

Do Public Disclosures Increase or Decrease Information Asymmetry? New Evidence from Analyst Forecast Announcements

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Abstract

Prior literature provides evidence that public information releases such as earnings announcements and management forecasts increase information asymmetry around the announcement. This study is the first to suggest and find evidence that the opposite is true in a release of public information by analysts. We illustrate the general insight that the announcement of public information can either increase or decrease information asymmetry at the announcement date. In particular, the direction of the effect depends upon the extent to which the information is already known by sophisticated investors, and the processing time of new information by market participants. We show that in contrast to earnings announcements and management earnings forecasts, analyst forecasts decrease information asymmetry. Further, we show that the effect of analyst forecasts on information asymmetry is mitigated after exogenous decreases in analysts' ability to obtain private information, which reduces the plausibility of alternative explanations of our main findings. Our analyses provide evidence that while firm-initiated information releases introduce frictions at the release date, analyst forecasts have the opposite effect. These findings enhance our understanding of effects of public release of information in capital markets.

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1. Introduction

Information asymmetry plays a critical role in capital markets. Numerous models and empirical papers relate information asymmetry to important factors such as the cost of capital (e.g. Diamond and Verrecchia 1991, Leuz and Verrecchia, 2000; Amihud and Mendelsen, 1986; Easley and O'Hara, 2004), efficient allocation of resources, and the availability of external funding to corporations (Bushman and Smith, 2001). Given the central role of information asymmetry in markets, it is surprising that, to our knowledge, no study to date has directly examined whether or how information announcements by financial analysts, who are critical capital market information intermediaries, affect information asymmetry. This lack of research is even more striking given contradicting theoretical predictions over the sign of the relation between information releases and information asymmetry (e.g., Kim and Verrecchia 1994). In this paper, we fill this void by examining the impact of analyst forecasts on information asymmetry in equity markets. Following prior literature that shows that earning announcement and management forecasts *increase* announcement period information asymmetry one may expect that a different public information announcement, analyst forecasts, will also increase announcement period information asymmetry. This study provides evidence that in a stark contrast to other public information announcements documented in the literature, analyst forecasts *decrease* announcement period information asymmetry. We develop the intuition for this result, and use a natural experiment to provide evidence that alternative explanations are unlikely.

There is a debate in extant literature concerning the contribution of analysts to the information environment in capital markets. On one hand, some findings suggest that analysts merely piggyback on recent news and that their outputs are largely information-free (e.g.,

Altinkiliç and Hansen 2009). On the other hand, numerous other empirical studies provide evidence that analysts' outputs such as earnings forecasts are informative in the sense that they influence stock price or trading (e.g., Ramnath et al. 2008). However, regardless of this debate, the informativeness of analyst outputs cannot be used to infer the directional effect of analyst outputs on information asymmetry. In particular, the idea upon which we build this study is that the directional effect of an information release (e.g., earnings announcement, management forecast, analyst forecast) on information asymmetry depends on how the information content of the release interacts with the differential information possessed by sophisticated (i.e., informed) investors relative to unsophisticated (i.e., uninformed) investors, and whether the information is processed or unprocessed.¹ For example, if sophisticated investors can interpret the information provided by analysts more precisely than unsophisticated investors, analyst outputs may increase information asymmetry. On the other hand, if analysts reveal to uninformed traders information that was previously possessed only by informed traders, then analyst outputs will reduce information asymmetry. Therefore, the effect of analyst outputs on information asymmetry cannot be inferred from evidence on informativeness.

To illustrate this insight we construct a stylized example based on the intuition of Kim and Verrecchia (1994) that utilize a similar framework of potential sources of information asymmetry. Kim and Verrecchia (1994) show theoretically that the disclosure of financial accounting information (e.g., earnings announcements, management forecasts, analyst forecasts) can induce announcement period increases in information asymmetry. Extant literature provides empirical evidence that both earnings announcements and management forecasts indeed *increase* announcement period information asymmetry (e.g., Lee, Mucklow and Ready 1993; Coller and

¹ Processed information refers to information that requires relatively little effort (cost) to incorporate into firm value expectations. Conversely, unprocessed information requires relatively high effort (cost) to incorporate into firm value expectations.

Yohn 1997). Although analysts produce several types information releases (e.g., earnings forecasts, stock recommendations, target prices), we focus our attention on analyst earnings forecasts, as these releases are the most frequent type of output, and are more directly comparable with earnings announcements and management earnings forecasts. One might expect analyst forecasts to have a similar effect on information asymmetry as found with earnings announcements and management forecasts. However, in stark contrast we show that analyst forecasts *decrease* announcement period information asymmetry. This occurs because analyst forecasts have distinguishing characteristics. In particular, as our stylized example suggests, whereas earnings announcements and management forecasts are information releases provided directly by firm insiders, analyst forecasts are information releases by sophisticated market participants who not only may have access to private firm information, but also apply sophisticated processing abilities to the underlying information that may narrow the processing gap between sophisticated and unsophisticated investors.

In our empirical analysis we first use an event study methodology to document that, on average, the information asymmetry component of the bid-ask spread *decreases* by approximately six percent in the two days after an analyst forecast relative to the two days prior to the forecast. Because there are, on average, between two and three analyst forecasts per firm-quarter, the overall quarterly magnitude of the real economic effect of analyst forecasts on a given firm's information asymmetry is therefore between twelve and eighteen percent. This result suggests that, on average, analyst forecasts reduce the information gap between unsophisticated and sophisticated investors. We corroborate this main finding by next showing that the magnitude of the decrease in information asymmetry increases in the information content of the forecast and in the level of analyst effort. To make clear the distinction in effects of analyst

forecasts on information asymmetry relative to the effects of firm-supplied information releases, we repeat our tests using earnings announcements and management forecasts and document an announcement period *increase* in information asymmetry, consistent with prior literature. We further document that, consistent with our expectations, all three types of information releases (i.e., analyst forecasts, management forecasts and earnings announcements) decrease information asymmetry over the week subsequent to the announcement.

To further buttress our causal interpretation of our findings, we exploit an exogenous shock that decreased analysts' ability to obtain and disseminate private information in their forecasts. The exogenous shock that we exploit is an aggregate set of regulatory actions that were taken in the early 2000s. For example, Regulation FD prohibited managers from providing private information to analysts. The Global Settlement prohibited analysts and in-house investment bankers from sharing information in order to reduce information flow between the two groups, which closed another source of analyst private information. We show that the effect of analyst forecasts on information asymmetry is mitigated after this set of regulatory actions was in place. Moreover, in a differences-in-differences sub-analysis, we show that this mitigation is more pronounced for forecasts issued by analysts from brokerage firms that were directly affected by the Global Settlement.

Together, these regulatory event tests and our general short-window event study design reduce concerns relating to reverse causality that have plagued prior literature that examines the relation between analyst outputs and firm information environment. In particular, the direction of causality between analyst activity and stronger information environment could go either way (e.g., Lang and Lundholm 1996). For example, although more analyst activity can drive lower information asymmetry, lower information asymmetry could attract analyst activity. In our

setting, this concern is mitigated because it is unlikely that the information content of a forecast is driven by the reduction in information asymmetry during our short event window. These results support the interpretation that analyst forecasts, on average, cause reductions in information asymmetry, and provide a lower bound estimate of the contribution of private information channels in the ability of analyst forecasts to reduce information asymmetry.

This paper contributes to the literature in several dimensions. First, our analysis reinforces the insight that, in principle, informativeness of publicly disclosed information does not imply a reduction or increase in information asymmetry. Therefore, prior findings that document price informativeness of analyst forecasts need not generalize to information asymmetry. This insight also allows us to draw a distinction between the findings in prior literature that firm-initiated information announcement increase information asymmetry to our findings that analysts forecasts decrease information asymmetry. Second, we document that, on average, analyst forecasts cause reductions in information asymmetry in equity markets. To our knowledge, this study is the first direct test of this relation. Although Lang and Lundholm (1996) show that greater analyst coverage is associated with an improved firm information environment, they admit that the direction of causality is unclear. Moreover, although prior literature examines effects between analyst coverage and the effect of earnings announcements on information asymmetry and finds no relation, we explicitly eliminate earnings announcements and directly examine the effect of analyst information releases on information asymmetry. Finally, we contribute to the literature that examines the effects of recent regulatory actions on properties of analyst outputs. Although extant literature provides evidence on how these regulatory actions affect informativeness of analyst outputs, ours is the first evidence on how these actions affected analysts' ability to reduce information asymmetry.

The remainder of the paper proceeds as follows: in Section 2 we discuss our motivation and develop our predictions. Section 3 describes our research design. Section 4 describes our sample selection and descriptive statistics. Section 5 discusses our results, and Section 6 concludes.

2. Background and Motivation

The effects of information asymmetry between sophisticated and unsophisticated investors in a particular firm's securities has been heavily studied. Extant literature typically assumes that information asymmetry arises between two types of investors: "sophisticated" (i.e., "informed") traders and "unsophisticated" (i.e., "uninformed") traders (e.g., Glosten and Milgrom 1985; Kalay 2012). Typically, such information asymmetry comes from two potential sources. First, sophisticated investors may have access to private information about the firm that is not accessible to unsophisticated investors. Second, sophisticated investors may have superior processing abilities with respect to public information, as compared to unsophisticated investors. That is, when information becomes public, sophisticated investors can make (superior) informed judgments about the implications of the public information for firm value, thereby exacerbating information asymmetry between themselves and unsophisticated investors.

Kim and Verrecchia (1994) utilize this framework of potential sources of information asymmetry to show theoretically that the disclosure of financial accounting information can induce announcement period increases in information asymmetry, assuming that the disclosures provide information for which there may be no alternative sources of private information and provide information that could lead to differential interpretations of firm value. Kim and Verrecchia (1994) consider many financial disclosures to fit this characterization, including earnings announcements, management forecasts, and analyst forecasts.

Consistent with the analysis in Kim and Verrecchia (1994), Lee, Mucklow and Ready (1993) find that bid-ask spreads increase at the time of earnings announcements. Similarly, Krinsky and Lee (1996) provide evidence that the adverse selection component of the bid-ask spread increases significantly surrounding earnings announcements, supporting the notion that earnings announcements indeed increase announcement period information asymmetry. Using the same theoretical logic, Coller and Yohn (1997) investigate the effects of management forecasts on information asymmetry. Similar to the evidence from earnings announcements, Coller and Yohn (1997) find that the information asymmetry component of the bid-ask spread increases immediately after the issuance of a management forecast. Interestingly (and intuitively), that study also finds that this announcement period increase in information asymmetry is temporary, in that bid-ask spreads one week after the forecast announcement are smaller than spreads one week prior to the forecast announcement. This finding is consistent with the notion that sophisticated investors' superior ability to process public information only provides them with a temporary advantage over unsophisticated investors.

We are unaware of any study that directly examines the effect of analyst forecasts on information asymmetry at the time of the forecast announcement. Whereas prior literature implicitly suggests that one might expect analyst forecasts to have a similar effect on information asymmetry as found with earnings announcements and management forecasts, analyst forecasts have distinguishing characteristics that warrant separate analysis. In particular, whereas earnings announcements and management forecasts are information releases provided directly by firm insiders, analyst forecasts are information releases by sophisticated market participants who not only may have access to private firm information, but also apply sophisticated processing abilities to the underlying information that may narrow the processing gap between sophisticated

and unsophisticated investors. In the following section, we present a stylized model that illustrates these forces, and how these forces may result in different effects than those found with earnings announcements and management forecasts.

We note that a large literature provides evidence that analyst research is an important channel through which information is impounded in stock prices (e.g., Womack 1996; Gleason and Lee 2003). However, evidence concerning the *informativeness* of analyst forecasts cannot be used to infer the effect of analyst forecasts on *information asymmetry*. We clearly illustrate this distinction in our illustrative example in Section 3 below. Therefore, how analyst forecasts affect information asymmetry remains an unanswered empirical question.

We note that prior literature also examines how the presence of information intermediaries affects the increase in information asymmetry surrounding earnings announcements. Although Yohn (1998) finds evidence that general information asymmetry is lower for firms with greater analyst following during the period leading up to and including earnings announcements, she finds no evidence that the presence of analysts mitigates the earnings announcement increase in information asymmetry. In contrast, Bushee et al. (2010) provide evidence that greater press coverage is associated with a lower abnormal bid-ask spread around earnings announcements. Whereas these studies examine interactive effects between the presence of information intermediaries and the effect of earnings announcements on information asymmetry, our study differs in that we examine the direct effect of information releases by analysts on information asymmetry, where by design we eliminate associated earnings announcement effects.

3. Development of Predictions

3.1. Overview and intuition

The key insight of our paper on which we base our predictions hinges on the distinction between "unprocessed" and "processed" information releases concerning firm value. Intuitively, we think of both earnings announcements and management forecasts as unprocessed information releases, i.e., both represent information released directly from a company without the benefit of processing and interpretation by an information intermediary (e.g., an analyst). In contrast, assuming that analysts take either private or public information about a given firm and provide additional interpretation concerning how that information affects firm value, we think of analyst forecasts as processed information releases. In this section, we outline a simplified example that illustrates mechanisms through which analyst forecasts (i.e., "processed" information releases) can have a different announcement period effect on information asymmetry between sophisticated and unsophisticated investors than does earnings announcements and management forecasts (i.e., "unprocessed" information releases).

Our example first shows that an unprocessed information release that provides information to *both* sophisticated and unsophisticated investors increases announcement period information asymmetry. Intuitively, this happens because when sophisticated investors receive new information they have a processing advantage and can therefore assimilate the information more quickly. In the longer-term, information asymmetry can either increase or decrease, depending on how the information release interacts with the prior information held by the sophisticated investor.²

² In our example we also examine the case of an unprocessed information release that provides no new information to sophisticated investors. In this case, information asymmetry is not affected at announcement, because unsophisticated investors need time to process the information before it can be assimilated.

Next, our example shows that a processed information release that provides information to *both* sophisticated and unsophisticated investors may either increase or decrease announcement period information asymmetry, depending on how the information release interacts with the prior information held by the sophisticated investor. Intuitively, if the new information allows the sophisticated investor to better understand her prior information, information asymmetry may increase. Otherwise, information asymmetry will decrease at announcement date, because the unsophisticated investor does not face the processing delay that generates the increase in information asymmetry in the case of unprocessed information. In the longer term, information asymmetry will not change relative to the short term, because no processing remains to be done after the announcement. Naturally, if the processed information release provides new information only to unsophisticated investors, announcement period information asymmetry (and longer-term information asymmetry) will decrease.

The notion that processed information releases can decrease announcement period information asymmetry is the key insight that is of direct interest in this study, as we consider an analyst forecast to be a processed information release, in that an analyst is considered to be a sophisticated information intermediary that adds processing ability to information released by firms. It is this insight that leads us to examine the prediction that, in contrast to earnings announcements and management forecasts (which are unprocessed information releases), analyst forecasts *decrease* announcement period information asymmetry.

In the remainder of this section, we present a stylized example that formalizes the intuition and predictions discussed above.

3.2. Stylized example setup

Consider firm A , whose true underlying value can take on one of five possibilities, $V \in \{5,10,15,20,25\}$, where each possibility is equally likely and this distribution is public knowledge. This example has three time periods. At $t = 0$, investors have their priors about V . At $t = 1$, there is a public information release, where some investors can process information faster than others. At $t = 2$, all market participants have incorporated information of the public announcement into their posterior beliefs about V .

There are two types of investors operating in the market, sophisticated (S) and unsophisticated (D), where sophisticated (i.e., informed) investors have two characteristics that distinguish them from unsophisticated investors.³ First, sophisticated investors have the ability to obtain private information about V . Second, sophisticated investors have superior ability (relative to unsophisticated investors) to process newly released public information; that is, given a public information announcement that provides a signal about V , S can more rapidly incorporate the signal into their information set relative to D . Without loss of generality, assume that the S investors' processing time is zero and the D investors' processing time is positive, i.e., S immediately incorporate information contained in the signal into their assessment of V , and D incorporates the information with a lag. For these reasons, at time zero sophisticated and unsophisticated investors may have different priors concerning V , hereafter denoted V_S and V_D .⁴ Assume that $V_S^0 \in \{10,20,25\}$ and $V_D^0 \in \{5,10,15,20,25\}$, where V_D^0 is simply the public

³ We assume that the percentage of S and D investors is exogenously determined. Alternatively, we could assume that D may choose to become sophisticated at some cost, but chooses not to because her costs are higher than S , and therefore D remains at a disadvantage relative to S .

⁴ The assumption of initial information asymmetry in our example is consistent with empirical evidence that information asymmetry is pervasive in markets. We leave as unspecified how much of this initial information asymmetry comes from private information held by sophisticated investors versus their superior processing abilities. As an alternative to this diverging priors assumption, one can assume that the sophisticated investor gets an additional private signal at any time prior to time $t=0$, or there is an unprocessed information release prior to $t=0$.

knowledge about V at $t=0$. In reality, sophisticated investors include hedge funds, mutual funds, and other institutional investors that expend resources (e.g., compensation for buy-side analysts) to obtain and analyze firm information, both private and public. We can quantify the degree of information asymmetry as follows: S has a 0.33 probability of guessing the true V , and D has a 0.20 probability of guessing the true V , which results in information asymmetry of 0.13 (0.33-0.20), where one can think of these probabilities as the precision of prior beliefs.

At $t=1$, there is a public information release, R , about firm value V (e.g., sell-side analyst forecast, earnings announcement, management forecast). This information release can be either unprocessed (R_U) or processed (R_P), where unprocessed information is a signal about V that requires further interpretation before it can be incorporated into V_S or V_D . Because of differences in processing ability, S has an advantage over D if the information release is unprocessed; that is, by assumption, S can use R_U immediately (at $t=1$), whereas D can use R_U only with a lag (i.e., at $t=2$). In contrast, R_P can be used immediately (i.e., at $t=1$) by both S and D .

3.3. *Illustrative cases*

Within the basic information structure developed above, we use six possible scenarios to illustrate how unprocessed and processed information releases may have different effects on announcement date information asymmetry. To summarize, the effects of an information release on information asymmetry depend on 1) whether the information release is processed or unprocessed, 2) whether the information release provides new information to S , 3) whether the information release provides new information to D , and 4) how any new information provided to S and/or D relates to their priors. We do not exposit the cases where an information release provides no information about V to either party, because such scenarios are both unrealistic and uninteresting. Further, we do not exposit a case where an information release provides

information about V to S but not to D . Again, this scenario is unrealistic, because is it essentially definitional that if the sophisticated investor receives new information from an information release, then the unsophisticated investor also receives new information (albeit with a processing lag in the case of unprocessed information).

3.3.1. Unprocessed announcements

Case 1a (R does not fully reveal V to S): Suppose $R_U^1 \in \{10, 20\}$. Given this particular R_U , S forms the following posterior at $t=1$: $V_S^1 \in \{10, 20\}$, i.e., S learns immediately some information about V but does not know the value with certainty. Because D has a processing lag, D cannot incorporate R_U at $t=1$ and therefore has the same information set as his prior, i.e., $V_D^0 \equiv V_D^1 \in \{5, 10, 15, 20, 25\}$. Accordingly, note that information asymmetry *increases* at the announcement period $t=1$ (from 0.13 at $t=0$ to 0.30). D forms the following posterior at $t=2$, i.e., after the processing lag: $V_D^2 \in \{10, 20\}$ which is identical to $V_S^2 \in \{10, 20\}$. This means that from $t=1$ to $t=2$, information asymmetry *decreases*, and overall information asymmetry *decreases* from $t=0$ to $t=2$ (i.e., from 0.13 to zero), because D and S have the same information set about V , i.e., $V_D^2 \equiv V_S^2$.

Case 1b (R fully reveals V to S): To illustrate how the information asymmetry effects depend on how the new information relates to S and D 's relative priors, now suppose $R_U^1 \in \{5, 10, 15\}$. Given this particular R_U , S forms the following posterior at $t=1$: $V_S^1 \in \{10\}$, i.e., S knows V with certainty (infinite precision). Because D has a processing lag, D cannot incorporate R_U at $t=1$ and therefore has the same information set as his prior, i.e., $V_D^0 \equiv V_D^1 \in \{5, 10, 15, 20, 25\}$. Accordingly, note that information asymmetry *increases* at $t=1$ (from 0.13 at $t=0$ to 0.80). D forms the following posterior at $t=2$, i.e., after the processing lag: $V_D^2 \in \{5, 10, 15\}$, while $V_S^1 \equiv V_S^2$

because S fully incorporated the information in R_U at $t=1$. This means that from $t=1$ to $t=2$, information asymmetry decreases, but overall information asymmetry *increases* from $t=0$ to $t=2$ (i.e., from 0.13 to 0.67), because although D learned, S now knows V with certainty.

Case 1c (R does not reveal anything about V to S): Suppose $R_U^1 \in \{10, 20, 25\}$. Given this particular R_U , S does not change her priors at $t=1$: $V_S^1 \in \{10, 20, 25\}$. Because D has a processing lag, D cannot incorporate R_U at $t=1$ and therefore has the same information set as his prior, i.e., $V_D^0 \equiv V_D^1 \in \{5, 10, 15, 20, 25\}$. Accordingly, note that information asymmetry *does not change* at $t=1$ (i.e., remains at 0.13). D forms the following posterior at $t=2$, i.e., after the processing lag: $V_D^2 \in \{10, 20, 25\}$ which is identical to $V_S^2 \in \{10, 20, 25\}$. This means that from $t=1$ to $t=2$, information asymmetry *decreases*, and overall information asymmetry *decreases* from $t=0$ to $t=2$ (i.e., from 0.13 to zero), because D and S have the same information set about V , i.e., $V_D^2 \equiv V_S^2$.

3.3.2. Processed announcements

Case 2a (R does not fully reveal V to S): Suppose $R_P^1 \in \{10, 20\}$. Given this particular R_P , S forms the following posterior at $t=1$: $V_S^1 = V_S^2 \in \{10, 20\}$, i.e., S learns from the announcement but still does not know V with certainty. In this case, because the information is processed D can also incorporate R_P at $t=1$ and therefore has the following information set at $t=1$ (and at $t=2$): $V_D^1 = V_D^2 \in \{10, 20\}$. Accordingly, note that now D knows exactly the same as S at $t=1$ because R_P revealed to him the information that S knows immediately. This means that information asymmetry *decreases* from time $t=0$ to $t=1$, i.e., from 0.13 to zero. Note further that there is no change in information asymmetry from $t=1$ to $t=2$ which means that there is an overall *decrease* in information asymmetry from $t=0$ to $t=2$.

Case 2b (R fully reveals V to S): To illustrate how the information asymmetry effects depend on how the new information relates to S and D 's relative priors, now suppose $R_p^1 \in \{5,10,15\}$. Given this particular R_p , S forms the following posterior at $t=1$: $V_S^1 = V_S^2 \in \{10\}$, i.e., S knows V with certainty (infinite precision) at $t=1$ (and at $t=2$). In this case, because R_p is processed information, D can also incorporate R_p at $t=1$ (i.e., there is no processing lag) and therefore has the following information set at $t=1$ (and at $t=2$): $V_D^1 = V_D^2 \in \{5,10,15\}$. Accordingly, note that despite the fact that D significantly updated his information set, information asymmetry *increases* at $t=1$ (i.e., from 0.13 to 0.67) because S knows V with certainty. There is no change in information asymmetry from $t=1$ to $t=2$, which means that there is an overall *increase* in information asymmetry from $t=0$ to $t=2$.

Case 2c (R does not reveal anything about V to S): Suppose $R_p^1 \in \{10,20,25\}$. Given this particular R_p , S does not change her priors at $t=1$: $V_S^1 = V_S^2 \in \{10,20,25\}$. In this case, because the information is processed D can also incorporate R_p at $t=1$ and therefore has the following information set at $t=1$ (and at $t=2$): $V_D^1 = V_D^2 \in \{10,20,25\}$. Accordingly, note that now D knows exactly the same as S at $t=1$ because R_p revealed to him the information that S knows immediately. This means that information asymmetry *decreases* from time $t=0$ to $t=1$, i.e., from 0.13 to zero. Note further that there is no change in information asymmetry from $t=1$ to $t=2$ which means that there is an overall *decrease* in information asymmetry from $t=0$ to $t=2$.

3.3.3. Summary of cases

Possible effects on information asymmetry (relative to $t=0$) from the six scenarios outlined above can be summarized as follows:

Case	R_U or R_P ?	New info to S ?	New info to D ?	Δ Info. Asym. (vs. $t=0$)	
				$t=1$	$t=2$
1a	R_U	Yes	Yes	↑	↓
1b	R_U	Yes	Yes	↑	↑
1c	R_U	No	Yes	0	↓
2a	R_P	Yes	Yes	↓	↓
2b	R_P	Yes	Yes	↑	↑
2c	R_P	No	Yes	↓	↓

Again, differences between 1a, 1b and 1c (2a, 2b and 2c) will be determined by how the new information provided to S and or D specifically relates to their priors. Note that if an unprocessed information release provides new information to S , information asymmetry at $t=1$ will *always* increase because of S 's processing advantage (e.g., Kim and Verrecchia 1994).

4. Research design and sample selection

4.1. General empirical setup

To test our prediction that analyst forecasts decrease announcement period information asymmetry, we use a special form of a daily event study that isolates the effect of a forecast on information asymmetry by directly measuring whether the information asymmetry component of bid-ask spread changes across the five-day window centered on the forecast date.⁵ It is well established that observed bid-ask spreads reflect not only information asymmetry, but also the specialist's order processing costs and inventory carrying costs.⁶ To control for these other components of bid-ask spread, we estimate a model based upon finance theory (e.g., Stoll 1978, Glosten and Milgrom 1985), variations of which have been empirically implemented in extant literature (e.g., Coller and Yohn 1997; Riedl and Serafeim 2009; Amiram et al. 2011). Specifically, we estimate the following model, which uses the daily bid-ask spread as the dependent variable and uses several independent variables to absorb its non-information

⁵ In untabulated analysis we find, on average, significant abnormal returns on analyst forecast announcement dates.

⁶ We use bid-ask spread to measure information asymmetry not only because doing so follows prior literature, but also because alternative measures of information asymmetry (e.g., PIN) are generally unavailable on a daily basis, which is crucial to our research design.

asymmetry components, where we use five daily observations centered on each forecast in our sample:

$$\begin{aligned}
 BASpread_{i,d} = & \beta_0 + \beta_1 PostFcst_{f,d} + \beta_2 Price_{i,d} + \beta_3 LnSize_{i,t-1} + \beta_4 Volatility_{i,t-1} \\
 & + \beta_5 Turnover_{i,t-1} + FirmFixedEffects + \varepsilon_{i,d}.
 \end{aligned} \tag{1}$$

BASpread is bid-ask spread percentage on trading day d , measured as high daily ask price minus low daily bid price, divided by closing price, multiplied by 100. Our primary variable of interest is *PostFcst*, which is an indicator variable that equals one if day d is either trading day +1 or +2 relative to the announcement day for analyst a 's forecast, and equals zero otherwise. That is, *PostFcst* captures the difference between bid-ask spread in the two days after the forecast and bid-ask spread immediately prior to the forecast. If forecasts indeed decrease announcement window information asymmetry, we expect $\beta_1 < 0$.

We include daily stock price (*Price*) to control for market makers' processing costs (Stoll 1978), prior quarter average daily turnover (*Turnover*) to control for liquidity of the firm's shares which affects inventory holding costs (Demsetz 1968), and prior quarter average return volatility (*RetVolatility*) and firm size (*LnSize*) to control for inventory risk. A particular advantage of this specification is that, because the firm-days immediately prior to the forecast serve as the control for the firm-days immediately after the event, endogeneity concerns that plague prior studies which examine the relation between analysts and firm information environment are mitigated. We introduce several slight modifications to this basic empirical structure in subsequent analyses. We discuss these modifications along with the associated results in Section 5.

4.2. *Sample selection and data*

We obtain analyst forecast data from the I/B/E/S detail EPS US file, and restrict our sample to one-quarter-ahead forecasts (i.e., $fpi = 6$) between the years 1993 and 2010, inclusive.

We require observations to have non-missing data for the forecast announcement date (*anndats*), forecast value (*value*), actual quarterly earnings (*actual*), earnings announcement dates (*anndats_act*) company identifier (*ticker*), forecast period ending date (*fpedats*) and the forecasting analyst (*analys*).⁷ Further, we delete observations where the forecast date (*anndats*) occurs after the earnings announcement date (*anndats_act*), as these represent data errors. Our analyses require stock price data from CRSP and accounting data from Compustat. Accordingly, we delete any observation for which we cannot obtain both a CRSP *permno* and Compustat *gvkey*. At this stage, the forecast sample contains 1,726,955 forecast observations. Next, we remove analyst forecasts that are within plus or minus two days of an earnings announcement of the forecasted firm in order to decrease the confounding effects.⁸ This deletion leaves us with 1,058,797 observations. We next form characteristic variables (*AbsPctDeviation* and *NFirmsCovered*). These reduce the sample to 1,026,156 forecast observations across 10,636 distinct firms and 11,293 distinct individual analysts.

Next, because we structure this analysis as a pre/post forecast day design, we delete firm-forecast day observations if there is another forecast day for the same firm in the leading or preceding two days to prevent overlapping observations that may confound our interpretation of the pre-post periods. This elimination leaves 572,015 forecast-day observations. Then, from CRSP we obtain prior quarter return volatility (*Volatility*) and prior quarter average turnover (*Turnover*), and remove missing observations. This further reduces our sample to 568,996 observations. We next append from CRSP daily bid-ask spread and stock price for the four trading-day window around each firm-forecast day observation, and truncate these variables at

⁷ We delete observations where *analys*=000000, as that code indicates that the particular analysts associated with a given forecast is unidentified.

⁸ Subsequently reported inferences are unaltered if we delete observations within plus or minus five days of an earnings announcement.

the 1% level, and only retain forecast-day observations that have non-missing data for the complete four-day window. This results in an initial bid-ask spread sample of 2,090,656 daily observations, which are by construction based on 522,664 distinct firm-forecast-day observations. Note that each observation is a unique combination of firm, fiscal period end, forecasting analyst, forecast date, and day relative to the forecast.

In our primary analyses our unit of study is a day on which a forecast is issued for a given firm. Accordingly, we only desire one observation for a firm-forecast day, regardless how many different individual analysts issue a forecast on that day. Therefore, we retain only one observation for each day on which a forecast was issued for a given firm-quarter, leaving 1,873,192 observations (i.e., the difference between 2,090,656 and 1,873,192 reflects the fact that more than one analyst may issue a forecast for the same firm on the same day).

In addition to our primary analysis based on forecast-day observations, we conduct tests for cross-sectional variation based on particular characteristics of specific analyst forecasts. For these tests of unique analyst characteristics we eliminate observations where two or more analysts issued a forecast on the same day for a given firm and fiscal period end. This leads to a subsample of 1,720,844 observations based on 430,211 distinct firm-forecast-day observations.

Table 1 presents descriptive statistics. We note that unconditional bid-ask spread is 3.89%, on average. This is clearly higher than the conditional bid-ask spread after eliminating inventory holding costs, as done in our multivariate analyses. Our sample firms are relatively large, with mean market value of equity of \$1.2 billion.

[Insert Table 1 here]

Table 2 presents a correlation matrix, with Pearson (Spearman) correlations reported above (below) the diagonal. Consistent with our key prediction, there is a negative correlation

between bid-ask spread and the post-forecast indicator. Although *BASpread* contains non-information asymmetry components, this correlation is consistent with our prediction that analyst forecasts decrease information asymmetry. In our multivariate analyses we control for non-information asymmetry components of spread.

[Insert Table 2 here]

5. Results and additional analyses

5.1. Main findings

Table 3 reports the results from the estimation of Eq. (1). The coefficient of *PostFcst* is -0.130 (t-statistic of -35.59 for a model without fixed effects and t-statistic of -35.50 for a model with firm fixed effects). Focusing on column 1 (i.e, the model without firm fixed effects) the average information asymmetry decreases from 2.365 percentage points to 2.235 percentage points, which represents an average decrease of 5.5% in information asymmetry across the two days after an analyst forecast relative to the two days prior to the forecast announcement. These results are consistent with our prediction that analyst forecasts, on average, decrease information asymmetry during the announcement period.

Because our research design uses daily observations surrounding a given analyst forecast, our analysis has a relatively large number of observations which can inflate the statistical significance of our coefficient estimates, even though we cluster standard errors by firm. Despite the strong economic magnitude implied by our coefficient estimates, to alleviate concern that our statistical significance simply comes from our large sample size, we repeat our analysis using a bootstrap approach. In particular, column (3) reports results where the coefficient estimates are the mean estimates across 100 iterations of Eq. (1) using random samples of 20,000 observations (i.e., 5,000 analyst forecasts), and the t-statistics are based on the standard deviation of the

coefficient estimates across the 100 iterations. The coefficient estimates are remarkably similar to those obtained in column (1) using our full sample, and all inferences remain comfortably significant.

[Insert Table 3 here]

One potential concern about the interpretation of our main finding is that rather than analyst forecasts causing the decrease in information asymmetry, what we observe may be the result of analysts issuing forecasts in the wake of a significant firm news event (that is neither an earnings announcement nor a management forecast), during the period when information asymmetry is in the process of being resolved. A related concern is that analysts may choose to issue forecasts when information asymmetry is already going down (i.e., they are followers, or they process information events at the same time that the market processes them). To mitigate concern that this alternative explanation is at play, we repeat our analysis using only forecasts where there is no other forecast for the same firm within a five day surrounding window. The logic behind this design is that if the alternative explanation holds, forecasts will be clustered in time. In other words, if our results obtain after eliminating clustered forecasts, the alternative explanation is unlikely. Untabulated results using this "non-clustered" forecast sample provide identical inferences to those reported in Table 3.⁹

5.2. Contrast with earnings announcements and management forecasts

As previously discussed, extant literature documents an announcement period increase in information asymmetry for earnings announcements and management earnings forecasts. In this section, we replicate these prior findings using our daily event study research design. This replication serves not only to lend confidence in our research design, but also makes obvious the

⁹ We repeat this robustness analysis separately for firms with greater than three analysts and greater than ten analysts, and obtain identical inferences.

differences between the effects of firm supplied information releases versus analyst forecasts on information asymmetry.

Panel A of Table 4 reports results from estimating a version of Eq. (1) where we replace *PostFcst* with *PostEA*, an indicator that equals one if day *d* is day +1 or +2 relative to an earnings announcement. Panel B of Table 4 similarly reports results from estimating a version of Eq. (1) where we replace *PostFcst* with *PostMF*, an indicator that equals one if day *d* is day +1 or +2 relative to a management earnings forecast. In both Panels, columns 3 and 4 reports corresponding results using a constant sample with our original analyst forecast indicator, *PostFcst*.

Focusing on the estimations with firm fixed effects, column 2 of Panel A documents that earnings announcements increase information asymmetry during the announcement period, consistent with prior literature, and with our prediction above that unprocessed information announcements increase information asymmetry at announcement. Specifically, the coefficient estimate on *PostEA* is 0.775 with a t-statistic of 68.63. Using a constant firm-quarter sample matched to the earnings announcement firm-quarters, column 4 reports inferences consistent with our main findings that analyst forecasts decrease announcement period information asymmetry. Focusing on the estimations with firm fixed effects, column 2 of Panel B documents that management forecasts increase information asymmetry during the announcement period, consistent with prior literature (e.g., Coller and Yohn 1997), results from earnings announcements, and with our prediction above that unprocessed information announcements increase information asymmetry at announcement. Specifically, the coefficient estimate on *PostMF* is 1.027 with a t-statistic of 39.70. Using a constant firm-quarter sample matched to the

earnings announcement firm-quarters, column 4 reports inferences consistent with our main findings that analyst forecasts decrease announcement period information asymmetry.

[Insert Table 4 here]

5.3. *Cross-sectional variation*

Having documented above that analyst forecasts decrease announcement period information asymmetry, we now examine cross-sectional variation in the effect of analyst forecasts on information asymmetry based on forecast and analyst characteristics. Specifically, we test whether the effect of an analyst forecast on information asymmetry varies in a predictable manner with the deviation from prevailing consensus (*AbsPctDeviation*) and the number of firms covered by the analyst (*NFirmsCovered*). We estimate the following variation of Eq. (1):

$$\begin{aligned}
 BASpread_{i,d} = & \beta_0 + \beta_1 PostFcst_{f,d} + \beta_2 Characteristic + \beta_3 PostFcst_{f,d} * Characteristic \\
 & + \beta_4 Price_{i,d} + \beta_5 LnSize_{i,t-1} + \beta_6 Volatility_{i,t-1} \\
 & + \beta_7 Turnover_{i,t-1} + FirmFixedEffects + \varepsilon_{i,d},
 \end{aligned} \tag{2}$$

where *Characteristic* is, alternatively, *AbsPctDeviation* and *NFirmsCovered*. *AbsPctDeviation* is measured as the absolute value of the percentage deviation of the analyst forecast from the consensus analyst forecast, where we calculate the consensus forecast as the weighted average of all outstanding forecasts given in the in the same and prior quarter to the analyst forecast, where the weights are assigned based on the lags between each forecast in the consensus and the day of the consensus estimate formation. *NFirmsCovered* is the number of distinct firms for which a given analyst issues a forecast in the given calendar quarter.

We expect *AbsPctDeviation* to amplify the effect of a forecast on information asymmetry, because we view this variable as a proxy for the amount of new processed information that analysts imbed in their forecast. In particular, because forecasts reduce

information asymmetry (i.e., $\beta_1 < 0$), we expect $\beta_3 < 0$. Following Barth et al. (2001), we consider *NFirmsCovered* to be a proxy for analyst effort in covering a particular firm, i.e., the more firms an analyst covers, the less ability she has to provide new processed information for any single firm-forecast. Accordingly, we expect $\beta_3 > 0$.

[Insert Table 5 here]

We report the results of the cross sectional tests in Table 5. In column 1 we examine the effect of the deviation of the analyst forecast from the prevailing consensus. We find that the coefficient of *PostFcast*AbsPctDeviation* is -0.028 (t-statistic of -4.03). This finding is consistent with our prediction that the higher the magnitude of the deviation from the prevailing consensus, the more new processed information the forecast contains, and therefore the larger the decrease in information asymmetry it provides.

In column 2 we report the results of the association between the number of firms covered by the analyst producing the forecast and the magnitude of the decrease in information asymmetry. We find that the coefficient of *PostFcast*NFirmsCovered* is 0.002 (t-statistic of 4.94). This finding is consistent with our prediction that the less effort exerted by the analyst on a given firm forecast, the less new processed information the forecast contains, and therefore the smaller the decrease in information asymmetry it provides.

5.5. *Longer-term information asymmetry effects*

Our main interest in this study is the effect of analyst forecasts on announcement period information asymmetry, because it is in the announcement period effect that we think analyst forecasts are conceptually distinct in their effects relative to firm supplied information releases such as earnings announcements and management forecasts. However, in this section we

consider the longer term effects of analyst forecasts on information asymmetry to further illustrate the distinction between analyst forecasts and firm-supplied information.

Specifically, in this section we analyze the longer-term effects of analyst forecasts on information asymmetry by estimating the following modification to Eq. (1), which compares pre-announcement information asymmetry to information asymmetry in various post announcement windows up to ten trading days after the forecast:

$$\begin{aligned}
 BASpread_{i,d} = & \beta_0 + \beta_1 PostFcst_{f,d} + \beta_2 PostFcst4_{f,d} + \beta_3 PostFcst6_{f,d} \\
 & + \beta_4 PostFcst8_{f,d} + \beta_5 PostFcst10_{f,d} + \beta_6 Price_{i,d} + \beta_7 LnSize_{i,t-1} \\
 & + \beta_8 Volatility_{i,t-1} + \beta_9 Turnover_{i,t-1} + FirmFixedEffects + \varepsilon_{i,d}
 \end{aligned} \tag{3}$$

PostFcst4 (*PostFcst6*, *PostFcst8*, *PostFcst10*) is an indicator variable that equals one if day *d* is either trading day +3 or +4 (+5 or +6, +7 or +8, +9 or +10) relative to the announcement day for analyst *a*'s forecast, and equals zero otherwise. All other variables are as previously defined. We conduct the same analysis for management forecasts and earnings announcements by replacing *PostFcst* with *PostMF* and *PostEA*, respectively.

Table 6 presents the results from estimating Eq. (3), where columns 1, 2, and 3 report results for analyst forecasts, management forecasts, and earnings announcements, respectively. Looking across all columns, the coefficient estimates on *PostFcst* provide consistent inferences with our main findings that in the two day post-announcement window information asymmetry decreases for analyst forecasts (21.3 basis points lower than pre-announcement) and increases for both management forecasts (105.6 basis points higher than pre-announcement) and earnings announcements (74.9 basis points higher than pre-announcement). Focusing on column 1, coefficient estimates from the additional *PostFcst2* through *PostFcst10* variables show that after the analyst forecast announcement window, information asymmetry remains lower than observed in the pre-forecast announcement period, consistent with our expectation and our discussion in

Section 3 above. For example, the coefficient on *PostFcst6* suggests that average information asymmetry in days +5 and +6 is 33.6 basis points lower than pre-forecast levels.

[Insert Table 6 here]

Focusing on management forecasts and earnings announcements in columns 2 and 3, respectively, consistent with prior literature we document that after the initial announcement period *increase* in information asymmetry there is a decrease in information asymmetry relative to the pre-announcement levels (e.g., Coller and Yohn 1997). For example, the coefficient on *PostFcst6* suggests that average information asymmetry in days +5 and +6 is 20.3 basis points (22.6 basis points) lower than pre-announcement levels for management forecasts (earnings announcements).

Figure 1, which depicts these regression results graphically, clearly reveals the different information asymmetry effects of analyst forecasts relative to both management forecasts and earnings announcements. Again, whereas all three information releases decrease longer term information asymmetry, analyst forecasts are distinct in that the decrease in information asymmetry begins at announcement. Moreover, we note that the magnitude of the total quarterly economic effect of analyst forecasts on information asymmetry is greater than represented in Table 6 and Figure 1, as there are on average 2.5 analyst forecasts per firm-quarter.

[Insert Figure 1 here]

6. Additional analysis: regulation and changes to the information environment

In this section, we consider the effect of a set of regulations that divides our sample period into two distinct regimes for analysts' information environment. Specifically, we use this set of regulations to structure tests that corroborate the interpretation of our main findings. First, we develop the intuition surrounding these additional tests and our associated predictions.

Second, we extend the stylized example from Section 3 to incorporate these new insights. Finally, we provide and discuss results of related empirical tests.

6.1. Background and predictions

There were at least six regulations issued between 2000 and 2003 that materially affected the information environment and activities of analysts (Bradshaw 2009). We take advantage of the existence of this set of relatively exogenous regulatory actions within our sample period, which reduced the ability of analysts to obtain and disseminate private information from both firm insiders and from within the analysts' own investment bank. If there is indeed a causal relation between forecasts and information asymmetry, these exogenous regulatory actions should affect this relation in a predictable fashion, which will buttress our causal interpretation. We note that in our study, we are not interested in examining the effects of any one particular regulation, but rather are more interested in considering these regulatory actions as a whole, and examining differences in the effects of forecasts on information asymmetry before and after the general period during which this aggregate set of regulations was implemented.

Regulation FD, which was issued in October 2000, states that managers may no longer disclose material private information to financial analysts. In mid-2002, NASD and NYSE enacted new rules (Rule 2711 and amended Rule 472, respectively) whose main purpose was to sever ties between investment banking and research departments within all brokerage houses operating in the U.S. In December 2002, the SEC announced the "Global Settlement" between various regulatory agencies and ten of the largest investment firms in the U.S. to resolve issues of conflicts of interest within brokerage firms. Among other provisions, firms were required to sever links between research and investment banking. In addition, Sarbanes-Oxley was issued in 2002, which likewise may have affected analysts' information environment (Bradshaw 2009).

Extant empirical evidence is consistent with these regulations having an impact on the properties of analyst forecasts. For example, Kadan et al. (2009) document that after Rule 2711, Rule 472, and the Global Settlement, the overall informativeness of analyst recommendations as measured by abnormal equity market reactions has declined. Similarly, Gintschel and Markov (2004) provide evidence that analyst forecasts and recommendations have lower price impact after the passage of Regulation FD.

6.2. *Extension of stylized example*

In this section, we incorporate the intuition developed above into the framework of our stylized example from Section 3. Recall that there exists a sophisticated investor (S) and an unsophisticated investor (D) within initial (time $t=0$) information asymmetry concerning the value of a firm (V) ($V_D^0 \in \{5,10,15,20,25\}$, $V_S^0 \in \{10,20,25\}$), where this information asymmetry can come from the sophisticated investor's possession of private information and/or superior processing of publicly available information. For this extension, suppose that S 's private information eliminates '15' and S 's superior processing eliminates '5' from the public information set to arrive at $V_S^0 \in \{10,20,25\}$. Based on our empirical findings above, we now take the result as given that analyst forecasts represent either Case 2a or 2c, where information asymmetry decreases both in the short and longer-term.

For purposes of this extension, consider the baseline example detailed in Section 3 to be conceptualized in the pre-2003 regime. Recall that $R_p^1 \in \{10,20\}$, $V_S^1 = V_S^2 \in \{10,20\}$, and $V_D^1 = V_D^2 \in \{10,20\}$. That is, before the analyst forecast (i.e., pre- R_p), D has a 0.20 probability of guessing the correct V , whereas S has a 0.33 probability, resulting in initial information asymmetry of 0.13. After the analyst forecast, both D and S have a 0.50 probability of guessing correct V . Therefore, information asymmetry decreases from 0.13 to zero.

Now suppose that post-2002, S can no longer eliminate '15' at $t=0$ because of difficulty in obtaining private information, similar to the difficulties faced by analysts in obtaining private information under the new regulatory regime. Therefore, the initial information sets are as follows: $V_D^0 \in \{5,10,15,20,25\}$ and $V_S^0 \in \{10,15,20,25\}$ (i.e., information asymmetry of $0.25-0.20 = 0.05$). Because the analyst cannot obtain private information, analyst forecasts reveal less private information, i.e., $R_p^1 \in \{10,15,20\}$. Nonetheless, note that after the analyst forecast information asymmetry goes down (from 0.05 to zero), as both S and D have the same information set: $V_D^1 \equiv V_S^1 \in \{10,15,20\}$. Again, two things are noteworthy in the pre to post-2003 comparison, both of which are consistent with our predictions in the section above. First, post-2003, overall information asymmetry decreases (i.e., from 0.13 to 0.05). Second, and more pertinent to the present study, post-2002 the effect of an analyst forecast on information asymmetry decreases (i.e., from -0.13 to -0.05).

6.3. *Research design and empirical findings*

To test our prediction that the effect of an analyst forecast on information asymmetry is mitigated in the post-regulatory period, we modify Eq. (1) as follows:

$$\begin{aligned}
 BASpread_{i,d} = & \beta_0 + \beta_1 PostFcst_{f,d} + \beta_2 PostReg_t + \beta_3 PostFcst_{f,d} * PostReg_t \\
 & + \beta_4 Price_{i,d} + \beta_5 LnSize_{i,t-1} + \beta_6 Volatility_{i,t-1} \\
 & + \beta_7 Turnover_{i,t-1} + FirmFixedEffects + \varepsilon_{i,d},
 \end{aligned} \tag{3}$$

where $PostReg$ is an indicator that equals one if quarter t is in calendar years after 2002, and equals zero otherwise. If the set of regulatory actions indeed mitigate the effect of analyst forecasts on information asymmetry, we expect $\beta_3 > 0$. To alleviate concerns about other confounding events affecting this test, we estimate Eq. (3) using sample observations only within the four years surrounding the regulatory actions (i.e., 2001 through 2004).

Columns 1 and 2 in Panel A of Table 7 present the results of estimating Eq. (3), which tests the combined effect of the regulations on the decrease in information asymmetry following analyst forecasts. First, we note that $\beta_2 < 0$ (coefficient estimate of -0.866 with a t-statistic of -38.89 in the column 1 specification), which provides evidence consistent with extant literature that general information asymmetry declined in the post-regulatory period (e.g., Eleswarapu et al. 2004). Moving directly to the predictions from our study, $\beta_3 > 0$ (coefficient estimate of 0.126 with a t-statistic of 7.80), which provides evidence that the regulatory changes indeed mitigated the ability of analyst forecasts to reduce information asymmetry, as predicted. Results from the column 2 estimation with firm fixed effects provides identical inferences.

We repeat the estimation of Eq. (3) after replacing PostFcst with, alternatively, PostMF and PostEA. In untabulated results, in contrast to the findings for analyst forecasts we find that this set of regulatory actions *exacerbated* the announcement period increase in information asymmetry for both management forecasts and earnings announcements (although significantly so only for earnings announcements). This result is consistent with the intuition that after the regulatory actions, these firm-supplied announcements contained relatively more information that required processing as compared to the pre-regulatory regime. Moreover, these contrasting results further mitigate the plausibility of alternative explanations for our primary findings.

[Insert Table 7 here]

Among the set of regulatory actions that affected analysts' information environment, the Global Settlement offers potential cross-sectional variation in its effect. As mentioned above, the Global Settlement directly involved ten particular investment banks. Although the adoption of the Global Settlement may have influenced the behavior of non-signatory banks, we conjecture that analysts from brokerage houses that participated directly in the Global Settlement should

experience relatively greater reduction in their ability to obtain private information. We use this feature to extend this test by examining whether the effects of the set of regulatory actions are more pronounced for analysts at firms that are direct participants in the Global Settlement. Specifically, we alter Eq. (3) as follows:

$$\begin{aligned}
BASpread_{i,d} = & \beta_0 + \beta_1 PostFcst_{f,d} + \beta_2 PostReg_t + \beta_3 PostFcst_{f,d} * PostReg_t \\
& + \beta_4 GlbSettler_a + \beta_5 PostReg_t * GlbSettler_a + \beta_6 PostFcst_{f,d} * GlbSettler_a \\
& + \beta_7 PostFcst_{f,d} * PostReg_t * GlbSettler_a + \beta_8 Price_{i,d} + \beta_9 LnSize_{i,t-1} \\
& + \beta_{10} Volatility_{i,t-1} + \beta_{11} Turnover_{i,t-1} + FirmFixedEffects + \varepsilon_{i,d},
\end{aligned} \tag{4}$$

where *GlbSettler* is an indicator variable that equals one if the analyst issuing the forecast comes from one of the ten brokerage houses that were part of the Global Settlement agreement, and equals zero otherwise.¹⁰ If forecasts from analysts at these firms indeed have their information asymmetry-reducing effects mitigated to a greater degree than analysts from firms that were not direct participants in the Global Settlement, we expect $\beta_7 > 0$.

Columns 3 and 4 in Panel A of Table 7 presents the regression results from estimating Eq. (4). As expected, $\beta_7 > 0$ (coefficient estimate of 0.087 with a t-statistic of 2.25 in the column 3 specification), which is consistent with forecasts issued by analysts from Global Settlers having less of a reducing effect on information asymmetry as compared to non-Global Settlers after implementation of the Global Settlement. Results from the column 4 estimation with firm fixed effects provide consistent inferences.

To ease interpretation of the key inferences from estimation of Eq. (4), Panel B of Table 7 provides a difference-in-differences presentation of key coefficient estimate combinations from the Panel A column (3) regression. First, note that for non-Global Settlers, forecasts decrease information asymmetry 6% prior to the regulations (0.194/3.233) and 1.7% after the regulations

¹⁰ We identify the brokerage house of a given analyst using the I/B/E/S broker translation file (*bran*).

(0.041/2.422). Next, note that for Global Settlers, forecasts decrease information asymmetry 7.4% prior to the regulations (0.248/3.337) and 0.3% after the regulations (0.008/2.312). This comparison again reveals that the effect of the Global Settlement on the ability of analyst forecasts to decrease information asymmetry was more pronounced for analysts at brokerage firms that participated in the Global Settlement.

7. Conclusion

In this paper, we examine the impact of analyst forecasts on information asymmetry in equity markets. Whereas earnings announcements and management forecasts are information releases provided directly by firm insiders, analyst forecasts are information releases by sophisticated market participants who not only may have access to private firm information, but also apply sophisticated processing abilities to the underlying information that may narrow the processing gap between sophisticated and unsophisticated investors. We construct a stylized example which shows that the directional effect of an information release (e.g., earnings announcement, management forecast, analyst forecast) on information asymmetry depends on how the information content of the forecast interacts with the differential information possessed by sophisticated (i.e., informed) investors relative to unsophisticated (i.e., uninformed) investors, and whether the information is processed or unprocessed.

We document that, in stark contrast to earnings announcements and management forecasts which increase announcement period information asymmetry, information asymmetry *decreases* upon announcement of an analyst forecast. We corroborate this main finding by next showing that the magnitude of the decrease in information asymmetry increases in the information content of the forecast and in analyst effort. We also exploit a set of regulatory actions during our sample period that diminished the ability of analysts to obtain and

communicate private information. We show that the effect of analyst forecasts on information asymmetry is mitigated after this set of regulatory actions was in place. Moreover, in a differences-in-differences sub-analysis, we show that this mitigation is more pronounced for forecasts issued by analysts from brokerage firms that were directly affected by the regulations. These results support the interpretation that analyst forecasts, on average, cause reductions in information asymmetry, and provide a lower bound estimate of the contribution of private information channels in the ability of analyst forecasts to reduce information asymmetry.

Our analysis provides the novel insight that, in principle, informativeness of publicly disclosed information does not imply a reduction of information asymmetry. This insight also allows us to draw a distinction between the findings in prior literature that firm-initiated information announcement increase information asymmetry to our findings that analyst forecasts decrease information asymmetry. Importantly, our results suggest that public information releases by information intermediaries has inherently different outcomes on information asymmetry than do firm-initiated information releases. Our results also highlight the importance of information intermediaries to information dissemination in the marketplace.

Appendix – Variable Definitions

<i>AbsPctDeviation_f</i>	The absolute percent deviation of analyst <i>a</i> 's current forecast <i>f</i> from the prevailing consensus on the day prior to the forecast. The consensus is calculated as the weighted average, by the age of the forecast, of all analysts' latest forecast for firm <i>i</i> for fiscal quarter <i>t</i> .
<i>BASpread_{i,d}</i>	Firm <i>i</i> 's percentage bid-ask spread on trading day <i>d</i> , measured as high daily ask price minus low daily bid price, divided by closing price, all multiplied by 100.
<i>GlbSettler_a</i>	An indicator variable that equals one if analyst <i>a</i> works for a brokerage house that was part of the “Global Settlement” agreement, and equals zero otherwise. The settling brokerage houses include: Bear Sterns, Credit Suisse First Boston, Deutsche Bank, Goldman Sachs, J.P. Morgan Chase, Lehman Brothers, Merrill Lynch, Morgan Stanley, Salomon Smith Barney, and UBS Warburg.
<i>LnSize_{i,t}</i>	Log of firm <i>i</i> 's average market value of equity during quarter <i>t</i> .
<i>NFirmsCovered_{a,t}</i>	Number of firms covered by analyst <i>a</i> during quarter <i>t</i> .
<i>PostEA_{i,t,d}</i>	An indicator variable that equals one on the two trading days immediately following firm <i>i</i> 's quarter <i>t</i> earnings announcement, and equals zero otherwise.
<i>PostFcst_{f,d}</i>	An indicator variable that equals one on the two trading days immediately following the announcement of analyst forecast <i>f</i> , and equals zero otherwise.
<i>PostFcst4_{f,d}</i>	An indicator variable that equals one on the third and fourth trading days immediately following the announcement of analyst forecast <i>f</i> , and equals zero otherwise.
<i>PostFcst6_{f,d}</i>	An indicator variable that equals one on the fifth and sixth trading days immediately following the announcement of analyst forecast <i>f</i> , and equals zero otherwise.
<i>PostFcst8_{f,d}</i>	An indicator variable that equals one on the seventh and eighth trading days immediately following the announcement of analyst forecast <i>f</i> , and equals zero otherwise.
<i>PostFcst10_{f,d}</i>	An indicator variable that equals one on the ninth and tenth trading days immediately following the announcement of analyst forecast <i>f</i> , and equals zero otherwise.

$PostMF_{i,t,d}$	An indicator variable that equals one on the two trading days immediately following a management forecast for firm i 's during quarter t , and equals zero otherwise.
$PostReg_t$	An indicator variable that represents the period after a set of regulations were passed in the early 2000s that materially limited the ability of analysts to obtain and disseminate private information; $PostReg = 1$ if firm i 's quarter t end date is in calendar year 2003 and after, and = 0 otherwise.
$Price_{i,d}$	Firm i 's stock price on day d , obtained from the daily CRSP file.
$Turnover_{i,t}$	Average daily stock turnover of firm i during quarter t .
$Volatility_{i,t}$	Firm return volatility, defined as the standard deviation of firm i 's daily stock return during fiscal quarter t .

Note: Subscripts a, f, i, t , and d refer to a particular analyst, earnings forecast, firm, fiscal quarter, and trading day, respectively. Further note that earnings forecast f is issued by a particular analyst a for a given firm i for fiscal quarter t .

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Figure 1
Information asymmetry following information releases relative to normalized pre-information baseline of zero

Figure 1 plots the *PostInfo* - *PostInfo10* coefficient estimates from the Table 6 regression estimation for analyst forecasts, management forecasts, and earnings announcements. The horizontal axis reflects the timing of the variable construction (e.g., day 4 corresponds to the *PostInfo4* coefficient estimates).

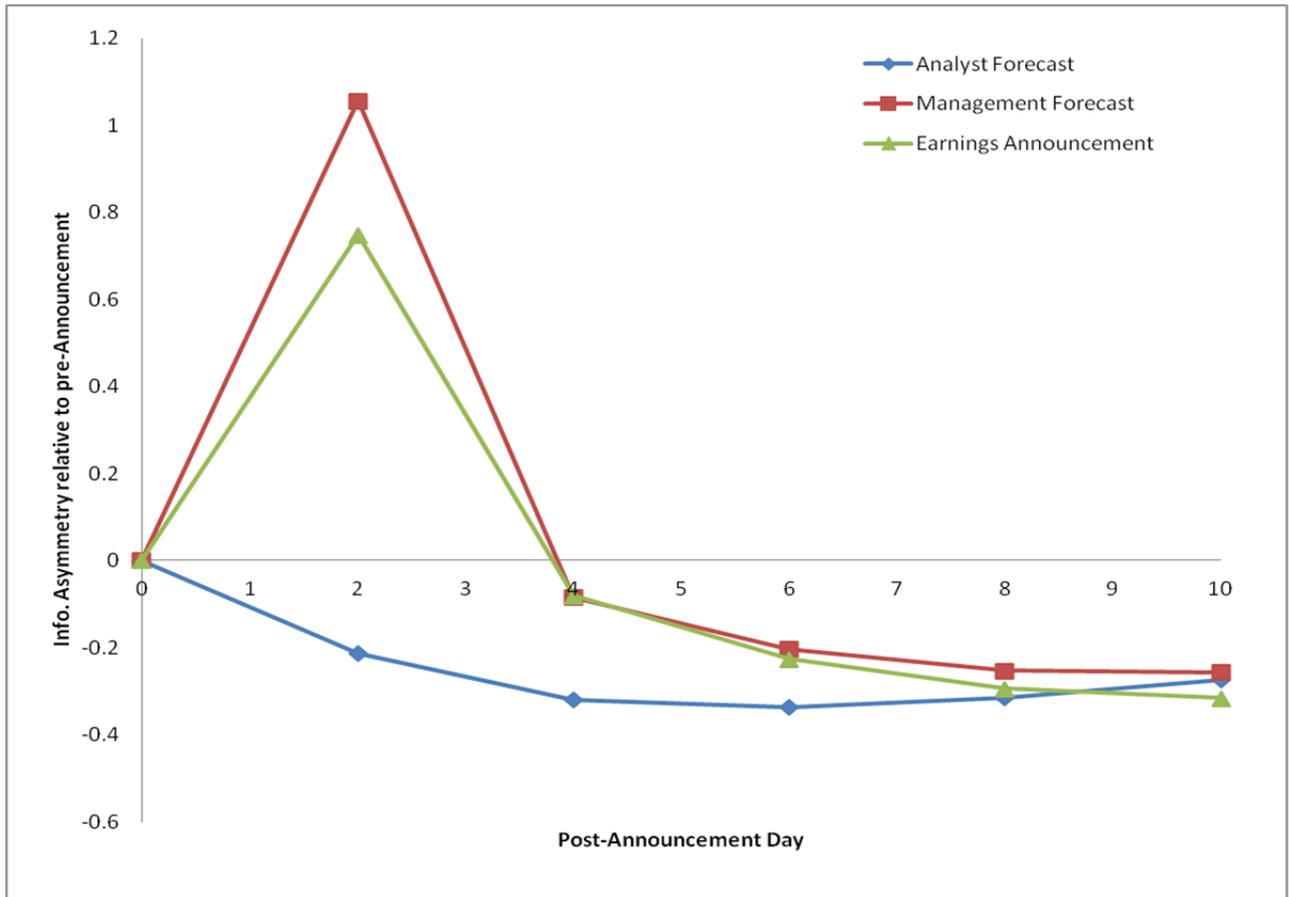


Table 1
Descriptive statistics

Table 1 presents the descriptive statistics. Variable definitions are reported in the appendix. The sample includes 1,873,192 observations.

Variable	Mean	StdDev	P25	P50	P75
<i>BASpread</i>	3.890	3.167	1.867	2.993	4.860
<i>Price</i>	28.784	20.559	14.000	24.250	38.460
<i>LnSize</i>	7.116	1.708	5.894	7.032	8.245
<i>Volatility</i>	0.029	0.016	0.017	0.025	0.036
<i>Turnover</i>	8.880	8.777	3.146	5.996	11.466
<i>AbsPctDeviation</i>	0.248	0.789	0.021	0.059	0.173
<i>NFirmsCovered</i>	13.719	9.759	8.000	12.000	17.000

Table 2
Correlation matrix

Table 2 presents correlations among key variables of interest. Pearson correlations are above the diagonal and Spearman correlations below. Correlations that are statistically significant at the $p < 0.05$ level are reported in bold. Variable definitions are reported in the appendix. The sample includes 1,873,192 observations.

	<i>BASpread</i>	<i>PostFcst</i>	<i>Price</i>	<i>LnSize</i>	<i>Volatility</i>	<i>Turnover</i>	<i>AbsPct-Deviation</i>	<i>NFirmsCovered</i>
<i>BASpread</i>		-0.021	-0.258	-0.254	0.517	0.269	0.119	-0.085
<i>PostFcst</i>	-0.015		0.000	0.000	0.000	0.000	0.000	0.000
<i>Price</i>	-0.366	0.000		0.629	-0.334	-0.002	-0.162	0.023
<i>LnSize</i>	-0.280	0.000	0.682		-0.345	0.037	-0.146	0.032
<i>Volatility</i>	0.581	0.000	-0.476	-0.415		0.446	0.154	-0.128
<i>Turnover</i>	0.346	0.000	-0.030	0.064	0.466		0.051	-0.080
<i>AbsPctDeviation</i>	0.202	0.000	-0.380	-0.292	0.267	0.096		0.003
<i>NFirmsCovered</i>	-0.097	0.000	0.058	0.059	-0.152	-0.088	0.003	

Table 3
Analyst forecasts and information asymmetry

Table 3 presents results of OLS estimation of Eq. (1). Variable definitions are in the appendix. Firm fixed effects are included but not reported. Robust t-statistics based on standard errors clustered by firm are reported in parentheses. The random sample in column (3) is based on 100 random subsamples of 20,000 observations (representing 5,000 unique firm-forecast day observations) from the main sample of 1,873,192 observations. T-statistics in column (3) are based on the standard deviation of the coefficient estimates across the 100 iterations. *, **, and *** indicate significance (two-sided) at the 10%, 5%, and 1% levels, respectively.

Dep. Var: Column	<i>BASpread</i> (1)	<i>BASpread</i> (2)	<i>BASpread</i> (3)
<i>Intercept</i>	2.365*** (60.07)	3.496*** (34.26)	2.361*** (12.35)
<i>PostFcst</i>	-0.130*** (-35.59)	-0.130*** (-35.50)	-0.133*** (-4.19)
<i>Price</i>	-0.011*** (-25.58)	-0.011*** (-17.89)	-0.011*** (-6.11)
<i>LnSize_{t-1}</i>	-0.109*** (-22.37)	-0.187*** (-12.78)	-0.111*** (-4.86)
<i>Volatility_{t-1}</i>	84.965*** (151.46)	66.012*** (105.90)	85.287*** (26.02)
<i>Turnover_{t-1}</i>	0.027*** (28.47)	0.024*** (16.21)	0.027*** (5.51)
Fixed effects	No	Firm	No
N	1,873,192	1,873,192	100
Adj. R^2	0.282	0.320	0.281

Table 4
Panel A: Earnings announcements, analyst forecasts, and information asymmetry – analysis of merged sample

Panel A of Table 4 presents results of OLS estimation of Eq. (1). Variable definitions are in the appendix. Firm fixed effects are included in columns 2 and 4, but not reported. Robust t-statistics based on clustered standard errors at the firm level are reported in parentheses. *, **, and *** indicate significance (two-sided) at the 10%, 5%, and 1% levels, respectively.

Information type:	Earnings Announcement		Analyst Forecast	
Dep. Var:	<i>BASpread</i>	<i>BASpread</i>	<i>BASpread</i>	<i>BASpread</i>
Column	(1)	(2)	(3)	(4)
<i>Intercept</i>	2.529*** (51.19)	2.765*** (24.31)	2.301*** (56.15)	3.238*** (31.50)
<i>PostEA</i>	0.775*** (69.07)	0.775*** (68.63)		
<i>PostFcst</i>			-0.129*** (-34.31)	-0.129*** (-34.22)
<i>Price</i>	-0.023*** (-34.76)	-0.026*** (-25.64)	-0.014*** (-29.26)	-0.014*** (-20.33)
<i>LnSize_{t-1}</i>	-0.088*** (-12.93)	0.017 (0.93)	-0.097*** (-19.06)	-0.147*** (-9.91)
<i>Volatility_{t-1}</i>	79.575*** (112.14)	55.054*** (71.67)	84.581*** (140.69)	65.969*** (99.03)
<i>Turnover_{t-1}</i>	0.057*** (42.01)	0.040*** (20.29)	0.032*** (30.54)	0.029*** (18.02)
Fixed effects	No	Firm	No	Firm
N	661,672	661,672	1,729,100	1,729,100
Adj. R^2	0.243	0.297	0.276	0.314

Table 4**Panel B: Management forecasts, analyst forecasts and information asymmetry – analysis of merged sample**

Panel B of Table 4 presents results of OLS estimation of Eq. (1). Variable definitions are in the appendix. Firm fixed effects are included in columns 2 and 4, but not reported. Robust t-statistics based on clustered standard errors at the firm level are reported in parentheses. *, **, and *** indicate significance (two-sided) at the 10%, 5%, and 1% levels, respectively.

Information type:	Management Forecast		Analyst Forecast	
Dep. Var:	<i>BASpread</i>	<i>BASpread</i>	<i>BASpread</i>	<i>BASpread</i>
Column	(1)	(2)	(3)	(4)
<i>Intercept</i>	3.813*** (37.77)	7.687*** (27.24)	3.195*** (34.64)	6.964*** (18.91)
<i>PostMF</i>	1.028*** (40.08)	1.027*** (39.70)		
<i>PostFcst</i>			-0.194*** (-19.33)	-0.194*** (-19.18)
<i>Price</i>	-0.016*** (-15.55)	-0.016*** (-9.92)	-0.014*** (-15.26)	-0.011*** (-7.74)
<i>LnSize_{t-1}</i>	-0.267*** (-21.20)	-0.691*** (-17.57)	-0.169*** (-15.99)	-0.623*** (-12.33)
<i>Volatility_{t-1}</i>	84.806*** (60.83)	55.713*** (34.30)	82.566*** (63.34)	61.054*** (35.05)
<i>Turnover_{t-1}</i>	0.023*** (9.13)	0.032*** (8.95)	0.020*** (9.95)	0.034*** (9.29)
Fixed effects	No	Firm	No	Firm
N	195,584	195,584	250,648	250,648
Adj. R^2	0.267	0.336	0.268	0.328

Table 5
Cross-sectional variation in reduction in information asymmetry following analyst forecasts

Table 5 presents results of OLS estimation of Eq. (2). Variable definitions are in the appendix. Firm fixed effects are included but not reported. Robust t-statistics based on clustered standard errors at the firm level are reported in parentheses. *, **, and *** indicate significance (two-sided) at the 10%, 5%, and 1% levels, respectively.

Dep. Var: <i>Characteristic</i> Var: Column	<i>BASpread</i> <i>AbsPctDeviation</i> (1)	<i>BASpread</i> <i>NFirmsCovered</i> (2)
<i>Intercept</i>	3.434*** (34.39)	3.549*** (35.25)
<i>PostFcst</i>	-0.099*** (-25.94)	-0.127*** (-21.09)
<i>Characteristic</i>	0.103*** (11.12)	-0.003*** (-6.59)
<i>Characteristic*PostFcst</i>	-0.028*** (-4.03)	0.002*** (4.94)
<i>Price</i>	-0.011*** (-17.21)	-0.011*** (-17.51)
<i>LnSize_{t-1}</i>	-0.185*** (-12.78)	-0.193*** (-13.28)
<i>Volatility_{t-1}</i>	64.828*** (103.34)	65.128*** (103.88)
<i>Turnover_{t-1}</i>	0.023*** (16.16)	0.024*** (16.29)
Fixed effects	Firm	Firm
N	1,720,844	1,720,844
Adj. R^2	0.320	0.320

Table 6
Analyst and management forecasts, earnings announcements and longer window information asymmetry

Table 6 presents results of OLS estimation of Eq. (3). Variable definitions are in the appendix. Firm fixed effects are included but not reported. Robust t-statistics based on clustered standard errors at the firm level are reported in parentheses. *, **, and *** indicate significance (two-sided) at the 10%, 5%, and 1% levels, respectively.

Information type: <i>PostInfo</i> variable: Dep. Var.: Column	Analyst Forecast <i>PostFcst</i> <i>BASpread</i> (1)	Mgmt Forecast <i>PostMF</i> <i>BASpread</i> (2)	Earn. Announce. <i>PostEA</i> <i>BASpread</i> (3)
<i>PostInfo</i>	-0.213*** (-45.03)	1.056*** (44.46)	0.749*** (82.10)
<i>PostInfo4</i>	-0.319*** (-63.34)	-0.084*** (-6.88)	-0.081*** (-13.45)
<i>PostInfo6</i>	-0.336*** (-64.62)	-0.203*** (-16.52)	-0.226*** (-36.49)
<i>PostInfo8</i>	-0.315*** (-59.66)	-0.253*** (-20.03)	-0.294*** (-47.20)
<i>PostInfo10</i>	-0.274*** (-51.69)	-0.257*** (-19.92)	-0.316*** (-49.41)
<i>Price</i>	-0.009*** (-14.27)	-0.013*** (-10.33)	-0.020*** (-25.47)
<i>LnSize_{t-1}</i>	-0.222*** (-17.63)	-0.587*** (-21.58)	-0.288*** (-21.90)
<i>Volatility_{t-1}</i>	62.614*** (118.10)	48.517*** (40.99)	40.752*** (90.19)
<i>Turnover_{t-1}</i>	0.019*** (15.12)	0.025*** (9.75)	0.025*** (20.08)
Fixed effects	Firm	Firm	Firm
N	4,037,736	747,192	4,552,836
Adj. R^2	0.314	0.333	0.269

Table 7
Analyst forecasts and information asymmetry pre- and post-regulatory actions

Table 7 presents results of OLS estimation of Eq. (4), using a sample period 2001-2004. Variable definitions are in the appendix. Firm fixed effects are included in columns 2 and 4, but not reported. Robust t-statistics based on clustered standard errors at the firm level are reported in parentheses. *, **, and *** indicate significance (two-sided) at the 10%, 5%, and 1% levels, respectively.

Panel A: Full regression results

Dep. Var: Column	<i>BASpread</i> (1)	<i>BASpread</i> (2)	<i>BASpread</i> (3)	<i>BASpread</i> (4)
<i>Intercept</i>	3.266*** (41.37)	6.944*** (20.56)	3.233*** (40.29)	6.918*** (20.43)
<i>PostFcst</i>	-0.208*** (-14.68)	-0.208*** (-14.53)	-0.194*** (-11.51)	-0.193*** (-11.40)
<i>PostReg</i>	-0.866*** (-38.89)	-1.121*** (-47.11)	-0.811*** (-32.63)	-1.086*** (-41.69)
<i>PostFcst*PostReg</i>	0.126*** (7.80)	0.125*** (7.67)	0.153*** (4.27)	0.122*** (3.67)
<i>GlbSettler</i>			0.104*** (5.40)	0.103*** (5.30)
<i>GlbSettler*PostReg</i>			-0.214*** (-5.39)	-0.126*** (-3.35)
<i>PostFcst* GlbSettler</i>			-0.054 (-1.59)	-0.053 (-1.57)
<i>PostFcst*GlbSettler*PostReg</i>			0.087** (2.25)	0.087** (2.23)
<i>Price</i>	-0.021*** (-25.92)	-0.013*** (-7.57)	-0.021*** (-25.88)	-0.013*** (-7.57)
<i>LnSize_{t-1}</i>	-0.109*** (-12.91)	-0.433*** (-9.16)	-0.110*** (-12.91)	-0.434*** (-9.18)
<i>Volatility_{t-1}</i>	76.439*** (72.16)	35.642*** (26.13)	76.429*** (72.24)	35.640*** (26.13)
<i>Turnover_{t-1}</i>	0.025*** (16.22)	0.007*** (2.71)	0.025*** (16.26)	0.007*** (2.74)
Fixed effects	No	Firm	No	Firm
N	309,248	309,248	309,248	309,248
Adj. <i>R</i> ²	0.361	0.428	0.361	0.428
<i>H0:</i>	<i>PostFcst + PostFcst*PostReg = 0</i>		<i>PostFcst*GlbSettler* PostReg+PostFcst* GlbSettler = 0</i>	
F-stat	95.517	95.407	3.332	3.331
Prob > F	0.000	0.000	0.033	0.034

Table 7, continued

Analyst forecasts and information asymmetry pre- and post-regulatory actions

Panel B: Difference-in-difference presentation of information asymmetry levels (without firm fixed effects, as in Column 3 in Panel A)

	<i>GlbSettler=0</i>		
	<i>PostReg=0</i>	<i>PostReg=1</i>	<i>Diff. PostReg (1-0)</i>
<i>PostFcst=0</i>	3.233*** (β_0)	2.422*** ($\beta_0+\beta_2$)	
<i>PostFcst=1</i>	3.039*** ($\beta_0+\beta_1$)	2.381*** ($\beta_0+\beta_1+\beta_2+\beta_3$)	
Diff. <i>PostFcst (1-0)</i>	-0.194*** (β_1)	-0.041*** ($\beta_1+\beta_3$)	0.153*** (β_3)
	<i>GlbSettler=1</i>		
	<i>PostReg=0</i>	<i>PostReg=1</i>	<i>Diff. PostReg (1-0)</i>
<i>PostFcst=0</i>	3.337*** ($\beta_0+\beta_4$)	2.312*** ($\beta_0+\beta_2+\beta_4+\beta_5$)	
<i>PostFcst=1</i>	3.089*** ($\beta_0+\beta_1+\beta_4+\beta_6$)	2.304*** ($\beta_0+\beta_1+\beta_2+\beta_3+\beta_4+\beta_5+\beta_6+\beta_7$)	
Diff. <i>PostFcst (1-0)</i>	-0.248*** ($\beta_1+\beta_6$)	-0.008*** ($\beta_1+\beta_3+\beta_6+\beta_7$)	0.240*** ($\beta_3+\beta_7$)
Diff. <i>GlobSettler (1-0)</i>			0.087** (β_7)