disclosure on investor uncertainty. We control for a comprehensive set of factors in our model. We include firms’ operational and financial characteristics, such as size, leverage, book to market ratio and quick ratio to take into consideration the information environment of the firm as well as the information demand of investors (Yezegel 2015). In addition, we control for the earnings surprise of the current quarter (SUR_EPS) because earnings surprises can influence investors’ future profitability expectation, which can influence investor’s uncertainty about firms’ future value. We also include three days cumulative abnormal return of window \([-1, +1]\) around 10-Q releases to control for the price discovery speed upon the release of new information (Lee 2012). We control for the number of analysts (N_ANALYST) because analysts are information media that offers professional opinions on firms’ value in response to any new information in the market (Healy and Palepu 2001). Since the severity of COVID-19 may significantly influence management’s understanding of how the pandemic affects their business, resulting in different levels of COVID disclosure, we control for the number of COVID cases (PCT_CASE) and COVID deaths (PCT_DEATH) of the firms’ domicile states. The abundance of domicile states’ healthcare resources can also influence the mental and physical health of firms’ executives who make the final disclosure decisions. Therefore, we control for the number of medical staff (STAFFPERPPL) and the number of hospitals per person (HOSPERPPL) of the firms’ domicile states. Lastly, considering different states have different lockdown measures that have significant impacts on the state’s economic activities, we use state fixed effects to control for the unobservable factors that may influence investor uncertainty. We also include industry and quarter fixed effects and cluster the standard errors by industry and quarter.

Besides using the change of daily volatility to measure investor uncertainty, we also use the average of daily volatility over different event windows to examine: (1) whether COVID-19 disclosure reduces investor uncertainty; (2) whether such effect recedes within 30 days after 10-Q releases. We use the following equation:

\[
\begin{align*}
AVAR_{i,t} &= \beta_0 + \beta_1 COVID_{19i,t} + \beta_2 SIZE_{i,t} \\
&\quad + \beta_3 BTM_{i,t} + \beta_4 CAR_{i,t} + \beta_5 N\_ANALYST_{i,t} \\
&\quad + \beta_6 L&EV_{i,t} + \beta_7 VOL\_SALE_{i,t} + \beta_8 QUICK_{i,t} \\
&\quad + \beta_9 PCT\_CASE_{i,t} + \beta_{10} HOSPERPPL_{i,t} \\
&\quad + \beta_{11} STAFFPERPPL_{i,t} \\
&\quad + \beta_{12} SUR\_EPS_{i,t} + \epsilon_{i,t}
\end{align*}
\]

In equation (2), the dependent variable is the average of daily abnormal volatility (AVAR). We calculate five VAR across different event windows: three days around 10-Q releases \([-1, +1]\), one day after releases \([0, +1]\), one week after \([0, +5]\), two weeks after \([+5, +10]\) and one month after \([+15, +30]\). We expect a significant negative coefficient \(\beta_0\) on COVID-19.
Industry COVID-19 disclosure practice and investor uncertainty

Stock price variances reflect the variation of investors’ beliefs and expectations of the firm’s future cash flow (Banerjee 2011). When firms in the same industry show a high variation of information regarding a similar risk (i.e., the COVID-19 outbreak), investors’ information processing costs may increase, leading to the high variation of pricing expectation (Ajinkya et al. 1991). Similarly, Lobo and Tung (2000) find that the differences in investors’ expectations can lead to higher return volatility. In this study, we argue that high industry COVID-19 disclosure dispersion reduces the comparability of firms’ information among peers. Investors would have a hard time valuing the impact of COVID-19 to the firm’s fundamental value, resulting in price disagreement among investors. Thus, we expect the firms in an industry with high COVID-19 disclosure dispersion are associated with high daily return volatilities during the 10-Q release windows. We use equation (3) below to test our proposition.

\[
AVAR_{i,t} = \gamma_0 + \gamma_1 IND\_COVID\_19_{i,t} + \gamma_2 SIZE_{i,t} \\
+ \gamma_3 BTM_{i,t} + \gamma_4 CAR_{i,t} + \gamma_5 N\_ANALYST_{i,t} \\
+ \gamma_6 LEV_{i,t} + \gamma_7 VOL\_SALE_{i,t} + \gamma_8 QUICK_{i,t} \\
+ \gamma_9 PCT\_CASE_{i,t} + \gamma_{10} HOSPERPPL_{i,t} \\
+ \gamma_{11} STAFF\_PERPPL_{i,t} \\
+ \gamma_{12} SUP\_EPS_{i,t} + \epsilon_{i,t}
\]  

(3)

In equation (3), we use five A VARs across different event windows as dependent variables: three days around 10-Q releases [−1, +1], one day after releases [0, +1], one week after [0, +5], two weeks after [+5, +10] and one month after [+15, +30]. We conjecture a significant positive coefficient on IND\_COVID\_19.

COVID-19 disclosure and analyst revision after 10-Q releases

In this section, we further examine whether COVID-19 disclosure also provides valuable information to analysts who are often considered to be more sophisticated participants in the market. Prior literature suggests that analysts, as professional investment intermediaries, are efficient in incorporating new information into their forecasts and would make adjustments to their forecasts when there is new information available (Zhang 2006; Yezeigel 2015). In other words, analysts are more likely to revise their forecasts if they learn new information about the firms. Upon the disclosure of the new information, analysts would interpret the new cues, incorporate them into their evaluation models and produce updated estimates that may be different from their prior prediction (Yezeigel 2015). Consistent with prior literature, we expect that COVID-19 disclosure would give analysts new information about the impact of the pandemic on firms’ future performance, which would trigger analysts to revise their next quarter forecasts. To test this prediction, we use the following equation (4):

\[
REV_{i,t} = \delta_0 + \delta_1 COVID\_19_{i,t} + \delta_2 SIZE_{i,t} \\
+ \delta_3 LEV_{i,t} + \delta_4 ROA_{i,t} \\
+ \delta_5 VAR_{i,t} + \delta_6 SUR\_EPS_{i,t} \\
+ \delta_7 M\&A_{i,t} + \delta_8 RD_{i,t} \\
+ \delta_9 NUM\_GEO_{i,t} + \epsilon_{i,t}
\]

(4)

In equation (4), REV\_i\_t measures the total number of analyst revisions of the next quarter’s earnings forecasts. We only consider revisions that occur between the issuance of the current quarter 10-Q and the next quarter 10-Q because this allows us to focus on the effect of the current quarter disclosure on the revisions of the next quarter forecasts. Our variable of interest is COVID\_19\_i\_t. We expect the coefficient \( \delta_1 \) to be positive and significant. Following prior studies (Zhang 2006; Yezeigel 2015), we control for factors that capture a firm’s information environment and investors’ demand for information. The detailed variable definitions are in Appendix A. We also control for industry and quarter fixed effects and cluster the standard errors by industry and quarter.

In addition, we also examine the directions of analyst forecast revision attributable to the COVID disclosure. This is because the nature of information plays an important role in driving analysts’ revision behaviours. Zhang (2006) shows that good (bad) news would lead to upward (downward) revisions of earnings forecasts, especially during times of high uncertainty. Similarly, Yezeigel (2015) investigates how new information affects analysts’ revisions of their stock recommendation and finds that analysts are more likely to revise the recommendation upward if the firms report positive earnings surprise. As firms respond to the SEC’s Disclosure Guidance by disclosing a significant amount of COVID-19 related risks and negative financial impacts, we project that COVID discussion may trigger only downward earning revisions, not upward ones. We estimate equation (5) to test this prediction:

\[
DOWNREV_{i,t}/UP\_REV_{i,t} = \delta_0 + \delta_1 COVID\_19_{i,t} \\
+ \delta_2 SIZE_{i,t} + \delta_3 LEV_{i,t} + \delta_4 ROA_{i,t} + \delta_5 VAR_{i,t} \\
+ \delta_6 SUR\_EPS_{i,t} + \delta_7 M\&A_{i,t} + \delta_8 RD_{i,t} \\
+ \delta_9 NUM\_GEO_{i,t} + \epsilon_{i,t}
\]

(5)
Where $\text{DOWNREVI (UPREVI)}$ captures the number of times that analysts revise earnings forecast downward (or upward). Similarly, we only consider revisions that occur between the release of the current quarter 10-Q and the next quarter 10-Q. We expect significant positive $\delta_1$ when the dependent variable is $\text{DOWNREVI}$, and insignificant $\delta_1$ when the dependent variable is $\text{UPREVI}$.

COVID-19 disclosure and analyst forecast dispersion after 10-Q releases

Schipper (1991) suggests that analysts’ decision processes can be representative of those of the whole market because analysts are intermediaries who receive and process financial information for investors. We thus further investigate how COVID-19 disclosure may assist analysts in achieving better consensus in future earnings forecasts. Prior studies suggest that firms with less public disclosure experience higher levels of analyst forecast dispersions (Lang and Lundholm 1996; Ali, Liu and Xu 2019). When less public information is available, analysts have to rely more on their own private channels to acquire information, which results in less consistent forecast numbers (Ali et al. 2019). Conversely, the risk of uncertainty can be reduced when firms start to disclose more information. Thus, we conjecture that more COVID-19 disclosure is associated with lower information risk. Since analyst dispersion is a good indicator of uncertainty among analysts (Barron and Stuerke 1998), we expect the level of COVID-19 disclosure is negatively associated with analyst forecast dispersion. We estimate the following OLS regression to assess this relationship:

$$\text{DISPERSION}_{it} = \varphi_0 + \varphi_1 \text{COVID-19}_{it} + \varphi_2 \text{SIZE}_{it} + \varphi_3 \text{BTM}_{it}$$
$$+ \varphi_4 \text{N_ANALYST}_{it} + \varphi_5 \text{SUR_EPS}_{it} + \varphi_6 \text{RD}_{it} + \varphi_7 \text{LOSS}_{it} + \varphi_8 \text{PCT_CASE}_{it}$$
$$+ \varphi_9 \text{PCT_DEATH}_{it} + \varepsilon_{i,t}$$

In equation (6), $\text{DISPERSION}$ is the standard deviation of the next quarter earnings forecast made after the current 10-Q release date. We measure $\text{DISPERSION}$ in multiple different windows: during the first month, second month and third month following the 10-Q release date. We only consider the forecasts that are issued between the issuance of the current quarter 10-Q and the next quarter 10-Q because this allows us to focus on the effect of the current quarter disclosure on the next quarter forecasts. We expect the coefficient $\varphi_1$ to be negative and significant. Following prior literature (e.g., Lang and Lundholm 1996; Hwang et al. 1996; Leung and Srinidhi 2006; Matolcsy and Wyatt 2006; Chalmers et al. 2012; Gul et al. 2013, etc.), we control for factors that may affect the quality of forecasts. The detailed variable definitions are in Appendix A. We also control for industry and quarter fixed effects and cluster the standard errors by industry and quarter.

COVID-19 disclosure and future financial and operational performance

Here we examine whether the level of COVID-19 disclosure is associated with negative financial and operational performance in the near future. As firms face higher operational risks due to the pandemic, managers need to adequately inform the market about the potential impact. The level of COVID disclosure in 10-Q filings could reflect the severity of the pandemic’s influence on the firms. Therefore, evidence of an association between the level of COVID-19 disclosure and future financial and operational performance would shed light on the intention of managers in providing these disclosures. We expect that managers use COVID-19 disclosure to inform investors about future operational risks, which would result in a negative association between COVID-19 disclosure and firm future performance. We estimate the following model to assess this relation.

$$\text{OPER_OUTCOME}_{i,t+1} = \omega_0 + \omega_1 \text{COVID-19}_{i,t}$$
$$+ \omega_2 \text{SIZE}_{i,t} + \omega_3 \text{BTM}_{i,t} + \omega_4 \text{LEV}_{i,t} + \omega_5 \text{VOL_OCF}_{i,t}$$
$$+ \omega_6 \text{FINANCE}_{i,t} + \omega_7 \text{QUICK}_{i,t} + \omega_8 \text{SPEC_ITEM}_{i,t}$$
$$+ \omega_9 \text{RD}_{i,t} + \omega_{10} \text{NUM_GEO}_{i,t}$$
$$+ \omega_{11} \text{PRIOR_CAR}_{i,t} + \varepsilon_{i,t}$$

In equation (7), $\text{OPER_OUTCOME}$ is one of the four future operational performance measures: sales of the next quarter ($\text{FUT_SALE}$), operating cash flows of the next quarter ($\text{FUT_OCF}$), operating income of the next quarter ($\text{FUT_OPICOME}$) and return on assets of the next quarter ($\text{FUT_ROA}$). We expect the coefficient $\omega_1$ to be negative and significant. Following prior literature (e.g., Vorst 2016; Hauser 2018; Harp and Barnes 2018; Huang et al. 2020), we control for general factors that may impact firms’ operating performance. In addition, we control for industry and quarter fixed effects and cluster the standard errors by industry and quarter.

The readability (and sentiment) of COVID disclosure and investor uncertainty

Besides establishing the COVID-19 disclosure contains value-relevant information that can reduce investor uncertainty,
uncertainty, we expand our inquiry to determine how the characteristics of the COVID-19 narrative modify the relationship between COVID-19 disclosure and investor uncertainty. Prior studies suggest that disclosure framing, such as the tone and the readability of the disclosure texts, may affect how the audience processes the information (Loughran and McDonald 2016; Allee et al. 2021). We believe that the readability and tone of the COVID-19 disclosures could be the conditions on which COVID-19 disclosure mitigates investor uncertainty.

First, we recognise that the COVID-19 disclosure will not be informative if investors are unable to understand the information. Prior literature suggests that a difficult-to-read document requires a higher cognitive effort to process, which limits the investors’ ability to search for and extract useful information in an efficient manner (Newell and Simon 1972; Tversky and Kahneman 1989; Lee 2012). Facing financial statements with limited readability, investors would experience high information processing costs and may fail to fully incorporate new information into stock prices (Bloomfield 2002; Lee 2012). Since quarterly reports contain key COVID-19 information that could help solve information uncertainty, a less readable disclosure can hinder an investor’s ability to process and use this information. Thus, we propose that the readability of the COVID-19 narrative can attenuate the reduction effect of COVID-19 disclosure on investor uncertainty. We test this prediction by estimating the following equation:

$$ \text{Uncertainty}_{i,t} = \theta_0 + \theta_1 \text{COVID}_19_{i,t} + \theta_2 \text{HIGH}_FOG_{i,t} + \theta_3 \text{COVID}_19_{i,t} \times \text{HIGH}_FOG_{i,t} + \theta \ast \text{CONTROLS} + \epsilon_{i,t} $$

where uncertainty is either $\ln(\frac{\text{AVAR}_{\text{POST}}}{\text{AVAR}_{\text{PRE}}})$ or AVAR; HIGH_FOG is an indicator variable set to one if the fog index of a firm’s COVID-19 disclosure is above the median of its industry peers, zero otherwise. Based on the prediction that low readability (i.e., HIGH_FOG = 1) attenuates the reduction effect of COVID-19 disclosure on uncertainty, we expect a positive coefficient $\theta_3$.

In addition to considering the readability’s moderation effect, we investigate whether the sentiment of COVID discussion in 10-Qs could also modify the relationship between disclosure and uncertainty. Veronesi (1999) documents that, during times of greater uncertainty, investors’ expectations about future cash flow become more sensitive to new information, which causes greater stock price volatility. Studies also show that the disclosure tone captures otherwise difficult to quantify aspects of firms’ fundamentals that investors do incorporate into their pricing decisions (Tetlock et al. 2008; Engelberg 2008). Druz et al. (2020) find that increases in negative tone in financial disclosure are associated with increases in investor uncertainty because management-expressed pessimism increases market pessimism, resulting in high stock volatility. Since the COVID-19 discussion reveals the damages caused by the pandemic, the negative sentiment can trigger high stock volatility (i.e., increases in investor uncertainty). Thus, we predict that a negative tone in the COVID-19 discussion would diminish the mitigating effect of COVID-19 disclosure on uncertainty. We estimate the following equation to test this prediction:

$$ \text{Uncertainty}_{i,t} = \rho_0 + \rho_1 \text{COVID}_19_{i,t} + \rho_2 \text{NEGA}_\text{SENTI}_{i,t} + \rho_3 \text{COVID}_19_{i,t} \ast \text{NEGA}_\text{SENTI}_{i,t} + \rho \ast \text{CONTROLS} + \epsilon_{i,t} $$

where Uncertainty is measured by using $\ln(\frac{\text{AVAR}_{\text{POST}}}{\text{AVAR}_{\text{PRE}}})$ and AVAR. NEGA_SENTI is an indicator variable set to one if a firm’s COVID discussion has a net negative tone, zero otherwise. Following prior studies (e.g., Davis et al. 2015; De Amicis et al. 2020), we compute the net negative tone as the difference between the number of positive words and the number of negative words divided by the total number of both positive and negative words. Based on the prediction that negative sentiment reduces the mitigating effect of COVID disclosure on uncertainty, we expect a positive coefficient $\rho_3$.

Data

Table 1 presents the detailed sample collection process. We start our sample selection process by calculating daily abnormal return volatility (AVAR) of 10-Q releases from January 2020 to December 2020. Using CRSP daily file, we obtain 7895 firm-quarter observations. We then merge this dataset with COMPUSTAT to collect firms’ financial information. We are left with 6127 firm-quarter observations as the initial sample. After merging the initial sample with the hand-collected COVID-19 disclosure dataset and constructing all control variables, we are left with 3722 firm-quarter observations. This sample is our main sample to test the relationship between COVID-19 disclosure and investor uncertainty.

To construct the analyst revision sample, we start with the initial sample and merge it with IBES, which provides analyst revision information. After constructing all variables needed for the analyst revision test, we are left with 5944 firm-quarter observations. For the analyst dispersion sample, we start with the initial sample and merge it with IBES analyst dispersion data. After constructing all variables needed for the analyst dispersion test, we are left with 4664 firm-quarter observations.

For the future financial and operating performance analysis, we first obtain the future financial and
Table 1 Sample selection

|                              | (1) Daily volatility | (2) Analyst revision | (3) Forecast dispersion | (4) Financial and operating performance | (5) Fog and Negative sentiment |
|------------------------------|----------------------|----------------------|-------------------------|-----------------------------------------|-------------------------------|
| Daily stock volatility of 10-Q release events from CRSP between 1/2020 and 12/2020 | 7895                 | 7895                 | 7895                     | 7895                                    | 7895                          |
| Less: observations fail to merge with COMPUSTAT | −1768               | −1768               | −1768                   | −1768                                   | −1768                         |
| Initial sample size         | 6127                 | 6127                 | 6127                    | 6127                                    | 6127                          |
| Less: observation missing control variable information in the volatility model | −2405               |                      |                         |                                         |                               |
| Sample size for the volatility test | 3722                 |                      |                         |                                         |                               |
| Less: observation missing control variable information in the analyst revision model |                      | −183                 |                         |                                         |                               |
| Sample size for the analyst revision test |                      |                      |                         |                                         |                               |
| Less: observation missing control variable information in the analyst dispersion model |                      |                      |                         |                                         | −1463                         |
| Sample size for the analyst dispersion test |                      |                      |                         |                                         | 4664                          |
| Less: observation missing control variable information in the financial and operating performance test |                      |                      |                         |                                         | −3790                         |
| Sample size for the financial and operating performance test |                      |                      |                         |                                         | 2337                          |
| Less: observations missing control variable information in Fog and negative sentiment tests |                      |                      |                         |                                         | −2439                         |
| Sample size for Fog and negative sentiment tests |                      |                      |                         |                                         | 3688                          |

operating performance information from COMPUSTAT from January to December 2020. We then merge this dataset with our initial sample. After constructing key variables in the test, we are left with 2337 firm-quarter observations.

Last, we construct two cross-sectional tests that investigate whether the characteristics of COVID-19 narratives can modify the relationship between COVID-19 disclosure level and investor uncertainty. We first measure the readability and sentiment of COVID-19 disclosure. We then merge the readability and sentiment datasets with the initial sample. After constructing key variables in the test, we are left with 3688 firm-quarter observations as the test sample.

Table 2 presents the sample statistics for each regression test. Panel A presents variables used in the investor uncertainty test. The mean of COVID_19 is 1.7396, suggesting that, on average, two out of every 1000 words in 10-Q filings are COVID-19 keywords. To visualise how management discloses COVID-19 information, we depict a line graph to reveal the level of COVID-19 discussion in 10-Qs in each month of 2020 (see Figure 1). Consistent with actual events, in January and February 2020, the average 10-Q COVID discussion was kept at 415.7 words. When the World Health Organization
### Table 2: Sample statistics

#### Panel A: COVID-19 disclosure and investor uncertainty

| variable                  | N   | mean  | sd   | p50  | min   | max   |
|---------------------------|-----|-------|------|------|-------|-------|
| COVID_19                  | 3722| 1.7396| 1.3626| 1.6680| 0.0000| 4.7363|
| IND_COVID_19              | 3722| 0.1406| 0.0243| 0.1377| 0.0000| 0.2281|
| ABV_MEDI_COVID            | 3722| 0.1078| 0.1089| 0.0768| 0.0000| 0.4286|
| BELOW_MEDI_COVID          | 3722| 0.1417| 0.0578| 0.1090| 0.0000| 0.3809|
| ln(AVAR_{post3})         | 3722| −0.0142| 1.0980| −0.0907| −2.7984| 3.4476|
| ln(AVAR_{post5})         | 3722| 0.1077| 0.9961| 0.0533| −2.3537| 3.6021|
| ln(AVAR_{post10})        | 3722| 0.1417| 0.8895| −0.0321| −1.6106| 3.8534|
| ln(AVAR_{post30})        | 3722| 0.4121| 0.9530| 0.2433| −1.7115| 3.9960|
| AVAR [{−1},+1]          | 3722| 0.4972| 0.5077| 0.2873| 0.0056| 2.3109|
| AVAR [0, +1]             | 3722| 0.5004| 0.4586| 0.3248| 0.0090| 2.1911|
| AVAR [0, +5]             | 3722| 0.4873| 0.3898| 0.4303| 0.0190| 2.0911|
| AVAR [+5, +10]           | 3722| 0.5024| 0.4044| 0.4946| 0.0217| 2.4205|
| AVAR [+15, +30]          | 3722| 0.5562| 0.3004| 0.4670| 0.0606| 2.7873|
| SIZE                     | 3722| 7.3433| 2.0157| 7.4330| 1.3707| 11.9530|
| BTM                      | 3722| 0.5892| 1.1888| −10.1601| 8.0946|
| CAR                      | 3722| −0.0011| 0.0098| −0.0007| −0.0341| 0.0301|
| N_ANALYST                | 3722| 1.7919| 0.8825| 1.7918| 0.0000| 3.3232|
| LEV                      | 3722| 0.3076| 0.2239| 0.2942| 0.0000| 1.0049|
| VOL_SALE                 | 3721| 98.473| 242.701| 19.064| 0.0000| 1640.288|
| SUR_EPS                  | 3722| 0.2652| 0.4525| 0.1100| 0.0000| 3.2000|
| QUICK                    | 3722| 2.5197| 3.4292| 1.4772| 0.0729| 41.5859|
| PCT_CASE                 | 3722| 0.0388| 0.0113| 0.0394| 0.0204| 0.0812|
| HOSPPEPPL                | 3722| 19.7790| 4.6879| 18.4524| 13.7435| 30.3565|
| STAFFPEPPL               | 3722| 4.2147| 3.9112| 3.3333| 1.0000| 24.0000|

#### Panel B: COVID-19 disclosure and analyst revision

| variable                  | N   | mean   | sd   | p50  | min   | max   |
|---------------------------|-----|--------|------|------|-------|-------|
| REVI                      | 5944| 10.2848| 9.7592| 7.0000| 0.0000| 45.0000|
| DOWN_REVI                 | 5944| 5.4393 | 6.2069| 3.0000| 0.0000| 30.0000|
| UP_REVI                   | 5944| 4.7897 | 6.1699| 3.0000| 0.0000| 30.0000|
| REVI_M1                   | 5944| 6.6898 | 6.0583| 5.0000| 0.0000| 27.0000|
| DOWN_REVI_M1              | 5944| 3.7246 | 4.3328| 2.0000| 0.0000| 20.0000|
| UP_REVI_M1                | 5944| 2.9135 | 4.0348| 1.0000| 0.0000| 20.0000|
| REVI_M2                   | 5944| 1.5720 | 2.4117| 1.0000| 0.0000| 13.0000|
| DOWN_REVI_M2              | 5944| 0.8170 | 1.4780| 0.0000| 8.0000|
| UP_REVI_M2                | 5944| 0.7308 | 1.4932| 0.0000| 9.0000|
| COVID_19                  | 5944| 1.5797 | 1.3537| 1.5526| 0.0000| 4.7363|
| SIZE                      | 5944| 7.6941 | 1.9912| 7.7613| 1.3707| 11.9530|
| ROA                       | 5944| −0.0189| 0.0945| 0.0020| −2.3683| 0.1391|
| AVAR [−1, +1]             | 5944| 0.5228 | 0.4820| 0.3358| 0.0090| 2.1911|
| SUR_EPS                   | 5944| 0.2732 | 0.4708| 0.1100| 0.0000| 3.0300|
| M&A                       | 5944| 0.2446 | 0.4299| 0.0000| 1.0000|
| SPEC_ITEM                 | 5944| −0.0092| 0.0296| −0.0002| −0.1968| 0.0295|
| RD                        | 5944| 0.4185 | 2.2837| 0.0000| 19.7576|
| NUM_GEO                   | 5944| 4.2147 | 3.9112| 3.3333| 1.0000| 24.0000|

#### Panel C: COVID-19 disclosure and analyst forecast dispersion

| variable                  | N   | mean   | sd   | p50  | min   | max   |
|---------------------------|-----|--------|------|------|-------|-------|
| DISPERSION_M1             | 4664| 0.1395 | 0.2033| 0.0700| 0.0000| 1.2700|
| DISPERSION_M2             | 4664| 0.1339 | 0.1995| 0.0700| 0.0000| 1.2400|
| DISPERSION_M3             | 4664| 0.1220 | 0.1863| 0.0600| 0.0000| 1.1800|
| DISPERSION_AVE            | 4664| 0.1373 | 0.2028| 0.0700| 0.0000| 1.3067|
| COVID_19                  | 4664| 1.7902 | 1.2914| 1.7478| 0.0000| 4.7363|
| SIZE                      | 4664| 7.8306 | 1.9340| 7.8679| 1.8489| 11.9530|
| BTM                       | 4664| 0.7280 | 1.1252| 0.4981| −10.1601| 8.0946|
| N_ANALYST                 | 4664| 1.8518 | 0.7677| 1.7918| 0.0000| 3.3222|
declared COVID-19 as a global pandemic in March, firms’ COVID-19 discussion level jumped to 4083.5 words. It continued to climb to 5130.5 in July and peaked at 5333.1 in October. For industry-level COVID-19 disclosure, the mean of IND_COVID_19 is 0.1406, suggesting the variances of COVID-19 keyword count within the same industry is 0.1406.

For dependent variables, the mean of \( \ln(\frac{\text{AVAR}_{\text{post}3}}{\text{AVAR}_{\text{pre}3}}) \) is -0.0142, suggesting post-three-day volatility is much less than pre-three-day daily volatility. The mean of \( \ln(\frac{\text{AVAR}_{\text{post}5}}{\text{AVAR}_{\text{pre}3}}) \) is 0.1077, indicating the post-five-day volatility is higher than pre-three-day volatility. The mean of \( \ln(\frac{\text{AVAR}_{\text{post}10}}{\text{AVAR}_{\text{pre}3}}) \) is 0.1417, suggesting the post-ten-day volatility is also higher than pre-three-day volatility. The mean of \( \ln(\frac{\text{AVAR}_{\text{post}30}}{\text{AVAR}_{\text{pre}3}}) \) is 0.4121, indicating post-30-day volatility is much higher than pre-three-day volatility. The trend of changes in daily volatility suggests that the information in 10-Q filings only temporarily reduces investor uncertainty. The market recovers its volatility quickly. A similar trend can also be detected when we measure investor uncertainty by directly using the average of daily abnormal volatility over a period of time. For example, the mean of \( \text{AVAR}[0, +1] \) is 0.5004, which is smaller than the mean of \( \text{AVAR}[5, +10] \), which is lower than the mean of \( \text{AVAR}[+15, +30] \).

For control variables, the mean of PCT_CASE is 0.1138, indicating that there are 0.11 confirmed coronavirus cases for every 1000 US residents in 2020. The mean of HOSPPERPPL is 0.0387, suggesting, on
average, one hospital serves 25000 residents.\textsuperscript{7} The mean of \textit{STAFFPERPPL} is 19.77, suggesting 20 medical professionals provide medical services for 1000 US residents.\textsuperscript{8} There are around two analysts following the sample firms (\textit{N\_ANALYST}). The mean of the cumulative abnormal return over a three-day release window (\textit{CAR}) is $-0.0011$, suggesting bad market reactions to 10-Q releases in general. The statistics of earning per share surprise (\textit{SUR\_EPS}) is 0.0265. The statistics of firms' financial characteristics (\textit{SIZE}, \textit{BTM}, \textit{LEV}, \textit{VOL\_SALE}, \textit{QUICK}) are consistent with prior literature.

Panel B presents sample statistics of variables used in the analyst revision test. The mean of \textit{REVI} is 10.285, suggesting that there are, on average, 10 earnings forecast revisions after 10-Q releases. The sample mean of \textit{DOWN\_REVI} is 5.4393, suggesting there are, on average, more than five downward revisions after 10-Q releases. On the contrary, the sample mean of \textit{UP\_REVI} is 4.7897, meaning there are only about 4.7 upward revisions after 10-Q releases. A similar pattern can also be detected in \textit{DOWN\_REVI\_M1} (or \textit{DOWN\_REVI\_M2}) and \textit{UP\_REVI\_M1} (or \textit{UP\_REVI\_M2}). The sample mean of \textit{ROA} is $-0.0189$, which is consistent with the reality of the economic lockdown and negative performance. \textit{SPEC\_ITEM}, \textit{RD} and \textit{NUM\_GEO} have consistent sample statistics as those in prior literature. The rest of the control variables have similar means as those in the uncertainty test.

Panel C presents the sample statistics of the variable used in the analyst dispersion test. The mean of \textit{DISPERSION\_M1}, \textit{DISPERSION\_M2} and \textit{DISPERSION\_M3} is 0.1395, 0.1339 and 0.1220, respectively. This suggests that forecast dispersions reduce as the forecast dates get closer to the next earnings announcement. The average analyst following of a sample firm is 2.0. The rest of the controls are consistent with those in the main test.

Panel D presents the sample statistics of variables used in future financial and operational performance tests. The mean of next quarter sales scaled by total asset is 0.1771, the mean of next quarter operating cash flow scaled by total asset is $-0.00003$, the mean of next quarter operating income scaled by total asset is $-0.0114$, and the mean of future return on asset is $-0.0237$. The rest of the controls have similar sample statistics as those in prior tests.

Lastly, Panel E presents the sample statistics of COVID-19 narrative characteristics. The mean of \textit{IS\_COVID} is 0.7861, suggesting 79\% of firms discussed COVID-19 in their 2020 10-Q s. \textit{TOTALWORDS} has a sample mean of 35482, meaning there are 35482 words in 10-Qs in general. \textit{COVID\_FOG} has a mean of 22.438, which means that it requires a post-graduate education level to understand the COVID-19 disclosure in forms 10-Q. \textit{COVID\_TONE} has 0.0011 suggesting the difference between positive words and negative words used to describe COVID-19 influences is close to zero. Further, when we construct an indicator to measure the percentage of firms using negative tones (\textit{NEGA\_SENTI}), we find only 35.37\% of firms express COVID in net negative sentiments.

Table 3 presents the Pearson correlation matrix of the main variables used in the regression models. We obtain variance inflation factors (VIF) for the variables to test for multicollinearity (un-tabulated). There is no indication of multicollinearity between the variables because none of the variables have a VIF value above 10.
|   | (1) | (2)       | (3)       | (4)       | (5)       | (6)       | (7)       | (8)       | (9)       | (10)      | (11)      | (12)      |
|---|-----|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1 | COVID_19 | 1         |           |           |           |           |           |           |           |           |           |           |
| 2 | IS_COVID | 0.6681    | 1         |           |           |           |           |           |           |           |           |           |
| 3 | IND_COVID_19 | 0.1024    | -0.0751   | 1         |           |           |           |           |           |           |           |           |
| 4 | ln(AVAR$_{post}$) | -0.0449   | -0.0243   | 0.0103    | 1         |           |           |           |           |           |           |           |
| 5 | ln(AVAR$_{pre}$) | -0.0407   | -0.0332   | 0.0026    | 0.9145    | 1         |           |           |           |           |           |           |
| 6 | ln(AVAR$_{post}$) | -0.0561   | -0.0565   | -0.021    | 0.8548    | 0.9271    | 1         |           |           |           |           |           |
| 7 | ln(AVAR$_{pre}$) | -0.0743   | -0.0733   | -0.0271   | 0.8405    | 0.902     | 0.9681    | 1         |           |           |           |           |
| 8 | ln(AVAR$_{post}$) | -0.0144   | -0.0243   | -0.0238   | 0.6769    | 0.7547    | 0.7936    | 0.8038    | 1         |           |           |           |
| 9 | AVAR [-1, +1] | -0.0875   | -0.007    | 0.0054    | 0.2973    | 0.1614    | 0.1175    | 0.1308    | -0.1912   | 1         |           |           |
| 10 | AVAR [0, +1] | -0.0842   | -0.0067   | 0.0035    | 0.089     | -0.0488   | -0.0738   | -0.056    | -0.3778   | 0.8965    | 1         |           |
| 11 | AVAR [0, +5] | -0.0944   | 0.0002    | 0.0115    | 0.3494    | 0.2678    | 0.2132    | 0.2152    | -0.1836   | 0.7972    | 0.753     | 1         |
| 12 | AVAR [+5, +10] | -0.0838   | -0.0033   | -0.0036   | -0.0134   | -0.0084   | 0.0993    | 0.0769    | -0.3025   | 0.5765    | 0.6352    | 0.6993    |
| 13 | AVAR [+15, +30] | -0.0748   | 0.0471    | 0.0014    | 0.0254    | -0.0158   | -0.0071   | -0.0017   | 0.002     | -0.0523   | 0.0841    | 0.1039    |
| 14 | SIZE | -0.0888   | -0.1035   | -0.022    | -0.0631   | -0.0687   | -0.0478   | -0.0632   | -0.0534   | -0.0112   | -0.0054   | -0.061    |
| 15 | BTM | 0.0274    | 0.0311    | -0.0843   | -0.0016   | 0.0006    | 0.0178    | 0.0066    | -0.01     | -0.004    | -0.0026   | 0.0224    |
| 16 | CAR | 0.0167    | -0.0169   | -0.0285   | 0.0106    | -0.0017   | 0.0029    | -0.002    | -0.0052   | 0.0841    | 0.1039    | 0.052     |
| 17 | N_ANALYST | -0.0934   | -0.06     | -0.014    | -0.0625   | -0.0667   | -0.0392   | -0.0438   | -0.0525   | -0.0021   | 0.006     | -0.0451   |
| 18 | LEV | -0.0205   | -0.0469   | 0.0564    | -0.0061   | 0.0142    | 0.0054    | -0.0067   | 0.0247    | -0.0477   | -0.0593   | -0.0559   |
| 19 | VOL_SALE | -0.1001   | -0.103    | -0.024    | -0.0216   | -0.0281   | -0.0067   | 0.0136    | -0.0028   | -0.0145   | -0.0121   | -0.0339   |
| 20 | SUR_EPS | -0.0164   | -0.0234   | 0.0452    | 0.0201    | 0.0168    | 0.0186    | 0.021     | 0.0228    | -0.0374   | -0.0421   | -0.0319   |
| 21 | QUICK | 0.0374    | 0.1183    | -0.0682   | 0.0309    | 0.0258    | 0.0141    | 0.0345    | 0.0049    | 0.2438    | -0.3038   | -0.3317   |
| 22 | PCT_CASE | -0.0474   | -0.1072   | -0.0005   | -0.0175   | -0.0105   | -0.0184   | 0.0049    | 0.2438    | -0.3038   | -0.3317   | -0.3795   |
| 23 | HOSP_HRPPPL | -0.0378   | -0.0351   | -0.0051   | -0.0161   | -0.0161   | -0.0146   | -0.0125   | -0.026    | 0.0004    | 0.0159    | 0.0096    |
| 24 | STAFF_HRPPPL | 0.0059    | -0.0312   | -0.0103   | 0.0146    | 0.0146    | 0.0156    | 0.0174    | 0.0075    | 0.0087    | -0.0042   | 0.0107    |

(Continued)
Multivariate Results

Covid-19 disclosure and investor uncertainty

Table 4 Panel A reports the results of equation (1). In column 1, the dependent variable is the daily volatility change between three days after and three days before 10-Q releases, that is, $\ln(\frac{AVAR_{POST}^3}{AVAR_{PRE}^3})$. We find the coefficient on COVID_19 is significantly negative (coefficient $=-0.045$, $p < 0.001$), suggesting that one standard deviation increase in COVID-19 disclosure is associated with 0.06 standard deviation reduction in investor uncertainty. In column 2, the dependent variable is the change of daily stock volatility between five days after and three days before 10-Q releases, $\ln(\frac{AVAR_{POST}^5}{AVAR_{PRE}^3})$. We detect a significantly negative coefficient on COVID_19 (coefficient $=-0.033$, $p < 0.05$), suggesting that the effect of COVID-19 disclosure on investor uncertainty sustains to five days after 10-Q releases. In column (3), the dependent variable extends to ten days after 10-Q releases. We consistently find a significant negative coefficient on COVID_19 (coefficient $=-0.027$, $p < 0.05$). However, in column 4, when the dependent variable extends to 30 days after 10-Q releases, we find the COVID disclosure does not have effects on uncertainty anymore. Observing the coefficient magnitude and the significance level from post-10-Q three days to post 10-Q 30 days (from column 1 to column 4), we conclude that COVID-19 disclosure provides value-relevant information, which reduces investor uncertainty, but mainly in the short run. This implies that the impact of COVID-19 disclosure may only be temporary.

Regarding control variables, we find that firm size is negatively associated with investor uncertainty, consistent with the notion that bigger firms may have a better information environment, which results in less investor uncertainty (Yezegel 2015). Similarly, we find that firms with high leverage have more investor uncertainty. This may be attributed to the higher default risk of high-leverage firms.

Table 4 Panel B presents the regression results of equation (2). First, we detect significantly negative coefficients on COVID_19 across all five windows, suggesting COVID-19 disclosure reduces investor uncertainty. This is consistent with our findings using the change of daily volatility. Second, the magnitude of the COVID_19 coefficient gradually decreases (i.e., $-0.04$ drops to $-0.029$) from column 1 to column 5. This reduction trend is consistent with our findings in Table 4 Panel A that the effect is stronger in the short run.

Taken together, the findings reported in Table 4 support our prediction that COVID-19 disclosure contains value-relevant information, which reduces uncertainty in the market.
### Table 4 Panel A 10-Q COVID disclosure and the change of daily stock volatility

|                | (1) \(\ln(\frac{AVAR_{\text{post}}}{AVAR_{\text{pre}}})\) | (2) \(\ln(\frac{AVAR_{\text{post}5}}{AVAR_{\text{pre}5}})\) | (3) \(\ln(\frac{AVAR_{\text{post}10}}{AVAR_{\text{pre}10}})\) | (4) \(\ln(\frac{AVAR_{\text{post}30}}{AVAR_{\text{pre}30}})\) |
|----------------|-----------------------------------------------------|---------------------------------|---------------------------------|---------------------------------|
| COVID_19       | -0.045*** (-3.07)                                   | -0.033** (-2.48)                | -0.027** (-2.30)                | -0.007 (-0.57)                  |
| CAR            | 1.234 (0.66)                                        | -0.468 (-0.28)                  | -0.701 (-0.48)                  | -2.922** (-1.96)                |
| SUR_EPS        | 0.041 (0.92)                                        | 0.060 (1.44)                    | 0.060 (1.63)                    | -0.008 (0.23)                   |
| SIZE           | -0.019 (-1.28)                                      | -0.030*** (-2.27)               | -0.023* (-1.95)                 | -0.020 (-1.65)                  |
| LEV            | 0.081 (0.86)                                        | 0.173** (2.09)                  | 0.081 (1.08)                    | 0.152* (1.94)                   |
| BTM            | 0.007 (0.40)                                        | 0.022 (1.48)                    | 0.023* (1.72)                   | 0.015 (1.13)                    |
| QUICK          | 0.008 (1.30)                                        | 0.005 (1.09)                    | 0.003 (0.70)                    | 0.003 (0.71)                    |
| N_ANALYST      | -0.053* (-1.69)                                    | -0.035 (-1.25)                  | -0.008 (-0.33)                  | -0.031 (-1.15)                  |
| PCT_DEATH      | -10.250 (-1.61)                                     | -11.907** (-1.98)               | -16.381*** (-2.82)              | -13.189** (-2.27)               |
| PCT_CASE       | 0.506 (1.15)                                        | 0.668 (1.58)                    | 1.015** (2.47)                  | 1.858*** (4.47)                 |
| HOSPPERPPL     | 23.243 (1.38)                                       | 22.555 (1.51)                   | 17.769 (1.30)                   | 13.853 (0.73)                   |
| STAFFPERPPL    | 0.054 (0.70)                                        | 0.085 (1.63)                    | 0.050 (0.95)                    | 0.131 (1.48)                    |
| CONSTANT       | -1.567 (-0.75)                                      | -2.544*** (-1.96)               | -1.596 (-1.21)                  | -3.777* (-1.66)                 |
| **State fixed effects** | Yes (2) ** | Yes (3) ** | Yes (4) ** | Yes (5) ** |
| **Quarter fixed effects** | Yes (2) ** | Yes (3) ** | Yes (4) ** | Yes (5) ** |
| **Industry fixed effects** | Yes (2) ** | Yes (3) ** | Yes (4) ** | Yes (5) ** |
| N              | 3722                                               | 3722                            | 3722                            | 3722                            |
| adj. R²        | 0.020                                              | 0.026                            | 0.040                            | 0.015                            |

Panel B 10-Q COVID disclosure and the average of daily return volatility over event windows

|                | (1) \(AVAR_{[-1, +1]}\) | (2) \(AVAR_{[0, +1]}\) | (3) \(AVAR_{[0, +5]}\) | (4) \(AVAR_{[+5, +10]}\) | (5) \(AVAR_{[+15, +30]}\) |
|----------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| COVID-19       | -0.035*** (-6.33)        | -0.040*** (-6.51)        | -0.036*** (-8.02)        | -0.031*** (-6.38)        | -0.029*** (-6.84)        |
| SIZE           | 0.000 (0.07)             | 0.004 (0.53)             | -0.013*** (-2.75)        | -0.011*** (-2.28)        | -0.017*** (-4.25)        |
| BTM            | -0.014** (-2.22)         | -0.013* (-1.90)          | 0.007 (0.23)             | 0.065 (1.09)             | -0.001 (-0.21)           |
| CAR            | 3.599*** (3.59)          | 3.003*** (2.70)          | 0.611 (0.69)             | 0.414 (0.44)             | -0.425 (-0.51)           |
| N_ANALYST      | 0.009 (0.82)             | 0.000 (0.01)             | 0.003 (0.31)             | 0.026*** (2.73)          | 0.008 (1.11)             |
| LEV            | -0.118*** (-3.45)        | -0.089** (-2.33)         | -0.048* (-1.69)          | -0.092*** (-3.19)        | -0.052** (-2.15)         |
| VOL_SALE       | 0.000 (0.04)             | -0.000 (-0.14)           | 0.000 (1.04)             | -0.000 (0.24)            | 0.000 (0.92)             |
| SUR_EPS        | -0.002 (-0.11)           | -0.001 (-0.04)           | 0.022 (1.61)             | 0.013 (0.84)             | 0.001 (0.05)             |
| QUICK          | -0.001 (-0.28)           | 0.000 (0.09)             | -0.001 (-0.30)           | -0.002 (-0.86)           | -0.001 (-0.51)           |
| PCT_CASE       | -0.637*** (-9.58)        | -0.679*** (-9.25)        | -0.650*** (-10.74)       | -0.736*** (-11.56)       | -0.326*** (-7.21)        |
| HOSPPERPPL     | -0.572 (-0.85)           | -1.218 (-1.61)           | -0.854 (-1.53)           | -0.765 (-1.39)           | -0.343 (-0.80)           |

(Continued)
Table 4 (Continued)

|          | (1) ln(\(AVAR_{post10} / AVAR_{pre10}\)) | (2) ln(\(AVAR_{post15} / AVAR_{pre15}\)) | (3) ln(\(AVAR_{post30} / AVAR_{pre30}\)) | (4) ln(\(AVAR_{post5} / AVAR_{pre5}\)) |
|----------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|
| STAFFPERPPL | 0.004**                                 | 0.005***                                | 0.006**                                 | 0.005***                                |
|          | (2.37)                                   | (2.99)                                   | (4.27)                                   | (3.52)                                   |
| CONSTANT | 1.504***                                | 1.554***                                | 1.390***                                | 1.325***                                |
|          | (6.20)                                   | (7.02)                                   | (5.76)                                   | (4.77)                                   |
| State fixed effects | Yes                                     | Yes                                     | Yes                                     | Yes                                     |
| Quarter fixed effects    | Yes                                     | Yes                                     | Yes                                     | Yes                                     |
| Industry fixed effects    | Yes                                     | Yes                                     | Yes                                     | Yes                                     |
| N        | 3722                                    | 3722                                    | 3722                                    | 3722                                    |
| adj. R²  | 0.188                                   | 0.162                                   | 0.246                                   | 0.271                                   |
|          |                                         |                                         |                                         |                                         |

Table 4 Panel A reports OLS regression results of the relationship between the level of COVID-19 disclosure and investor uncertainty. In column 1, the dependent variable ln(\(AVAR_{post10} / AVAR_{pre10}\)) is the nature log of the division between the daily abnormal stock volatility of three days after 10-Q releases and three days before the 10-Q release. This measure captures the change of daily volatility between pre- and post-10-Q periods. The independent variable COVID-19 is defined as the word count of COVID-19 keywords scaled by the total word counts of the 10-Q, multiplying 1000. In column 2, the dependent variable ln(\(AVAR_{post15} / AVAR_{pre15}\)) measures the daily volatility change between five days after and three days before 10-Q release. In column 3, the dependent variable ln(\(AVAR_{post30} / AVAR_{pre30}\)) measures the daily volatility change between ten days after and three days before 10-Q release. In column 4, the dependent variable ln(\(AVAR_{post5} / AVAR_{pre5}\)) captures the change of daily volatility between 30 days after and three days before 10-Q releases. We expect a negative coefficient on COVID-19 across four columns. The control variables are defined in Appendix A. The model specification includes state, industry and quarter fixed effects. The standard errors are clustered at firm and quarter level. Significance levels are based on two-tailed tests. *, **, *** denotes significance level at p < 0.1, p < 0.05 and p < 0.01, respectively. All continuous variables are winsorised at 1% and 99% percentiles.

Table 4 Panel B reports OLS regression results of the relationship between the level of COVID-19 disclosure and the average of daily abnormal return volatility. The independent variable of all columns is COVID-19, defined as the count of COVID keywords in firms’ 10-Qs, scaled by the total word count of 10-Q and times 1000. The dependent variable in column (1), AVAR[−1, +1], is the average of daily abnormal volatility during the period [−1, +1]. The dependent variable in column 2, AVAR[0, +1] is the average of daily abnormal volatility during the period [0, +1]. In column (3), the dependent variable AVAR [0, +5] is the average of daily abnormal volatility during the period [0, +5]. In columns (4) and (5), the dependent variable AVAR [+5, +10] and AVAR [+15, +30] are the average of daily abnormal volatility during the period [+5, +10] and [+15, +30]. The detailed definitions of all variables are in Appendix A. The model specifications include state, industry and quarter fixed effects. The standard errors are clustered at firm and quarter level. Significance level are based on two-tailed tests. *, **, *** denotes significance level at p < 0.1, p < 0.05 and p < 0.01, respectively. All continuous variables are winsorised at 1% and 99% percentiles.

Industry-wide COVID disclosure practice and investor uncertainty

Industry COVID disclosure dispersion and investor uncertainty

Table 5 reports the regression results of the relationship between AVAR and IND_COVID_19. Consistent with our prediction, across five columns, the coefficients on IND_COVID_19 are positive and significant at a p-value less than 0.01. For example, in column 1, where the dependent variable is AVAR[−1, +1], the coefficient on IND_COVID_19 is +37.641, suggesting that a one standard deviation increase in industry-wide COVID-19 disclosure dispersion corresponds with almost two standard deviations increase in investor uncertainty.10 These findings suggest high industry-wide COVID-19 disclosure dispersion increases investor uncertainty after 10-Q releases. In other words, the industry-wide COVID-19 disclosure practice is significantly associated with investors’ decoding the COVID-19 process. High disclosure variation within the same industry confuses investors and reduces information comparability, in turn, increasing uncertainty.

Above-industry-median COVID-19 disclosure and investor uncertainty

To further our knowledge of how industry-wide COVID-19 disclosure affects investor uncertainty, we examine whether abnormal COVID-19 disclosure affects investor uncertainty. We measure abnormal COVID-19 disclosure by computing the distance between the extent of a firm’s COVID-19 disclosure and its industry median. Specifically, we use each firm’s COVID-19-word count minus its industry median count. A positive disclosure distance stands for relatively more COVID-19 disclosures, vice versa. We then split our main sample into firms with positive distances (i.e., ABV_MEDI_COVID) and firms with negative ones (i.e., BLW_MEDI_COVID). Based on our main finding that the COVID-19 disclosure reduces investor uncertainty, we expect that firms with above-median COVID disclosure would experience significant uncertainty reduction.
Table 5  Industry-wide COVID-19 disclosure and post-10-Q daily stock volatility

|                | (1) AVAR [−1, +1] | (2) AVAR [0, +1] | (3) AVAR [0, +5] | (4) AVAR [+5, +10] | (5) AVAR [+15, +30] |
|----------------|-------------------|------------------|-----------------|--------------------|--------------------|
| IND_COVID_19   | 37.641***         | 37.338***        | 36.594***       | 36.013***          | 38.042***          |
|                | (3.35)            | (3.33)           | (3.37)          | (3.51)             | (4.00)             |
| SIZE           | −0.636***         | −0.635***        | −0.634***       | −0.634***          | −0.644***          |
|                | (−22.35)          | (−22.41)         | (−22.43)        | (−21.98)           | (−22.01)           |
| BTM            | 0.216***          | 0.219***         | 0.221***        | 0.232***           | 0.269***           |
|                | (3.89)            | (3.93)           | (3.96)          | (4.08)             | (4.42)             |
| N_ANALYST      | −0.173***         | −0.175***        | −0.175***       | −0.180***          | −0.177***          |
|                | (−3.07)           | (−3.08)          | (−3.06)         | (−3.06)            | (−2.98)            |
| LEV            | 2.070***          | 2.062***         | 2.056***        | 2.066***           | 2.115***           |
|                | (11.23)           | (11.22)          | (11.21)         | (11.14)            | (11.23)            |
| VOL_SALE       | 0.001***          | 0.001***         | 0.001***        | 0.001***           | 0.001***           |
|                | (8.56)            | (8.50)           | (8.51)          | (8.43)             | (8.60)             |
| SUR_EPS        | 0.435***          | 0.436***         | 0.434***        | 0.436***           | 0.464***           |
|                | (4.77)            | (4.79)           | (4.76)          | (4.71)             | (4.72)             |
| QUICK          | 0.015             | 0.014            | 0.014           | 0.014              | 0.013              |
|                | (0.78)            | (0.77)           | (0.75)          | (0.73)             | (0.68)             |
| PCT_CASE       | 0.837***          | 0.828***         | 0.810***        | 0.816***           | 0.741***           |
|                | (3.12)            | (3.10)           | (3.02)          | (2.98)             | (2.69)             |
| HOSPPERPPL     | −13.029           | −12.870          | −11.169         | −9.694             | −8.552             |
|                | (−0.99)           | (−0.97)          | (−0.84)         | (−0.72)            | (−0.63)            |
| STAFFPERPPL    | 0.007             | 0.012            | 0.020           | 0.026              | 0.019              |
|                | (0.17)            | (0.27)           | (0.45)          | (0.59)             | (0.41)             |
| CONSTANT       | 2.510             | 2.448            | 2.332           | 2.272              | 2.277              |
|                | (1.37)            | (1.33)           | (1.29)          | (1.31)             | (1.38)             |
| State fixed effects | Yes          | Yes                  | Yes             | Yes                | Yes                |
| Quarter fixed effects | Yes       | Yes                      | Yes             | Yes                | Yes                |
| Industry fixed effects | Yes     | Yes                       | Yes             | Yes                | Yes                |
| N              | 3713              | 3713              | 3713            | 3713               | 3713               |
| adj. R²        | 0.443             | 0.443             | 0.443           | 0.440              | 0.443              |

This table reports OLS regression results of the relationship between the COVID-19 disclosure dispersion within the same industry and the average daily abnormal return volatility. The independent variables in all columns are IND_COVID_19, defined as the standard deviation of the count of COVID-19 key words of all firms in the same industry, scaled by the total words of 10-Q. The dependent variable in column (1), AVAR [−1, +1], is the average of daily abnormal volatility during the period [−1, +1]. The dependent variable in column 2, AVAR[0, +1] is the average of daily abnormal volatility during the period [0, +1]. In column (3), the dependent variable AVAR [0, +5] is the average of daily abnormal volatility during the period [0, +5]. In columns (4) and (5), the dependent variable AVAR [+5, +10] and AVAR [+15, +30] are the average of daily abnormal volatility during the period [+5, +10] and [+15, +30]. The detailed definitions of all variables are in Appendix A. The model specifications include state, industry and quarter fixed effects. The standard errors are clustered at firm and quarter level. Significance level are based on two-tailed tests. *, **, *** denotes significance level at p < 0.1, p < 0.05 and p < 0.01, respectively. All continuous variables are winsorised at 1% and 99% percentiles.

in the post-10-Q periods, whereas firms with below-median COVID disclosure may not experience any reduction of investor uncertainty.

Table 6 Panel A presents the regression results of firms with positive COVID disclosure distance. We find significant and negative coefficients on ABV_MEDI_COVID across five columns, suggesting firms with high COVID-19 disclosure are associated with a substantial reduction in investor uncertainty. On the other hand, Table 6 Panel B presents the results of firms with negative COVID disclosure distance. We detect non-significant coefficients on BLW_MEDI_COVID across five columns, suggesting firms with low COVID disclosure cannot reduce investor uncertainty. Overall, the results in Table 6 further support our main finding that COVID-19 disclosures can reduce investor uncertainty.

COVID-19 disclosure and analyst revision after 10-Q releases

In this section, we examine whether sophisticated market participants such as analysts also utilize COVID-19 disclosure information. Table 7 column 1 reports the results of equation (4). We find that COVID_19 is positively associated with REVI (coefficient = 0.190, p < 0.01). This means a one standard deviation increase in COVID-19 disclosure is associated with 0.03 standard deviation increase in analyst revision, suggesting that more COVID-19 information disclosed in forms 10-Q triggers more analyst earnings forecast revisions. COVID-19 disclosure provides important information cues that facilitate revision of analysts’ prior forecasts.
### Table 6 Panel A Above industry median COVID-19 disclosure and post-10-Q daily volatility

|                  | (1) | (2) | (3) | (4) | (5) |
|------------------|-----|-----|-----|-----|-----|
|                  | AVAR $[-1, +1]$ | AVAR $[0, +1]$ | AVAR $[0, +5]$ | AVAR $[+5, +10]$ | AVAR $[+15, +30]$ |
| ABV_MEDI_COVID   | $-0.554^*$ | $-0.547^*$ | $-0.532^*$ | $-0.560^*$ | $-0.622^*$ |
|                  | ($-1.73$) | ($-1.72$) | ($-1.67$) | ($-1.79$) | ($-1.99$) |
| SIZE             | $-0.641^{***}$ | $-0.641^{***}$ | $-0.639^{***}$ | $-0.635^{***}$ | $-0.642^{***}$ |
|                  | ($-17.95$) | ($-18.12$) | ($-18.03$) | ($-17.52$) | ($-17.43$) |
| BTM              | $0.220^{***}$ | $0.221^{***}$ | $0.223^{***}$ | $0.237^{***}$ | $0.265^{***}$ |
|                  | ($2.71$) | ($2.73$) | ($2.75$) | ($2.86$) | ($3.02$) |
| N_ANALYST        | $-0.143^{**}$ | $-0.140^{**}$ | $-0.142^{**}$ | $-0.150^{**}$ | $-0.161^{**}$ |
|                  | ($-2.15$) | ($-2.11$) | ($-2.10$) | ($-2.12$) | ($-2.25$) |
| LEV              | $2.333^{***}$ | $2.327^{***}$ | $2.307^{***}$ | $2.312^{***}$ | $2.369^{***}$ |
|                  | ($10.10$) | ($10.14$) | ($10.06$) | ($9.94$) | ($10.04$) |
| VOL_SALE         | $0.001^{***}$ | $0.001^{***}$ | $0.001^{***}$ | $0.001^{***}$ | $0.001^{***}$ |
|                  | ($7.44$) | ($7.43$) | ($7.39$) | ($7.33$) | ($7.46$) |
| SUR_EPS          | $0.386^{***}$ | $0.386^{***}$ | $0.380^{***}$ | $0.374^{***}$ | $0.419^{***}$ |
|                  | ($3.54$) | ($3.54$) | ($3.48$) | ($3.39$) | ($3.61$) |
| QUICK             | $0.026$ | $0.026$ | $0.025$ | $0.026$ | $0.027$ |
|                  | ($0.91$) | ($0.91$) | ($0.89$) | ($0.91$) | ($0.93$) |
| PCT_CASE         | $0.756^{**}$ | $0.763^{**}$ | $0.757^{**}$ | $0.744^{***}$ | $0.648^*$ |
|                  | ($2.24$) | ($2.28$) | ($2.25$) | ($2.18$) | ($1.90$) |
| HOSPPERPPL       | $-18.961$ | $-19.030$ | $-17.561$ | $-15.884$ | $-15.804$ |
|                  | ($-1.20$) | ($-1.20$) | ($-1.10$) | ($-0.98$) | ($-0.98$) |
| STAFFPERPPL      | $0.024$ | $0.029$ | $0.037$ | $0.045$ | $0.047$ |
|                  | ($0.46$) | ($0.55$) | ($0.71$) | ($0.86$) | ($0.89$) |
| CONSTANT         | $6.227^{***}$ | $6.132^{***}$ | $5.930^{***}$ | $5.752^{***}$ | $5.767^{***}$ |
|                  | ($4.69$) | ($4.58$) | ($4.44$) | ($4.38$) | ($4.45$) |

State fixed effects: Yes
Quarter fixed effects: Yes
Industry fixed effects: Yes
N: 2538
adj. $R^2$: 0.439

### Panel B Below industry median COVID-19 disclosure and post-10-Q daily volatility

|                  | (1) | (2) | (3) | (4) | (5) |
|------------------|-----|-----|-----|-----|-----|
|                  | AVAR $[-1, +1]$ | AVAR $[0, +1]$ | AVAR $[0, +5]$ | AVAR $[+5, +10]$ | AVAR $[+15, +30]$ |
| BLW_MEDI_COVID   | $0.944$ | $0.883$ | $0.925$ | $0.991$ | $0.814$ |
|                  | ($0.85$) | ($0.79$) | ($0.83$) | ($0.88$) | ($0.71$) |
| SIZE             | $-0.624^{***}$ | $-0.620^{***}$ | $-0.624^{***}$ | $-0.631^{***}$ | $-0.648^{***}$ |
|                  | ($-12.02$) | ($-11.93$) | ($-12.03$) | ($-11.99$) | ($-12.20$) |
| BTM              | $0.198^{***}$ | $0.202^{***}$ | $0.206^{***}$ | $0.211^{***}$ | $0.273^{***}$ |
|                  | ($2.79$) | ($2.83$) | ($2.87$) | ($2.89$) | ($3.64$) |
| N_ANALYST        | $-0.307^{***}$ | $-0.316^{***}$ | $-0.313^{***}$ | $-0.314^{***}$ | $-0.281^{**}$ |
|                  | ($-2.65$) | ($-2.72$) | ($-2.69$) | ($-2.66$) | ($-2.35$) |
| LEV              | $1.227^{***}$ | $1.209^{***}$ | $1.223^{***}$ | $1.236^{***}$ | $1.245^{***}$ |
|                  | ($3.93$) | ($3.86$) | ($3.92$) | ($3.91$) | ($3.90$) |
| VOL_SALE         | $0.001^{***}$ | $0.001^{***}$ | $0.001^{***}$ | $0.001^{***}$ | $0.001^{***}$ |
|                  | ($4.60$) | ($4.54$) | ($4.58$) | ($4.61$) | ($4.90$) |
| SUR_EPS          | $0.490^{***}$ | $0.488^{***}$ | $0.496^{***}$ | $0.508^{***}$ | $0.517^{***}$ |
|                  | ($2.95$) | ($2.94$) | ($2.99$) | ($2.98$) | ($2.81$) |
| QUICK             | $-0.005$ | $-0.005$ | $-0.005$ | $-0.007$ | $-0.009$ |
|                  | ($-0.22$) | ($-0.24$) | ($-0.24$) | ($-0.32$) | ($-0.42$) |
| PCT_CASE         | $1.047^{***}$ | $1.001^{***}$ | $0.969^{**}$ | $0.997^{***}$ | $0.969^{**}$ |
|                  | ($2.34$) | ($2.22$) | ($2.16$) | ($2.17$) | ($2.09$) |
| HOSPPERPPL       | $9.019$ | $10.037$ | $10.978$ | $12.543$ | $19.150$ |
|                  | ($0.25$) | ($0.28$) | ($0.31$) | ($0.36$) | ($0.54$) |
| STAFFPERPPL      | $-0.180^*$ | $-0.180^*$ | $-0.181^*$ | $-0.178^*$ | $-0.181^*$ |
|                  | ($-1.75$) | ($-1.75$) | ($-1.77$) | ($-1.74$) | ($-1.77$) |

(Continued)
This finding reaffirms COVID-19 disclosure contains value-relevant information.

Columns 2 and 3 report the results of equation (5). We find that COVID-19 disclosure is only associated with the total number of downward revisions (\textit{DOWNREVI}) (coefficient = 0.131, \( p < 0.01 \)) but is not significantly associated with the total number of upward revisions (\textit{UPREVI}). This confirms the notion that COVID-19 disclosure provides value-relevant information about the negative impact of the pandemic on the firm's value, based on which analysts further revise downward their expectation for the firm's future earnings.

To further our analyses, we investigate how long it takes for analysts to revise their forecasts after 10-Q releases. Columns 4, 5 and 6 present the effect of COVID-19 disclosure on analyst revision during the first one month following the issuance of form 10-Q. Columns 7, 8 and 9 report the effects on analyst revision in the second month after the issuance of form 10-Q. We find that COVID-19 disclosure only influences revisions within the first month after the disclosure and this effect diminishes in the second month.

Overall, the findings in Table 7 confirm that COVID-19 disclosure contains value-relevant information, which is utilised by analysts in updating their forecasts. This provides direct and convincing evidence to support the notion that COVID-19 disclosure provides value-relevant information about the pandemic.

COVID-19 disclosure and analyst forecast dispersion after 10-Q releases

We also examine whether COVID-19 disclosure decreases information risk by reducing analyst forecast dispersion. Table 8 presents the results from the estimation of equation (6). In column 1, in which the dependent variable is \textit{DISPERSION\_M1}, we find \textit{COVID\_19} is negatively associated with \textit{DISPERSION\_M1} (coefficient = \(-0.006, p < 0.1\)), indicating one standard deviation increase in COVID-19 disclosure corresponds with 0.04 standard deviation decrease in analyst forecast dispersion.\(^{12}\) This suggests more COVID-19 disclosure is associated with lower analyst forecast dispersion, which is consistent with the conjecture that the high volume of COVID-19 disclosure can reduce information risks. In columns 2 and 3, where the dependent variables are \textit{DISPERSION\_M2} and \textit{DISPERSION\_M3}, we also find \textit{COVID\_19} is negatively associated with analyst forecast dispersions that are made in the second and third month after 10-Q releases. Similarly, when we use the average analyst forecast dispersion across three months after the 10-Q releases as the dependent

| Table 6 (Continued) |
|----------------------|
| (1) \text{AVAR \([-1, +1]\)} | (2) \text{AVAR \([0, +1]\)} | (3) \text{AVAR \([0, +5]\)} | (4) \text{AVAR \([5, +10]\)} | (5) \text{AVAR \([+15, +30]\)} |
| \text{CONSTANT} | 12.405*** | 12.360*** | 12.400*** | 12.405*** | 12.315*** |
| \(N\) | 1176 | 1176 | 1176 | 1176 | 1176 |
| \text{adj.} \text{R}^2 | 0.465 | 0.462 | 0.467 | 0.466 | 0.467 |
| \text{State fixed effects} | Yes | Yes | Yes | Yes | Yes |
| \text{Quarter fixed effects} | Yes | Yes | Yes | Yes | Yes |
| \text{Industry fixed effects} | Yes | Yes | Yes | Yes | Yes |

Table 6 Panel A reports OLS regression results of the relationship between the above-industry-median COVID-19 disclosure and the average daily abnormal volatility. The independent variables in all columns are \textit{AVAR\_MEDI\_COVID}, defined as the COVID keyword counts of firms that have COVID-19 keywords more than its industry median. The dependent variable in column (1), \textit{AVAR \([-1, +1]\)}, is the average of daily abnormal volatility during the period \([-1, +1]\). The dependent variable in column 2, \textit{AVAR\([0, +1]\)} is the average of daily abnormal volatility during the period \([0, +1]\). In column (3), the dependent variable \textit{AVAR \([0, +5]\)} is the average of daily abnormal volatility during the period \([0, +5]\). In columns (4) and (5), the dependent variable \textit{AVAR \([5, +10]\)} and \textit{AVAR \([+15, +30]\)} are the average of daily abnormal volatility during the period \([5, +10]\) and \([+15, +30]\). The detailed definitions of all variables are in Appendix A. The model specifications include state, industry and quarter fixed effects. The standard errors are clustered at firm and quarter level. Significance level are based on two-tailed tests. *, **, *** denotes significance level at \(p < 0.1\), \(p < 0.05\) and \(p < 0.01\), respectively. All continuous variables are winsorised at 1% and 99% percentiles.

Table 6 Panel B reports OLS regression results of the relationship between the below-industry-median COVID-19 disclosure and the average daily abnormal volatility. The independent variables in all columns are \textit{BLW\_MEDI\_COVID}, defined as the COVID keyword counts of firms that have COVID-19 keywords less than its industry median. The dependent variable in column (1), \textit{AVAR \([-1, +1]\)}, is the average of daily abnormal volatility during the period \([-1, +1]\). The dependent variable in column 2, \textit{AVAR\([0, +1]\)} is the average of daily abnormal volatility during the period \([0, +1]\). In column (3), the dependent variable \textit{AVAR \([0, +5]\)} is the average of daily abnormal volatility during the period \([0, +5]\). In columns (4) and (5), the dependent variable \textit{AVAR \([5, +10]\)} and \textit{AVAR \([+15, +30]\)} are the average of daily abnormal volatility during the period \([5, +10]\) and \([+15, +30]\). The detailed definitions of all variables are in Appendix A. The model specifications include state, industry and quarter fixed effects. The standard errors are clustered at firm and quarter level. Significance level are based on two-tailed tests. *, **, *** denotes significance level at \(p < 0.1\), \(p < 0.05\) and \(p < 0.01\), respectively. All continuous variables are winsorised at 1% and 99% percentiles.
Table 7  10-Q COVID-19 disclosure and analyst forecast revisions

|                | (1)     | (2)     | (3)     | (4)     | (5)     | (6)     | (7)     | (8)     | (9)     |
|----------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
|                | REVI    | DOWN_REVI | UP_REVI | REVI_M1 | DOWN_REVI_M1 | UP_REVI_M1 | REVI_M2 | DOWN_REVI_M2 | UP_REVI_M2 |
| COVID_19       | 0.190*** | 0.131*** | 0.072   | 0.147*** | 0.152*** | −0.003  | −0.003  | −0.001  | 0.010   |
|                | (2.83)  | (2.69)  | (1.43)  | (3.33)  | (4.24)  | (−0.10) | (−0.14) | (−0.08) | (0.75)  |
| SIZE           | 3.555*** | 1.931*** | 1.585*** | 2.185*** | 1.301*** | 0.844*** | 0.499*** | 0.254*** | 0.233*** |
|                | (50.78) | (38.92) | (31.76) | (51.27) | (37.28) | (26.05) | (24.60) | (19.33) | (18.51) |
| LEV            | −1.223** | −0.905*** | −0.316  | −0.485  | −0.386*  | −0.085  | −0.156  | −0.160*  | −0.014  |
|                | (−2.57) | (−2.89) | (−0.90) | (−1.57) | (−1.68) | (−0.35) | (−1.17) | (−1.91) | (−0.15) |
| ROA            | −7.439*** | −4.483*** | −3.086*** | −4.157*** | −2.865*** | −1.200*** | −1.642*** | −0.783*** | −0.833*** |
|                | (−5.53) | (−4.80) | (−3.83) | (−5.75) | (−4.95) | (−2.27) | (−3.88) | (−3.34) | (−3.22) |
| AVAR           | 0.889*** | 1.440*** | −0.648*** | 0.401*** | 0.893*** | −0.500*** | 0.166*** | 0.207*** | −0.070*  |
| [−1,+1]        | (4.05)  | (8.48)  | (−4.34) | (3.00)  | (7.81)  | (−4.84) | (2.40)  | (4.04)  | (−1.82) |
| SUR_EPS        | 0.000   | −0.264  | 0.201   | −0.197  | −0.344*** | 0.155  | 0.177*** | 0.107**  | 0.061   |
|                | (0.00)  | (−1.56) | (1.17)  | (−1.38) | (−3.13) | (1.39)  | (2.41)  | (2.27)  | (1.25)  |
| M&A            | −0.545** | −0.234  | −0.320* | −0.145  | −0.015  | −0.130  | −0.078  | −0.046  | −0.036  |
|                | (−2.25) | (−1.33) | (−1.77) | (−0.93) | (−0.12) | (−1.03) | (−1.07) | (−0.97) | (−0.77) |
| SPEC_ITEM      | 8.805** | 2.965   | 6.403** | 6.878*** | 2.874*  | 4.217*** | −0.763  | −1.197*  | 0.629   |
|                | (2.42)  | (1.23)  | (2.46)  | (3.15)  | (1.77)  | (2.27)  | (−0.61) | (−1.74) | (0.72)  |
| RD             | 0.206*** | 0.029   | 0.175*** | 0.160*** | 0.027   | 0.127*** | 0.037*** | 0.005   | 0.032*** |
|                | (5.97)  | (1.20)  | (5.99)  | (6.37)  | (1.46)  | (5.34)  | (2.85)  | (0.74)  | (3.42)  |
| NUM_GEO        | −0.009  | 0.011   | −0.023  | 0.013   | 0.002   | 0.006   | −0.015*  | −0.000  | −0.016*** |
|                | (−0.30) | (0.52)  | (−0.99) | (0.67)  | (0.10)  | (0.36)  | (−1.92) | (−0.06) | (−3.57) |
| CONSTANT        | −18.872*** | −8.916*** | −9.555*** | −12.308*** | −6.260*** | −5.679*** | −1.667*** | −0.602  | −0.943*** |
|                | (−8.92) | (−6.55) | (−9.94) | (−9.35) | (−6.58) | (−9.47) | (−2.85) | (−1.31) | (−5.06) |

Quarter fixed effects
Industry fixed effects

(Continued)
Table 7 (Continued)

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| REVI | DOWN | REVI | UP | REVI | M1 | DOWN | REVI | M1 | UP | REVI | M2 | DOWN | REVI | M2 | UP |
| N | 5944 | 5944 | 5944 | 5944 | 5944 | 5944 | 5944 | 5944 | 5944 | 5944 | 5944 | 5944 | 5944 | 5944 | 5944 |
| adj. R² | 0.515 | 0.399 | 0.339 | 0.496 | 0.358 | 0.267 | 0.283 | 0.209 | 0.202 |

This table reports the OLS regression results of the relationship between the level of COVID-19 disclosure and the count of analyst revisions after current 10-Q releases and before the next quarter releases. The independent variable in column 1, REVI, is the total number of analyst revisions after 10-Q releases. In column 2, DOWN, is the total number of downward analyst revisions. In column 3, UP, is the total number of upward analyst revisions. In columns 4, 5 and 6, REVI_M1, DOWN_REVI_M1 and UP_REVI_M1 measure the number of total revisions, downward revisions and upward revisions made in the first month after 10-Q releases. In columns 7, 8 and 9, REVI_M2, DOWN_REVI_M2 and UP_REVI_M2 measure the number of total revisions, downward revisions and upward revisions made in the second month after 10-Q releases. All variables are defined in Appendix A. The model specification includes industry and quarter fixed effects. The standard errors are clustered at firm and quarter level. Significance levels are based on two-tailed tests. *, **, *** denotes significance level at p < 0.1, p < 0.05 and p < 0.01, respectively. All continuous variables are winsorised at 1% and 99% percentiles.

We further investigate the relationship between COVID-19 disclosure and the firm’s future financial and operational performance. Table 9 presents the results from the estimation of equation (7). Column 1 reports the relationship between COVID-19 disclosure and future sales (FUT_SALE). We find a significant negative coefficient on COVID_19 (coefficient = −5.584, p < 0.05). This finding suggests that a high-level of current quarter COVID-19 disclosure sends a strong signal of future sales decreases. Column 2 reports the relationship between COVID-19 disclosure and future operating cash flow (FUT_OCF). We also detect a negative and significant coefficient on COVID_19 (coefficient = −14.107, p < 0.05). This finding suggests firms with high volume COVID-19 information are associated with real cash flow risks in near future. Column 3 reports the relationship between COVID-19 disclosure and future operating income (FUT_OP_INCOME). We detect a significant negative coefficient on COVID_19 (coefficient = −15.094, p < 0.01). This finding suggests a high-level COVID disclosure is also associated with lower future operating income. In column 4, we detect a significantly negative association between COVID-19 disclosure and future return on assets. Consistently, all four columns present evidence that high volume COVID-19 disclosure is associated with real operational risks in the next quarter. This supports our conjecture that management uses COVID-19 disclosure to forewarn the market about upcoming operational setbacks caused by the pandemic.

The readability (and sentiment) of COVID disclosure and investor uncertainty

Table 10 present the regression results of equation (8). In Panel A, where dependent variables are ln(AVAR_POST), we detect positive and significant coefficients on HIGH_FOG*COVID-19 in three out of five testing windows. This positive coefficient on the interaction term mitigates the reduction effect of COVID-19 disclosure on investor uncertainty, which supports our prediction that low readable COVID narratives attenuate the negative relationship between COVID disclosure and stock volatility. Similarly, in Panel B, where the dependent variables are AVAR, we also detect significant and positive coefficients on the interaction term in the short variable (i.e., DISPERSION_AVE), we find a consistent negative relationship between COVID_19 and forecast dispersion. These regression results confirm our prediction that COVID-19 disclosure reduces analyst forecast dispersion because high volume COVID-19 disclosure reduces information risks.
Table 8 10-Q COVID-19 disclosure and analyst forecast dispersion

|                | (1) DISPERSION_M1 | (2) DISPERSION_M2 | (3) DISPERSION_M3 | (4) DISPERSION_AVE |
|----------------|-------------------|-------------------|-------------------|-------------------|
| COVID_19       | -0.006*           | -0.008**          | -0.006*           | -0.006*           |
|                | (-1.76)           | (-2.32)           | (-1.82)           | (-1.75)           |
| SIZE           | 0.054             | 0.026             | 0.027             | 0.017             |
|                | (1.51)            | (-1.05)           | (-1.22)           | (0.43)            |
| BTM            | 0.010             | 0.004             | 0.008             | 0.007             |
|                | (1.53)            | (0.77)            | (1.38)            | (1.18)            |
| N_ANALYST      | 0.007             | 0.011             | 0.004             | 0.014             |
|                | (0.38)            | (0.78)            | (0.24)            | (0.77)            |
| SUR_EPS        | 0.000             | 0.006             | -0.012*           | 0.008             |
|                | (0.04)            | (0.40)            | (-1.88)           | (0.50)            |
| RD             | 0.001             | 0.007             | 0.007***          | 0.007*            |
|                | (0.60)            | (1.59)            | (3.11)            | (1.71)            |
| LOSS           | -0.006            | -0.005            | -0.004            | -0.002            |
|                | (-0.86)           | (-0.71)           | (-0.65)           | (-0.21)           |
| PCT_CASE       | -0.272***         | -0.280***         | -0.273***         | -0.337***         |
|                | (-6.13)           | (-6.03)           | (-6.98)           | (-6.73)           |
| PCT_DEATH      | 1.754***          | 2.627***          | 2.911***          | 3.115***          |
|                | (2.62)            | (3.74)            | (4.75)            | (4.15)            |
| CONSTANT       | -0.274            | 0.333*            | 0.334**           | 0.001             |
|                | (-1.01)           | (1.71)            | (1.98)            | (0.00)            |
| Firm fixed effects | Yes              | Yes              | Yes              | Yes              |
| N              | 4994              | 4994              | 4994              | 4664              |
| adj. $R^2$     | 0.660             | 0.668             | 0.606             | 0.692             |

This table reports the OLS regression results of the relationship between the level of COVID-19 disclosure and the analyst forecast dispersion. The independent variable of all columns is COVID_19, defined as the count of COVID keywords in firms’ 10-Qs. The dependent variable in column 1, DISPERSION_M1, is the standard deviation of the next quarter earnings forecast made in the first month after the 10-Q release. The dependent variable in column 2, DISPERSION_M2, is the standard deviation of the next quarter earnings forecast made in the second month after the 10-Q release. In column 3, the dependent variable, DISPERSION_M3, is the standard deviation of the next quarter earnings forecast made in the third month after the 10-Q release. In column 4, dependent variable, DISPERSION_AVE, is the average of the standard deviation of the next quarter earnings forecasts during three months after the 10-Q release. All variables are defined in Appendix A. The model specification includes firm fixed effects. The standard errors are clustered at firm and quarter level. Significance levels are based on two-tailed tests. *, **, *** denotes significance level at $p < 0.1$, $p < 0.05$ and $p < 0.01$, respectively. All continuous variables are winsorised at 1% and 99% percentiles.

run windows. This provides consistent evidence that supports our conjecture.

Table 11 presents the results of equation (9). In both panels, we fail to detect any significant coefficients on NEGA_SENTI*COVID_19. We are cautious in interpreting our results. The insignificant coefficients could mean that the COVID-19 disclosure tone has no moderation effect on the relationship between COVID-19 disclosure and investor uncertainty. Alternatively, it could also be viewed as the periods tested are not long enough to detect the effect. In particular, investors often take a long time to incorporate the disclosure tone (soft information) into pricing decisions (Engelberg 2008).

Conclusion

We study how COVID-19 disclosure in 10-Qs affects uncertainty of market participants. Despite a significant body of literature on the pandemic and market reaction, there is little research on how the pandemic information in public filings affects investor uncertainty about firms’ fundamental value. More generally, there is little research on how increased disclosure affects investor uncertainty. This omission is significant because it is reasonable to expect that an important goal of financial reporting is to reduce investor uncertainty.

We examine the firms’ quarterly filings in the year 2020 because the quarterly filings allow the management to inform the market in a timely and extensive manner about the impact of COVID-19 on the firm’s value. We use the abnormal return volatility to measure uncertainty and calculate the change in volatility between three-days before and three-days after the 10-Q releases, which captures the short-term effect of the disclosure. We then measure the change in volatility between three-days before and 30 days after the 10-Q releases, which captures the long-run effect of disclosure on investor uncertainty. We find that COVID disclosure in 10-Qs is associated with a significant reduction in short-run market volatility. This suggests that the COVID disclosure in quarterly filings conveys new value-relevant information to the market that resolves investor uncertainty. Also, we find these effects...
become less pronounced at longer durations, which suggests the resolution effect of quarterly COVID disclosure is mainly temporary. This is perhaps because COVID disclosure in 10-Qs does not contain information that reveals permanent changes to the firm’s underlying value.

We then study how the industry wide COVID disclosure affects investor uncertainty. We find a significant and positive association between industry COVID-19 disclosure dispersion and abnormal return volatilities around 10-Q release windows. This suggests that COVID-19 disclosure variation within the same industry reduces information comparability across firms, resulting in fewer opportunities for investors to utilise COVID-19 information to decode future profitability. In addition, we find firms with above industry median COVID-disclosure levels are associated with a significant reduction in investor uncertainty, whereas firms with below industry median disclosure levels are associated with a non-significant reduction. These findings further support that the volume of COVID-19 information matters to the market.

We further investigate how COVID disclosure affects the behaviour of analysts, who are considered sophisticated market participants. We find a significant positive association between COVID-19 disclosure level and analyst revisions, specifically downward revisions, in post 10-Q periods. This suggests quarterly filing’s COVID-19 discussion contains value-relevant information that analysts use to update their earnings forecast. We further find that COVID-19 disclosure is negatively associated with analyst dispersion in future earnings forecasts. This finding further supports our conjecture that COVID-19 disclosure can reduce investor uncertainty.

In addition, we study the relationship between COVID-19 disclosure and firms’ future financial and operating performance. We expect that the level of COVID-19 disclosure is associated with the severity of COVID disruption in the near future. We thus find a significant negative association between COVID-19 disclosure and future earnings and operating performance.

**Table 9 COVID-19 disclosure and future financial and operational results**

|                  | (1)       | (2)       | (3)       | (4)       |
|------------------|-----------|-----------|-----------|-----------|
|                  | FUT_SALE  | FUT_OCF   | FUT_OPER_INCOME | FUT_ROA   |
| COVID_19         | −5.585**  | −14.107** | −15.094***  | −6.918*   |
|                  | (−2.56)   | (−2.12)   | (−3.90)    | (−1.67)   |
| SIZE             | −8.655*** | 18.316**  | −1.737     | −18.553***|
|                  | (−4.48)   | (2.18)    | (−0.32)    | (−3.30)   |
| BTM              | −10.669***| −12.844** | −9.505*    | −14.587** |
|                  | (−4.99)   | (−2.07)   | (−1.88)    | (−2.37)   |
| LEV              | −17.276   | −34.137   | 41.844*    | 13.627    |
|                  | (−0.99)   | (−0.74)   | (1.65)     | (0.46)    |
| VOL_OCF          | −0.014*** | 1.345***  | 0.559***   | 0.343***  |
|                  | (−3.57)   | (22.41)   | (12.11)    | (9.03)    |
| FINANCE          | −55.086***| −48.580   | −25.045    | −31.521   |
|                  | (−2.73)   | (−1.00)   | (−0.61)    | (−0.90)   |
| QUICK            | −5.723*** | 0.049     | −0.484     | 0.107     |
|                  | (−7.62)   | (0.05)    | (−0.81)    | (0.13)    |
| SPEC_ITEM        | 196.050***| 506.324*  | 286.559*   | 387.334*  |
|                  | (2.74)    | (1.90)    | (1.90)     | (1.92)    |
| RD               | −5.377*** | −3.150**  | −3.166***  | −2.400*** |
|                  | (−3.36)   | (−2.26)   | (−4.43)    | (−2.91)   |
| NUM_GEO          | 0.794     | 0.443     | −1.963     | −2.027    |
|                  | (0.86)    | (0.17)    | (−1.09)    | (−1.31)   |
| PRIOR_CAR        | 31.727    | 41.160    | 32.633     | 52.177    |
|                  | (0.72)    | (0.46)    | (0.59)     | (−0.79)   |
| CONSTANT         | 268.706***| −149.049  | 74.562     | 188.235***|
|                  | (5.39)    | (−1.47)   | (1.05)     | (2.94)    |
| Quarter fixed effects | Yes   | Yes   | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes |
| N                | 2337      | 2335      | 2334       | 2336      |
| adj. $R^2$       | 0.380     | 0.804     | 0.674      | 0.403     |

This table reports the OLS regression results of the relationship between the level of COVID-19 disclosure and the future financial and operational performance. The independent variable of all columns is COVID_19, defined as the count of COVID keywords in firms 10-Qs. The dependent variable in column 1, FUT_SALE, is the next quarter sales scaled by total assets. The dependent variable in column 2, FUT_OCF, is the next quarter operating cash flow scaled by total asset. In column 3, the dependent variable, FUT_OPER_INCOME, is the next quarter operating income scaled by total asset. In column 4, dependent variables FUT_ROA is the next quarter net income scaled by total asset. All variables are defined in Appendix A. The model specification includes industry and quarter fixed effects. The standard errors are clustered at firm and quarter level. Significance levels are based on two-tailed tests. *, **, *** denotes significance level at $p < 0.1$, $p < 0.05$ and $p < 0.01$, respectively. All continuous variables are winsorised at 1% and 99% percentiles.
Table 10 Panel A Fog index modifies the effect of COVID-19 disclosure on the change of daily stock volatility

|                | (1) | (2) | (3) | (4) |
|----------------|-----|-----|-----|-----|
| COVID_19       | −0.055** | −0.035* | −0.033* | −0.017 |
|                | (−2.36) | (−1.65) | (−1.72) | (−0.92) |
| HIGH_FOG       | −0.105 | −0.082 | −0.088 | 0.014 |
|                | (−1.61) | (−1.39) | (−1.62) | (0.26) |
| HIGH_FOG*COVID_19 | 0.061** | 0.062** | 0.052** | 0.016 |
|                | (2.10) | (2.39) | (2.19) | (0.70) |
| CONTROLS       | Yes | Yes | Yes | Yes |
| State fixed effects | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes |
| Quarter fixed effects | Yes | Yes | Yes | Yes |
| N              | 3688 | 3688 | 3688 | 3688 |
| adj. $R^2$     | 0.010 | 0.014 | 0.029 | 0.091 |

Panel B Fog index modifies the effect of COVID-19 disclosure on the daily stock volatility

|                | (1) | (2) | (3) | (4) |
|----------------|-----|-----|-----|-----|
| COVID_19       | −0.050*** | −0.044*** | −0.029*** | −0.030*** |
|                | (−5.21) | (−6.09) | (−3.83) | (−4.39) |
| HIGH_FOG       | −0.047 | −0.035 | 0.009 | −0.007 |
|                | (−1.42) | (−1.41) | (0.32) | (−0.26) |
| HIGH_FOG*COVID_19 | 0.022* | 0.017* | 0.001 | 0.002 |
|                | (1.67) | (1.72) | (0.08) | (0.26) |
| CONTROLS       | Yes | Yes | Yes | Yes |
| State fixed effects | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes |
| Quarter fixed effects | Yes | Yes | Yes | Yes |
| N              | 3688 | 3688 | 3688 | 3686 |
| adj. $R^2$     | 0.167 | 0.258 | 0.266 | 0.176 |

This table reports regression results that test whether the readability of COVID disclosure attenuates the negative relationship between COVID-19 disclosure and investor uncertainty. In Panel A, the study of interest is the interaction term HIGH_FOG*COVID_19. We expect positive coefficients on the interaction terms. The dependent variables are the change of daily volatility between post and before 10-Q releases, $\ln\left(\frac{AV\ AR_{post}}{AV\ AR_{pre}}\right)$. Similarly, in Panel B, the study of interest is the interaction term HIGH_FOG*COVID_19. We also expect positive coefficients on the interaction terms. The dependent variables are the average of daily volatility of different 10-Q release windows. All variables are defined in Appendix A. The model specifications include state, industry and quarter fixed effects. The standard errors are clustered at firm and quarter level. Significance level are based on two-tailed tests. *, **, *** denotes significance level at $p < 0.1$, $p < 0.05$ and $p < 0.01$, respectively. All continuous variables are winsorised at 1% and 99% percentiles.

disclosure and multiple measures of future financial and operating performance. This suggests that management uses COVID-disclosure in 10-Q filings to forewarn investors about upcoming operational setbacks caused by the pandemic.

Lastly, we investigate whether the readability and sentiment of COVID-19 disclosure can modify the mitigating effect of COVID-19 disclosure on investor uncertainty. Consistent with the theoretical prediction, we find that low readable COVID-19 discussion attenuates the mitigating effects of COVID-19 disclosure on investor uncertainty. However, we do not detect any significant modification effect of disclosure sentiment on the mitigating effects.

Collectively, our evidence is largely consistent with theoretical prediction in that we observe that public disclosure of pandemic information reduces investor uncertainty in the short run when the public is highly anxious about the unknown. Thus, our paper provides consistent and robust evidence that confirms the value of public financial disclosure and re-emphasises that timely public disclosure is critical and valuable to all market participants, both naïve and sophisticated. It also highlights the importance of a firm’s commitment to disclosure transparency and credibility.

Further, the finding of industry-wide COVID-19 disclosure dispersion informs us that COVID-19 disclosure practice is less than desirable. We observe high COVID-19 disclosure dispersion within the same industry reduces the resolution effect of COVID information on investor uncertainty. This means, driven by various reporting motivations, firms may not often practise financial reporting in line with investors’ best interests. As for regulators, COVID-19 disclosure practices suggest that a voluntary reporting guideline in a pandemic cannot provide the desired quality
Table 11 Panel A COVID narrative sentiment modifies the effect of COVID-19 disclosure on the change of daily stock volatility

|                 | (1) $\ln(\frac{AVAR_{post3}}{AVAR_{pre3}})$ | (2) $\ln(\frac{AVAR_{post5}}{AVAR_{pre3}})$ | (3) $\ln(\frac{AVAR_{post10}}{AVAR_{pre3}})$ | (4) $\ln(\frac{AVAR_{post30}}{AVAR_{pre3}})$ |
|-----------------|-------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|
| COVID_19        | $-0.040^{**}$                            | $-0.030^*$                                 | $-0.026^*$                                 | $0.000$                                    |
|                 | $(-2.34)$                                 | $(-1.94)$                                  | $(-1.88)$                                  | $(0.01)$                                   |
| Nega_Senti      | 0.079                                     | 0.057                                      | 0.063                                      | 0.082                                      |
|                 | $(1.04)$                                   | $(0.85)$                                   | $(1.05)$                                   | $(1.30)$                                   |
|                 | $-0.011$                                   | $-0.013$                                   | $-0.014$                                   | $-0.031$                                   |
| Nega_Senti*COVID_19 | $(-0.33)$                               | $(-0.45)$                                  | $(-0.53)$                                  | $(-1.18)$                                  |
| CONTROLS        | Yes                                       | Yes                                        | Yes                                        | Yes                                        |
| State fixed effects | Yes                                      | Yes                                        | Yes                                        | Yes                                        |
| Quarter fixed effects | Yes                                     | Yes                                        | Yes                                        | Yes                                        |
| Industry fixed effects | Yes                                     | Yes                                        | Yes                                        | Yes                                        |
| $N$             | 3688                                      | 3688                                       | 3688                                       | 3688                                       |
| adj. $R^2$      | 0.024                                     | 0.026                                      | 0.040                                      | 0.019                                      |

Panel B COVID narrative sentiment modifies the effect of COVID-19 disclosure on the daily stock volatility

|                 | (1) $\ln(\frac{AVAR_{[0,+1]}}{AVAR_{pre3}})$ | (2) $\ln(\frac{AVAR_{[0,+5]}}{AVAR_{pre3}})$ | (3) $\ln(\frac{AVAR_{[+5,+10]}}{AVAR_{pre3}})$ | (4) $\ln(\frac{AVAR_{[+15,+30]}}{AVAR_{pre3}})$ |
|-----------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|
| COVID_19        | $-0.046^{***}$                             | $-0.041^{***}$                             | $-0.031^{***}$                             | $-0.059^{***}$                             |
|                 | $(-4.72)$                                  | $(-5.87)$                                  | $(-4.44)$                                  | $(-4.25)$                                  |
| Nega_Senti      | 0.057                                      | $0.060^{**}$                               | $0.077^{**}$                               | 0.089                                      |
|                 | $(1.42)$                                   | $(1.98)$                                   | $(2.31)$                                   | $(1.49)$                                   |
|                 | $-0.012$                                   | $-0.015$                                   | $-0.019$                                   | $-0.027$                                   |
| Nega_Senti*COVID_19 | $(-0.77)$                                | $(-1.27)$                                  | $(-1.57)$                                  | $(-1.26)$                                  |
| CONTROLS        | Yes                                        | Yes                                        | Yes                                        | Yes                                        |
| State fixed effects | Yes                                      | Yes                                        | Yes                                        | Yes                                        |
| Quarter fixed effects | Yes                                     | Yes                                        | Yes                                        | Yes                                        |
| $N$             | 3688                                       | 3688                                       | 3688                                       | 3688                                       |
| adj. $R^2$      | 0.204                                      | 0.320                                      | 0.347                                      | 0.245                                      |

This table reports regression results that test whether the negative sentiment of COVID disclosure attenuates the negative relationship between COVID-19 disclosure and investor uncertainty. In Panel A, the study of interest is the interaction term $\text{Nega}_\text{Senti} \times \text{COVID}_\text{19}$. We expect positive coefficients on the interaction terms. The dependent variables are the change of daily volatility between post and before 10-Q releases, $\ln(\frac{AVAR_{post3}}{AVAR_{pre3}})$. Similarly, in Panel B, the study of interest is the interaction term $\text{Nega}_\text{Senti} \times \text{COVID}_\text{19}$. We also expect positive coefficients on the interaction terms. The dependent variables are the average of daily volatility of different 10-Q release windows. All variables are defined in Appendix A. The model specifications include state, industry and quarter fixed effects. The standard errors are clustered at firm and quarter level. Significance level are based on two-tailed tests. *, **, *** denotes significance level at $p < 0.1$, $p < 0.05$ and $p < 0.01$, respectively. All continuous variables are winsorised at 1% and 99% percentiles.

and quantity of information to investors. To protect investors, the SEC may need to develop comprehensive and mandatory emergency reporting guidelines to assist market participants before the next ‘black swan’ event. Additionally, our findings also urge regulators in other markets to take necessary actions to encourage firms to disclose COVID-19 related information. As economies become more interconnected, it is common for investors to use information from the global markets in forming their pricing decisions (DeFond et al. 2011; Neel 2017). More COVID-19 disclosure from international firms would further mitigate the tremendous uncertainty caused by the pandemic, in turn, assisting investors to make better trading decisions locally and internationally.

Notes
1 We use the following words and phrases as keywords: ‘PANDEMIC’, ‘CORONA VIRUS’, ‘CONTAGIOUS’, ‘INFECTION’, ‘VIRUS’, ‘OUTBREAK’, ‘COVID-19’, ‘COVID’, ‘CHINA VIRUS’ and ‘PNEUMONIA’.

2 To calculate the number of negative words and positive words, we utilise the Quanteda R package. Benoit et al. (2018) and Arratia et al. (2021) suggest that the Quanteda R package is one of the most efficient software packages to process sentiment in...
financial texts. This approach is also commonly used in the economics and finance literature (e.g., Dybowski and Kempa 2020, Rybinski 2020, Ferrara et al. 2021, etc.). The Quanteda R package identifies the sentiment by using the Lexicoder Sentiment Dictionary (Young and Soroka 2012). Lexicoder Sentiment Dictionary is a bag-of-word dictionary designed for automatic sentiment coding that is widely used in news coverage, legislative debates and public policy. The reason we do not use the Loughran-McDonald Financial dictionary (Loughran and McDonald, 2011) is that the nature of COVID-19 disclosure is more aligned with news coverage rather than traditional financial disclosure. Using the function – quanteda.sentiment in the Quanteda R package, we can process the 10-Q texts discussing COVID-19 information and count the number of negative and positive words.

3 The definitions of variables are provided in Appendix A.
4 The COVID-19 keywords are: ‘PANDEMIC’, ‘CORONA VIRUS’, ‘CONTAGIOUS’, ‘INFECTIOUS’, ‘VIRUS’, ‘OUTBREAK’, ‘COVID-19’, ‘COVID’, ‘CHINA VIRUS’ and ‘PNEUMONIA’.
5 Figure 1 depicts the number of words used to discuss COVID-19 information rather than the count of COVID-19 keywords.
6 We collect the COVID-19 confirmed cases from USA Facts.
7 *(number of hospital/population). The mean of HOSPPPERPL is 0.0387, suggesting there is 0.04 hospital per 1000 residents. It also can be interpreted as one hospital serves about 25,000 US residents.
8 We gather the number of hospitals and hospital staff in each state from the US Bureau of Labor Statistics.
9 This is calculated as (0.045*1.3626)/0.2033 = 0.0558 where 0.045 is the coefficient on COVID-19, 1.3626 is the standard deviation of COVID-19 and 0.2033 is the coefficient on COVID-19.
10 This is calculated as (0.190*1.3626)/9.7592 = 0.0265 where 0.190 is the coefficient on COVID-19, 1.3626 is the standard deviation of COVID-19 and 9.7592 is the standard deviation of REVOL.
11 This is calculated as (0.006*1.3626)/0.2033 = 0.0402, where 0.006 is the coefficient on COVID-19, 1.3626 is the standard deviation of COVID-19 and 0.2033 is the standard deviation of DISPERSSION_M1.
12 This is calculated as (0.006*1.3626)/0.2033 = 0.0402, where 0.006 is the coefficient on COVID-19, 1.3626 is the standard deviation of COVID-19 and 0.2033 is the standard deviation of DISPERSSION_M1.

Data Availability Statement

Data are available from the public sources cited in the paper.

References

Al-Awadhi, A.M., Alsaifi, K., Al-Awadhi, A. and Alhammadi, S. 2020, ‘Death and Contagious Infectious Diseases: Impact of the COVID-19 Virus on Stock Market Returns’, Journal of Behavioral and Experimental Finance, 27: 100326.

Ajinjya, B.B., Atiase, R.K. and Gift, M.J. 1991, ‘Volume of Trading and the Dispersion in Financial Analysts’ Earnings Forecasts’, The Accounting Review, 389–401.

Akhtaruzzaman, M., Boubaker, S. and Sensoy, A. 2021, ‘Financial Contagion During COVID–19 Crisis’, Finance Research Letters, 38: 101604.

Albuiescu, C.T. 2021, ‘COVID-19 and the United States Financial Markets’ Volatility’, Finance Research Letters, 38: 101699.

Ali, A., Liu, M., Xu, D. and Yao, T. 2019, ‘Corporate Disclosure, Analyst Forecast Dispersion, and Stock Returns’, Journal of Accounting, Auditing & Finance, 34 (1): 54–73.

Allee, K.D., Do, C. and Sterin, M. 2021, ‘Product Market Competition, Disclosure Framing, and Casting in Earnings Conference Calls’, Journal of Accounting and Economics, 101405.

Arratia, A., Avalos, G., Cabaña, A., Duarte-López, A. and Renedo-Mirambell, M. 2021, ‘Sentiment Analysis of Financial news: Mechanics and Statistics’, in Data Science for Economics and Finance (pp. 195–216). Springer, Cham.

Banerjee, S. 2011, ‘Learning From Prices and the Dispersion in Beliefs’, The Review of Financial Studies, 24 (9): 3025–68.

Barron, O.E. and Stuerke, P.S. 1998, ‘Dispersion in Analysts’ Earnings Forecasts as a Measure of Uncertainty’, Journal of Accounting, Auditing & Finance, 13 (3): 245–70.

Beaver, W.H. 1968, ‘The Information Content of Annual Earnings Announcements’, Journal of Accounting Research, 67–92.

Benoit, K., Watanahe, K., Wang, H., Nulty, P., Obeng, A., Muller, S. and Matsuo, A. 2018, ‘Quanteda: An R Package for The Quantitative Analysis of Textual Data’, Journal of Open Source Software, 3 (30): 774.

Bloomfield, R.J. 2002, The Incomplete Revelation Hypothesis and Financial Reporting, Available at SSRN 312671

Bradbury, M.E. and Schröder, L.B. 2012, ‘The Content of Accounting Standards: Principles Versus Rules’, The British Accounting Review, 44 (1): 1–10.

Cao, S.S., Ma, G., Tucker, J.W. and Wan, C. 2018, ‘Technological Peer Pressure and Product Disclosure’, The Accounting Review, 93 (6): 95–126.

Chalmers, K., Clinch, G., Godfrey, J.M. and Wei, Z. 2012, ‘Intangible Assets, IFRS and Analysts’ Earnings Forecasts’, Accounting & Finance, 52 (3): 691–721.

Dybowski, T.P. and Kempa, B. 2020, ‘The European Central Bank’s Monetary Pillar After the Financial Crisis’, Journal of Banking & Finance, 121: 105965.

Chen, J.V. and Li, F. 2013, Estimating the Amount of Estimation in Accruals. Working paper.

Davis, A.K., Ge, W., Matsumoto, D. and Zhang, J.L. 2015, ‘The Effect of Manager–Specific Optimism on the Tone of Earnings Conference Calls’, Review of Accounting Studies, 20 (2): 639–73.

DeFond, M., Hu, X., Hung, M. and Li, S. 2011, ‘The Impact of Mandatory IFRS Adoption on Foreign Mutual Fund Ownership: The Role of Comparability’, Journal of Accounting and Economics, 51 (3): 240–58.
Evidence from 10-Q Filings

De Amicis, C., Falconieri, S. and Tastan, M. 2020, ‘Sentiment Analysis and Gender Differences in Earnings Conference Calls’, Journal of Corporate Finance, 101809.

Druz, M., Petzov, I., Wagner, A.F. and Zeckhauser, R.J. 2020, ‘When Managers Change Their Tone, Analysts and Investors Change Their Tune’, Financial Analysts Journal, 76 (2): 47–69.

Engelberg, J. 2008, ‘Costly Information Processing: Evidence From Earnings Announcements’, In AFA 2009 San Francisco Meetings Paper.

Ferrara, F.M., Masciandaro, D., Moschella, M. and Romelli, D. 2021, ‘Political Voice on Monetary Policy: Evidence from the Parliamentary Hearings of the European Central Bank (No. 21159)’, BAFFI CAREFIN, Centre for Applied Research on International Markets Banking Finance and Regulation, Università Bocconi, Milano, Italy.

Gul, E.A., Hutchinson, M. and Lai, K.M. 2013, ‘Gender-Diverse Boards and Properties of Analyst Earnings Forecasts’, Accounting Horizons, 27 (3): 511–38.

Hao, Y. and Dong, B. 2022, ‘Determinants and Consequences of Risk Disclosure: Evidence from Chinese Stock Markets during the COVID-19 Pandemic’, Emerging Markets Finance and Trade, 58 (1): 35–55.

Haroon, O. and Rizvi, S.A.R. 2020, ‘COVID-19: Media Coverage and Financial Markets Behavior—A Sectoral Inquiry’, Journal of Behavioral and Experimental Finance, 31 (1-3): 405–40.

Harp, N.L. and Barnes, B.G. 2018, ‘Internal Control Weaknesses and Acquisition Performance’, The Accounting Review, 93 (1): 235–58.

Hauser, R. 2018, ‘Busy Directors and Firm Performance: Evidence From Mergers’, Journal of Financial Economics, 128 (1): 16–37.

Healy, P.M. and Palepu, K.G. 2001, ‘Information Asymmetry, Corporate Disclosure, and the Capital Markets: A Review of the Empirical Disclosure Literature’, Journal of Accounting and Economics, 31 (1-3): 405–40.

Huang, K., Li, M. and Markov, S. 2020, ‘What Do Employees Know? Evidence From a Social Media Platform’ The Accounting Review, 95(2): 199–226.

Hwang, L.S., Jan, C.L. and Basu, S. 1996, ‘Loss Firms and Analysts’ Earnings Forecast Errors’ The Journal of Financial Statement Analysis, 1 (2).18–30.

Kaplaniski, G. and Levy, H. 2010, ‘Exploitable Predictable Irrationality: The FIFA World Cup Effect on the US Stock Market’ Journal of Financial and Quantitative Analysis, 45 (2): 535–53.

Landsman, W.R. and Maydew, E.L. 2002, ‘Has the Information Content of Quarterly Earnings Announcements Declined In The Past Three Decades?’ Journal of Accounting Research, 40 (3): 797–808.

Lang, M.H. and Lundholm, R.J. 1996, ‘Corporate Disclosure Policy and Analyst Behavior’, The Accounting Review, 467–92.

Larcker, D.E., Lynch, B., Tayan, B. and Taylor, D.J. 2020, The Spread of Covid-19 Disclosure. Rock Center for Corporate Governance at Stanford University Closer Look Series: Topics, Issues and Controversies in Corporate Governance No. CGRP-84.

Lee, Y.J. 2012, ‘The Effect of Quarterly Report Readability on Information Efficiency of Stock Prices’, Contemporary Accounting Research, 29 (4): 1137–70.

Lee, L.F., Hutton, A.P. and Shu, S. 2015, ‘The Role of Social Media in the Capital Market: Evidence From Consumer Product Recalls’ Journal of Accounting Research, 53 (2): 367–404.

Leung, S. and Srinidhi, B. 2006, ‘The Effect of the Private Securities Litigation Reform Act on Analyst Forecast Properties: The Impact of Firm Size and Growth Opportunities’, Journal of Business Finance & Accounting, 33 (3-4): 767–92.

Li, F., Lundholm, R. and Minnis, M. 2013, ‘A Measure of Competition Based on 10-K Filings’, Journal of Accounting Research, 51 (2): 399–436.

Lobo, G.J. and Tung, S.S. 2000, ‘Financial Analysts’ Earnings Forecast Dispersion and Intraday Stock Price Variability Around Quarterly Earnings Announcements’, Review of Quantitative Finance and Accounting, 15 (2): 137–51.

Loughran, T. and McDonald, B. 2011, ‘When is a Liability Not a Liability? Textual Analysis, Dictionaries, and 10-Ks’, The Journal of Finance, 66 (1): 35–65.

Loughran, T. and McDonald, B. 2016, ‘Textual Analysis in Accounting and Finance: A Survey’, Journal of Accounting Research, 54 (4): 1187–230.

Loughran, T. and McDonald, B. 2020, Management Disclosure of Risk Factors and COVID—19. Available at SSRN 3575157.

Matolcsy, Z. and Wyatt, A. 2006, ‘Capitalized Intangibles and Financial Analysts’ Accounting & Finance, 46 (3): 457–79.

Mazur, M., Dang, M. and Vega, M. 2020, ‘COVID-19 and the March 2020 Stock Market Crash. Evidence from S&P1500’ Finance Research Letters, 101690.

Neel, M. 2017, ‘Accounting Comparability and Economic Outcomes of Mandatory IFRS Adoption’, Contemporary Accounting Research, 34 (1): 658–90.

Newell, A. and Simon, H.A. 1972, Human Problem Solving (Vol. 104, No. 9). Prentice-Hall, Englewood Cliffs, NJ.

Rogers, I.L., Skinner, D.J. and Van Buskirk, A. 2009, ‘Earnings Guidance and Market Uncertainty’, Journal of Accounting and Economics, 48 (1): 90–109.

Rybinski, K. 2020, ‘Should Asset Managers Pay for Economic Research? A Machine Learning Evaluation’, The Journal of Finance and Data Science, 6: 31–48.

Schipper, K. 1991, ‘Analysts’ Forecasts’, Accounting Horizons, 5 (4): 105.

Shaley, R. 2009, ‘The Information Content of Business Combination Disclosure Level’, The Accounting Review, 84 (1): 239–70.

Su, Z., Fang, T. and Yin, L. 2017, ‘The Role of News-Based Implied Volatility Among US Financial Markets’, Economics Letters, 157: 24–27.
Evidence from 10-Q Filings

J. Hao and V.T. Pham

Tetlock, P.C. 2007, ‘Giving Content to Investor Sentiment: The Role of Media in the Stock Market’, The Journal of Finance, 62 (3): 1139–68.

Tetlock, P.C., Saar-Tsechansky, M. and Mackassy, S. 2008, ‘More Than Words: Quantifying Language to Measure Firms’ Fundamentals’, The Journal of Finance, 63 (3): 1437–67.

Tversky, A. and Kahneman, D. 1989, ‘Rational Choice and the Framing of Decisions’, in Multiple Criteria Decision Making and Risk Analysis Using Microcomputers (pp. 81–126). Springer, Berlin, Heidelberg.

Veronesi, P. 1999, ‘Stock Market Overreactions to Bad News In Good Times: A Rational Expectations Equilibrium Model’, The Review of Financial Studies, 12 (5): 975–1007.

Verrecchia, R.E. 1983, ‘Discretionary Disclosure’, Journal of Accounting and Economics, 5: 179–94.

Vorst, P. 2016, ‘Real Earnings Management and Long-Term Operating Performance: The Role of Reversals in Discretionary Investment Cuts’, The Accounting Review, 91 (4): 1219–56.

Yezege, A. 2015, ‘Why Do Analysts Revise Their Stock Recommendations After Earnings Announcements?’, Journal of Accounting and Economics, 59 (2–3): 163–81.

Young, L. and Soroka, S. 2012, ‘Affective News: The Automated Coding of Sentiment in Political Texts’, Political Communication, 29 (2): 205–31.

Zaremba, A., Kizys, R., Aharon, D.Y. and Demir, E. 2020, ‘Infected Markets: Novel Coronavirus, Government Interventions, and Stock Return Volatility Around the Globe’, Finance Research Letters, 35: 101597.

Zhang, D., Hu, M. and Ji, Q. 2020, ‘Financial Markets Under The Global Pandemic of COVID-19’, Finance Research Letters, 101528.

Zhang, X.F. 2006, ‘Information Uncertainty and Analyst Forecast Behavior’, Contemporary Accounting Research, 23 (2): 565–90.

| Variable name | Definition | Time | Obs. Level |
|---------------|------------|------|------------|
| Test variables: | | | |
| COVID_19 | =the word count of COVID-19 keywords scaled by the total word count in Form 10-Q, multiplying 1000. The Covid-19 related keywords are ‘COVID’, ‘Coronavirus’, ‘Coved’, ‘Corona virus’, ‘lockdown’, ‘pandemic’, ‘pneumonia’ and ‘outbreak’ | Jan–Dec 2020 | firm-quarter |
| IND_COVID_19 | =the standard deviation of the count of COVID-19 keywords scaled by the total word count in 10-Q filings of all firms in the same industry that is identified by the same SIC code | Jan–Dec 2020 | firm-quarter |
| ABV_MEDI_COVID | =the word count of COVID-19 keywords scaled by the total number of words in 10-Q if COVID_DISTANCE is positive. COVID_DISTANCE is defined in the control variable section | Jan–Dec 2020 | firm-quarter |
| BLW_MEDI_COVID | =the word count of COVID-19 keywords scaled by the total number of words in 10-Q if COVID_DISTANCE is positive. COVID_DISTANCE is defined in the control variable section | Jan–Dec 2020 | firm-quarter |
| HIGH_FOG | =1 if the fog index of the firm’s COVID-19 discussion in above its industry means, 0 otherwise | Jan–Dec 2020 | firm-quarter |
| NEGA_SENTI | =1 if the net tone of the firm’s COVID-19 discussion is negative, 0 otherwise. The net tone is calculated using the number of positive words minus the number of negative words, scaled by the total of number of COVID keywords | Jan–Dec 2020 | firm-quarter |

Dependent variables:

\( \ln(\frac{AVAR_{post3}}{AVAR_{pre3}}) \) =the natural log of the division between AVAR of three days after 10-Q release and AVAR of three days before 10-Q release | Jan–Dec 2020 | firm-quarter |

\( \ln(\frac{AVAR_{post5}}{AVAR_{pre3}}) \) =the natural log of the division between AVAR of five days after 10-Q release and AVAR of three days before 10-Q release | Jan–Dec 2020 | firm-quarter |

\( \ln(\frac{AVAR_{post10}}{AVAR_{pre3}}) \) =the natural log of the division between AVAR of ten days after 10-Q release and AVAR of three days before 10-Q release | Jan–Dec 2020 | firm-quarter |

\( \ln(\frac{AVAR_{post30}}{AVAR_{pre3}}) \) =the natural log of the division between AVAR of 30 days after 10-Q release and AVAR of three days before 10-Q release | Jan–Dec 2020 | firm-quarter |
### Test variables:

| Variable name | Definition | Time | Obs. Level |
|---------------|------------|------|------------|
| AVAR[−1, +1]  | the average of the abnormal return volatility over three-day event window centering the 10-Q release date. We follow Landsman and Maydew (2002) by using following formula: $\text{AVAR}_{i,t} = \mu_i |\sigma^2|$. $\mu_i = R_{it} - (\alpha_i + \beta_i R_{m,t})$. $R_{it}$ is the raw return of firm $i$ for the day $t$, and $R_{m,t}$ is the equal weighted return of market for day $t$. $\alpha_i$ and $\beta_i$ are firm $i$’s market model parameter estimates and $\sigma^2$ is the variance of firm $i$’s market model adjusted return, each of which is calculated during period $t = -250$ to $t = -10$ days | Jan–May 2020 | firm-quarter |
| AVAR[0, +1]  | the average of the abnormal return volatility between the 10-Q release day and one day after. The calculation of AVAR is the same as that of AVAR[−1, +1]. | Jan–Dec 2020 | firm-quarter |
| AVAR[0, +5]  | the average of the abnormal return volatility between the 10-Q release day and the five days after. The calculation of AVAR is the same as that of AVAR[−1, +1]. | Jan–Dec 2020 | firm-quarter |
| AVAR[0, +5]  | the average of the abnormal return volatility between the 10-Q release day and five days after. The calculation of AVAR is the same as that of AVAR[−1, +1]. | Jan–Dec 2020 | firm-quarter |
| AVAR[5, +10] | the average of the abnormal return volatility between five days after the 10-Q release day and ten days after. The calculation of AVAR is the same as that of AVAR [−1, +1]. | Jan–Dec 2020 | firm-quarter |
| AVAR[15, +30] | the average of the abnormal return volatility between the 15 days after 10-Q releases and 30 days after. The calculation of AVAR is the same as that of AVAR [−1, +1]. | Jan–Dec 2020 | firm-quarter |
| REVI | total number of analyst revisions of next quarter earnings forecast made after the current 10-Q release and before the next quarter 10-Q release. | Jan–Dec 2020 | firm-quarter |
| DOWN_REVI | total number of downward revisions of next quarter earnings forecast made after the current 10-Q release and before the next quarter 10-Q release. | Jan–Dec 2020 | firm-quarter |
| UP_REVI | total number of upward revisions of next quarter earnings forecast made after the current 10-Q release and before the next quarter 10-Q release. | Jan–Dec 2020 | firm-quarter |
| REVI_M1 | the number of revisions of the next quarter earnings forecast made in the first month after current 10-Q release date. | Jan–Dec 2020 | firm-quarter |
| DOWN_REVI_M1 | the number of downward revisions of the next quarter earnings forecast made in the first month after current 10-Q release date. | Jan–Dec 2020 | firm-quarter |
| UP_REVI_M1 | the number of upward revisions of the next quarter earnings forecast made in the first month after current 10-Q release date. | Jan–Dec 2020 | firm-quarter |
| REVI_M2 | the number of revisions of the next quarter earnings forecast made in the second month after current 10-Q release date. | Jan–Dec 2020 | firm-quarter |
| DOWN_REVI_M2 | the number of downward revisions of the next quarter earnings forecast made in the second month after current 10-Q release date. | Jan–Dec 2020 | firm-quarter |
| UP_REVI_M2 | the number of upward revisions of the next quarter earnings forecast made in the second month after current 10-Q release date. | Jan–Dec 2020 | firm-quarter |
| DISPERSION_M1 | the standard deviation of next quarter earnings forecast made in the first month after current 10-Q release date. | Jan–Dec 2020 | firm-quarter |
| DISPERSION_M2 | the standard deviation of next quarter earnings forecast made in the second month after current 10-Q release date. | Jan–Dec 2020 | firm-quarter |
| DISPERSION_M3 | the standard deviation of next quarter earnings forecast made in the third month after current 10-Q release date. | Jan–Dec 2020 | firm-quarter |
| DISPERSION_AVE | the average of the standard deviation of next quarter earnings forecast made during three months after current 10-Q release date. | Jan–Dec 2020 | firm-quarter |
| FUT_SALE | quarterly sales scaled by the total asset in $t + 1$. | Jan–Dec 2020 | firm-quarter |
| FUT_OCF | quarterly operating income scaled by the total asset in $t + 1$. | Jan–Dec 2020 | firm-quarter |
| FUT_OP_INCOME | quarterly operating income scaled by the total asset in $t + 1$. | Jan–Dec 2020 | firm-quarter |
| FUT_ROA | quarterly net income scaled by the total asset in $t + 1$. | Jan–Dec 2020 | firm-quarter |

(Continued)
| Variable name          | Definition                                                                                                                                                                                                 | Time                   | Obs. Level |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|------------|
| Test variables:       |                                                                                                                                                                                                          |                        |            |
| BTM                   | =book value of total equity divides the market value of total equity Jan–Dec 2020 firm-quarter                                                                                                              | Jan–Dec 2020           | firm-quarter |
| CAR                   | =the market model cumulative abnormal return during the period (−1, +1) of firms’ 10-Q filing dates. The estimation window of normal daily return is (−250, −10) days before 10-Q filing dates Jan–Dec 2020 firm-quarter | Jan–Dec 2020           | firm-quarter |
| COVID_DISTANCE        | =COVID-19 keywords count – its industry median of COVID-19 keywords count. Both keyword counts are scaled by the total word count of 10-Q, multiplying 1000 Jan–Dec 2020 firm-quarter                          | Jan–Dec 2020           | firm-quarter |
| COVID_FOG             | =the fog index of the COVID-19 discussion in firm’s 10-Qs Jan–Dec 2020 Firm-quarter                                                                                                                        | Jan–Dec 2020           | Firm-quarter |
| COVID_TONE            | =the number of positive words used to discuss COVID minus the number of negative words used to discuss COVID, scaled by the total words used to discuss COVID in firm’s 10-Qs Jan–Dec 2020 Firm-quarter            | Jan–Dec 2020           | Firm-quarter |
| FINANCE               | =1 if the firm engages in external financing activity, zero otherwise Jan–Dec 2020 Firm-quarter                                                                                                            | Jan–Dec 2020           | Firm-quarter |
| HOSPPERPPL            | = the number of hospitals per 1000 residents in a firm’s domicile state Jan–Dec 2020 Firm-quarter                                                                                                         | Jan–Dec 2020           | firm-quarter |
| IS_COVID              | =1 if the 10-Q filing contains COVID-19 related key words, zero otherwise Jan–Dec 2020 Firm-quarter                                                                                                         | Jan–Dec 2020           | firm-quarter |
| LEV                   | =total long-term liability scaled by the total assets Jan–Dec 2020 firm-quarter                                                                                                                           | Jan–Dec 2020           | firm-quarter |
| LOSS                  | =1 if the net income is negative, zero otherwise Jan–Dec 2020 firm-quarter                                                                                                                             | Jan–Dec 2020           | firm-quarter |
| M&A                   | =1 if the firm has merger and acquisition activities, 0 otherwise Jan–Dec 2020 firm-quarter                                                                                                             | Jan–Dec 2020           | firm-quarter |
| N_ANALYST             | =the number of analysts following the firm Jan–Dec 2020 firm-quarter                                                                                                                                 | Jan–Dec 2020           | firm-quarter |
| NUM_GEO               | =the number of geographic segments of the firm Jan–Dec 2020 firm-quarter                                                                                                                            | Jan–Dec 2020           | firm-quarter |
| PCT_CASE              | =the number of COVID-19 positive cases scaled by the population of the firm’s domicile state, multiplying 1000. Jan–Dec 2020 firm-quarter                                                                   | Jan–Dec 2020           | firm-quarter |
| PCT_DEATH             | =the number of COVID-19 death scaled by the population of the firm’s domicile state, multiplying 1000. Jan–Dec 2020 firm-quarter                                                                         | Jan–Dec 2020           | firm-quarter |
| PRIOR_CAR             | =the market model cumulative abnormal return during the period (−30, 0) of firm’s 10-Q filing date. The estimation window of normal daily return is (−250, −10) days before 10-Q filing dates Jan–Dec 2020 firm-quarter | Jan–Dec 2020           | firm-quarter |
| QUICK                 | =current assets minus inventory, then scaled by the total current liability Jan–Dec 2020 firm-quarter                                                                                                | Jan–Dec 2020           | firm-quarter |
| RD                    | = research and development expenses scaled by the total sales Jan–Dec 2020 firm-quarter                                                                                                                | Jan–Dec 2020           | firm-quarter |
| ROA                   | =operating incomes scaled by the total asset Jan–Dec 2020 firm-quarter                                                                                                                               | Jan–Dec 2020           | firm-quarter |
| SIZE                  | =the nature log of total assets Jan–Dec 2020 firm-quarter                                                                                                                                              | Jan–Dec 2020           | firm-quarter |
| SPEC_ITEM             | =the value of special items scaled by the total asset Jan–Dec 2020 firm-quarter                                                                                                                         | Jan–Dec 2020           | firm-quarter |
| STAFFPPERPPL          | = the number of medical staff per 1000 residents in a firm’s domicile state Jan–Dec 2020 firm-quarter                                                                                                       | Jan–Dec 2020           | firm-quarter |
| SUR_EPS               | =the earnings per share surprise, which equals to the absolute value of the difference between the actual earnings per share and the mean of most recent analyst forecasts of earnings per share for the current quarter Jan–Dec 2020 firm-quarter | Jan–Dec 2020           | firm-quarter |
| YRMONTH               | =the month of year 2020 based on 10-Q release date. Staring with 1 representing January 2020; 2 representing February; 3 representing March, etc Jan–Dec 2020 firm-quarter                                             | Jan–Dec 2020           | firm-quarter |
| TURNOVER              | =the mean of the daily trading volume scaled by the number of shares outstanding over periods of [−49, −5] days before 10-Q releases Jan–Dec 2020 firm-quarter                                                | Jan–Dec 2020           | firm-quarter |
| VOL_OCF               | =the standard deviation of the operating cash flow in prior four quarters Jan–Dec 2020 firm-quarter                                                                                                    | Jan–Dec 2020           | firm-quarter |
| VOL_SALE              | =the standard deviation of total sales in prior four quarters Jan–Dec 2020 firm-quarter                                                                                                               | Jan–Dec 2020           | firm-quarter |