Investor Uncertainty and Voluntary Disclosure

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Abstract: We examine whether managers respond to unexpected increases in investor uncertainty by accelerating the release of relevant information. If managers possess firm-specific information that could help resolve uncertainty among investors, we expect them to release it in a timely manner, independent of the nature of the news. Using a global panel containing observations from 33 countries over the 2004 to 2019 period, we find evidence consistent with this prediction. We identify unexpected increases in investor uncertainty by extreme stock price movements and show that firms are both more likely to issue voluntary disclosure and timelier in doing so after such shocks. The results are stronger when managers are likely endowed with more private information but mitigated or even opposite when the sources of investor uncertainty are macroeconomic rather than firm-specific factors. The voluntary disclosure following information shocks contains more verifiable, financial information and is more value relevant to investors as measured by absolute announcement returns and (abnormal) trading volume. Overall, our findings suggest that management responds to increased demand for information in times of investor uncertainty.

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1. Introduction

In this study, we provide large sample evidence on the relation between information uncertainty among investors and firms' voluntary disclosure, a subject of inherent interest in accounting research. We define information uncertainty as investors' overall perception of the riskiness of future cash flows, which is a combination of the real volatility of the firm's cash flows and investors' priors about the information precision of those cash flows. Whereas disclosure's ability to reduce the real volatility of cash flows is limited, managers can increase the disclosure about the variance of expected cash flows. Against this backdrop, we study firms' propensity and timeliness of voluntary disclosure in the aftermath of extreme changes to information uncertainty and test the information content and value relevance of the new disclosures for investors.

We derive our predictions from models of voluntary disclosure (for overviews see Verrecchia 2001; Beyer et al. 2010). In these models, managers typically provide information about expected cash flows (first moment) while assuming the riskiness of the cash flows (second moment) is known. In this setting, a sudden decrease in the precision of investors' beliefs (or increase in uncertainty) about the firm's future operations—all else being equal—leads to a higher probability of managers releasing voluntary disclosure (Verrecchia 1990, Corollary 4).[1] Similarly, an increase in uncertainty likely affects the firm's assessed cash flow covariances with other firms in the economy and, in turn, its cost of capital (Lambert, Leuz and Verrecchia 2007, Proposition 2). Sudden spikes in information uncertainty therefore incentivize managers to provide additional disclosures that help estimate these covariances. If we extend these models and allow the variance of expected cash flows to be unknown, investors' heterogenous beliefs give rise to a separate

[1] We can also express this relation as a function of the precision of managers' private information (Verrecchia 1990, Corollary 3). If managers have better information about the impact of the sudden increase in uncertainty on the firm's future cash flows, the likelihood of voluntary disclosure will increase.

variance uncertainty premium, and information on the riskiness of future cash flows becomes beneficial (e.g., Buraschi and Jiltsov 2006; Jørgensen and Kirschenheiter 2003). More precisely, Heinle and Smith (2017, Proposition 2) show that in a dynamic setting managers follow up increases in (perceived) cash flow variance uncertainty with more disclosures on these risks. The resulting reduction in investor uncertainty can lower the firm's cost of capital.

Building on the above analytical intuition, we hypothesize that—*on average*—managers are more likely to issue voluntary disclosure after large, unexpected changes to firm-specific (or idiosyncratic) information uncertainty and do so in a timely manner that is informative to investors. Consistent with these arguments, prior work shows that managers supply more voluntary disclosure in response to specific events that adversely affect firms' information environment (e.g., Leuz and Schrand 2009; Anantharaman and Zhang 2011; Balakrishnan, Billings, Kelly, and Ljungqvist 2014) or to abnormal run-ups in stock price volatility (Billings, Jennings, and Lev 2015). Yet, an increase in information uncertainty could also have opposite effects. For instance, in the wake of the 2009 financial crisis, many firms stopped giving annual earnings estimates citing high uncertainty about future cash flows (Kim, Pandit and Wasley 2016). Similarly, many firms announced changes in their earnings guidance policies during the first months of the COVID-19 pandemic (e.g., Hope, Li, Ma, and Su 2023).[2] Prior literature also shows that firms with higher real cash flow volatility are less likely to provide voluntary disclosure (e.g., Waymire 1985; Chen, Matsumoto, and Rajgopal 2011). Thus, if managers suffer from the same (macroeconomic) shock to uncertainty as investors and lack private information on its consequences, they may opt to reduce or delay voluntary disclosure due to reputational, litigation, or other cost concerns.[3]

[2] See, e.g., "Coronavirus erases guidance from 40% of S&P 500." *The Wall Street Journal*, June 28, 2020.

[3] In a way, one can interpret this outcome as the case in Verrecchia (1990) in which the private signal to the manager contains less information than the cost it imposes if released, so it is better withheld. Or, as in Dye (1985), investors have imperfect knowledge of managers' information endowment upon the increase in uncertainty, allowing

We empirically test our predictions using a large global firm-day dataset drawn from 33 countries over the 2004 to 2019 period. Using international data allows us to exploit the substantial variation in idiosyncratic information uncertainty across firms over time while controlling for common factors that affect all firms in a country on a day. Another advantage of the cross-country setting is that we can study economy-wide shocks that are not necessarily aligned in time across countries as well as interactions between firm-level information shocks and macroeconomic conditions such as recessionary trends or high market volatility that could render the interpretation of sudden increases in investor uncertainty more difficult. Finally, cross-country differences in disclosure regulations and disclosure practices should strengthen the power of our tests.

One key construct in our analysis are the shocks to information uncertainty. In line with prior literature, we use extreme movements in individual stock prices as a widely available proxy for unexpected increases in firm-specific information uncertainty (e.g., Conrad, Cornell, Landsman, and Rountree 2006; Savor 2012; Jiang and Zhu 2017). The underlying assumption here is that infrequent but large daily returns are triggered by the arrival of new information (Fama 1991) that leaves investors less informed about the prospects of the firm.[4] Specifically, we identify information shocks as trading days on which a firm's daily return is in the top or bottom 1st percentile of the overall sample distribution (i.e., outside 2.326 standard deviations from the sample mean across all countries and years before any sample restrictions). We are agnostic about the exact nature of the signal that caused the information shock (akin to Basu 1997 or Ball, Kothari, and Robin 2000 when examining conditional conservatism) and do not limit the timing to specific,

managers to hide the (bad) news. In Lambert, Leuz, and Verrecchia (2007) incentives for disclosure are low if the information signal does not allow investors to reassess the firm's cash flow covariances with the market (or even moves an unconditional covariance that is negative closer to zero and, hence, leads to *higher* cost of capital).

[4] In the sensitivity analyses (see Section 4.2), we also use extreme daily turnover as alternative proxy for information uncertainty (Kim and Verrecchia 1991) and, for a subset of U.S. firms with option data, the Smith and So (2022) *RiskInfo* measure, which directly captures changes in investors' expectations about the future return variance.

one-time episodes (e.g., Leuz and Schrand 2009, Anantharaman and Zhang 2011) or regularly anticipated events (e.g., Billings, Jennings, and Lev 2015).[5] However, we make sure that the shock days do not coincide with concurrent earnings announcements or firm-initiated press releases and management forecasts. The latter two disclosures also serve as our proxies for a firm's voluntary disclosure activity, and we collect them from RavenPack and Capital IQ.

We begin the analysis by examining the propensity of voluntary disclosure after sudden increases in investor uncertainty. Specifically, we create an indicator variable marking, on a given day, whether a firm was issuing a voluntary disclosure within the next 20 trading days and then regress it on another indicator for whether the day coincides with an information shock. We choose the 20-day window to allow enough time for management to prepare a forecast which on average takes about 12 days for U.S. firms (APQC 2018). Consistent with our predictions, we find that firms are up to 3.6 percentage points more likely to issue a press release or management forecast after information shocks compared to the unconditional mean disclosure likelihood of 36% on any regular day, regardless of whether the shock was positive or negative.

Next, we examine disclosure timeliness. The intuition is that if subsequent disclosures are indeed a response to increased investor uncertainty, we expect firms to release new information quicker than the average voluntary disclosure. When we compare time-to-disclosure (within a 20-trading-day window) on days with an information shock with time-to-disclosure on any other day, we find that managers are up to 5.1% faster to issue a press release or management forecast. Based

[5] To get a better idea of what kind of information signals contribute to the extreme stock price reactions, we conduct an analysis of news sources for a random sample of 100 information shocks. Of the 74 shocks for which we could identify "material" signals in the news, many related to firm-specific media coverage (e.g., product releases or failures, FDA approvals, court rulings, rumors, relevant peer disclosures), some were related to changes in analyst coverage, some were industry-specific (e.g., revisions of industry outlook), some were related to managers' private information which became public through insider trades, and some could have been in anticipation of pending news releases. In a few cases, we also identified firm-initiated disclosures as the potential triggering events that were not picked up by our data sources.

on the sample median of 9 days until the next disclosure, this finding suggests an earlier release of the information by one trading day. We note that this number likely is a lower bound estimate, as our sample focuses on firms that regularly engage in voluntary disclosure. The results equally hold for positive and negative shocks as well as for the largest sample countries individually.[6] We derive these estimates after including a comprehensive set of control variables as well as firm and country-day (or country-industry-day) fixed effects. Thus, in our most stringent model, the effects are identified from between firm differences on a given day in an industry and country, which abstracts from regional differences in disclosure practices and macroeconomic trends in the data.

We further corroborate our results in three alternative settings. First, we repeat the analysis for a sample of earnings announcements and compare those that coincide with information shocks to those without. The idea is to test if our predictions extend to increases in investor uncertainty that are likely triggered by firm-initiated disclosures. They do and the timeliness of voluntary disclosure improves by up to 14.7% or two days. Second, we use Japan as a placebo test because for Japanese firms management forecasts around earnings announcements are effectively mandated (Kato, Skinner, and Kunimura 2009). Thus, the timing of these forecasts should be detached from sudden changes in investor uncertainty in the run-up period. Accordingly, we find no change in the timeliness of such mandated forecasts but do find that Japanese firms are quicker to issue voluntary disclosures during other periods of the year. Finally, in a similar test for U.S. firms, we consider the issuance (and, hence, timing) of press releases bundled with earnings announcements as quasi-mandatory and for them, the results essentially disappear.

[6] We do not find an asymmetric disclosure response to positive versus negative shocks which may seem inconsistent with Kothari, Shu, and Wysocki (2009, hereafter KSW). Yet, KSW focus on disclosure events for which managers have private information (i.e., dividend changes and earnings forecasts), whereas we target situations with extreme uncertainty which may require managers to reassess their existing or gather new information (e.g., Hail, Muhn, and Oesch 2021). KSW also note that post Reg FD, which severely limited selective disclosure (and happened before our sample period), they find a reduced tendency (or ability) of managers to delay bad news.

We next examine cross-sectional and time-series patterns. First, we find that managers are quicker to disclose after an information shock when they are better informed. We proxy for private information endowment with firm attributes that suggest a higher value of insider knowledge such as high analyst forecast dispersion and large goodwill, impairment, or inventory amounts. In turn, when managers are less likely to possess private information due to the underlying fundamental volatility of the firm, the disclosure response is muted, particularly for negative shocks. Second, we focus on aggregate shocks to uncertainty that affect many firms in an economy, as there the relation with voluntary disclosure is not a priori clear. When we define information shocks on the country level instead of firm level (i.e., on days with extreme local market index returns), we find that firms delay press releases or management forecasts by up to 24% or three days. This result is consistent with managers needing more time to interpret the new situation. Similarly, using several time-varying proxies for macroeconomic uncertainty such as changes in GDP or country risk and aggregate forecast dispersion or earnings variability, we find that the disclosure response to information shocks is abated or no different than on any regular day.

Finally, we turn to the value relevance of voluntary disclosures. We first measure the information content of voluntary disclosures based on certain textual attributes. We find that the sentiment of press releases generally mimics the nature of the information shock (positive or negative), and that they contain more financial, verifiable news. The same holds for management forecasts that are more likely to include forward-looking sentences and financial metrics. Turning to capital market outcomes, we find that absolute abnormal stock returns and (abnormal) trading volume are higher in the two days around voluntary disclosures following an information shock. The results suggests that managers try to overcome the adverse selection problem amid heightened investor uncertainty, and, in turn, investors perceive the new information as valuable.

The analysis of how information uncertainty among investors acts as determinant of voluntary disclosure is not entirely new to the literature but has been looked at by prior work. For instance, studies show that managers respond to the sudden loss of analyst coverage (e.g., Anantharaman and Zhang 2011; Balakrishnan et al. 2014), abnormal levels of investor uncertainty in the run-up to earnings announcements (e.g., Billings, Jennings, and Lev 2015), or heightened economic policy uncertainty (Nagar, Schoenfeld, and Wellman 2019) by expanding voluntary disclosure. It has also been shown that managers change voluntary disclosure after public news announcements that are not directly related to their own firms such as restatements by peer firms (Sletten 2012) or earnings announcements by major customers (Cho, Kim, and Zang 2020).

We build on and extend this literature by abstracting from narrowly defined but isolated settings or periodic but often anticipated public announcements and measure information shocks in a generic way that solely relies on extreme, short-term deviations in share prices.[7] This approach offers several advantages: (i) It lets us precisely pinpoint what firms, industries, or countries are affected by the unexpected changes in fundamental volatility or information precision. (ii) We can observe the exact timing of the information shocks which varies largely in the cross-section and over the years and is arguably random for the individual firm. (iii) It allows us to construct an intuitive measure for the disclosure responsiveness of management by counting the days until the next disclosure. By limiting the analysis to a short disclosure window, we render the causal link between triggering events and disclosure more plausible. (iv) We can impose a stringent diff-in-diff research design that is applicable to a large cross-section of firms.[8] Thus, in line with the

[7] Similar in spirit, Sadka, Sandhu, and Sivaramakrishnan (2022) also examine management's likelihood to issue forecasts after news "shocks," but their focus is on long-window, relatively vague quarter-by-quarter stock price changes and management forecasts released at any point in the subsequent quarter, which muddles the empirical evidence on the direct link between spikes in information uncertainty and voluntary disclosure.

[8] The identifying assumption is that the unobservable factors triggering the extreme stock price movements exclusively work through this channel and are not correlated with other factors leading to accelerated disclosure,

Bayesian approach to causal inference (e.g., Glaeser and Guay 2017; Christensen 2020), our study complements prior (narrowly defined) settings by providing broad sample evidence on the *average* (instead of local) treatment effect of this fundamental accounting relation. Our large sample approach covering many countries and time periods also allows us to reconcile the findings of negative correlations between information uncertainty and disclosure (e.g., Waymire 1985; Chen, Matsumoto, and Rajgopal 2011; Kim, Pandit, and Wasley 2016) with the positive associations often shown in the literature. We find that managers, on average, are not only quicker to respond in the aftermath of an information shock but do so in a more factual manner that is value relevant to investors. More to the point, we show that depending on the nature of the information shock (firm-specific versus macroeconomic), managers' response can differ.

In addition, extant theoretical models often relate an *exogenous* improvement in the quantity and quality of voluntary disclosure to reduced information asymmetry, increased market liquidity, or lower cost of capital (Verrecchia 2001; Easley and O'Hara 2004; Lambert, Leuz and Verrecchia 2007). A key challenge facing empirical studies in this area is that voluntary disclosure is, by definition, endogenous (see e.g., Beyer et al. 2010). This complicates the relation, since it is reasonable to think that the same factors that drive firms' disclosure choices also directly affect capital market outcomes, leading to a *positive* correlation between investor uncertainty and, hence, expected returns and voluntary disclosure (Clinch and Verrecchia 2015). Prior work uses advanced econometrics to model the endogenous disclosure choice (e.g., Eugster 2020) or quasi-natural experiments to mitigate concerns about omitted factors driving both the disclosure change *and* the cost of capital effect (e.g., Leuz and Schrand 2009; Balakrishnan et al. 2014). We follow the latter approach and use unanticipated extreme stock returns as proxy for fundamental changes in investor

which seems plausible given the largely random distribution of the shocks and that we compare the shock days to any other (regular) day potentially leading to a disclosure over a short-term window.

uncertainty to model firms' disclosure. In that sense, we provide evidence on the first necessary condition of the disclosure-cost of capital relation. Because our findings are drawn from a large cross-section of firms and events, they suggest an equilibrium behavior of how managers respond to changes in features of the economy that exacerbate the adverse selection problem.

Finally, our study adds to the literature on voluntary disclosure in an international context. Prior studies examine the effects of country-level events such as mandatory IFRS adoption (Li and Yang 2016) or institutional factors such as investor protection (Li, Ng, Tsang, and Urcan 2019) on voluntary disclosure. We show that the positive relation between information uncertainty and voluntary disclosure does indeed generalize to a large cross-section of countries and is present in many jurisdictions around the globe. Yet, during times of macroeconomic uncertainty that simultaneously affects many firms in the economy, managers curb their disclosure response. From this perspective, our study adds to the papers examining the role of economic policy and political uncertainty on voluntary disclosure (e.g., Kim, Pandit, and Wasley 2016; Nagar, Schoenfeld, and Wellman 2019; Bird, Karolyi, and Ruchti 2023). We further complement the evidence on the benefits of greater levels of firm transparency shown during times of heightened uncertainty and crisis periods (e.g., Lang and Maffett 2011; Hail, Muhn, and Oesch 2021). In our case, managers provide new information over and above earlier disclosures so that investors can better interpret and contextualize the sudden increase in uncertainty.

2. Hypothesis Development and Related Literature

Theoretical work on voluntary disclosure shows that increased information uncertainty among investors can trigger two potentially countervailing effects. On the one hand, increased information uncertainty can be associated with more disclosure. Intuitively, Verrecchia (1990) shows that when less is commonly known about future cash flows, more pressure is exerted by the market on

managers to reveal their private information. Also, sudden spikes in information uncertainty are often associated with increased cost of capital, representing an additional incentive for managers to provide voluntary disclosure. For example, Lambert, Leuz, and Verrecchia (2007) show that an increase in information uncertainty is likely to affect the firm's assessed cash flow covariance with other firms in the economy and, in turn, its cost of capital. In such situations, additional disclosures help estimate these covariances.

The above models assume that managers provide information about expected cash flows (first moment) while the variance of the cash flows (second moment) is known. However, if we relax this assumption and allow the second moment to be unknown, investors' heterogenous beliefs give rise to a separate variance uncertainty premium. In such a context, information on the riskiness of future cash flows becomes beneficial to investors (e.g., Buraschi and Jiltsov 2006; Jørgensen and Kirschenheiter 2003). Indeed, Heinle and Smith (2017) show that in a dynamic setting, managers respond to increases in investor-perceived cash flow variance uncertainty with more disclosure on these risks. All these models point to a generally positive relation between investor uncertainty and managers' voluntary disclosure.

On the other hand, increased information uncertainty can lead to an inverse relation with voluntary disclosure. Although managers typically are endowed with superior private information than investors, unexpected spikes in information uncertainty can affect the perceived quality or quantity of their information advantage. For instance, Verrecchia (1990) shows that as the quality of the manager's private information declines, markets exert less pressure, lowering the disclosure threshold. Similarly, Dye (1985) and Jung and Kwon (1988) show that investors are less inclined to demand disclosure if they are uncertain whether managers possess private information. Kim (2023) builds on these models and shows that a reduction in investor uncertainty about managerial

type (not future cash flows) leads managers to release previously withheld information. These countervailing forces are particularly salient in the context of macroeconomic uncertainty, when managers' endowment with high-quality private information is in doubt. In such cases, firms may opt to reduce or delay voluntary disclosure, giving rise to a negative relation.

There exists empirical evidence in support of both these theoretical predictions. Consistent with a positive link, managers have been shown to respond to uncertainty-driven investor demand for more information. For example, managers issue forecasts when investors have inaccurate beliefs (Ajinkya and Gift 1984), information asymmetry among investors is high (Coller and Yohn 1997), there exists abnormally elevated volatility in the periods leading up to regularly scheduled earnings releases (Billings, Jennings, and Lev 2015), or earnings announcements fail to abate investor concerns about future cash flows (Wang, Sarath, and Rai 2023). Other evidence shows that managers respond to adverse changes in firms' information environment with increased disclosure. Such specific, often one-time events include the loss of financial intermediaries (Anantharaman and Zhang 2011; Balakrishnan et al. 2014), shocks to the perceived precision of corporate reporting (Leuz and Schrand 2009), unexpected changes to currency exchange rates (Hail, Muhn, and Oesch 2021), increases in financial statement complexity (Guay, Samuels, and Taylor 2016), and higher economic policy or political uncertainty (Nagar, Schoenfeld, and Wellman 2019; Bird, Karolyi, and Ruchti 2023).

Consistent with a negative link, a long-standing finding in the literature is that firms with higher cash flow volatility are less likely to provide voluntary disclosure (e.g., Waymire 1985; Chen, Matsumoto, and Rajgopal 2011). Prior studies also show that managers experience greater difficulty in forecasting and releasing forward-looking information in periods of high uncertainty. For example, Kim, Pandit and Wasley (2016) or Hope et al. (2023) find that during periods of high

macroeconomic uncertainty such as the 2008 financial crisis or the Covid-19 pandemic, firms are less likely to issue management forecasts. These results suggest that managers tend to withhold information during periods of heightened uncertainty because they themselves are unsure about the prospects of the firm.

In sum, we can conceptually and empirically tie sudden increases in information uncertainty among investors to changes in voluntary disclosure. Under regular conditions, we expect firms to be more likely to issue voluntary disclosure and to be quicker in doing so. The information content of news releases in response to such uncertainty shocks should be larger. Yet, in situations or during times when managers are less likely to be endowed with private information (or investors are uncertain about the endowment), we expect these relations to be weakened or the opposite.

3. Research Design and Data

3.1 Empirical Model for Propensity and Timeliness Analyses

In our first set of analyses, we examine whether firms subject to a sudden increase in investor uncertainty are more likely to issue a voluntary disclosure and are more timely to do so. We test these predictions using a firm-day panel. Figure 1 illustrates the data structure and the coding of some of the key variables. *Information Shock* is our main variable of interest and marks firm-days that coincide with extreme daily stock returns. We define extreme returns as those that are 2.326 standard deviations—equivalent to a *z*-score of 1% in a normal distribution—above (*Positive Shock*) or below the sample mean (*Negative Shock*). We further make sure that shock days are not immediately preceded by an earnings announcement or voluntary disclosure. To validate our *Information Shock* variable, we use the Smith and So (2022) *RiskInfo* measure for our subset of U.S. firms with option data available. *RiskInfo* directly captures variance uncertainty among

investors. Consistent with heightened uncertainty, we find significantly higher *RiskInfo* values around earnings announcements that coincide with return shock days than around those without.[9]

When studying the propensity of voluntary disclosure, we use *Has Disclosure* as dependent variable. *Has Disclosure* is a binary variable indicating, on a given day, whether the firm was issuing a voluntary disclosure within the next 20 trading days or not. We choose a 20-trading day window to allow management enough time to prepare the release of new information while at the same time not being implausibly long for the stipulated link between the uncertainty shock and managers' disclosure response.[10] We measure voluntary disclosure as firm-initiated press releases and management forecasts.

When studying timeliness, we use *Days to Disclosure* as dependent variable and set it equal to the count of days until the firm releases its next voluntary disclosure. We again limit the pre-disclosure window (see Figure 1) to 20 trading days and only include days within that window in the sample. Thus, by construction, each observation must have a voluntary disclosure within a range of +1 to +20 days.[11] For the regressions, we transform the variable (plus one) by the natural logarithm, implicitly putting more weight on quicker reaction times.[12]

[9] For the 4,707 earnings announcements of U.S. firms with data available (denoting a subset of column 1, Table 5, Panel C), the absolute magnitude of $RiskInfo_{30}$ for earnings announcements *with* return shocks is about 2 times larger than the same value for the other earnings announcements. As a benchmark, Smith and So (2022), Figure 4, report an average multiplier of 5 comparing actual earnings announcements to pseudo announcements.

[10] This time frame is in line with statistics from the American Productivity & Quality Center (APQC)'s 2018 *Planning and Management Accounting Open Standards Benchmarking* survey of 1,416 U.S. firms. The survey reports a median time to prepare a financial forecast of 12 days. The fastest 25% of businesses can prepare a financial forecast in eight days or less, while the slowest take 16 days or longer (APQC, 2018).

[11] When we assess this research design choice and repeat the timeliness analyses with a pre-disclosure window of 10 (30) trading days, the results are very similar to those reported (see Table 5 Panel A).

[12] Since the lower bound of the *Days to Disclose* measure is 1, our results are less susceptible to the bias in "log of 1 plus" regressions described in Cohn, Liu and Wardlaw (2022). Yet, in robustness tests, we confirm that our results are similar when we use *Days to Disclose* without log transformation or log transformation without adding 1.

Combining the independent and dependent variables, we estimate the following ordinary least squares (OLS) regression model with observations from firm *i* on day *t*:

$$\textit{Has Disclosure}_{i,t} \text{ or } \textit{Days to Disclosure}_{i,t} = \beta_1 \textit{ Information Shock}_{i,t} + \sum \beta_j \textit{ Controls}_j + \sum \beta_k \textit{ Fixed Effects}_k + \varepsilon_{i,t}. \quad (1)$$

We estimate this model in a sample that combines shock days and any other days which are comparable in terms of disclosure propensity or timeliness. Thus, in the propensity analysis, we expect the coefficient β_1 to be positive, indicating that following days with extreme stock returns, managers are more likely to issue a voluntary disclosure relative to any regular day. Similarly, in the timeliness analysis, we expect the coefficient β_1 to be negative, indicating a quicker release of new information after shock days relative to the other days.

We include a comprehensive set of firm-level control variables such as firm size, profitability, or institutional ownership in the model to account for commonly known determinants of voluntary disclosure (see Section 3.3 and Appendix A). Our main specification includes firm and country-by-calendar day fixed effects. The former control for time-invariant, unobserved firm attributes that shape a firm's overall voluntary disclosure behavior. The latter limit the identification to stem from between firm variation on a given day in a country as they control for time series and country specific trends in the data. We cluster standard errors at the country level.

3.2 Empirical Model for Information Content Analyses

In our second set of analyses, we focus on the information content of the voluntary disclosures. As Figure 1 illustrates, the main variable of interest is the indicator *Following Information Shock* that codes up whether a disclosure had an *Information Shock* in the preceding 20 trading days or not. For each disclosure *d* of firm *i*, we estimate the following OLS regression model:

$$Information\ Content_{d,i} = \beta_1\ Following\ Information\ Shock_{d,i} + \Sigma\ \beta_j\ Controls_j + \Sigma\ \beta_k\ Fixed\ Effects_k + \varepsilon_{d,i.} \quad (2)$$

In this specification, we compare voluntary disclosures that managers presumably release as a reaction to information shocks to any other voluntary disclosure. When it comes to the dependent variable, we use a series of proxies to measure *Information Content*. First, we examine textual attributes of the disclosures. For press releases, we measure the *Sentiment* as well as the amount of verifiable, *Financial Information* that they contain (see Appendix B for details). For management forecasts, we count the number of *Forecast Sentences*, representing forward-looking information, and the number of *Financial Metrics* (see Appendix C for details). Second, we examine capital market outcomes and use two-day (absolute) cumulative abnormal returns (*CAR* and *Abs. CAR*) and share *Turnover* as proxies for how investors perceive the information content of the voluntary disclosure.

A positive coefficient β_1 in Eq. (2) would suggest that voluntary disclosures after information shocks are phrased in a more positive tone, contain more hard, forward-looking information, and are accompanied by larger absolute stock returns and turnover than any other disclosure. All these attributes are indicative of higher value relevance. As before, the model contains a comprehensive set of control variables as well as firm and country-by-calendar day fixed effects.

3.3 Sample Selection and Variable Description

We start our sample selection with collecting all firm-day observations over the 2004 to 2019 period with Datastream stock price data and Worldscope accounting data available. We then apply several filters: (1) We require firms to have total assets upwards of 10 USD million. (2) For a firm to be included, our data sources for voluntary disclosure (RavenPack for firm-initiated press releases and Capital IQ for management forecasts) must contain at least two datapoints over the

sample period. We exclude firm-days that occur before the first or after the last disclosure of an individual firm. (3) We only include observations from countries with, on average, 10 or more firms per year. Note that we drop Japanese firms from the sample because in Japan many management forecasts are effectively mandated (Kato, Skinner, and Kunimura 2009). (4) To reduce the weight of the United States as the largest sample country, we randomly pick the same number of firms as we have U.K. firms (second largest country) before applying the data filters. (5) When studying timeliness, we limit the sample to firm-days that are followed by a voluntary disclosure within the next 20 trading days. If an *Information Shock* occurs during the pre-disclosure window (see Figure 1), we first make sure that it is not preceded by an earnings announcement or disclosure on days $t = 0, -1$, or -2. We then only retain the shock day but not the other days from that window in the sample to avoid biasing the analysis. For pre-disclosure windows without an *Information Shock*, we include all days unless the window is shortened by an earlier disclosure. These regular days serve as our benchmark group during uneventful times.

This selection procedure yields a base sample of 5,654 unique firms drawn from 33 countries over the years 2004 to 2019, giving rise to 2,222,669 firm-day observations. In Table 1, we present a breakdown of the sample composition by country (Panel A) and year (Panel B). We report the number of firm-days, voluntary disclosures, and information shocks. Ideally, we would expect the sample proportions of these three items to be about the same. For instance, in Panel A, Australia makes up 3% of the firm-days, records 2.6% of the disclosures and 4.2% of the shock days. These relations generally hold except for Canada and the United States. In Canada, we observe a disproportionally high number of shock days. Closer inspection of the data reveals that the return shocks are driven by the many Canadian firms in the natural resource extraction industry, which

was suffering from high stock price volatility during the sample period.[13] In the United States, the number of voluntary disclosures is unusually high due to better database coverage.

Panel B presents the same statistics over time. The number of firm-days and disclosures gradually increases, reflecting general improvements in market liquidity and database coverage. Not surprisingly, the information shocks reveal a pronounced spike around the global financial crisis in 2008 (17.0%) and 2009 (14.5%). Given the high number of affected firms, this period is likely an ideal testing ground for the effects of macroeconomic uncertainty (see Section 4.4).

In Table 2, we present descriptive statistics for the variables used in the regression estimation. In our largest sample used for the propensity analyses, for which we only require firms to have at least one voluntary disclosure over the course of a year (N = 6,180,138), 36% of the observations, on average, have a disclosure within the next 20 days (*Has Disclosure* = 1). The median time to disclosure is 9 trading days, slightly below the theoretical mean of 10 days in our 20-day window. Almost 4% of the firm-days coincide with an *Information Shock*. This proportion is higher than what our cutoff value at the top and bottom 1 percentile would suggest. The reasons include the way how we construct the sample (i.e., only include the shock days from the treated pre-disclosure windows), the slightly fatter tails of the actual return distribution versus a normal distribution, and the differential sample attrition when we impose the data requirements.

For the control variables, we largely follow Li and Yang (2016) and include various firm attributes that have been shown to affect firms' voluntary disclosure. *Total Assets* is a proxy for firm size and age, as large and more mature firms tend to have better information environments. *Leverage* and *Equity Issuance* reflect the firms' financing needs, as firms with a greater need for

[13] In sensitivity analyses (not tabulated), we exclude (i) Canada as a whole, (ii) Canadian energy firms, or (iii) all mining and oil and gas extraction firms from the sample and find, if anything, stronger results than those reported.

external capital tend to be more transparent. We include measures of firms' growth opportunities (*Book-to-Market*), historical accounting returns (*Return on Assets* and *Earnings Variability*), and stock return volatility (*Return Variability)*. Their effects on disclosure are ambiguous. On the one hand, high growth and volatility are associated with higher information asymmetry for firm outsiders, leading to more investor demand for information. On the other hand, higher fundamental uncertainty may render managers' private information less useful, thus reducing their propensity to voluntarily disclose due to reputational and litigation concerns (Waymire 1985).

We further include analyst coverage (*Number of Analyst*), foreign and domestic institutional ownership (*Inst. Ownership*), and a firm's *ADR Listing* status as firms often respond to financial intermediaries' and large blockholders' information demand (Lang and Lundholm 1996; Bhojraj, Blacconiere, and D'Souza 2004; Ajinkya, Bhojraj, and Sengupta 2005). We control for *Negative News* as firms could alter their disclosure decisions to minimize litigation risk (Skinner 1994; Roychowdhury and Sletten 2012). Finally, we include the liquidity of a firm's stock using the proportion of *Zero Return Days* as proxy as well as the frequency of ongoing reporting (*Quarterly Reporting*). For details on the variable definitions see Appendix A.

4. Empirical Results

4.1 Propensity of Voluntary Disclosure After Information Shocks

We begin with the analysis of the likelihood of voluntary disclosure after sudden increases in investor uncertainty. In Table 3, we report the coefficients from estimating equation (1) using *Has Disclosure* as the dependent variable. The sample is substantially larger than in our timeliness tests, because the only restriction we impose (on top of the regular data filters) is that each firm

day must have at least one disclosure in the subsequent 252 trading days. This convention is to ensure that sample firms are covered by our data sources and have a history of voluntary disclosure.

In column 1, we include all firm-level control variables but no fixed effects. The coefficient on *Information Shock* is significantly positive. The magnitude suggests a 3.5 percentage points increase in the likelihood of disclosure over any regular day, which—based on the unconditional sample mean—has a disclosure likelihood of 36% to begin with. This number is economically significant but not too large to be implausible. Many of the control variables behave as one would expect. Larger, less profitable firms with more leverage, a higher proportion of institutional investors, an ADR listing, and more frequent reporting are more likely to provide additional disclosure. The same holds if a firm faces negative earnings news. In turn, smaller, less liquid firms are less forthcoming with their voluntary disclosure.

In column 3, we impose our comprehensive fixed-effects structure. Notably, in this model, we draw the identification from firms in the same country and on the same day that differ whether they experience an extreme stock price movement or not. The coefficient on *Information Shock* remains positive and significant, but the magnitude is reduced to a 1.3 percentage point increase in disclosure likelihood.

In columns 2 and 4, we repeat these analyses but separately estimate the effects for positive (*Positive Shock*) and negative information shocks (*Negative Shock*). The propensity of voluntary disclosure increases regardless of the sign of the extreme stock price movement and the magnitudes are only slightly smaller for negative shocks. Overall, the results are consistent with our expectations and suggest that, on average, managers respond to an increase in investor uncertainty by providing more voluntary disclosure.

4.2 Timeliness of Voluntary Disclosure After Information Shocks

We next examine the timeliness of voluntary disclosure in response to an information shock. Table 4 reports the results from estimating equation (1) using *Days to Disclosure* as the dependent variable. Note that in these analyses, we only include firm-days within a pre-window of 20 trading days from the next disclosure. In column 1, the specification without fixed effects, the coefficient on *Information Shock* is negative and significant, indicating that managers are about 5% faster to issue a press release or management forecast after days with extreme stock returns relative to any regular day.[14] Based on the sample median of 9 days until the next disclosure, this finding suggests an earlier release of the information by one trading day.

In column 3, after including firm and country-by-day fixed effects, the coefficient continues to be significantly negative, suggesting an increase in timeliness by about 4%. When separating out the positive and negative shocks (columns 2 and 4), the increase in timeliness is present for both types of extreme stock returns, but slightly more pronounced for positive events. One could interpret this finding as consistent with managers' tendency to release good news quicker and hold on to bad news for longer (Kothari, Shu, and Wysocki 2009), but the difference between the two coefficients is not statistically significant.

The control variables behave as expected (and in line with the findings in Table 3). Larger firms with higher leverage and more volatile earnings or returns are quicker to release new information. So are firms facing negative news or having undergone an equity offering. Higher institutional ownership and having an ADR listing also increases the pressure on management to

[14] We calculate this magnitude as $e^{-0.050} - 1 = 4.9\%$.

report on a timely basis. Overall, the results in Table 4 are consistent with our conjecture that firms respond to sudden increases in investor uncertainty by issuing more timely disclosures.

We next subject these main findings to various sensitivity tests and explore them in alternative settings. In Table 5, Panel A, we assess the impact of various important research design choices. In the first two columns, we repeat the analyses but shorten the pre-disclosure window to 10 days or extend it to 30 days instead of the arbitrarily chosen 20 days used in the main analysis. The results remain similar as both the coefficients on the *Positive Shock* and *Negative Shock* variables are negative and significant. As one would expect, the coefficient magnitude increases with the length of the pre-disclosure window.

We then assess the sensitivity of the results to our measurement of the information shocks. In column 3, we define the *Information Shock* variable separately for each country based on the country-specific return distributions. This approach ensures an equal proportion of extreme return days across countries regardless of the local microstructure of the capital markets, industry composition, and macroeconomic conditions. It also helps address concerns that an individual industry or country dominates the analysis. The results remain very similar to those reported in Table 4. In column 4, we use extreme daily turnover instead of stock returns to define sudden increases in investor uncertainty. Trading volume has been theoretically (e.g., Kim and Verrecchia 1991) and empirically (e.g., Bamber 1987) linked to information uncertainty and the Bayesian updating by market participants due to the arrival of new information. Because trading volume only assumes non-negative values, we define *Positive Shocks* at the top 2 percentile of the overall sample distribution. Firms that experience an extreme turnover day are about 6.5% quicker to issue management forecasts or press releases.

Finally, in column 5, we adapt the Smith and So (2022) *RiskInfo* metric that directly captures variance uncertainty among investors for our purposes. Specifically, for the subset of U.S. sample firms with 30-day standardized option data available, we calculate the daily changes in implied volatility from the options and use the extreme top 2 percentile of the *RiskInfo* distribution to define the *Positive Shock* variable. This indicator marks days when investors' risk expectations about a specific firm spike and a lot of uncertainty is present. The results using this alternative and direct measure of information uncertainty are very similar to those reported, increasing our confidence in the return-based measure that we use for our large, cross-country sample.

In Panel B of Table 5, we repeat the analyses separately for the five largest sample countries: the United States, Canada, the United Kingdom, Germany, and France. The idea here is to see whether the analyses hold for the largest contributors to our sample but also to uncover potential differences due to the institutional environment (e.g., Ball, Kothari, and Robin 2000). As the table shows, the results are essentially present in all five countries. However, the relation how managers react to positive or negative information shocks somewhat differs across countries. On the one hand, the reaction is almost symmetric for U.S. firms, a common law country with highly developed and liquid capital markets. In the other economies, there is more of an asymmetry between positive and negative shocks. Most notably, in Germany, a code law country, managers are quicker to react to negative information shocks than to positive shocks.[15]

In Panel C of Table 5, we extend our analysis to alternative settings. First, we test whether the findings also apply to information shocks that themselves were likely triggered by a firm-initiated disclosure (i.e., reverse causality). Remember that in our baseline model, we solely focus on shocks

[15] In additional analyses (not tabulated), we separately or jointly drop the three largest sample countries (United States, Canada, United Kingdom) from the analyses and find results very similar to those reported in Table 4.

that are *not* preceded by other disclosures. To loosen this condition, we compare the disclosure reaction to earnings announcements with and without sudden increases in investor uncertainty. Specifically, the treated events are those earnings announcements that are accompanied by an *Information Shock* on days t = 0, +1, or +2. All other earnings announcements serve as benchmark.[16] As column 1 in Panel C shows, the disclosure reaction to earnings announcements that likely caused a spike in investor uncertainty is even more pronounced than during "regular" shock days without such a confounding disclosure. The coefficients on *Positive Shock* and *Negative Shock* suggest an increase in disclosure timeliness of about 15% or 2 days.

Next, we perform a falsification test and exploit the fact that in Japan, firms are effectively mandated to issue a management forecast together with an earnings announcement (Kato, Skinner, and Kunimura 2009). Because the timing of earnings announcements is largely predetermined, the release of the accompanying management forecasts is also predetermined. Thus, the timeliness of such bundled management forecasts should be unrelated to the occurrence of extreme stock price movements in the days leading up to the earnings announcement.

Based on this intuition, we code up all management forecasts that were issued within [-2, +2] days around an earnings announcement as mandatory. We then examine their timeliness relative to whether there occurred an *Information Shock* within the previous 20 days. As column 2 in Panel C shows, we do not find a differential timeliness for these mandatory forecasts following a sudden increase in investor uncertainty. However, when we repeat the analysis for all the other voluntary disclosures by Japanese firms (i.e., press releases and management forecasts not bundled with earnings announcements), we do find that managers are quicker to respond after an

[16] For treated earnings announcements, we use the day of the information shock. We compare these shock days with the three days around the benchmark earnings announcements (i.e., t = 0, +1, +2).

information shock (even though only the *Positive Shock* coefficient is statistically significant. Taken together, the results in columns 2 and 3 of Panel C strongly corroborate our hypothesis and do so using an out-of-sample placebo test.

In column 4 of Panel C, we conduct a similar analysis for U.S. firms. It is customary for U.S. firms to issue an accompanying press release during quarterly earnings announcements, making such disclosures and their timing quasi-mandatory in nature. Thus, we code up all press releases that were issued within [-2, +2] days around an earnings announcement as mandatory and examine their timeliness relative to extreme stock price movements during the 20-day lead up period. As the results show, we do find a negative coefficient for *Positive Shocks*, but only at the 10% significance level and with a magnitude that is less than half of the coefficient for the full U.S. sample (Panel B, column 1). The coefficient for *Negative Shocks* is insignificant. These results are consistent with our argument that the timing for these bundled press releases should be largely unaffected by changes in information asymmetry.

Finally, we conduct a series of additional sensitivity analyses (not tabulated): (1) We impose an even tighter fixed-effects structure by replacing the county-by-day fixed effects with country-by-industry-by-day fixed effects, using one-digit SIC industry for the refinement. (2) We define the *Information Shock* variable with daily stock returns adjusted by local market index returns. (3) We limit the *Information Shock* variable to even more extreme events and set the cutoff value at the top and bottom 0.5-percentile level of the overall sample distribution. For all these variants, the results remain similar to those reported and none of the inferences change.

4.3 Cross-sectional Analyses – Role of Private Information

Next, we examine the cross-sectional patterns in our main findings. Managers' ability to respond to an increase in uncertainty depends on both the quantity and quality of the private

information they are endowed with. Related, managers' willingness to respond is a function of the extent to which they are expected to possess private information (e.g., Dye, 1985; Jung and Kwon 1988) and that their private information signal is perceived to be more precise (e.g., Verrecchia 1990). Under such conditions, they are likely to face more pressure from investors demanding voluntary disclosure, especially after an information shock occurs. To test these predictions, we extend equation (1) as follows:

$$\begin{aligned} \textit{Days to Disclosure}_{i,t} = {} & \beta_1 \textit{Information Shock}_{i,t} + \beta_2 \textit{Information Shock}_{i,t} \text{ x } \textit{PART} + \\ & \beta_3 \textit{PART} + \Sigma \beta_j \textit{Controls}_j + \Sigma \beta_k \textit{Fixed Effects}_k + \varepsilon_{i,t.} \end{aligned} \quad (3)$$

PART is a binary variable that partitions our sample into subsets of firms based on our cross-sectional predictions. We include both the main effect on the partitioning variable as well as the interaction term with *Information Shock*. The coefficient of interest, $\beta_{2,}$ reflects managers' incremental propensity to issue (delay) disclosure when they are endowed (not endowed) with firm-specific private information. The first four partitioning variable captures instances when managers are more likely to have an information advantage. We use *Forecast Dispersion* to capture the level of information asymmetry between managers and other capital market participants (Barron, Kim, Lim, and Stevens 1998; Leuz 2003). *Goodwill Amount* identifies firms with a large share of intangible assets; *Impairment Losses* identifies firms when the value of intangible assets is uncertain. In both cases, managers are better informed about the value of the firm's assets than outsiders (Barth, Kasznik, and McNichols 1999). A high level of inventory (*Inventory*) is likely to reflect instances when managers are either directly responsible for inventory growth in anticipation of increased demand, or are facing potential write-downs (Hutton, Lee, and Shu 2012). Table 6 columns 1 to 4 present the results. Consistent with the baseline specification, the main effects of *Positive Shock* and *Negative Shock* are associated with more timely voluntary disclosures. More importantly, seven of the eight coefficient estimates on β_2 are significantly

negative across each of the four columns. The evidence suggests that when managers are more likely endowed with private information, firms are quicker to disclose additional information in response to a sudden increase in investor uncertainty.

We also identify circumstances where managers are likely to have less precise private information. When firms experience high fundamental volatility in their operations (reflected in either high *Return Variability* or *Cash Flow Variability*), it is more difficult for managers to make accurate forecasts of future operations (Waymire, 1985). Table 6 columns 5 and 6 present the results. While the main effects of *Positive Shock* and *Negative Shock* continue to be negative, there are asymmetric responses to positive versus negative shocks in the cross-section. Specifically, for firms with high return and cash flow variability, we observe a positive and significant β_2 coefficient for *Negative Shock*, suggesting that managers' disclosure responses to negative shocks are slower. This pattern is consistent with the predictions in Penno (1996) that firms will respond to a negative public signal with extensive information production that is likely to be labor-intense and time-consuming (a "back-to-the-wall" policy).

4.4 Time-series Analyses – Macroeconomic Uncertainty

In this section, we use two approaches to examine the effect of macroeconomic uncertainty on firms' disclosure. Country-level changes in macroeconomic conditions are largely exogenous for the individual firms. Therefore, to the extent that managers are less likely to have high-quality private information on the consequences of such uncertainty, we expect that managers may opt to reduce to delay voluntary disclosure. Our first approach re-estimates equation (1) using information shocks defined at the market level. Specifically, *Positive Shock* (*Negative Shock*) is defined as days during which the local market's daily index return is 2.326 standard deviations above (below) the sample mean. Table 7 column 1 presents the results. Consistent with our

prediction, we document a positive coefficient on both *Positive Shock* and *Negative Shock*, suggesting that managers delay disclosure when facing such macroeconomic shocks.

Our second approach estimates equation (3) using time-varying, country-level macroeconomic conditions as partitioning variables. The set of partitioning variables includes: high changes in GDP from the same quarter last year (*GDP Change*), high aggregate analyst forecast dispersion in the country (*Aggregate Forecast Dispersion*), high country risk following Hassan, Schwedeler, Schreger, and Tahoun (2023) (*Country Risk Score*), high aggregate volatility in firm profits (*Aggregate Earnings Variability*), a high proportion of loss-making firms (*Aggregate Loss Percentage*). Table 7 columns 2 to 6 present the results. The coefficient estimates on β_2 are positive across all columns and significant for eight out of the ten cases. These results suggest that during periods of high macroeconomic uncertainty, firms are slower to issue voluntary disclosure after information shocks, consistent with the intuition that managers are less likely to be endowed with high-quality private information in this context.

4.5 Information Content of Voluntary Disclosure After Information Shocks

In our final set of analyses, we examine the information content of voluntary disclosures released after a sudden increase in investor uncertainty. First, we focus on textual attributes of the press releases and management forecasts. Table 8 reports the results of estimating equation (2). Note that in this specification, the unit of analysis is an individual disclosure, and the main variable of interest is an indicator for whether the disclosure was released as response to an information shock or not in the preceding 20 trading days.

For press releases, we investigate the tone of the disclosure (*Sentiment*) and the amount of verifiable, quantitative information it contains (*Financial Information*). For a detailed description of all variable definitions in this section, see Appendix A. Column 1 shows a significant negative

coefficient on *Following Negative Shock*, suggesting that managers phrase press releases issued after a negative shock mainly in a negative tone. The coefficient *Following Positive Shock* indicates a positive tone but is not significant. In column 2, both coefficients are positive and significant, indicating that press releases following an information shock are more likely to contain verifiable, financial information such as sales forecasts or margin estimates.

For management forecasts, we examine the extent of forward-looking information (based on the number of sentences that contain such terms as "anticipate" or "expect;" see Appendix C) as well as the number of financial metrics they contain (e.g., EBIT or profit). In columns 3 and 4 of Table 8, we report positive coefficients across both types of shocks, which are significant in three out of the four cases. The results suggest that management forecasts issued after an information shock are phrased in a more forward-looking tone and contain more hard, verifiable information than the other forecasts. In sum, these findings are consistent with managers trying to be more informative in their disclosures when faced with a sudden increase in uncertainty.

In Table 9, we switch the perspective and examine how investors perceive these supposedly more informative voluntary disclosures. We include the same set of controls as in our timeliness analyses (Table 4) plus additional variables for the concurrent release of an earnings announcement (*Concurrent EA*), the time since the preceding information shock (*Days Since Previous Shock*), and the change in *Operating Income*. First, in column 1, we examine signed cumulative abnormal returns (*CAR*) computed over the two days around the release of the voluntary disclosure (i.e., days $t = 0$ and +1). We do not have specific expectations about the signs on the shock coefficients. While the coefficient on *Following Positive Shock* is essentially zero, the one on *Following Negative Shock* is positive and significant. This finding suggests that the disclosures issued in

response to a negative information shock help clarify the reasons that might have led to a significant drop in stock prices and, hence, are perceived as good news.

To better get at the information content of the disclosures, we use the absolute value of the cumulative abnormal returns (*Abs. CAR*) as the dependent variable and report results in column 2. Both shock coefficients are positive and highly significant. In terms of magnitude, the coefficients are comparable to those for the concurrent release of earnings announcements. The findings suggest that investors perceive these disclosures as more informative than those released during regular times, consistent with expectations.

Finally, in columns 3 and 4, we examine investors' trading behavior and use two-day share *Turnover* and *Abnormal Volume* as the dependent variables, in line with Beaver (1968) and Beaver, McNichols, and Wang (2020). All four shock coefficients are positive and three are statistically significant. The results suggest that the newly released information allows investors to update their priors and, in doing so, incentivizes them to trade. More to the point, the trading reactions are larger compared to those around management forecasts and press releases that were *not* preceded by extreme stock returns. This finding is consistent with managers providing incrementally useful information after a sudden increase in information uncertainty among investors. At the same time, the volume reactions are smaller than those around earnings announcements, which seems plausible as typically more information is released when a firm announces its earnings.

5. Conclusion

In this study, we examine changes in firms' voluntary disclosure behavior following sudden increases in investor uncertainty. We use extreme stock price movements to proxy for such increases in information uncertainty that likely exacerbate the adverse selection problem between managers and investors. Firm-initiated press releases and management forecasts serve as our proxy

for voluntary disclosure. Building on extant disclosure theories, we would expect the propensity and timeliness of voluntary disclosure to increase in the aftermath of heightened uncertainty because managers are likely in a better position to interpret the unknown situation due to access to new and existing inside information. We further expect the effects to be stronger when managers are endowed with more private information, but weaker or even reversed when the uncertainty simultaneously affects many parties, including management.

We test the above predictions for a large global sample containing observations drawn from 33 countries over the 2004 to 2019 period. We find that firms, *on average*, are both more likely to issue voluntary disclosure and timelier in doing so after information shocks. The effects are indeed stronger when managers have more private information but become weaker or even opposite during periods of high macroeconomic uncertainty. We further show that the voluntary disclosures following increases in investor uncertainty contain more hard, verifiable information and, in turn, investors perceive them as more value relevant. Overall, our results shed light on this fundamental relation between investors' beliefs about the second moment of a firm's expected cash flows and its disclosure response. In equilibrium, managers try to abate the adverse selection problem by providing new information. Only when they are not in the position to do so or the expected benefits of additional disclosure are small, they withhold or delay the release of new information.

We can also interpret our findings as large sample evidence on the first necessary condition in the disclosure-cost of capital relation. In our setting, the disclosure choice is a response to increased uncertainty which likely also causes cost of capital to increase and—if unaccounted for—leads to a *positive* correlation between the two constructs (Clinch and Verrecchia 2015). Only if firms' voluntary disclosure goes beyond what is induced by the exogenous shock, one would

expect an unambiguously negative effect on cost of capital. We leave analyses like these that could build on our approach to address the identification challenges to future research.

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Appendix A
Variable Definitions

Panel A: Information Event Variables

Information Shock (indicator)	The variable takes on the value of "1" for firm *i* on day *t* if a firm's daily stock return falls outside of 2.326 standard deviations of the sample mean daily stock return (i.e., z-score of 1 percent), and "0" otherwise. We compute daily stock returns as $(ri_t / ri_{t-1}) - 1$, using Datastream's total return index (RI). The sample to determine extreme daily stock returns is the largest possible with return and disclosure data available (i.e., across all sample countries and years and before applying filters such as requiring data for the control variables or limiting the sample to the 20 trading days leading up to a disclosure).
Positive Shock; Negative Shock (indicators)	The two variables partition the *Information Shock* variable into firm-days on which stock returns exceed (*Positive*) or fall below (*Negative*) the extreme-stock-return threshold.
Following Information Shock (indicator)	The variable takes on the value of "1" for firm *i*'s disclosure *d* (press release or management forecast) if there was an *Information Shock* during the pre-disclosure window (i.e., from the close of trading day $t = -20$ or the day after *i*'s previous disclosure until day $t = -1$ before the disclosure of *d*), and "0" otherwise.
Following Positive Shock; Following Negative Shock (indicators)	The two variables partition the *Following Information Shock* variable into disclosures following a *Positive Shock* or *Negative Shock*.

Panel B: Disclosure Variables Used as Regressands

Has Disclosure (indicator)	The variable takes on the value of "1" for firm *i* on day *t* if the firm releases a disclosure *d* (press release or management forecast) in the next 20 trading days (i.e., from day $t = +1$ to $t = +20$), and "0" otherwise. We use RavenPack to identify firm-initiated press releases (i.e., NEW_TYPE = press-release). To pare down the number of press releases, we require a relevance score of 100 and the topic to be "business" or ESG related (i.e., topic = "society" and group = "aid," "bankruptcy," "civil-unrest," "corporate-responsibility," "crime," "health," "industrial-accidents," "labor-issues," "legal," "natural-disasters," "pollution," "regulatory," "security," or "war-conflict"). We use Capital IQ to identify management forecasts (i.e., EVENT TYPE = corporate guidance). We assign disclosures released during local trading hours to day $t = 0$. Disclosures released after the close of local trading (but before the start of trading on the next day) or on a non-trading day are assigned to the next trading day (i.e., $t = +1$) within a window of 7 calendar days.
Days to Disclosure (# days)	The variable equals the count of trading days from day *t* of firm *i* until the day the firm releases a disclosure *d* (press release or management forecast) in the next 20 trading days. By construction, the variable is bound between +1 and +20.
Sentiment (score)	RavenPack event sentiment score (ESS) for firm *i*'s disclosure *d* (press releases). When there are multiple press releases on day *t*, we compute the mean ESS score. The ESS score ranges from 0 to 100, with values above 50 representing positive events.
Financial Information (indicator)	The variable takes on the value of "1" for firm *i*'s disclosure *d* (press releases) if it contains current or forward-looking financial information, and "0" otherwise. We identify financial information based on RavenPack's GROUP and TYPE taxonomy (see Appendix B for details).

# Forecast Sentences (count)	The variable equals the count of sentences with forward-looking information in firm *i*'s disclosure *d* (management forecasts). When there are multiple forecasts on day *t*, we sum over all forecasts. We use Capital IQ's synopsis field "situation" as proxy for *d* and flag sentences if they contain at least one forward-looking term such as the firm "aims" or the company "expects" (see Appendix C for the full list and details).
# Financial Metrics (count)	The variable equals the count of unique financial metrics mentioned in firm *i*'s disclosure *d* (management forecasts). When there are multiple forecasts on day *t*, we aggregate over all forecasts. We use Capital IQ's synopsis field "situation" as proxy for *d* and flag financial metrics in forecast sentences if they match terms such as "EBIT" or "EPS" (see Appendix C for the full list and details).
CAR; Abs. CAR (%)	The (absolute) cumulative abnormal return of firm *i* on trading days $t = 0$ and +1 around disclosure *d* (press release or management forecast). We compute daily (index) returns as $(ri_t / ri_{t-1}) - 1$, using Datastream's total return index (RI). We subtract daily local index returns from firm returns to compute abnormal returns.
Turnover (ratio)	The mean share turnover of firm *i* on trading days $t = 0$ and +1 around disclosure *d* (press release or management forecast). We compute daily share turnover as the number of shares traded divided by the number of shares outstanding as indicated in Datastream. That is, [turnover by volume (VO) * price (P) / market value (MV)] with market value equal to the number of ordinary shares in issue multiplied by price.
Abnormal Volume (ratio)	The difference between the mean share *Turnover* of firm *i* on trading days $t = 0$ and +1 around disclosure *d* (press release or management forecast) and the mean share *Turnover* of firm *i* during an estimation period (measured over days $t = -130$ to $t = -25$), scaled by the standard deviation of daily share *Turnover* in the estimation period.

Panel C: Cross-Sectional Variables

Forecast Dispersion (std. dev.)	The yearly mean of firm *i*'s monthly standard deviations in analysts' one-year ahead annual earnings-per-share forecasts as reported in the I/B/E/S consensus summary file (STDEV). We require that, on average, three or more analysts (NUMEST ≥ 3) cover firm *i* during the year for the computation of this variable.
Goodwill Amount (ratio)	Gross goodwill amount (Worldscope item 2502) minus accumulated amortization on goodwill (item 2503), scaled by total assets (item 2999). If missing, we set this variable to zero.
Impairment Losses (ratio)	Impairment of goodwill (Worldscope item 18225) scaled by total assets (item 2999). If missing or negative, we set this variable to zero.
Inventory (ratio)	Total inventories (Worldscope item 2101) scaled by total assets (item 2999).
Return Variability (std. dev.)	The standard deviation of daily stock returns computed over all trading days of firm *i* in the sample. We compute daily stock returns as $(ri_t / ri_{t-1}) - 1$, using Datastream's total return index (RI).
Cash Flow Variability (std. dev.)	The standard deviation of annual net operating cash flows (Worldscope item 4860) scaled by total assets (item 2999) and computed over all sample years of firm *i*. We require at least five cash flow observations for the computation of this variable.
GDP Change (%)	The quarterly percentage change in a country's gross domestic product from the same quarter last year using constant prices (source: www.theGlobalEconomy.com).
Aggregate Forecast Dispersion (std. dev.)	The country-quarter mean of firm-level analyst forecast dispersion. We measure forecast dispersion as the quarterly mean of firm *i*'s monthly standard deviations in analysts' one-year ahead annual earnings-per-share forecasts as reported in the I/B/E/S consensus summary file (STDEV).

Country Risk Score (score)	Measure of country risk at the country-quarter level from Hassan et al. (2022) that is derived from the amount of time executives and investors at a firm spend discussing risks associated with country *c* in their earnings conference calls held in quarter *q*.
Aggregate Earnings Variability (std. dev.)	The standard deviation of firm-level *Return on Assets* computed over all sample firms in a country-year.
Aggregate Loss Percentage (%)	Proportion of firms with negative earnings-per-share (Worldscope item 5201) out of all sample firms in a country-year.

Panel D: Control Variables

Total Assets (USD million)	Total Assets in USD (Worldscope item 7230).
Return on Assets (ratio)	Operating income (Worldscope item 1250) divided by the mean of total assets (item 2999) computed over the years $y = 0$ and -1.
Book-to-Market (ratio)	Book value of common equity (Worldscope item 3501) divided by the market value of equity (item 8001).
Leverage (ratio)	Long-term debt (Worldscope item 3251) divided by total assets (item 2999).
Earnings Variability (std. dev.)	The standard deviation of annual earnings-per-share (Worldscope item 5201) computed over the years $y = 0$ to -4 and scaled by total assets per share. We compute the latter as total assets (item 2999) divided by the number of common shares outstanding (item 5301). We require earnings-per-share data in the years $y = 0$ to -2 for the computation of this variable.
Return Variability (std. dev.)	The standard deviation of annual stock returns (Worldscope item 8801) computed over the years $y = 0$ to -4. We require annual stock returns data in the years $y = 0$ to -2 for the computation of this variable.
Number of Analysts (count)	Yearly mean of firm *i*'s monthly number of analysts with a one-year ahead annual earnings-per-share forecast as reported in the I/B/E/S consensus summary file (NUMEST).
Inst. Ownership – Domestic; *Inst. Ownership - Foreign* (%)	The yearly means of shares held by domestic (IO_DOM) or foreign (IO_FOR) institutional investors as a percentage of market capitalization, computed based on the methodology from Ferreira and Matos (2008). We download this data from Factset Ownership.
Negative News (indicator)	The variable takes on the value of "1" if a firm's operating income (Worldscope item 1250) decreases from year $y = -1$ to 0, and "0" otherwise.
Equity Issuance (indicator)	Following Li and Yang (2016), the variable takes on the value of "1" if a firm's number of common shares outstanding (Worldscope item 5301) increases by 20 percent or more from year $y = -1$ to 0, and "0" otherwise.
ADR Listing (indicator)	The variable takes on the value of "1" if a firm has sponsored ADRs traded on NYSE or Nasdaq in year *y*, and "0" otherwise. We identify these firms using Datastream's ADR status (ADR) and further include securities whose names contain the terms "depository shares," "depository receipts," and "ADR." For Israeli and Canadian firms, this variable takes on the value of "1" if a firm is directly listed on NYSE or Nasdaq.
Zero Return Days (%)	Proportion of trading days with zero daily stock returns out of all potential trading days in year *y*. We define zero return days as days with no change in Datastream's total return index (RI) and zero turnover by volume (VO).

Quarterly Reporting (indicator)	The variable takes on the value of "1" if the firm reports interim results at a quarterly frequency (Worldscope item 5200), and "0" otherwise.
Concurrent EA (indicator)	The variable takes on the value of "1" if the release of a firm's disclosure *d* (press release or management forecast) on trading day $t = 0$ overlaps with an earnings announcement over the window $t = -2$ to +2, and "0" otherwise. We use Worldscope annual and interim earnings-per-share report dates (items 5901-5905) to construct this variable.
Days Since Previous Shock (# days)	The variable equals the count of trading days from the day of firm *i*'s previous *Information Shock* until the day of the disclosure *d* (press release or management forecast). If the *Information Shock* occurred outside the pre-disclosure window (i.e., more than 20 trading days ago), we set the variable to +20.
Δ *Operating Income* (%)	Percentage change in operating income (Worldscope item 1250) from year $y = -1$ to 0.

Unless indicated otherwise, accounting data and market values are measured as of the fiscal-year end of firm *i* in year *y*. Except for variables with natural lower or upper bounds (e.g., *Leverage*), we truncate variables at the first and 99th percentile using the largest sample possible (i.e., across all sample countries and years and before applying the data filters). To avoid data errors, we arbitrarily truncate daily stock returns at +/– 75 percent before computing extreme stock returns.

Appendix B
Identification of Press Releases Containing Financial Information

To identify whether a firm-initiated press release contains current or forward-looking financial information, we use RavenPack's GROUP and TYPE taxonomy. Specifically, we use the following GROUP-TYPE combinations to flag press releases as containing financial information:

GROUP	*TYPE*
analyst-ratings	all types
bankruptcy	all types
credit-ratings	all types
dividends	all types
earnings	all types
equity-actions	capex; capex-guidance; expenses; expenses-guidance; investment; savings; savings-guidance; delisting-review; trading
indexes	all types
investor-relations	conference-call
price-targets	all types
products-services	demand-guidance; market-guidance; production-outlook; supply-guidance
revenues	all types
stock-prices	all types
technical-analysis	all types

Appendix C
Identification of Forecast Sentences and Financial Metrics in Management Forecasts

We follow the approaches in Li (2010, Appendix B) and Bozanic et al. (2018, Online Appendix) to identify sentences with forward-looking information in management forecasts. We use the text in Capital IQ's "situation" field to proxy for a firm's forecasts as released by management. This field contains summaries of management guidance of U.S. and non-U.S. firms, some of which translated from local language announcements into English. To encompass this international sample, we use a modified wordlist with the following forward-looking terms to flag forecast sentences:

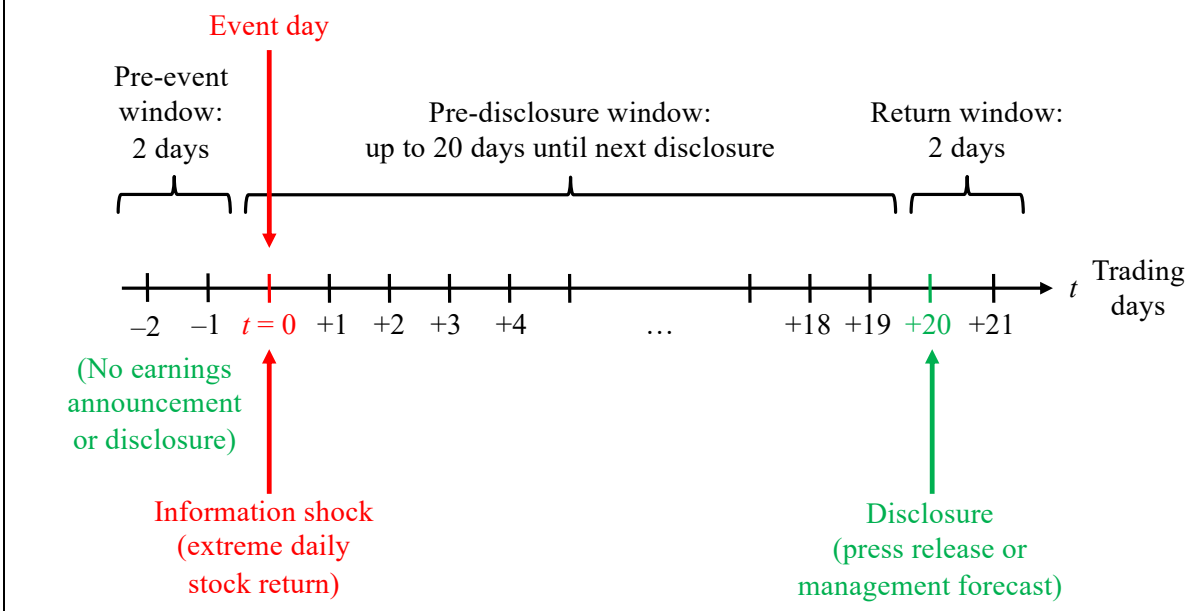
aim	estimate	may	reaffirm
anticipate	expect	might	reiterate
assume	forecast	objective	see
believe	goal	outlook	seek
budget	guide	plan	should
can	hope	possible	target
commit	intend	predict	track
could	likely	project	will
earmark	maintain	raise	

For verbs, we also include the conjugated forms (e.g., "estimates" or "estimated") and noun forms ("estimation") in the algorithm. Because sometimes the "situation" field contains information about analyst forecasts, we exclude sentences in which the terms "street," "analyst," "consensus," "prevailing," or "previous" appear within three words of the forward-looking term. This convention prevents the misclassification of sentences such as "analysts expect EPS to reach 90 cents in 2020."

To identify and count the unique financial metrics mentioned in the management forecasts, we search the forecast sentences for whether they contain the following income statement and cash flow metrics (and their variants):

sale	EBIT	profit	capex
revenue	tax rate	loss	investment
cost	earnings	EPS	capital
EBITDA	income	expenditure	cash flow

Figure 1: Data Structure for Firm-Day Panel



Coding of key variables for firm *i* on day $t = 0$:

Variable	Value
Information Shock	1
Has Disclosure	1
Days to Disclosure	20

Coding of key variables for firm *i*'s disclosure *d* on day $t = +20$:

Variable	Value
Following Information Shock	1
Sentiment	65
CAR	0.014

The figure illustrates the data structure for our firm-day panel and the coding of some of the key variables in the analyses. The unit of observation is a trading day of firm *i*. For each trading day we examine whether it coincides with an extreme daily stock return (i.e., outside of 2.326 standard deviations from the sample mean; *Information Shock* = 1), and whether it is followed by a voluntary disclosure within the next 20 days (*Has Disclosure* = 1). We measure voluntary disclosures as firm-initiated press releases and management forecasts. When analyzing the timeliness of disclosures, we focus on the period leading up to firm *i*'s next disclosure *d* and, for each trading day, count the days until its release (*Days to Disclosure* = [1, 20]). To mitigate the confounding effects of concurrent firm disclosures, we make sure that days with an *Information Shock* are not preceded by an earnings announcement or disclosure on day $t = 0$, –1, or –2. In some analyses, we use the disclosure *d* of firm *i* as unit of observation. For each disclosure, we code up whether it had an *Information Shock* in the preceding 20 trading days (*Following Information Shock* = 1). We also examine the content of the disclosure, for instance, whether it had a positive or negative tone, measured as the RavenPack event sentiment score (*Sentiment*). Finally, we examine the market reaction to the disclosure, for instance, by looking at the cumulative abnormal return in the two days around its release (*CAR*).

Table 1: Sample Composition by Country and Year

Panel A: Number of Observations, Disclosures, and Information Shocks by Country

	Unique	*Firm-Days*		*Disclosures*		*Information Shocks*	
	Firms	*N*	*%*	*N*	*%*	*N*	*%*
Australia	296	65,787	3.0	5,534	2.6	3,649	4.2
Austria	45	18,982	0.9	1,221	0.6	276	0.3
Belgium	54	19,285	0.9	1,403	0.7	323	0.4
Brazil	44	9,489	0.4	748	0.3	209	0.2
Canada	844	391,572	17.6	42,387	19.7	25,298	29.1
China	48	2,908	0.1	274	0.1	176	0.2
Denmark	87	45,822	2.1	3,599	1.7	1,206	1.4
Finland	107	67,085	3.0	5,522	2.6	1,540	1.8
France	265	132,573	6.0	10,105	4.7	1,947	2.2
Germany	375	154,388	6.9	13,392	6.2	5,374	6.2
Hong Kong	346	33,381	1.5	3,412	1.6	2,902	3.3
India	101	23,654	1.1	2,114	1.0	512	0.6
Ireland	31	10,154	0.5	800	0.4	396	0.5
Israel	59	34,793	1.6	3,393	1.6	831	1.0
Italy	65	18,039	0.8	1,337	0.6	338	0.4
Malaysia	31	4,203	0.2	250	0.1	32	0.0
Mexico	43	15,760	0.7	1,160	0.5	232	0.3
The Netherlands	75	33,871	1.5	2,957	1.4	548	0.6
New Zealand	25	7,121	0.3	404	0.2	40	0.0
Norway	92	24,014	1.1	2,326	1.1	1,385	1.6
Philippines	23	4,891	0.2	322	0.1	61	0.1
Poland	30	4,899	0.2	344	0.2	93	0.1
Russia	39	13,807	0.6	1,151	0.5	378	0.4
Singapore	41	10,638	0.5	806	0.4	208	0.2
South Africa	130	41,793	1.9	3,176	1.5	1,066	1.2
South Korea	28	3,386	0.2	271	0.1	60	0.1
Spain	43	10,937	0.5	770	0.4	128	0.1
Sweden	146	54,199	2.4	4,757	2.2	815	0.9
Switzerland	122	52,224	2.3	3,819	1.8	665	0.8
Taiwan	59	16,090	0.7	1,465	0.7	277	0.3
Thailand	26	5,605	0.3	397	0.2	124	0.1
United Kingdom	946	226,457	10.2	18,752	8.7	7,238	8.3
United States	988	664,862	29.9	76,785	35.7	28,549	32.9
Total	5,654	2,222,669	100.0	215,153	100.0	86,876	100.0

(continued on next page)

Table 1 (continued)

Panel B: Number of Observations, Disclosures, and Information Shocks by Year

	Firm-Days		*Disclosures*		*Information Shocks*	
	N	*%*	*N*	*%*	*N*	*%*
2004	82,322	3.7	8,798	4.1	2,058	2.4
2005	104,301	4.7	10,119	4.7	1,964	2.3
2006	105,799	4.8	10,538	4.9	2,459	2.8
2007	108,280	4.9	10,850	5.0	2,700	3.1
2008	70,801	3.2	10,418	4.8	14,758	17.0
2009	90,131	4.1	12,116	5.6	12,605	14.5
2010	152,780	6.9	14,807	6.9	4,540	5.2
2011	152,110	6.8	15,571	7.2	6,914	8.0
2012	172,789	7.8	16,025	7.4	4,337	5.0
2013	182,245	8.2	16,157	7.5	4,305	5.0
2014	170,995	7.7	14,701	6.8	4,283	4.9
2015	157,610	7.1	14,233	6.6	5,422	6.2
2016	158,343	7.1	15,166	7.0	6,699	7.7
2017	183,630	8.3	15,843	7.4	3,925	4.5
2018	175,506	7.9	15,729	7.3	5,048	5.8
2019	155,027	7.0	14,082	6.5	4,859	5.6
Total	2,222,669	100.0	215,153	100.0	86,876	100.0

The sample in our base specification (see Table 4, column 1) comprises 2,222,669 firm-day observations from 33 countries between 2004 and 2019 with data available. We require firms to have total assets upwards of 10 USD million. For a firm to be included, our data sources for voluntary disclosures (RavenPack for firm-initiated press releases and Capital IQ for management forecasts) must contain at least two datapoints over the sample period. We only include observations from countries with, on average, 10 or more firms per year. We drop Japanese firms from the sample because in Japan many management forecasts are effectively mandated. To reduce the weight of the United States as the largest sample country, we randomly pick 1,112 U.S. firms to be included, which is the same number as unique U.K. firms (second largest country) before applying the data filters. The base sample only includes firm-days that are followed by a voluntary disclosure within the next 20 trading days. The variable *Information Shock* marks firm-days that coincide with extreme daily stock returns (i.e., outside of 2.326 standard deviations from the sample mean). We make sure that days with an *Information Shock* are not preceded by an earnings announcement or disclosure on day $t = 0, -1,$ or -2. The table reports the number of unique firms, firm-days, voluntary disclosures, and information shocks by country (Panel A) and year (Panel B).

Table 2: Descriptive Statistics for Variables Used in the Regression Analyses

	Mean	*Std. Dev.*	*P1*	*P25*	*Median*	*P75*	*P99*
Dependent Variables:							
Has Disclosure (indicator)	0.360	0.480					
Days to Disclosure (# days)	9.300	5.723	1.000	4.000	9.000	14.000	20.000
Information Events:							
Information Shock (indicator)	0.039	0.194					
Positive Shock (indicator)	0.022	0.147					
Negative Shock (indicator)	0.017	0.129					
Main Control Variables:							
Log(*Total Assets*) (USD million)	7.471	1.888	3.086	6.136	7.592	8.841	11.151
Return on Assets (ratio)	0.070	0.104	-0.292	0.029	0.069	0.116	0.320
Book-to-Market (ratio)	0.601	0.497	-0.036	0.291	0.483	0.774	2.521
Leverage (ratio)	0.191	0.169	0.000	0.038	0.164	0.294	0.682
Earnings Variability (std. dev.)	0.063	0.283	0.001	0.012	0.024	0.049	0.586
Return Variability (std. dev.)	0.414	0.360	0.083	0.211	0.318	0.490	1.867
Number of Analysts (count)	9.322	8.092	0.000	3.000	7.083	13.583	33.667
Inst. Ownership – Domestic (%)	0.278	0.302	0.000	0.034	0.141	0.462	0.964
Inst. Ownership – Foreign (%)	0.112	0.128	0.000	0.019	0.072	0.159	0.598
Negative News (indicator)	0.398	0.489					
Equity Issuance (indicator)	0.053	0.224					
ADR Listing (indicator)	0.028	0.164					
Zero Return Days (%)	0.042	0.056	0.000	0.027	0.031	0.035	0.336
Quarterly Reporting (indicator)	0.745	0.436					

All definitions for the variables reported are in Appendix A. The sample corresponds to our base specification (see Table 4, column 1) and comprises 2,222,669 firm-day observations from 33 countries between 2004 and 2019 with data available (except for the variable *Has Disclosure*, for which we use an expanded sample of 6,180,138 as shown in Table 3, column 1).

Table 3: Propensity of Voluntary Disclosures in the Aftermath of Information Shocks

Has Disclosure as Dependent Variable	*(1)*	*(2)*	*(3)*	*(4)*
Information Events:				
Information Shock	0.035***	–	0.013***	–
	(5.39)		(3.46)	
Positive Shock	–	0.036***	–	0.013***
		(6.22)		(4.01)
Negative Shock	–	0.033***	–	0.012**
		(4.40)		(2.69)
Control Variables:				
Log(*Total Assets*)	0.016***	0.016***	0.028***	0.028***
	(2.84)	(2.84)	(8.92)	(8.92)
Return on Assets	-0.087***	-0.087***	0.011	0.011
	(-3.85)	(-3.85)	(0.79)	(0.79)
Book-to-Market	-0.018*	-0.018*	-0.005	-0.005
	(-1.91)	(-1.91)	(-1.68)	(-1.68)
Leverage	0.072*	0.072*	0.025**	0.025**
	(1.85)	(1.85)	(2.39)	(2.39)
Earnings Variability	0.003	0.003	0.000	0.000
	(0.85)	(0.86)	(0.03)	(0.03)
Return Variability	-0.013	-0.013	0.006*	0.006*
	(-1.43)	(-1.43)	(1.86)	(1.86)
Log(1+*Number of Analysts*)	-0.002	-0.002	0.022***	0.022***
	(-0.35)	(-0.35)	(4.80)	(4.80)
Inst. Ownership – Domestic	0.372***	0.372***	0.075***	0.075***
	(7.90)	(7.90)	(4.06)	(4.06)
Inst. Ownership – Foreign	0.137	0.137	0.061***	0.061***
	(1.54)	(1.54)	(2.77)	(2.77)
Negative News	0.007*	0.007*	0.003*	0.003*
	(1.99)	(1.99)	(1.85)	(1.85)
Equity Issuance	0.023	0.023	0.005*	0.005*
	(1.45)	(1.45)	(1.78)	(1.78)
ADR Listing	0.091**	0.091**	0.016	0.016
	(2.68)	(2.68)	(0.48)	(0.48)
Zero Return Days	-0.091*	-0.091*	-0.058**	-0.058**
	(-1.83)	(-1.83)	(-2.23)	(-2.23)
Quarterly Reporting	0.158***	0.158***	0.030**	0.030**
	(3.74)	(3.74)	(2.46)	(2.46)
Fixed Effects	None	None	Firm & Country-Day	Firm & Country-Day
Adjusted R^2	9.7%	9.7%	28.0%	28.0%
N	6,180,138	6,180,138	6,176,731	6,176,731

The table reports OLS coefficient estimates and (in parentheses) *t*-statistics from regressions of a binary variable indicating, on day *t*, whether firm *i* was going to issue a voluntary disclosure within the next 20 trading days (*Has Disclosure* = 1) on *Information Shock* and various control variables. The variable *Information Shock* marks firm-days that coincide with extreme daily stock returns that are 2.326 standard deviations above (*Positive Shock*) or below the sample mean (*Negative Shock*). We also make sure that days with an *Information Shock* are not preceded by an earnings announcement or disclosure on day $t = 0, -1$, or -2. For detailed variable definitions see Appendix A. The sample comprises a maximum of 6,180,138 firm-day observations from 33 countries between 2004 and 2019. We draw this sample after applying our data filters (see notes to Table 1) and – to make sure sample firms have a history of issuing voluntary disclosures – only include trading days with at least one datapoint in either RavenPack (firm-initiated press releases) or Capital IQ (management forecasts) in the subsequent year (i.e., within the next 252 trading days). We include an intercept and fixed effects (as indicated) in the models, but do not report the coefficients. We assess statistical significance based on robust standard errors clustered by country and indicate significance at the 1%, 5%, and 10% levels (two-tailed) with ***, **, and *.

Table 4: Timeliness of Voluntary Disclosures in the Aftermath of Information Shocks

Log(1+Days to Disclosure) as Dependent Variable	*(1)*	*(2)*	*(3)*	*(4)*
Information Events:				
Information Shock	-0.050***	–	-0.040***	–
	(-5.90)		(-6.62)	
Positive Shock	–	-0.052***	–	-0.043***
		(-6.78)		(-8.03)
Negative Shock	–	-0.047***	–	-0.036***
		(-4.79)		(-4.66)
Control Variables:				
Log(*Total Assets*)	-0.015***	-0.015***	-0.013***	-0.013***
	(-4.02)	(-4.02)	(-7.41)	(-7.42)
Return on Assets	0.064***	0.064***	-0.001	-0.001
	(3.99)	(3.99)	(-0.08)	(-0.07)
Book-to-Market	0.020***	0.020***	0.001	0.001
	(3.50)	(3.50)	(0.28)	(0.27)
Leverage	0.004	0.004	-0.017**	-0.017**
	(0.16)	(0.16)	(-2.41)	(-2.41)
Earnings Variability	-0.007**	-0.007**	-0.001	-0.001
	(-2.52)	(-2.53)	(-0.20)	(-0.20)
Return Variability	-0.008	-0.007	-0.009**	-0.009**
	(-1.58)	(-1.58)	(-2.60)	(-2.60)
Log(1+*Number of Analysts*)	-0.006	-0.006	-0.021***	-0.021***
	(-0.67)	(-0.67)	(-7.77)	(-7.78)
Inst. Ownership – Domestic	-0.169***	-0.169***	-0.041***	-0.041***
	(-6.43)	(-6.43)	(-3.33)	(-3.33)
Inst. Ownership – Foreign	-0.033	-0.033	0.001	0.001
	(-0.64)	(-0.64)	(0.05)	(0.04)
Negative News	-0.004**	-0.004**	-0.002	-0.002
	(-2.18)	(-2.17)	(-1.66)	(-1.66)
Equity Issuance	-0.022*	-0.022*	-0.016***	-0.016***
	(-1.72)	(-1.72)	(-2.86)	(-2.86)
ADR Listing	-0.058**	-0.058**	-0.059	-0.059
	(-2.65)	(-2.65)	(-1.67)	(-1.67)
Zero Return Days	-0.013	-0.013	0.046*	0.046*
	(-0.27)	(-0.27)	(1.82)	(1.82)
Quarterly Reporting	-0.061***	-0.061***	0.011	0.011
	(-3.87)	(-3.87)	(1.33)	(1.32)
Fixed Effects	None	None	Firm & Country-Day	Firm & Country-Day
Adjusted R^2	1.2%	1.2%	11.0%	11.0%
N	2,222,669	2,222,669	2,206,438	2,206,438

The table reports OLS coefficient estimates and (in parentheses) *t*-statistics from regressions of a variable marking, on day *t*, the count of days until firm *i* releases its next voluntary disclosure (*Days to Disclosure* = [1, 20]) on *Information Shock* and various control variables. The variable *Information Shock* marks firm-days that coincide with extreme daily stock returns that are 2.326 standard deviations above (*Positive Shock*) or below the sample mean (*Negative Shock*). For detailed variable definitions see Appendix A. The sample comprises a maximum of 2,222,669 firm-day observations from 33 countries between 2004 and 2019 and only includes firm-days that are followed by a voluntary disclosure within the next 20 trading days (see also notes to Table 1). We include an intercept and fixed effects (as indicated) in the models, but do not report the coefficients. We assess statistical significance based on robust standard errors clustered by country and indicate significance at the 1%, 5%, and 10% levels (two-tailed) with ***, **, and *.

Table 5: Sensitivity Analyses of Disclosure Timeliness after Information Shocks

Panel A: Important Research Design Choices

Log(1+Days to Disclosure) as Dependent Variable	*(1) Pre-disclosure Window of 10 Days*	*(2) Pre-disclosure Window of 30 Days*	*(3) Shocks Defined Within Country*	*(4) Shocks Defined Based on Extreme Turnover*	*(5) Shocks Defined Based on Smith & So (2022) Metric*
Information Events:					
Positive Shock	-0.037***	-0.066***	-0.048***	-0.062***	-0.060***
	(-5.28)	(-11.83)	(-11.23)	(-14.66)	(-5.86)
Negative Shock	-0.037***	-0.060***	-0.037***	–	–
	(-4.10)	(-7.66)	(-4.24)		
Control Variables	Included	Included	Included	Included	Included
Fixed Effects	Firm & Country-Day	Firm & Country-Day	Firm & Country-Day	Firm & Country-Day	Firm & Day
Adjusted R^2	6.2%	16.0%	11.0%	10.0%	9.5%
N	1,288,255	2,944,186	2,192,302	2,867,078	628,274

Panel B: Largest Sample Countries

Log(1+Days to Disclosure) as Dependent Variable	*(1) United States*	*(2) Canada*	*(3) United Kingdom*	*(4) Germany*	*(5) France*
Information Events:					
Positive Shock	-0.044***	-0.035***	-0.043***	-0.057***	-0.064***
	(-5.54)	(-3.35)	(-3.56)	(-4.10)	(-3.96)
Negative Shock	-0.040***	-0.016	-0.024*	-0.104***	0.015
	(-4.42)	(-1.31)	(-1.68)	(-5.61)	(0.63)
Control Variables	Included	Included	Included	Included	Included
Fixed Effects	Firm & Day	Firm & Day	Firm & Day	Firm & Day	Firm & Day
Adjusted R^2	9.5%	8.8%	4.3%	15.0%	11.0%
N	698,355	485,113	212,581	143,453	101,089

Panel C: Alternative Settings

Log(1+Days to Disclosure) as Dependent Variable	*(1) Shocks Following Earnings Announcements*	*(2) Japan (Mandatory Mgt. Forecasts)*	*(3) Japan (Voluntary Disclosures)*	*(4) United States (Quasi-Mandatory Press Releases)*
Information Events:				
Positive Shock	-0.148***	-0.002	-0.041***	-0.020*
	(-5.32)	(-0.18)	(-2.76)	(-1.86)
Negative Shock	-0.159***	0.001	-0.017	0.002
	(-4.15)	(0.06)	(-0.92)	(0.19)
Control Variables	Included	Included	Included	Included
Fixed Effects	Firm & Country-Month	Firm & Day	Firm & Day	Firm & Day
Adjusted R^2	12.0%	68.0%	12.0%	47.0%
N	26,775	180,775	152,053	244,087

(*continued on next page*)

Table 5 (continued)

The table reports OLS coefficient estimates and (in parentheses) *t*-statistics from estimating variations of our base specification (see Table 4, column 4). For detailed variable definitions see Appendix A. In Panel A, we assess the following important research design choices: (1) we shorten the pre-disclosure window (see Figure 1) to 10 days or (2) extend it to 30 days instead of using the 20-day window. (3) We define the *Information Shock* variable separately for each country based on the country-specific return distributions and cutoffs (at the 1-percentile level) instead of using the overall sample return distribution. (4) We define the *Information Shock* variable based on extreme daily share turnover instead of stock returns. Because turnover only assumes non-negative values, we use the top 2 percentile of the overall turnover distribution as cutoff. (5) We use the Smith and So (2022) *RiskInfo* measure of investors' risk expectations to identify information shocks. That is, for the subset of U.S. firms in our sample with option data available (source: OptionMetrics), we compute daily changes in the *RiskInfo* measure based on 30-day standardized option contracts as shown in equation (12) of Smith and So (2022, p. 388). We then set the *Information Shock* variable equal to "1" for the top 2 percentile of the overall *RiskInfo* distribution, marking the days with extreme spikes in investors' risk expectations. In Panel B, we report results for the five largest sample countries in terms of firm-day observations. In Panel C, we extend our analysis to alternative settings and samples: (1) We examine the timeliness of voluntary disclosures (within 20 trading days) after firms' earnings announcements ($t = 0$) that are either accompanied by or free of an *Information Shock* on day $t = 0$, +1, or +2. (2) We focus on Japanese firms and examine the timeliness of management forecasts that are bundled with earnings announcements (i.e., in the days $t = -2$ to +2), for which the release (and timing) is effectively mandated. (3) The same setting as (2), but we examine the timeliness of all other (non-bundled) and, hence, voluntary management forecasts and press releases by Japanese firms. (4) We focus on U.S. firms and examine the timeliness of press releases that are bundled with earnings announcements (i.e., in the days $t = -2$ to +2), for which we consider the release (and timing) quasi-mandatory because firms have developed a practice of issuing them. We include an intercept, the full set of controls, and fixed effects (as indicated) in the models, but do not report the coefficients. We assess statistical significance based on robust standard errors clustered by country (Panel A, columns 1 to 4, and Panel C, column 1) or firm (all other columns) and indicate significance at the 1%, 5%, and 10% levels (two-tailed) with ***, **, and *.

Table 6: Role of Managers' Private Information

Log(1+Days to Disclosure) as Dependent Variable	*(1) > 75% Forecast Dispersion*	*(2) > 50% Goodwill Amount*	*(3) > 50% Impairment Losses*	*(4) > 75% Inventory*	*(5) > 75% Return Variability*	*(6) > 75% Cash Flow Variability*
Information Events:						
Positive Shock	-0.034***	-0.037***	-0.037***	-0.039***	-0.052***	-0.046***
	(-6.20)	(-6.66)	(-4.88)	(-6.44)	(-5.54)	(-7.15)
Negative Shock	-0.041***	-0.025***	-0.031***	-0.028***	-0.069***	-0.045***
	(-4.42)	(-4.48)	(-3.07)	(-4.09)	(-3.23)	(-4.85)
*Positive Shock * PART*	-0.015***	-0.023*	-0.019*	-0.020**	0.011	0.008
	(-3.50)	(-2.00)	(-1.99)	(-2.20)	(0.93)	(0.95)
*Negative Shock * PART*	0.006	-0.049***	-0.019*	-0.029**	0.044*	0.016**
	(1.26)	(-3.91)	(-1.82)	(-2.20)	(1.82)	(2.11)
Control Variables	Included	Included	Included	Included	Included	Included
Control Variables * *PART*	Included	Included	Included	Included	Included	Included
Fixed Effects	Firm & Country-Day	Firm & Country-Day	Firm & Country-Day	Firm & Country-Day	Firm & Country-Day	Firm & Country-Day
Fixed Effects * *PART*	Included	Included	Included	Included	Included	Included
Adjusted R^2	11.0%	11.0%	11.0%	11.0%	11.0%	11.0%
N	2,176,314	2,177,752	2,181,754	2,064,327	2,178,475	2,144,434

The table reports OLS coefficient estimates and (in parentheses) *t*-statistics from estimating variations of our base specification (see Table 4, column 4). Specifically, we interact the *Positive Shock* (*Negative Shock*) variable with a binary indicator (*PART*) to examine the timeliness of voluntary disclosures across subsets of firms. We code PART equal to "1" (and "0" otherwise) if: (1) The average yearly analyst *Forecast Dispersion* for firm *i* is above the 75th percentile. (2) The average *Goodwill Amount* for firm *i* is above the 50th percentile out of all firms reporting goodwill during the sample period. (3) The average amount of *Impairment Losses* for firm *i* is above the 50th percentile out of all firms reporting goodwill impairments during the sample period. (4) The average *Inventory* for firm *i* is above the 75th percentile. (5) The standard deviation of daily stock returns over the sample period for firm *i* (*Return Variability*) is above the 75th percentile. (6) The standard deviation of annual net operating cash flows over the sample period for firm *i* (*Cash Flow Variability*) is above the 75th percentile. For detailed variable definitions see Appendix A. We include an intercept, the full set of controls, and fixed effects (as indicated) in the models, but do not report the coefficients. We assess statistical significance based on robust standard errors clustered by country and indicate significance at the 1%, 5%, and 10% levels (two-tailed) with ***, **, and *.

Table 7: Role of Macroeconomic Uncertainty

Log(1+Days to Disclosure) as Dependent Variable	*(1) Macro-economic Shocks*	*(2) < 15% GDP Change*	*(3) > 85% Aggregate Forecast Dispersion*	*(4) > 85% Country Risk Score*	*(5) > 85% Aggregate Earnings Variability*	*(6) > 85% Aggregate Loss Percentage*
Information Events:						
Positive Shock	0.194**	-0.043***	-0.046***	-0.048***	-0.047***	-0.047***
	(2.08)	(-6.62)	(-8.61)	(-5.16)	(-9.13)	(-9.13)
Negative Shock	0.216**	-0.042***	-0.045***	-0.040***	-0.040***	-0.042***
	(2.05)	(-4.41)	(-4.91)	(-3.50)	(-4.85)	(-4.98)
*Positive Shock * PART*		0.003	0.015**	0.029***	0.022***	0.020***
		(0.36)	(2.19)	(3.55)	(5.40)	(4.01)
*Negative Shock * PART*		0.020*	0.039***	0.027**	0.016	0.023***
		(1.80)	(2.96)	(2.56)	(1.08)	(2.85)
Control Variables	Included	Included	Included	Included	Included	Included
Fixed Effects	Firm & Country-Month	Firm & Country-Day	Firm & Country-Day	Firm & Country-Day	Firm & Country-Day	Firm & Country-Day
Adjusted R^2	6.1%	11.0%	11.0%	11.0%	11.0%	11.0%
N	2,566,187	2,206,300	2,206,438	2,075,167	2,206,438	2,206,438

The table reports OLS coefficient estimates and (in parentheses) *t*-statistics from estimating variations of our base specification (see Table 4, column 4). In column 1, we examine extreme return days on the country level and code up firm-days on which the local market index return is 2.326 standard deviations above (*Positive Shock*) or below (*Negative Shock*) the sample mean index return. In columns 2 to 6, we interact the firm-specific *Positive Shock* (*Negative Shock*) variable with a binary indicator (*PART*) to examine the timeliness of voluntary disclosures across subsets of firms. We code PART equal to "1" (and "0" otherwise) if: (2) The year-over-year quarterly percentage change in GDP in a country-quarter (*GDP Change*) is below the 15th percentile. (3) The average analyst forecast dispersion computed over all firms in the previous country-quarter (*Aggregate Forecast Dispersion*) is above the 85th percentile. (4) The *Country Risk Score* from Hassan et al. (2022) measured at the country-quarter level is above the 85th percentile. (5) The standard deviation of firm-level return on assets in a country-year (*Aggregate Earnings Variability*) is above the 85th percentile. (6) The proportion of firms with negative earnings-per-share in a country-year (*Aggregate Loss Percentage*) is above the 85th percentile. For detailed variable definitions see Appendix A. We include an intercept, the full set of controls, and fixed effects (as indicated) in the models, but do not report the coefficients. We assess statistical significance based on robust standard errors clustered by country and indicate significance at the 1%, 5%, and 10% levels (two-tailed) with ***, **, and *.

Table 8: Content of Voluntary Disclosures in the Aftermath of Information Shocks

	Press Releases		*Management Guidance*	
Dependent Variable	*(1) Sentiment*	*(2) Financial Information*	*(3)* Log(1+# *Forecast Sentences*)	*(4)* Log(1+# *Financial Metrics*)
Information Events:				
Following Positive Shock	0.006	0.015**	0.030***	0.020
	(0.11)	(2.61)	(3.06)	(1.56)
Following Negative Shock	-0.264*	0.026**	0.022*	0.026**
	(-2.01)	(2.69)	(1.81)	(2.17)
Control Variables	Included	Included	Included	Included
Fixed Effects	Firm & Country-Day	Firm & Country-Day	Firm & Country-Day	Firm & Country-Day
Adjusted R^2	18.0%	31.0%	20.0%	25.0%
N	140,183	140,183	44,796	44,796

The table reports OLS coefficient estimates and (in parentheses) *t*-statistics from regressions of various variables measuring the content of voluntary disclosures on *Following Positive* (*Negative*) *Shock* and control variables. The variable *Following Positive* (*Negative*) *Shock* marks a disclosure *d* of firm *i* that had an extreme positive (negative) daily stock return in the preceding 20 trading days. The sample consists of either the firm-initiated press releases (source: RavenPack) or management forecasts (source: Capital IQ) included in our base specification with data available (see notes to Table 1). We use the following dependent variable: (1) We measure whether a press release had a positive or negative tone, based on RavenPack's event *Sentiment* score. Higher values indicate more positive tone. (2) We code up press releases as "1" if they contain current or forward-looking *Financial Information*, based on RavenPack's GROUP and TYPE taxonomy. (3) We count the sentences in a management forecast that contain forward-looking information, measured by forward-looking terms such as the firm "aims" or "expects" (*# Forecast Sentences*). (4) We count the unique financial metrics mentioned in a management forecast, measured by terms such as "EBIT" or "EPS" (*# Financial Metrics*). For detailed variable definitions see Appendix A. We include an intercept, the full set of controls (see Table 9; except for *Concurrent EA*), and fixed effects (as indicated) in the models, but do not report the coefficients. We assess statistical significance based on robust standard errors clustered by country and indicate significance at the 1%, 5%, and 10% levels (two-tailed) with ***, **, and *.

Table 9: Market Reactions to Voluntary Disclosures in the Aftermath of Information Shocks

Dependent Variable	*(1)* *CAR*	*(2)* *Abs. CAR*	*(3)* *Turnover*	*(4)* *Abnormal Volume*
Information Events:				
Following Positive Shock	-0.001	0.010***	0.002***	0.177**
	(-1.42)	(9.42)	(3.51)	(2.74)
Following Negative Shock	0.007***	0.013***	0.001***	0.155
	(6.05)	(8.98)	(7.23)	(1.27)
Control Variables:				
Concurrent EA	-0.000	0.012***	0.004**	0.755***
	(-0.89)	(5.61)	(2.41)	(5.37)
Log(1+*Days Since Previous Shock*)	-0.001	-0.008***	-0.003**	-0.588***
	(-1.68)	(-16.58)	(-2.62)	(-4.47)
Log(*Total Assets*)	-0.001***	-0.001***	0.001***	0.016
	(-4.12)	(-3.46)	(2.84)	(0.31)
Return on Assets	0.006**	-0.012***	0.001	-0.083
	(2.35)	(-4.29)	(1.61)	(-0.19)
Book-to-Market	-0.005***	0.005***	0.000	-0.064*
	(-21.46)	(11.11)	(0.61)	(-1.95)
Leverage	0.000	0.006***	0.001	-0.034
	(0.05)	(4.19)	(1.02)	(-0.59)
Earnings Variability	0.000	0.002**	0.001	-0.042
	(0.10)	(2.60)	(1.15)	(-1.35)
Return Variability	0.001	0.004***	0.003***	0.018
	(1.40)	(6.45)	(3.01)	(0.41)
Log(1+*Number of Analyst*)	-0.004***	-0.000	0.000	-0.054
	(-5.51)	(-0.76)	(1.14)	(-1.11)
Inst. Ownership - Domestic	-0.003	-0.006***	0.005**	-0.130**
	(-0.97)	(-6.27)	(2.45)	(-2.50)
Inst. Ownership - Foreign	-0.008***	0.005*	0.006	0.338
	(-4.72)	(1.97)	(1.69)	(0.69)
Negative News	-0.002***	0.000	0.000*	-0.011
	(-5.40)	(1.46)	(1.90)	(-0.63)
Δ *Operating Income*	0.019***	0.012***	0.003	0.468
	(5.16)	(5.69)	(1.22)	(1.33)
Equity Issuance	-0.000	0.002*	0.003**	0.209***
	(-0.68)	(1.89)	(2.21)	(3.05)
ADR Listing	0.002	-0.000	-0.002**	0.152*
	(0.66)	(-0.18)	(-2.70)	(1.74)
Zero Return Days	0.028***	-0.002	-0.008**	1.642*
	(4.75)	(-0.31)	(-2.27)	(1.76)
Quarterly Reporting	-0.002	-0.003*	-0.001*	-0.167*
	(-1.56)	(-1.98)	(-1.82)	(-1.93)
Fixed Effects	Firm & Country-Day	Firm & Country-Day	Firm & Country-Day	Firm & Country-Day
Adjusted R^2	4.6%	22.0%	14.0%	13.0%
N	184,734	184,734	170,831	168,715

The table reports OLS coefficient estimates and (in parentheses) *t*-statistics from regressions of various market outcome variables around the release of voluntary disclosures (i.e., days $t = 0$ and +1) on *Following Information Shock* and control variables. We split the variable *Following Information Shock* into *Following Positive* (*Negative*) *Shock* variables marking a disclosure *d* of firm *i* that had an extreme positive (negative) daily stock return in the preceding 20 trading days. The sample consists of all the firm-initiated press releases and management forecasts included in our base specification with data available (see notes to Table 1). We use two-day (absolute) cumulative abnormal returns (*CAR* and *Abs. CAR*), share *Turnover*, and *Abnormal Volume* as the dependent variables. For detailed variable definitions see Appendix A. We include an intercept and fixed effects (as indicated) in the models, but do not report the coefficients. We assess statistical significance based on robust standard errors clustered by country and indicate significance at the 1%, 5%, and 10% levels (two-tailed) with ***, **, and *.