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Increased mandated disclosure frequency and price formation: evidence from the 8-K expansion regulation

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Abstract Regulators claim that increased mandated disclosure frequency should lead to more efficient price formation. However, analytical models suggest that mandating disclosure may actually impede the price formation process, and prior empirical studies have been unable to document a relation between mandatory disclosure and improved price formation. We re-examine this relationship using a recent SEC regulation that increased the frequency of mandated event disclosures in form 8-K. We show that price formation improves after the mandate, where firms with the largest increases in mandatory disclosure experience the greatest improvements in price formation. Our evidence is consistent with the idea that mandating an increase in the frequency that material events must be disclosed is associated with improved price formation.

Keywords Regulation · Mandatory disclosure · 8-K filings · Price formation

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1 Introduction

This study examines whether a 2004 SEC regulatory change that significantly increased the frequency with which material events must be publicly disclosed in 8-K filings led to more efficient price formation.[1] The regulation required more frequent reporting of a number of material events that firms were previously not required to report until quarter-end, with the intent of providing investors with more timely access to value-relevant information prior to the release of the next periodic report. Underlying this push toward more real time disclosure is the SEC's belief that mandating more frequent disclosure helps the market assimilate information into the value of a company's securities more efficiently, thus improving the capital formation process (SEC 2004).

> *Only through the steady flow of timely, comprehensive, and accurate information can people make sound investment decisions. The result of this information flow is a far more active, efficient, and transparent capital market that facilitates the capital formation so important to our nation's economy.* (SEC 2013)

However, analytical models and prior empirical work suggest that *mandatory* increases in disclosure frequency may not result in the SEC's desired outcome of more timely price formation. For example, the model of Gigler and Hemmer (1998) suggests that mandating more frequent disclosure could increase firms' overall costs of disclosure (e.g., production and dissemination costs) to the point that firms decrease their other disclosures. From an empirical perspective, Butler et al. (2007) find no evidence that a mandated shift from semi-annual to quarterly reporting improved the price formation process, leading them to conclude that "there is little evidence to support the claim that regulation forcing firms to report more frequently improves earnings timeliness" (p. 182). Lerman and Livnat (2010) examine the same regulation we study, and, while not their primary focus, in additional analyses, they conjecture that, if it was successful at impounding information into prices on a more timely basis, the market reaction to periodic filings (10-K/Qs) should be reduced. However, they find no evidence of a reduced market response to periodic filings after the mandate. While this lack of evidence suggests that mandated increases in disclosure may not improve price formation, it is also possible that the settings and research designs of these studies (which we discuss in Section 2) may not be ideally suited to identifying the effects of mandatory disclosure on price formation.

We examine our primary question of whether the speed of price formation increased after the regulation using an intraperiod timeliness (*IPT*) measure (Butler et al. 2007; Bushman et al. 2010). Consistent with the SEC's desire to pull forward information that was not previously released until the end of the quarter, we calculate IPT over the entire quarter culminating at the earnings announcement, as this announcement summarizes the firm's quarterly performance and confirms information released throughout the quarter. One advantage of IPT is that it measures the timeliness with which information

[1] We define price formation as the speed with which information is incorporated into a firm's stock price. Following prior research (e.g., Butler et al. 2007; Bushman et al. 2010), we measure price formation using intraperiod timeliness (IPT). We provide a detailed description of how this measure is calculated along with illustrative examples in the internet appendix.

is impounded into price over the entire quarterly reporting cycle, while holding the magnitude of information content and price responses constant during that quarterly period. This advantage is particularly important in our setting, as it mitigates potential concerns that differences in total quarterly information content or magnitude of returns between firms or across time are influencing our results.

Consistent with our prediction, we first provide evidence that the increase in mandated disclosure is associated with more efficient price formation, on average. Next, to demonstrate that the improvement in price formation was due to the increase in mandatory disclosure and not some confounding factor, we identify a set of firms that were most impacted by the regulation (i.e., those with the largest increases in 8-K disclosure frequency as a result of the mandate) as well as a set of firms that were least impacted. To ensure these two samples are similar across observable covariates, we use entropy balancing in all of our analyses (Hainmueller 2012; McMullin and Schonberger 2017). Using a difference-in-differences design, we find those firms most impacted by the regulation experienced the greatest improvements in price efficiency and that this effect is statistically and economically significant. In particular, price efficiency increased by approximately 7% more for those firms most impacted by the regulation. This finding suggests that the mandated increase in disclosure appears to be the primary driver of the increase in the speed of price formation.

We then conduct a series of additional analyses to provide further support for the notion that the increase in the speed of price formation we document was indeed driven by the mandate. First, we use an alternative, ex ante, method to identify those firms that were more likely impacted by the regulation based on their willingness to voluntarily disclose asset disposals and impairments in the pre-regulation period. We focus on these events as firms could voluntarily elect to disclose them in an 8-K in the pre-regulation period, but their disclosure was mandated following the passage of the regulation. We find that our results are robust to this alternative, ex ante, identification method.

Next, we provide a series of tests to mitigate concerns that our results are driven by arbitrary increases in voluntary, rather than mandatory, disclosure. We do this by separating 8-Ks into mandatory and voluntary categories based on item number. We also rule out the possibility that firms may apply differential thresholds for good versus bad news events after the regulation in order to avoid disclosing bad news. In particular, we document that there is virtually no difference in the percentage of bad news 8-Ks from the pre- to the post-regulation period, which suggests that any discretion managers may use to apply differential thresholds for good versus bad news does not appear to have been affected by the regulation. In addition, we perform a number of other tests that provide results consistent with those of our primary analyses.

In summary, our evidence suggests that mandated increases in disclosure frequency can indeed improve price formation. This evidence contributes to our understanding of whether shifts to a more continuous disclosure regime are likely to impact the speed of price formation, and as such complements studies examining these effects (Butler et al. 2007). We also contribute to the growing literature that identifies factors that influence the efficiency of the price formation process as well as the literature that examines the benefits and costs of disclosure regulation (Leuz and Wysocki 2016).

2 Background and motivation

2.1 Disclosure frequency

While our focus is on the price formation effects of *mandated* changes to disclosure frequency, a number of studies have examined the determinants and market consequences of *voluntary* increases in disclosure frequency. For example, Leftwich et al. (1981) provide early evidence on the determinants of a firm's choice to report more frequently. McNichols and Manegold (1983) find reductions in return volatility for firms voluntarily shifting from annual to interim reporting. Van Buskirk (2012) examines firms' voluntary provision of monthly revenue disclosures and finds that the decision to regularly issue these disclosures does not lead to reductions in information asymmetry. However, the decision does result in lower market reactions to quarterly earnings announcements.

Two recent studies examine the shift from semi-annual to quarterly reporting. Fu et al. (2012) find this shift lead to reductions in the cost of equity and information asymmetry. Most closely related to this study, Butler et al. (2007) examine the same shift to quarterly reporting as Fu et al., but they investigate whether this leads to improved price formation (the construct of interest here). They find quicker price formation for firms that voluntarily change to quarterly reporting but no evidence of improved price formation for firms when more frequent reporting is mandated. Overall, these studies provide evidence consistent with capital market benefits for voluntary increases in disclosure frequency but no evidence of quicker price formation for mandated increases in disclosure frequency.

2.2 Mandatory disclosure regulation

Firms face transaction and proprietary costs that may outweigh the perceived benefits of increased disclosure and thus prevent them from voluntarily increasing their disclosure levels (Lang and Lundholm 1993). In an effort to overcome firms' reluctance to disclose information, the SEC requires firms to meet certain minimum disclosure requirements. Indeed, since its inception, the SEC has made several steps toward a more continuous disclosure system by significantly increasing the frequency with which material information is reported. These steps include requiring annual reporting, semi-annual reporting, quarterly reporting, and disclosure of select material events through 8-K filings.

Our focus is on the impact of an increase in the frequency with which material events must be disclosed in 8-K filings. The SEC's push for a continuous disclosure system dates back to the Securities Act of 1934, where certain events not previously reported in Form 10-K filings were required to be reported on a timely basis in Form 8-K. Over time, the SEC has focused more on the role of 8-K filings in providing investors with more frequent access to material information.[2] The SEC's presumption is that 8-K filings "play a critical role in the periodic reporting system, which is intended to provide investors with a continuous stream of corporate information" (SEC 1982). In

[2] See Pastena (1979), Carter and Soo (1999), and Lerman and Livnat (2010) for background on the mandated changes to 8-K regulation over the past several decades.

other words, if mandated 8-K disclosures are effective, they should give investors access to value-relevant information on a more frequent basis prior to the filing of the next periodic report. Consistent with 8-K filings containing useful information, Carter and Soo (1999) provide evidence of significant market reactions to their filings.

This push for a more continuous disclosure regime is not limited to the United States, as the European Union has also pushed for greater disclosure frequency. In particular, in 2007 the EU's Transparency Directive required all listed firms to provide quarterly Interim Management Statements. Prior to this regulation, Cuijpers and Peek (2010) show that the voluntary choice between quarterly and semiannual reporting had no effect on the overall precision of investors' information, but it did make periodic reporting more important for price discovery, relative to other sources of information. Subsequent work by Ernstberger et al. (2017) shows an increase real earnings management after firms were required to provide quarterly reports. This evidence suggests that there is interest outside the U.S. regulatory environment in terms of the market effects of increased mandatory disclosure.

2.3 SEC 8-K disclosure regulation of 2004

Effective August 23, 2004, the SEC initiated a rule that dramatically increased the frequency with which firms were required to disclose materials events. In particular, the regulation increased the number of items that were reportable on Form 8-K by adding 10 new events that required disclosure and expanding the disclosure requirements for two previously required events. The newly mandated disclosures include such material events as a material impairment (item 2.06), the creation of an off-balance sheet obligation (item 2.03), a termination of a material definitive agreement (item 1.02), and nonreliance on previously issued financial statements (item 4.02). At the same time, the regulation expanded the required disclosure of items related to departure and election of directors and principal officers (item 5.02) and amendments to articles of incorporation or bylaws (item 5.03). Appendix 1 provides descriptions of all 8-K item numbers and identifies those that were introduced or expanded by the regulation.

It is important to note that, while there is little discretion in the choice to disclose the newly mandated items *after* the regulation, firms could elect to disclose these items *before* the regulation under the voluntary "other events" classification (item 8.01). As such, it is likely that certain firms disclosed these items prior to the regulation and would thus be largely unaffected by the regulation, while others elected not to do so and would thus be highly impacted. Finally, both before and after the regulation, firms have some discretion in their choice to disclose events falling under the categories "results of operations and financial condition" (item 2.02) and "information pursuant to Regulation FD" (item 7.01). It is unclear whether the mandate would affect managers' discretion to disclose these types of information, and thus it is important to consider the potential implications of these items where managers have some discretion in our analyses (see Section 5.1.2 below).

Lerman and Livnat (2010) examine the impact of the new disclosure requirements and document that the newly mandated 8-K disclosures, on average, are associated with

abnormal return volatility and trading volume around their filing dates.[3] This evidence is consistent with 8-K disclosures having significant information content, but it is unclear whether these disclosures merely create volatility or lead to more efficient price formation. Although Lerman and Livnat (2010) do not directly examine the impact of increased mandatory disclosure on price formation, they do examine a related topic of whether the mandated increase in 8-K disclosure frequency diminished the information content of subsequent periodic reports (i.e., 10-Q/K filings). They do not find any evidence of diminished information content of periodic reports, following the regulation, and conjecture that, to be fully impounded into price, the information in 8-Ks likely needs to be viewed within the context of the additional information provided in the next periodic filing. Their indirect evidence suggests that the 8-K mandate may not result in information being impounded into price in a more efficient manner.

2.4 Price formation

Given the SEC's motivation in increasing the frequency of mandated disclosure to enable the market to assimilate previously undisclosed information into the value of a company's securities on a more efficient basis (SEC 2004), the focus of our paper is on the efficiency of price formation. We define price formation as the speed with which information is impounded into a firm's stock price over a specific period. As such, we contribute to a growing literature that examines factors that influence the speed with which information is impounded into price.

Early work in this area by Gleason and Lee (2003) finds evidence of cross-sectional variation in the speed of the price formation process following analyst forecast revisions based on the level of innovation in the revision, whether the revision was made by a "celebrity" analyst, and the level of the firm's analyst coverage. Bushman et al. (2010) document that earlier private information dissemination to lenders results in more efficient price formation when institutional investors are involved in the firm's syndicated loans. Additionally, the readability of 10-Q and 10-K filings has recently been shown to impede the speed with which information is impounded into stock prices (You and Zhang 2009; Lee 2012), and Zhang et al. (2013) find that information risk and transaction costs are also important determinants of the speed of price formation. Finally, Twedt (2016) documents that newswire dissemination increases the speed with which management earnings guidance information is incorporated into price.

Among prior research examining price formation, the study most directly related to our research question is Butler et al. (2007), who examine how changes in the frequency of interim reporting affects the efficiency of price formation. They document improved price formation when an increase in the periodicity of reporting from semi-annual to quarterly is *voluntary*. However, they find no evidence that a *mandated* increase in disclosure frequency has any impact on price formation. They thus conclude there is no support for the claim that mandating firms to report more frequently improves the speed of price formation. Their evidence is also consistent with theoretical

[3] There is also a large literature that uses 8-K filings to examine market reactions to specific events. Examples include (1) Schwartz and Soo (1996), Ettredge et al. (2001), and Whisenant et al. (2003) for auditor change announcements; (2) Chambers and Penman (1984), Easton and Zmijewski (1989), and Collins and Hribar (2000) for earnings; and (3) Feldman et al. (2008) for nonreliance on previously issued financial statements. The focus of these studies is primarily the short-term reactions to the disclosed events.

work that suggests that mandated disclosures may crowd out the market effects of other disclosures, leading to less efficient price formation (Gigler and Hemmer 1998, 2001).

2.5 Motivation

Prior research suggests that voluntary increases in the frequency of disclosure can result in improved price formation (Butler et al. 2007) as well as reductions in the cost of equity and information asymmetry (Fu et al. 2012). However, studies also suggest that the costs firms face from increased disclosure frequency may prevent them voluntarily increasing their disclosure for a variety of reasons. In addition to the traditional proprietary cost argument for nondisclosure provided in the literature (Verrecchia 1983), more recent literature provides a variety of reasons why managers may elect not to more frequently disclose market-relevant information. For instance, preparers may face increased preparation costs (Kajuter et al. 2016). Further, mandating more frequent disclosure may lead to increases in managerial myopia (Kraft et al. 2017) and managerial evaluation risk (Fu et al. 2017). Given the potential reluctance of managers facing these costs to disclose more frequently, regulators may need to mandate more frequent disclosures to achieve their desired market outcomes.[4]

Given the apparent benefits from more frequent disclosure, it is somewhat surprising that no empirical evidence to date documents that mandating firms to disclose more frequently is associated with an improvement in price formation. One possible explanation for this lack of evidence is that studies may have examined this question in settings not well suited to identifying an impact of an increase in mandatory disclosure on price formation. Specifically, the change in the frequency of disclosure used by Butler et al. (2007) (i.e., a shift from semi-annual to quarterly reporting) to examine changes in price formation may not provide a large enough increase in the frequency of disclosure to observe an effect. Additionally, examining a historical setting (1950–1973) in which the information environment was less technologically sophisticated may reduce the likelihood of finding an effect. Moreover, Butler et al. (2007) draw their conclusions from a sample of 82 firms. Thus, not detecting a relation between mandated disclosure and price formation may be attributable to a lack of power in their setting.

Similarly, Lerman and Livnat's (2010) conclusions with respect to this issue are based on evidence from market reactions to individual information events (i.e., 10-Q/K reports) that, on average, have minimal price and volume reactions (Li and Ramesh 2009). The lack of overall variation in reactions to the filing of 10-Q/K reports may make it difficult to isolate a reduction in the information content of the filings.[5] Thus, it is possible that the SEC's conjectures regarding the benefits of mandated disclosure on price formation may be correct, but evidence in support

[4] As discussed in Section 4 of the internet appendix, we provide evidence consistent with the notion that the firms most impacted by the regulation (i.e., those that had the largest increase in disclosure) had the highest pre-regulation levels of proprietary costs.

[5] Consistent with the limited investor response to 10-Q/K filings, in untabulated tests we fail to find evidence of a significant impact of the regulation on IPT in the 14-day window after the EAD and leading up to the 10-K/Q. This lack of evidence in this short window is consistent with Lerman and Livnat's (2010) analysis, which finds no reduction in periodic filings' information content after the regulation and provides support for our use of the earnings announcement as the end point of our price formation window.

of these claims has not been documented due to issues related to settings examined and research designs used in prior studies.

Of course, this lack of empirical evidence could also be attributable to an actual lack of an association between mandated disclosure and price formation. Indeed, there are several reasons to believe that mandating more frequent disclosure may not have the intended effect of increasing the speed of price formation. For instance, the market may already have access to the mandatorily disclosed information through other voluntary sources.[6] To the extent that mandated disclosures create market frictions by crowding out other potentially more informative voluntary disclosures (Beyer et al. 2010), one might expect regulated increases in disclosure to not have the intended consequence of faster price formation (Gigler and Hemmer 1998; Noh et al. 2017).[7] Finally, the regulation may not impact price formation in the predicted manner if investors cannot assess and price the 8-K information until they have the more complete information perspective provided by the subsequent periodic filing (as discussed by Lerman and Livnat 2010).

Taken together, these factors make it unclear whether mandating an increase in the frequency of disclosure will necessarily lead to more efficient price formation. Stated formally, our research question is as follows.

- *RQ: Is an increase in the frequency of mandated disclosure associated with an increase in the speed of price formation?*

3 Sample selection and descriptive statistics

3.1 Variable definitions and sample

We examine how mandated increases in disclosure frequency impact the efficiency with which information is impounded into price. We measure the speed of price formation using the same intraperiod timeliness (*IPT*) metric as Butler et al. (2007), incorporating the modifications of Bushman et al. (2010) to focus on a quarterly window using daily abnormal returns. This measure captures how quickly information is impounded into price over a specified period. The IPT measure is designed to hold constant both price responses and information content, which mitigates potential concerns that differences in information content or magnitude of returns between firms or across time may influence our results.

To construct this measure, we calculate the area under the cumulative-price-change curve over 63 trading days starting from 60 trading days prior to the earnings

[6] This is also consistent with firms perceiving these newly mandated disclosures as providing minimal benefits. Specifically, a firm's decision not to voluntarily disclose these items in the pre-regulation period may be driven by the belief that the disclosures provide insufficient benefits, relative to the costs associated with making those disclosures (Leuz and Wysocki 2016).

[7] Gigler and Hemmer (1998) model a periodic disclosure framework, where they predict that mandating more frequent interim reports may lead to reductions in voluntary disclosures, due to an overall increase in the cost of disclosure (e.g., production costs). They suggest that, because voluntary disclosures are often more precise indicators of firm value, mandating disclosure could actually lead to a reduction in price-informativeness. Consistent with this crowding out notion, a concurrent study by Noh et al. (2017) provides evidence that the 2004 8-K mandate results in a significant decrease in voluntary disclosure.

announcement date to two trading days following the earnings announcement. As do Bushman et al. (2010), we use a 63-day trading window to identify the speed with which information is incorporated into price during the full span of the quarterly earnings cycle, up to and including the quarterly earnings report.[8] The formula for the IPT measure is:

$$IPT = \frac{1}{2}\sum_{t=-60}^{2} \frac{\left(Abn\_Return_{(t-1)} + Abn\_Return_{(t)}\right)}{Abn\_Return_{(2)}}.$$

By distributing the ½ and collecting similar terms, this equation can be simplified to:

$$IPT = \left(\sum_{t=-60}^{2} \frac{Abn\_Return_{(t)}}{Abn\_Return_{(2)}}\right) + \frac{1}{2},$$

where $t = 0$ is the current period earnings announcement date and $Abn\_Return_{(t)}$ is the abnormal buy-and-hold return from the beginning of 60 days prior to the earnings announcement to the end of day t. The intuition underlying the measure is that a larger value indicates more efficient price formation; the faster information is incorporated into price during the quarter, the greater the impact of that information on the IPT measure.[9]

There are several features of the IPT metric that make it uniquely suited to our research question. For example, IPT incorporates the timing of the 8-K disclosures made during the quarter. An 8-K disclosure made early in the quarter will have a larger effect on the measure than the same disclosure made later in the quarter. These timing differences are an important component of the price formation process, since the earlier information is made public, the earlier investors are able to react to it and incorporate it into price. In addition, IPT incorporates the relative magnitude of the information content of the 8-K disclosures, compared to other disclosures made during the quarter, including the earnings announcement itself. If an 8-K disclosure constitutes a relatively small (large) portion of the overall information content contained in all disclosures made during the quarter, it will have a relatively small (large) impact on the IPT measure. Also, by including the total quarterly abnormal return in the denominator, the IPT measure holds constant the overall level of economic activity within a quarter.

We perform our analyses around the effective date of the SEC's regulation that dramatically increased the form 8-K disclosure requirements, August 23, 2004.[10] We begin by examining whether the regulation led to an on average increase in the speed of

[8] To properly interpret the IPT measure, it is important to use an endpoint culminating with the release of the summary information for the quarter. Following Bushman et al. (2010), we use the earnings announcement as our endpoint, because it provides a common and meaningful date across all firms where a significant amount of information becomes public. In addition, we select the earnings announcement, rather than the 10-Q/K, as research has shown that there is little to no average market reaction to these periodic filings (Li and Ramesh 2009). To reduce the likelihood that prior-period earnings information is affecting the measure, we eliminate any firm-quarters from our sample where a prior-period earnings announcement is made during the 63-trading-day window.

[9] More detail on the calculation of IPT along with illustrative examples can be found in the internet appendix.

[10] As evidence of this large increase, we find that, for our sample firms, the total number of 8-K items issued per year nearly doubled from 121,314 before the regulation to 223,878 after the regulation (untabulated).

price formation for all firms. However, to provide better identification that the change to mandatory disclosure is responsible for any observed changes in price formation, in our primary analyses, we compare those firms most likely to be impacted by the regulation to those firms least likely to be impacted, as explained below.

The 2004 SEC regulation raised the legal minimum frequency of disclosure (e.g. disclosure floor) of material events through an 8-K. As such, we expect firms most impacted by this new disclosure floor to exhibit the greatest improvements in price formation, since firms already voluntarily disclosing these events prior to the regulation are unlikely to realize incremental price formation benefits from the regulation. We identify firms most impacted by the regulation and those firms least impacted based on the extent to which the firms' 8-K disclosure frequencies changed as a result of the SEC regulation.

We begin this identification by collecting 8-K disclosure data from the SEC's Electronic Data Gathering, Analysis, and Retrieval (EDGAR) database during the four quarters prior to and the four quarters following the regulation date, where there is nonmissing outcome and control data. We then use a PERL script to extract the firm identifier (CIK), filing date, and item numbers filed with each 8-K filing. Using this extraction process, we identify the number of 8-K items the company filed with the SEC during a given quarter (*Num_Item*).

We then calculate the percentage change in the number of 8-K items the company filed with the SEC from the four quarters immediately prior to the regulation to the four quarters post-regulation (*Item_Change*), after eliminating all firm-quarters that contain the regulation date (August 23, 2004). Next, we split all firms into terciles based on their percentage change in 8-K disclosure frequency. Finally, we create an indicator variable, *High_Impact*, equal to one if the firm is in the highest tercile of *Item_Change*, equal to zero if the firm is in the lowest tercile of *Item_Change*, and missing otherwise.[11]

We include control variables in our analyses to capture various aspects of the firm and its information environment, such as overall performance *ROA*, the natural log of the number of news articles written about the firm during the quarter *ln(News)*, growth prospects *BTM*, size *ln(MVE)*, operational complexity *ln(B_Segs)*, geographic complexity *ln(G_Segs)*, the natural log of analyst following *ln(Follow)*, the percentage of institutional ownership *InstOwn*, an indicator for loss firms *Loss*, investments made during the quarter *Capx*, the capital structure of the firm *Leverage*, and both firm-specific and aggregate risk, as captured by return volatility *FirmRetVol* and *AggRetVol*. Finally, we include time trends (*Time* and $Time^2$) to control for potential trends in the speed of price formation over time.[12] All variables are defined in Appendix 2.

[11] We use the highest and lowest terciles to ensure that the regulation had distinct impacts on the high and low impact firms. In addition, as noted, our tests focus on the four quarters on either side of the regulation. Bertrand et al. (2004) raise a potential concern that serial correlation may affect the standard errors when using multiple observations in the pre and post period. To address this concern we perform a robustness test (untabulated), where, for each firm, we average together the four quarters of data before and the four quarters after the regulation to create a single variable for each of the pre and post periods. We then re-run our primary analyses using this substantially reduced sample and find that the significance and economic magnitude of the coefficients are unaffected.

[12] In addition to these primary controls, the internet appendix provides results showing that our findings are robust to controlling for potential changes in the timeliness or textual and numeric content of 8-K disclosures.

Our final sample consists of firm-quarters with nonmissing earnings announcement dates in Compustat, nonmissing returns data from CRSP, total assets greater than zero, and no prior earnings announcements that fall within the price formation window. We also require each firm to satisfy the above data requirements for at least one quarter in each of the pre- and post-regulation periods and to issue at least one 8-K in both the pre- and post-regulation periods. This last requirement addresses concerns that firms without active 8-K disclosure activity may differ significantly from our sample firms, due to either disclosure compliance issues or lack of economic activity. This sample selection process yields a final sample of 35,794 firm-quarters in the time period surrounding the regulation.[13]

3.2 Descriptive statistics

Table 1 presents descriptive statistics for our full sample of firm-quarter observations. The descriptive evidence on *Num_Item* suggests that the average firm in our sample issued nearly five 8-K items in a given quarter, where firms at the 25th percentile issued two items and firms at the 75th percentile issued six 8-K items. We also provide descriptives for the other dependent and independent variables used throughout our study. Note that the descriptive statistics on the variable of interest in our study (*IPT*) are comparable to those reported by Bushman et al. (2010), with both a mean and median value of 27.

4 Primary analyses

4.1 Full sample analysis

We begin our formal analyses by documenting a general increase in the speed of price formation after the SEC's 8-K regulation date (August 23, 2004). To do this, we estimate the following OLS regression on our full sample of firms-quarters immediately surrounding the regulation date.

$$IPT = \beta_1 Post + \gamma Controls + \lambda IndustryFE + \epsilon \quad (1)$$

where *IPT* is the firm-quarter's intraperiod timeliness measure and *Post* is an indicator variable equal to one if the quarter occurred after the passage of the SEC's new Form 8-K disclosure requirements. If the regulation resulted in improved price formation for all firms, on average, then we expect to observe a positive and significant β_1. We winsorize all continuous variables at the first and 99th percentile and cluster standard errors by firm. To further limit the impact of potential noise and outliers inherent in returns-based IPT measures (Bushman et al. 2010; Drake et al. 2017), we remove observations with absolute studentized residuals greater than two from of our analyses.[14]

[13] In untabulated tests, we cluster standard errors by year-quarter and find this does not affect our results.

[14] Although there is potential for noise in the IPT measure, there is no reason to expect this noise to introduce any type of bias into our inferences. In Section 5.4, we provide evidence that our results are robust to alternative methods of addressing outliers, including retaining the extreme observations with studentized residuals greater than two or using a decile-ranked version of IPT.

Table 1 Descriptive statistics

Variable	Mean	Std. Dev	25th	Median	75th
Num_Item	4.719	4.656	2.000	4.000	6.000
IPT	27.243	51.584	9.160	27.835	45.443
Prop_Bad_News	0.516	0.382	0.000	0.500	1.000
Abs_EA_Ret	0.056	0.061	0.015	0.035	0.076
8K_Prop_Ret	0.240	2.257	−0.158	0.162	0.599
ROA	−0.006	0.062	−0.003	0.006	0.018
ln(News)	2.580	1.556	1.792	2.773	3.555
BTM	0.526	0.426	0.275	0.463	0.694
ln(MVE)	5.857	1.946	4.459	5.785	7.158
ln(B_Segs)	0.554	0.699	0.000	0.000	1.099
ln(G_Segs)	0.549	0.688	0.000	0.000	1.099
ln(Follow)	1.185	1.017	0.000	1.099	1.946
InstOwn	0.458	0.309	0.167	0.454	0.734
Loss	0.279	0.448	0.000	0.000	1.000
Capx	0.010	0.015	0.001	0.005	0.012
Leverage	0.166	0.194	0.001	0.099	0.265
FirmRetVol	0.278	0.176	0.158	0.229	0.342
AggRetVol	0.722	0.163	0.608	0.698	0.784

This table presents descriptive statistics for key variables for the full sample of 35,794 firmquarter observations for 4,638 firms. All continuous variables are winsorized at the first and 99th percentiles. See Appendix 2 for variable definitions

Table 2 reports the results of estimating Model (1). This model estimates whether there is more efficient price formation, on average, following the regulation for all firms. The coefficient on *Post* is positive and significant at the 5% level using a two-tailed test (2.450, t-statistic = 2.259), consistent with our prediction. This coefficient estimate suggests that the IPT effect for a firm-quarter in the post-regulation period increases by 6.64%, compared to a firm-quarter in the pre-regulation period, holding all else constant.[15] This result is consistent with an overall improvement in the speed of price formation immediately following the regulation.[16]

4.2 Analysis of high and low impact firms

As previously discussed, if the increase in the speed of price formation captured by Model (1) is due to increased mandated disclosure frequency, we would expect to observe the greatest improvements in price formation in those firms not voluntarily disclosing the information prior to the regulation. As such, we identify high impact firms as those with the largest increases in 8-K disclosure as a result of the regulation.

[15] This estimate is derived by combining the coefficient estimate on *Post* with the intercept value of 36.912 (untabulated). Results are nearly identical if industry fixed effects are omitted.

[16] In the internet appendix, we provide a series of tests (i.e., placebo tests and quarter-by-quarter tests) that show our results are unique to the period surrounding the passage of the regulation.

Table 2 The effect of disclosure regulation on price formation (full sample analysis)

Variable	Dependent Variable = IPT	
	Coef	T-Stat
Post (+)	2.450**	2.259
ROA	−3.270	−0.580
ln(News)	−0.130	−0.602
BTM	−0.022	−0.029
ln(MVE)	−0.317	−1.107
ln(B_Segs)	−0.465	−1.048
ln(G_Segs)	−0.351	−0.690
ln(Follow)	−0.770*	−1.743
InstOwn	−3.458**	−2.493
Loss	1.366*	1.659
Capx	−13.487	−0.611
Leverage	1.117	0.730
FirmRetVol	−3.620*	−1.753
AggRetVol	−0.582	−0.227
Time	−17.131	−1.279
$Time^2$	6.359	0.529
Industry FE	Yes	
Adj. R^2	0.32%	
N	33,974	

This table presents results for the estimation of model (1). Model (1) is estimated on the full sample of firm-quarters surrounding the regulation. The dependent variable is the continuous measure of IPT. All continuous variables are winsorized at the first and 99th percentiles, and observations with absolute studentized residuals greater than 2 are removed from the analysis. See Appendix 2 for variable definitions. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, using a two-tailed test. Predicted signs are provided for hypothesized variables in parentheses after the variable name. Standard errors are clustered by firm. Industry fixed effects are also included in the model

We then implement a difference-in-difference approach to examine the change from the pre-regulation period to the post-regulation period in price formation for high impact firms relative to low impact firms. We use this approach to mitigate the impact of any potential market-wide shifts in the speed of price formation that may have occurred during the transition period that are unrelated to the 8-K disclosure regulation. Specifically, we estimate the following OLS regression, again with standard errors clustered by firm.

$$IPT = \beta_1 Post + \beta_2 High\_Impact + \beta_3 Post^{*} High\_Impact + \gamma Controls + \lambda IndustryFE + \in, \quad (2)$$

where we include indictor variables for the high impact sample (*High_Impact*), post-regulation firm-quarters (*Post*), and the interaction of *Post* and *High_Impact*. The coefficient on the interaction term β_3 is the difference-in-difference estimator.

A positive and significant β_3 is consistent with our prediction that an increase in mandated disclosure is associated with more efficient price formation for high impact, relative to low impact, firms.

To provide assurance that any potential differences in firm characteristics are not influencing our results, we follow Hainmueller (2012) and McMullin and Schonberger (2017) and implement entropy balancing in our analyses examining high and low impact firms. Entropy balancing is a recently developed technique, akin to matching, that identifies weights for each low impact sample observation to achieve nearly identical distributions of underlying fundamentals (i.e., near perfect covariate balance) between the high impact and weighted low impact samples.[17] Panel A of Table 3 presents information on the mean, variance, and skewness of firm characteristic variables for the high impact and low impact samples before and after entropy balancing. A visual comparison of the variable distributions after balancing indicates that any differences in fundamentals are nearly entirely eliminated after entropy balancing. Unless otherwise noted, we use the entropy-balanced sample of high and low impact firms in all subsequent tests.

Panel B of Table 3 provides the results of estimating Model (2) after entropy balancing. We find that the difference-in-difference estimator β_3 is positive and significant (2.911, t-statistic = 2.081). With respect to economic magnitude, we find that, when combining the coefficient estimates on the applicable independent variables, the IPT effect for the *High_Impact* firms increases by 6.65% as a result of the regulation, while the *Low_Impact* firms experience a slight reduction.[18] We also note that, in this model, the coefficient on *Post* is no longer significant (−0.989, t-statistic = 0.666). Thus these results provide evidence that the observed improvement in the speed of price formation is driven by those firms most impacted by the regulation. Although most of our control variables are insignificant, we do find an unexpected negative association between *IPT* and both *Ln(Follow)* and *InstOwn*. In particular, while we would expect that higher analyst following and greater institutional ownership would be disciplining mechanisms, our results instead suggest that firms with higher levels of activity by these economic actors are associated with slower price formation. One conjecture is that both analysts and institutional investors prefer firms where they can better exploit their abilities to garner private information that is not immediately impounded into stock prices.[19]

Overall, the findings presented in Tables 2 and 3 are consistent with the SEC's conjecture that an increase in the frequency of mandated disclosure improves the speed of price formation. To strengthen our confidence in these results, through the remainder of the paper and its associated internet appendix, we implement a number of alternative approaches to isolating the impact of the 8-K regulation on the speed of price formation.

[17] Results are robust to using the full, nonweighted sample of high and low impact firms (untabulated).

[18] These effects are derived by combining the applicable coefficient estimates with the intercept value of 29.877 (untabulated). Results are nearly identical if industry fixed effects are omitted.

[19] In Section 5.5, we perform additional cross-sectional analyses to better understand whether the regulation differentially impacted firms with high and low institutional ownership.

Table 3 The effect of disclosure regulation on price formation (analysis of high and low impact firms)

Panel A: Covariate Balance Before and After Entropy Balancing

Before Balancing	**High Impact Firms**			**Low Impact Firms**		
Variable	Mean	Variance	Skewness	Mean	Variance	Skewness
ROA	−0.008	0.004	−3.469	−0.004	0.004	−3.550
ln(News)	2.580	2.447	−0.048	2.509	2.409	−0.072
BTM	0.550	0.223	2.327	0.516	0.167	1.525
ln(MVE)	5.778	4.023	0.293	5.781	3.601	0.176
ln(B_Segs)	0.603	0.515	0.587	0.522	0.470	0.780
ln(G_Segs)	0.588	0.496	0.778	0.489	0.448	1.020
ln(Follow)	1.131	1.030	0.379	1.150	1.018	0.307
InstOwn	0.453	0.095	0.088	0.439	0.097	0.178
Loss	0.312	0.215	0.814	0.260	0.192	1.094
Capx	0.011	0.000	2.837	0.009	0.000	3.163
Leverage	0.170	0.038	1.335	0.166	0.038	1.397
FirmRetVol	0.291	0.036	1.788	0.274	0.030	1.892
AggRetVol	0.731	0.032	1.862	0.718	0.024	1.859
Time	0.431	0.016	0.263	0.434	0.013	0.430
$Time^2$	0.202	0.014	3.071	0.201	0.012	2.732

After Balancing	**High Impact Firms**			**Low Impact Firms**		
Variable	**Mean**	**Variance**	**Skewness**	**Mean**	**Variance**	**Skewness**
ROA	−0.008	0.004	−3.469	−0.008	0.004	−3.453
ln(News)	2.580	2.447	−0.048	2.582	2.441	−0.056
BTM	0.550	0.223	2.327	0.550	0.223	2.365
ln(MVE)	5.778	4.023	0.293	5.777	4.015	0.293
ln(B_Segs)	0.603	0.515	0.587	0.602	0.515	0.591
ln(G_Segs)	0.588	0.496	0.778	0.585	0.495	0.786
ln(Follow)	1.131	1.030	0.379	1.130	1.029	0.382
InstOwn	0.453	0.095	0.088	0.453	0.095	0.091
Loss	0.312	0.215	0.814	0.311	0.214	0.817
Capx	0.011	0.000	2.837	0.011	0.000	2.848
Leverage	0.170	0.038	1.335	0.170	0.038	1.334
FirmRetVol	0.291	0.036	1.788	0.291	0.036	1.789
AggRetVol	0.731	0.032	1.862	0.731	0.032	1.863
Time	0.431	0.016	0.263	0.431	0.016	0.245
$Time^2$	0.202	0.014	3.071	0.202	0.014	3.056

Panel B: Regression Results

Variable	**Dependent Variable = *IPT***	
	Coef	**T-Stat**
Post	−0.989	−0.666
High_Impact	−0.953	−0.946
*Post*High_Impact (+)*	2.911**	2.081
ROA	−2.800	−0.413

Table 3 (continued)

ln(News)	−0.384	−1.420
BTM	0.566	0.628
ln(MVE)	0.268	0.716
ln(B_Segs)	−0.358	−0.660
ln(G_Segs)	−0.446	−0.689
ln(Follow)	−1.179**	−2.168
InstOwn	−4.445**	−2.471
Loss	0.978	0.958
Capx	−30.866	−1.041
Leverage	0.910	0.478
FirmRetVol	0.961	0.394
AggRetVol	−0.838	−0.269
Time	1.941	0.127
$Time^2$	−5.752	−0.416
Industry FE	Yes	
Adj. R^2	0.41%	
N	22,832	

This table presents our primary analysis of high and low impact firms. Panel A provides descriptives on covariate balance before and after entropy balancing, while Panel B presents results for the estimation of model (2). Model (2) is estimated on the entropy-balanced sample of high and low impact firm-quarter observations (i.e., omitting those firms in the middle tercile of Item_Change). The dependent variable is the continuous measure of IPT. All continuous variables are winsorized at the first and 99th percentiles, and observations with absolute studentized residuals greater than 2 are removed from the analysis. See Appendix 2 for variable definitions. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, using a twotailed test. Predicted signs are provided for hypothesized variables in parentheses after the variable name. Standard errors are clustered by firm. Industry fixed effects are also included in the model

5 Additional analyses

5.1 Isolating the impact of the regulation

In our main tests, we classify firms as most and least affected by the regulation based on their observed changes in 8-K disclosure behavior from pre to post-regulation, and we use entropy balancing to reduce the likelihood that potential differences in firm characteristics are influencing our results. In this section, we use two alternative methods to further isolate the price formation effects of the regulation. We first use an alternative, ex-ante measure of regulation impact that enables us to identify firms that were more or less likely to be impacted by the regulation, based on their willingness to voluntarily disclose the events related to the newly mandated disclosures in the pre-regulation period. In the second set of analyses, we provide evidence that our results are driven by the newly mandated 8-K disclosures and not changes in previously required or voluntary 8-Ks.

5.1.1 Asset disposals and impairments

We begin by providing an alternative measure of regulation impact using an ex-ante measure of the likelihood a firm will be impacted by the regulation. To do this, we

focus on asset disposals and impairments, as firms could voluntarily elect to disclose these events in an 8-K in the pre-regulation period, but these events would be required to be disclosed by all firms following the passage of the regulation. Importantly, we can use Compustat to identify the existence of these events prior to the regulation, even when the firm elects not to disclose the event in an 8-K filing. Thus we identify 8245 firm-years with an asset disposal or impairment during the pre-regulation period, as indicated by their financial statements. We then search every 8-K issued by the firm during the year for the words "disposal," "impairment," or "writedown" to identify whether the firm voluntarily disclosed the event in an 8-K. Next, we classify those firms that had one of these events but elected not to voluntarily disclose it in an 8-K as high impact firms (i.e., *High_Impact_ Ex_Ante* = 1), while those firms who both experienced the event and voluntarily disclosed it in an 8-K are classified as low impact firms (*High_Impact_Ex_Ante* = 0). Finally, we apply this classification to all firm-quarters with available data in the pre and post-regulation periods, yielding a sample of 8774 (8068) high (low) impact firm-quarters.

Results for estimating Model (2), after replacing *High_Impact* with *High_Impact_Ex_Ante*, are presented in Panel A of Table 4. Despite the significant reduction in sample size in this analysis, we find that the interaction term is positive and significant (t-statistic = 1.725). This evidence suggests that mandating disclosure for firms that had previously elected nondisclosure is associated with faster price formation, consistent with the intent of the SEC in passing the regulation.

5.1.2 Isolating changes in mandatory and voluntary disclosure

Our primary analyses focus on the impact of all 8-K disclosures filed before and after the regulation. In this section, we seek to isolate several alternative subgroups of 8-K disclosure to help ensure that our results are driven by the newly mandated disclosures, rather than changes in previously required or voluntary 8-K disclosures. Under each subgroup, we re-calculate the percentage change in the (now adjusted) number of 8-K items that the company filed with the SEC from the period immediately prior to the regulation to the post-regulation period based on the reduced sample. We then create a new indicator variable, *High_Impact_Adj*, that takes the value of one if the firm is in the highest tercile of the percentage change for the adjusted sample, equal to zero if the firm is in the lowest tercile, and missing otherwise. We then re-examine the results from Model (2) after replacing *High_Impact* with the different *High_Impact_Adj* variables.

The first alternative measure of mandatory 8-K disclosure frequency, *Alternative (1)*, is designed to rule out the possibility that changes in previously mandated disclosure items are influencing our results. Because these items were already mandated prior to the 2004 regulation, they should not be impacting our results. In particular, we exclude those items that were mandatory in both the pre and post-regulation periods (i.e., 1.03, 2.01, 4.01, 5.01, 5.02, 5.04, and 5.05 based on the SEC's new numbering system).[20] As shown in the first column of Panel B of Table 4, even in this reduced sample, we

[20] Appendix A provides a summary of item descriptions. As previously discussed, the numbering scheme changed with the regulation. The excluded 8-K filing numbers are based on the new numbering system, while 8-K filed during the pre-regulation period were adjusted to match the corresponding post-regulation classifications.

Table 4 Alternative methods of isolating the impact of the regulation

Variable	Dependent Variable = *IPT*	
	Coef	**T-Stat**
Post	0.517	0.263
High_Impact_Ex_Ante	−0.881	−0.681
*Post*High_Impact_Ex_Ante (+)*	3.021*	1.725
Controls	Yes	
Industry FE	Yes	
Adj. R^2	0.49%	

Panel B: Isolating Changes in Mandatory and Voluntary Disclosure

Variable	*Alternative (1)* Mandatory		*Alternative (2)* More Restrictive Mandatory		*Alternative (3)* Most Restrictive Mandatory		*Alternative (4)* Voluntary	
	Coef	**T-Stat**	**Coef**	**T-Stat**	**Coef**	**T-Stat**	**Coef**	**T-Stat**
Post	−1.231	−0.81	0.975	0.594	−0.311	−0.198	1.072	0.724
High_Impact_Adj	−0.825	−0.814	−1.318	−1.286	−1.104	−1.064	0.744	0.747
*Post*High_Impact_Adj (+)*	2.964**	2.123	3.152**	2.238	2.363*	1.662	0.932	0.683
Controls	Yes		Yes		Yes		Yes	
Industry FE	Yes		Yes		Yes		Yes	
Adj. R^2	0.43%		0.45%		0.49%		0.39%	

This table presents results for the estimation of model (2), where Panel A uses an alternative, ex-ante measure of regulation impact based on the existence of, and voluntary disclosure of, impairments and disposals in the preregulation period, and Panel B presents results for the estimation of model (2) using a series of alternative measures of regulation impact based on various measures of mandatory and voluntary 8-K disclosures, as defined in Section 5.1.2. Model (2) is estimated on the entropy-balanced sample of high and low impact firm-quarter observations (i.e., omitting those firms in the middle tercile of Item_Change). The dependent variable is the continuous measure of IPT. All continuous variables are winsorized at the first and 99th percentiles, and observations with absolute studentized residuals greater than 2 are removed from the analysis. See Appendix 2 for variable definitions. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, using a two-tailed test. Predicted signs are provided for hypothesized variables in parentheses after the variable name. Standard errors are clustered by firm. Industry fixed effects are also included in the model

continue to observe a significantly greater increase in the speed of price formation for high impact firms, relative to low impact firms, following the regulation (t-statistic = 2.123) using this alternative measure of high impact firm identification.

For our next alternative measure, we continue to exclude those items that were mandatory in both the pre- and post-regulation periods as we did *Alternative (1)*, but we now also exclude 8-K disclosures over which managers have more discretion from the post-period sample (i.e., voluntary 8-Ks). Managers have the most discretion over the "Other Items" category of 8-Ks (item 8.01). As such, in *Alternative (2)*, we remove all voluntary item 8.01 8-Ks from our post-period sample. This modification rules out the possibility that our results are driven by simultaneous increases in the firm's release of these voluntary 8-Ks. As shown in the second column of Panel B, using *Alternative (2)*, we continue to observe a significantly greater increase in the speed of price formation for high impact firms relative to low impact firms following the regulation (t-statistic = 2.238).

In our third alternative measure of mandatory disclosure, *Alternative (3),* we continue to exclude those items that were mandatory in both the pre- and post-regulation periods and all post-period item 8.01 s but now further exclude an even broader set of voluntary 8-K items that research suggests that managers may have some discretion over. In particular, managers may also have discretion over the disclosure of items 7.01 and 2.02 (Lerman and Livnat 2010), so we exclude these items also. Column 3 of Panel B of Table 4 reports the results using *Alternative (3)*. Despite the large reduction in the number of 8-K items used in creating this alternative measure, as well as the concern that some of these items may have a mandatory component that if eliminated would bias against us finding a result, we continue to observe a positive and significant coefficient on *High_Impact_Adj* (t-statistic = 1.662), which is consistent with a greater increase in the speed of price formation for high impact firms, relative to low impact firms, following the regulation.

Thus far, we have focused on isolating the impact of mandatory disclosure. In our last alternative measure, we take the opposite approach and examine the potential impact of increases in *voluntary* 8-K items. In particular, for *Alternative (4) - Voluntary*, we continue to exclude those items that were mandatory in both the pre- and post-regulation periods, but now we further exclude all mandatory items (i.e., including those items newly mandated by the regulation) from our post-period sample. Thus this analysis provides us with a measure of the change in a firm's *voluntary* 8-K disclosure from pre to post regulation. Results using this measure are presented in the final column of Panel B of Table 4. As shown, the interaction term is insignificant (t-statistic 0.683), indicating that changes in voluntary 8-K disclosure around the time of the regulation do not appear to impact price formation. Collectively, the results in Table 4 Panel B provide strong evidence that our findings are driven by changes in mandatory disclosure frequency attributable specifically to the regulation and not by spurious changes in voluntary disclosure.

5.2 Isolating changes in managerial discretion over good and bad news

We next examine whether the mandate impacted the relative proportion of positive versus negative 8-K disclosures firms file over the course of an average quarter. This is important to consider because, although the 2004 SEC rule increased the

number of events that trigger the requirement to file an 8-K, it is possible that firms may interpret this requirement with bias by altering what they deem as a "material" event. In other words, firms could begin applying differential thresholds for good versus bad news events after the regulation to avoid disclosing bad news. We examine this possibility by classifying every 8-K in our sample as containing either bad or good news, based on whether the two-day abnormal market reaction to its filing was negative.

We provide univariate evidence on the proportion of 8-Ks containing bad news in Panel A of Table 5. As shown, there is very little difference (less than half a percent) in the percentage of bad news 8-Ks from the pre-regulation period to the post-regulation period. We observe similarly minor differences when we partition the sample into the high and low impact firms. This univariate evidence suggests that the regulation did not alter firms' thresholds for disclosing bad news. We also examine this phenomenon in a multivariate setting by re-estimating Model (2), replacing *IPT* as the dependent variable with *Prop_Bad_News*, which is equal to the percentage of 8-Ks filed during the quarter that contain bad news based on two-day returns. The results, provided in Panel B of Table 5, are consistent with the univariate evidence in Panel A, and we find no evidence of the regulation affecting the relative proportion of bad news 8-K disclosures. This evidence suggests that any discretion managers may use to apply differential thresholds for good versus bad news does not appear to have been affected by the regulation.

5.3 Fixed effects

The inclusion of various fixed effects has become increasingly popular in the accounting literature to control for a certain type of correlated omitted variable bias (i.e., industry, firm, and time invariant characteristics). In our primary analyses, we include industry fixed effects and two time trend dummies in an already somewhat constrained difference-in-differences model that compares groups before and after the regulation. The inclusion of additional fixed effects is a trade-off, as more stringent tests may help rule out unidentified correlated omitted variables but may also remove meaningful variation in the model.

In particular, a long line of econometric studies discuss the potential for an attenuation bias on coefficients of interest when regressions incorporate extensive fixed effects.[21] For example, Angrist and Pischke (2009) state: "(a)lthough they control for a certain type of omitted variable, fixed effect estimates are notoriously susceptible to attenuation bias from measurement error" (p. 225). In short, these authors explain that regression models with a high number of fixed effect parameters may become sensitive to measurement error resulting in overfitting of measurement noise and thus attenuation of the coefficient of interest. Angrist and Pischke (2009, p. 226) further explain that fixed effect estimation approaches "may kill some of the omitted variable bias bathwater, but they also remove much of the useful information in the baby, the variable of interest."

[21] See Griliches and Hausman (1986), Angrist and Pischke (2009), McKinnish (2008), and Gormley and Matsa (2014).

Table 5 Changes in managerial discretion over good and bad news disclosures

Panel A: Proportions of Bad News 8-Ks

	Full Sample	High Impact Firms	Low Impact Firms	Difference
Pre-Regulation	51.26%	51.74%	51.08%	0.66%
Post-Regulation	51.53%	52.08%	51.14%	0.94%
Difference	0.26%	0.34%	0.06%	

Panel B: Regression Analysis

Variable	DV = *Prop_Bad_News*	
	Coef	**T-Stat**
Post	0.018	1.461
High_Impact	−0.002	−0.241
*Post*High_Impact (+)*	0.006	0.567
Controls	Yes	
Industry FE	Yes	
Adj. R^2	1.33%	

This table presents analyses related to managerial discretion over good and bad news disclosures. Panel A presents proportions of 8-Ks containing bad news, where news content is determined based on the market reaction to the filing. Panel B presents results for the estimation of model (2), where the dependent variable is the proportion of 8-Ks filed during the quarter that contain bad news. Model (2) is estimated on the entropy-balanced sample of high and low impact firm-quarter observations (i.e., omitting those firms in the middle tercile of Item_Change). All continuous variables are winsorized at the first and 99th percentiles, and observations with absolute studentized residuals greater than 2 are removed from the analysis. See Appendix 2 for variable definitions. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, using a two-tailed test. Predicted signs are provided for hypothesized variables in parentheses after the variable name. Standard errors are clustered by firm. Industry fixed effects are also included in the model

Noting these concerns, we provide a more complete description of the implications of including additional fixed effects in our setting. To do this, we tabulate a series of additional analyses that include various fixed effects in Panel A of Table 6. We begin by reporting in column 1 the coefficient of interest *Post*High_Impact* from our main model that includes industry fixed effects: 2.91 (t-Stat = 2.08), as seen in Table 3 Panel B. In columns 2 and 3, we then separately include firm and time (year-quarter) fixed effects resulting in coefficients of 2.871 (t-Stat = 1.88) and 2.335 (t-Stat = 1.70), respectively. In the final column, we include both time and firm fixed effects together in the model, resulting in a coefficient of 1.988 (t-Stat = 1.42).

This monotonically decreasing magnitude of the coefficient of interest as we add more fixed effects is consistent with greater attenuation bias, as adding more fixed effects increases the sensitivity of the regression estimation to measurement noise. Given that we are already running a rather constrained difference-in-differences model comparing groups before and after the regulation, finding a positive coefficient on all of the models and statistical significance at conventional levels using two-tailed tests in 3 of the 4 fixed-effect specifications indicates that, while attenuation bias may be present, inferences largely remain unchanged by the inclusion of this series of extensive fixed effects.

Table 6 Alternative model specifications

Panel A: Alternative Fixed-Effect Specifications

Variable	Industry FE (Main Result)		Firm FE		Year-Qtr FE		Firm and Year-Qtr FE	
	Coef	T-Stat	Coef	T-Stat	Coef	T-Stat	Coef	T-Stat
Post	−0.989	−0.666	−1.293	−0.774				
High_Impact	−0.953	−0.946			−0.842	−0.830		
*Post*High_Impact (+)*	2.911**	2.081	2.871*	1.875	2.335*	1.695	1.988	1.416
Controls	Yes		Yes		Yes		Yes	
Firm FE	Yes		Yes		No		Yes	
Year-Qtr FE	No		No		Yes		Yes	
Adj. R^2	0.79%		0.79%		0.87%		2.02%	

Panel B: Alternative Outlier Treatments

Variable	Retaining obs. With student residual > 2		Using Decile Ranked Measure of IPT	
	Coef	T-Stat	Coef	T-Stat
Post	−1.857	−0.561	−0.018	−0.356
High_Impact	−4.155*	−1.816	−0.050	−1.493
*Post*High_Impact (+)*	7.393**	2.333	0.111*	2.391
Controls	Yes		Yes	
Industry FE	Yes		Yes	
Adj. R^2	0.23%		Ordinal Logit	

Table 6 (continued)

Panel C: Alternative IPT Winsorizing and Trimming								
Variable	**1st and 99th%**		**3rd and 97th%**		**10th and 90th%**		**0 ≤ IPT ≤ 62.5**	
	Coef	**T-Stat**	**Coef**	**T-Stat**	**Coef**	**T-Stat**	**Coef**	**T-Stat**
Winsorizing *(Main Result)*								
Post								
High_Impact								
*Post*High_Impact (+)*	2.911**	2.081	2.344**	2.264	2.274***	2.590	1.533***	2.598
Controls	Yes		Yes		Yes		Yes	
Industry FE	Yes		Yes		No		Yes	
Adj. R^2	0.41%		0.76%		0.60%		0.79%	
Trimming								
Post	−1.593	−1.218	−0.617	−0.660	0.136	0.212	0.905*	1.649
High_Impact	−1.004	−1.195	−0.817	−1.321	−0.741*	−1.743	−0.268	−0.794
*Post*High_Impact (+)*	2.367**	2.007	1.806**	2.087	1.710***	2.779	0.412	0.852
Controls	Yes		Yes		Yes		Yes	
Industry FE	Yes		Yes		No		Yes	
Adj. R^2	0.56%		0.94%		2.12%		2.15%	

This table presents results for the estimation of model (2), where Panel A includes alternative fixed effects in the model (which cause the main effect of High_Impact and/or Post to drop out of the model), Panel B uses alternative methods of addressing outliers, and Panel C uses alternative levels of winsorizing and trimming the IPT variable. For comparative purposes, the R2 values in Panel A are adjusted to remove the impact of the firm fixed effects. Model (2) is estimated on the entropy-balanced sample of high and low impact firm-quarter observations (i.e., omitting those firms in the middle tercile of Item_Change). The dependent variable is the continuous measure of IPT except for the second column of Panel B where it is the decile ranked measure of IPT. All continuous variables are winsorized at the first and 99th percentiles except for IPT as noted in Panel C, and observations with absolute studentized residuals greater than 2 are removed from the analyses except as noted in the first column of the Panel B analysis. See Appendix 2 for variable definitions. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, using a two-tailed test. Predicted signs are provided for hypothesized variables in parentheses after the variable name. Standard errors are clustered by firm. Industry fixed effects are also included in the first column of Panel A analysis and the Panel B and C analyses

5.4 Alternative outlier treatments

We next show that our results are robust to alternative methods of treating outliers. From a theoretical standpoint, one might expect that IPT would be rather tightly distributed between the values of 0 and 62.5.[22] However, in reality, during the 63-trading day window with which we measure IPT, a firm may have negative (positive) returns for a portion of the window and then flip to a positive (negative) overall quarterly return, leading to an IPT value less than 0. In addition, during the 63-day IPT window, stock prices often exceed the ending price, leading to an IPT value greater than 62.5. These normal occurrences can lead to a broader distribution of values of the IPT variable, and the resulting variation that is inherent in returns-based IPT measures has been recognized and discussed elsewhere (e.g., Bushman et al. 2010; Drake et al. 2017).

Throughout our study, we minimize the impact of outliers in IPT by removing those observations with absolute studentized residuals greater than two from our continuous measure of IPT. In this section, we first demonstrate that our results are robust to the inclusion of these observations by repeating our primary analysis using the continuous measure of IPT as the dependent variable but retaining all observations (i.e., including those with absolute studentized residuals greater than two). As an alternative approach to dealing with influential outliers, we next follow prior research (Drake et al. 2017; Allee et al. 2018) and use a decile-ranked version of IPT (along with ordinal logistic regression). We present the results in Table 6 Panel B. As shown, we continue to find results consistent with those of our primary analysis, as the interaction term on *Post*High_Impact* is positive and significant in both cases (t- and z-statistics of 2.333 and 2.391, respectively).[23]

An additional and common way to deal with potential outliers is through either winsorization or trimming. Throughout our study, we winzorize all continuous variables at the first and 99th percentiles. Here, we examine the sensitivity of our results to alternative levels of winsorizing or trimming the IPT variable. Specifically, in Table 6 Panel C we report results after winzoring or trimming IPT at the following levels: 1) first and 99th percentiles, 2) third and 97th percentiles, 3) 10th and 90th percentiles, and 4) IPT at values of 0 and 62.5. As shown, after winzorization we continue to find positive and significant results on *Post*High_Impact* in all cases (t-statistics of 2.081, 2.264, 2.590, and 2.598 respectively). After trimming at the same levels, we continue to find positive and significant results on the interaction term in all but the final case, where we remove observations with IPT values below 0 or over 62.5 (t-statistics of

[22] Specifically, during the 63-trading day-window with which we measure IPT, a lack of any price response until the end of earnings announcement window would result in an IPT value of 0, while an immediate and complete price response on the first day of the quarter, with no subsequent change in price, would result in an IPT value of 62.5.

[23] The results reported in Panel B of Table 6 demonstrate that our results are not driven by the inclusion/exclusion of potential extreme observations. Not surprisingly, when extreme observations are included, the coefficient on the interaction term in the first column of Table 6 Panel B is larger than the coefficient reported in Panel B of Table 3, where these extreme observations are excluded. We also note that the difference in the coefficient magnitudes across the columns of Table 6 Panel B is largely attributable to the difference in dependent variables (continuous measure of IPT versus decile-ranked measure).

2.007, 2.087, 2.779, and 0.852 respectively).[24] Overall, the results in Panels B and C of Table 6 suggest that our results are robust to a variety of alternative approaches to reduce the potential impact of outliers.

5.5 Institutional ownership

In our primary analyses, we document that increased mandated disclosure has an overall positive effect on the speed of price formation. These tests also revealed that, on average, firms with more sophisticated users of financial information, such as institutional investors, were associated with slower price formation. In this section, we examine whether the regulation differentially impacted firms with high and low levels of institutional ownership.

On the one hand, an increase in mandatory disclosure may impose frictions on the market with respect to the processing of information (Simon 1955; Bloomfield 2002), as the regulation dramatically increased the number of disclosures that investors need to process. As such, firms with greater institutional investors should be better able to deal with the additional disclosures. On the other hand, institutional investors could also serve a disciplinary mechanism in the pre-regulation period, where firms would be more likely to voluntarily disclose information that would be valuable to investors.

Based on prior findings that more sophisticated investors are less impacted by information overload (Miller 2010) and the evidence from our primary analyses that institutional investors do not appear to be associated with greater price formation, we predict that firms with higher levels of institutional ownership can better process and efficiently price the additional disclosures required by the mandate. We test this prediction by re-estimating Model (2) but partitioning the sample on above/below median levels of institutional ownership. The results, presented in Table 7, confirm our prediction, as the coefficient on *Post*High_Impact* is significantly positive in the high institutional ownership subsample but insignificantly different from zero in the low institutional ownership subsample. This evidence suggests that increased mandatory disclosure is more likely to lead to faster price formation when a firm's investor base is sophisticated enough to process the additional disclosures.

5.6 Linking price formation to 8-K and EA market reactions

The SEC's motivation for the 8-K mandate was to reduce the delay with which firms disclose important information to the market, thus enabling the market to assimilate the information into price earlier in the quarter, resulting in a faster price formation process. In this section, we provide more direct evidence that the information contained in the newly mandated 8-K disclosures drives the price formation effects documented thus far.

First, if the SEC was successful in its attempt to require firms to accelerate the disclosure of significant events, rather than waiting until the next earnings

[24] Negative IPT values correctly capture the underlying economics of slower price formation, where returns at the beginning of the period are negative (positive) and then toward the end of the period flip, to result in an overall positive (negative) quarterly return. In contrast, the economic interpretation of IPT values above 62.5 is less clear. As such, we also re-run (untabulated) our analysis after removing only those observations with IPT values above 62.5 and find that the coefficient on *Post*High_Impact* is positive and significant (t-statistic of 2.251).

Table 7 High and low institutional ownership sample partitions

	High Institutional Ownership		Low Institutional Ownership	
Dependent Variable = IPT	Coef	T-Stat	Coef	T-Stat
Post	−6.563***	−2.835	2.981	1.484
High_Impact	−3.863**	−2.461	1.086	0.827
*Post*High_Impact (+)*	**5.534*** **	**2.687**	**0.342**	**0.176**
Controls	Yes		Yes	
Industry FE	Yes		Yes	
Adj. R^2	0.67%		0.35%	

This table presents results for the estimation of model (2), where the model is estimated separately for firm-quarters with above and below median levels of institutional ownership. Model (2) is estimated on the entropy-balanced sample of high and low impact firm-quarter observations (i.e., omitting those firms in the middle tercile of Item_Change). The dependent variable is the continuous measure of IPT. All continuous variables are winsorized at the first and 99th percentiles, and observations with absolute studentized residuals greater than 2 are removed from the analysis. See Appendix 2 for variable definitions. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, using a two-tailed test. Predicted signs are provided for hypothesized variables in parentheses after the variable name. Standard errors are clustered by firm. Industry fixed effects are also included in the model

announcement, we would expect those firms most affected by the regulation to experience a reduction in the market reaction to their earnings announcements following the regulation. To test this assumption, we re-estimate Model (2), replacing *IPT* with a new dependent variable, *Abs_EA_Ret*, equal to the absolute abnormal two-day market reaction to the earnings announcement. As shown in the first column of Panel A of Table 8, we find a significant and negative interaction term (t-statistic = −2.571), indicating that those firms most impacted by the regulation experienced a reduction in the information content of their quarterly earnings announcements from pre to post regulation, compared to the low impact firms.

Next, we provide more direct evidence that the information in 8-Ks is linked to faster price formation. Our evidence suggests that the newly mandated 8-K filings individually appear to contain information content, as the mean absolute abnormal two-day return around the filing date for our sample (untabulated) is 3.7% (median 2.0%), but it is unclear whether these event returns ultimately impact price formation or just create volatility. As such, we provide a series of tests to more directly show that the increase in price formation stems from the 8-K filing returns.

In our first test, we examine whether the proportion of the high impact firms' quarterly return contained within 8-K disclosures increased as a result of the regulation. If the regulation prompted firms to begin disclosing important events earlier in the quarter through 8-Ks, rather than waiting until the earnings announcement, we would expect the proportion of the total quarterly abnormal return generated by these 8-K disclosures to increase for the high impact firms following the regulation. To investigate this possibility, we again re-estimate Model (2), this time replacing *IPT* with a dependent variable *8K_Prop_Ret*, which is equal to the sum of the signed abnormal two-day market reactions to all 8-Ks issued during the quarter, scaled by the signed quarterly abnormal return. Results

Table 8 Linking price formation to 8-K and earnings announcement market reactions

Panel A: Earnings Announcement and 8-K Market Reaction Tests				
Variable	**DV = Abs_EA_Ret**		**DV = 8K_Prop_Re**	
	Coef	**T-Stat**	**Coef**	**T-Stat**
Post	0.000	0.842	−0.038	−1.161
High_Impact	0.001	1.388	−0.062***	−2.940
*Post*High_Impact (+)*	−0.003**	−2.571	0.082***	2.742
Controls	Yes		Yes	
Industry FE	Yes		Yes	
Adj. R^2	27.00%		0.94%	

Panel B: Price Formation Partitioned on *8K_Prop_Ret*				
Dependent Variable = IPT	**High 8K_Prop_Ret**		**Low 8K_Prop_Ret**	
	Coef	**T-Stat**	**Coef**	**T-Stat**
Post	−2.718	−1.122	−0.311	−0.136
High_Impact	−1.983	−1.309	−1.977	−1.349
*Post*High_Impact (+)*	6.488***	3.264	2.134	1.014
Controls	Yes		Yes	
Industry FE	Yes		Yes	
Adj. R^2	1.03%		0.41%	

This table presents results for the estimation of model (2), where the dependent variable in the first column of Panel A is the absolute abnormal two-day market reaction to the earnings announcement, the dependent variable in the second column of Panel A is the sum of the signed abnormal two-day market reactions to all 8-Ks issued by the firm during the quarter scaled the quarterly return, and the dependent variable in Panel B is IPT, with the model estimated separately for firm-quarters with above and below median levels of 8K_Prop_Ret (the dependent variable in the second columns of Panel A). Model (2) is estimated on the entropy-balanced sample of high and low impact firm-quarter observations (i.e., omitting those firms in the middle tercile of Item_Change). All continuous variables are winsorized at the first and 99th percentiles, and observations with absolute studentized residuals greater than 2 are removed from the analysis. See Appendix 2 for variable definitions. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, using a two-tailed test. Predicted signs are provided for hypothesized variables in parentheses after the variable name. Standard errors are clustered by firm. Industry fixed effects are also included in the model

are presented in the second column of Panel A of Table 8, where the coefficient on the interaction term is positive and significant (t-statistic = 2.742). This suggests that, after the regulation, 8.2% more of the total quarterly return for those firms most impacted by the regulation is attributable to 8-Ks, relative to the least impacted group. This is consistent with the market reactions to 8-Ks constituting a greater proportion of the total quarterly return for high impact firms as a result of the regulation.

Finally, we provide a more direct connection between the market reactions to 8-K disclosures and price formation by re-estimating Model (2) with *IPT* as the dependent variable but partitioning the sample on above and below median values of *8K_Prop_Ret*. The results of this analysis are presented in Panel B of Table 8, where we find a strong and positive effect on the interaction term in the high 8-K market reaction sample and no effect in the low 8-K market reaction sample (t-statistics of 3.264 and 1.014, respectively). This evidence indicates the 8-K disclosures are

responsible for the improved price formation that we document and not some unobservable difference correlated with *IPT*.

5.7 Other analyses

We discuss and tabulate a number of additional analyses in the paper's internet appendix. In particular, we provide results from a series of placebo tests and alternative analyses that collectively support the notion that our primary results are unique to the mandate. We also provide tests that mitigate concerns that a reduction in the time lag or changes in textual content of 8-K disclosures are affecting our results. Finally, we provide evidence that firms most impacted by the regulation faced significantly greater proprietary costs prior to the regulation, which is consistent with these firms facing non-investor-related costs that likely prevented them from voluntarily disclosing at what might be viewed as optimal levels from a price formation standpoint prior to the regulation.

6 Conclusion

This study examines whether more frequent mandated disclosure leads to faster price formation. The SEC asserts that more frequent mandated disclosure should facilitate more efficient price formation. However, analytical models suggest that mandating increased disclosure may actually impede the price formation process. Consistent with these predictions, prior empirical studies have been unable to document a relation between mandatory disclosure and improved price formation.

We re-examine this question by investigating whether a recent regulation that substantially increased the frequency with which material events must be publicly disclosed in 8-K filings impacted the speed of price formation. In our setting, we find that price formation improves following the regulation and, more importantly, that firms with the largest increases in disclosure exhibit the greatest improvements.

Our evidence suggests that increases in mandated disclosure can lead to more efficient price formation. As such, our study contributes to the debate about the market effects of increases in mandatory disclosure. Further, our findings should be of interest to managers in determining appropriate disclosure practices for their firms as well as regulators concerned with the effects of shifts to a more continuous disclosure regime.

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Appendix 1

Form 8-K item descriptions

Item	Description	Introduced By Regulation?
1.01	Entry into a Material Definitive Agreement	Yes
1.02	Termination of a Material Definitive Agreement	Yes
1.03	Bankruptcy or Receivership	No
2.01	Completion of Acquisition or Disposition of Assets	No
2.02	Results of Operations and Financial Condition	No
2.03	Creation of a Direct Financial Obligation or an Obligation under an Off-Balance Sheet Arrangement of a Registrant	Yes
2.04	Triggering Events That Accelerate or Increase a Direct Financial Obligation or an Obligation under an Off-Balance Sheet Arrangement	Yes
2.05	Costs Associated with Exit or Disposal Activities	Yes
2.06	Material Impairments	Yes
3.01	Notice of Delisting or Failure to Satisfy a Continued Listing Rule or Standard; Transfer of Listing	Yes
3.02	Unregistered Sales of Equity Securities	Yes
3.03	Material Modifications to Rights of Security Holders	Yes
4.01	Changes in Registrant's Certifying Accountant	No
4.02	Non-Reliance on Previously Issued Financial Statements or a Related Audit Report or Completed Interim Review	Yes
5.01	Changes in Control of Registrant	No
5.02	Departure of Directors or Principal Officers; Election of Directors; Appointment of Principal Officers	Expanded
5.03	Amendments to Articles of Incorporation or Bylaws	Expanded
5.04	Temporary Suspension of Trading Under Registrant's Employee	No
5.05	Amendments to the Registrant's Code of Ethics, or Waiver of a Provision of the Code of Ethics	No
7.01	Regulation FD Disclosure	No
8.01	Other Events	No
9.01	Financial Statements and Exhibits	No

The date of the regulation was August 23rd, 2004. Items 5.02 and 5.03 were significantly expanded by the regulation (SEC 2004; Lerman and Livnat 2010). Also note that all item numbers are based on the new item classification scheme (i.e., post regulation).

Appendix 2

Variable definitions

8K_Prop_Ret	= the signed size, BTM, and momentum (5 × 5 × 5) adjusted buy-and-hold return over the two-day period beginning on the 8-K filing date, summed across all 8-Ks filed during the quarter, and scaled by the signed quarterly size, BTM, and momentum adjusted buy-and-hold return.
Abs_EA_Ret	= the absolute size, BTM, and momentum (5 × 5 × 5) adjusted buy-and-hold return over the two-day period beginning on the earnings announcement date.
AggRetVol	= the standard deviation of daily market (value-weighted) returns over the 63-day trading day window beginning 60 trading days prior to the earnings announcement and ending two trading days after it.
Avg_Num_Numbers	= the average number of numbers in all 8-Ks filed by the firm during the quarter.
Avg_Num_Words	= the average number of words in all 8-Ks filed by the firm during the quarter.
Avg_Timeliness	= the average number of days between the event date and the filing date of all 8-K disclosures made by the firm during the quarter.
BTM	= the book-to-market ratio as of the end of the quarter.
Capx	= capital expenditures during the quarter scaled by total assets.
FirmRetVol	= the standard deviation of daily raw returns over the 63-day trading day window beginning 60 trading days prior to the earnings announcement and ending two trading days after it.
High_Impact	= an indicator variable equal to one if the firm is in the sample of firms most impacted by the regulation, zero if the firm is in the sample of firms least impacted by the regulation, and missing otherwise. Firms in the highest (lowest) tercile of *Item_Change* are defined as most (least) impacted.
High_Impact_Adj	= an indicator variable equal to one if the firm is in the sample of firms most impacted by the regulation, zero if the firm is in the sample of firms least impacted by the regulation, and missing otherwise, using the alternative measures of regulation impact as defined in Section 5.1.2.
High_Impact_Ex_Ante	= an indicator variable equal to one if the firm is in the sample of firms most impacted by the regulation, zero if the firm is in the sample of firms least impacted by the regulation, and missing otherwise, using the ex-ante measure of regulation impact based on the existence of, and voluntary disclosure of, impairments and disposals in the pre-regulation period, as defined in Section 5.1.1.
InstOwn	= the number of shares held by institutional investors, scaled by total shares outstanding as of the end of the quarter.
IPT	= the intraperiod timeliness measure, calculated over the 63-day trading day window beginning 60 trading days prior to the earnings announcement and ending two trading days after it. See the internet appendix for more details.
Item_Change	= the percentage change in the number of 8-K items the company filed with the SEC from the pre-regulation period to the post-regulation period.
Leverage	= long-term debt scaled by total assets as of the end of the quarter.
ln(B_Segs)	= the natural logarithm of the number of the compan's unique business segments as of the end of the quarter.
ln(Follow)	= the natural logarithm of the number of analysts following the firm as of the end of the quarter.
ln(G_Segs)	= the natural logarithm of the number of the company's unique geographic segments as of the end of the quarter.
ln(MVE)	= the natural logarithm of market value of equity as of the end of the quarter.

ln(News)	= the natural logarithm of one plus the number of articles written about the firm in the Dow Jones News Archives during the quarter, provided by RavenPack.
Loss	= an indicator variable equal to one if net income for the quarter was less than zero and zero otherwise.
Num_Item	= the number of 8-K items the company filed with the SEC during the quarter.
Post	= an indicator variable equal to one if the quarter occurred after the passage of the SEC's new Form 8-K disclosure requirements on August 23, 2004, and zero otherwise.
Prop_Bad_News	= the proportion of 8-Ks issued during the quarter that contain bad news, where bad news is determined based on a negative two day size, BTM, and momentum (5 × 5 × 5) adjusted buy-and-hold return to the filing.
ROA	= return on assets for the quarter, calculated as net income before extraordinary items divided by total assets.
Time	= a count variable that begins at 0.01 and increases by 0.01 for each month of the sample period.
$Time^2$	= the squared value of *Time*.

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