Narrative Tone and Capital Investments

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Abstract: This study contributes to the literature on the relationship between the tone of financial disclosure narratives and capital investments. Specifically, we examine conditions where managers have differential incentives to disclose incrementally informative and misleading investment narratives. First, we argue that managers have fewer incentives to disclose misleading investment narratives if their content can be verified from concurrently disclosed numbers. Consistent with this argument, we find that the tone of a sample of 10-K disclosures is positively associated with current-period investments, suggesting that managers disclose incrementally informative narratives on the investment level. Second, we argue that, when the investment outcomes hamper their interests, managers have heightened incentives to disclose misleading investment efficiency narratives, as investment efficiency is not readily verifiable from concurrently disclosed numbers. Consistent with this argument, we find that the tone is more negatively associated with investment efficiency when firms: (a) undertake large vis a vis small investments (b) undertake vis a vis do not undertake new investments in the year (c) overinvest vis a vis underinvest and (d) decrease vis a vis increase investment efficiency. Overall, our results suggest that managers may disclose misleading narratives when the investment outcomes misalign with their interests.

Keywords: Tone, Investment Level, Investment Efficiency, Narratives, 10-K.

1. Introduction

Recent capital markets research has received some attention on the linkage between firms' investment decisions and the lexical features of their financial disclosures (e.g., Berns, Bick, Flugum, & Houston, 2022; Cho & Muslu, 2021; Durnev & Mangen, 2020). Notably among these studies, Berns et al. (2022) document that the tone of the Management Discussion and Analysis (MD&A) section of 10-Ks predicts one-year ahead investments. Arguably, this implies that financial disclosure narratives signal future investment activities, thus allowing users to gauge future managerial behaviour. Nevertheless, extant research largely ignores the relationship between the narrative tone and the reported (current-period) investment level, which is useful in estimating firms' growth potential and future earnings (Durnev & Mangen, 2020; Li, 2010; Roychowdhury, Shroff, & Verdi, 2019). Extant research is also agnostic of the conditions under which managers have differential incentives to disclose incrementally informative vis a vis misleading investment narratives. This interests us because managerial motivations to disclose misleading narratives is exacerbated when the narrative content is not readily verifiable, potentially lowering its decision-usefulness (Hutton, Miller, & Skinner, 2003; Huang, Teoh, & Zhang, 2014; Kimbrough & Wang, 2014; Mercer, 2005). Our study contributes to the literature by addressing these research gaps.

We first examine the relationship between the narrative tone and the reported investment level. Financial reporting regulations mandate firms to provide quantitative disclosures of their investment level, by periodically reporting the value of fixed and intangible assets, research and development (R&D) expenses, acquisitions, divestments and trading and operating activities (Hoberg & Phillips, 2010; Li, 2010; Roychowdhury et al., 2019). Consistent with the expectations-adjustment hypothesis, managers have incentives to supplement these quantitative disclosures with narrative commentary on their investment undertakings – to align the expectations of financial statement users with their own

assessments (Davis, Piger, & Sedor, 2012; Davis, Ge, Matsumoto, & Zhang, 2015; Hutton et al., 2003). Managers are unlikely to disclose narratives that are easily refutable by concurrently reported numbers – to preserve their credibility (Mercer, 2005) and to avoid managerial and market penalties (Kimbrough & Wang, 2014). Therefore, we hypothesize that the narrative tone is positively associated with the reported investment level.

We also explore the relationship between the narrative tone and investment efficiency. Unlike the investment level, firms are not mandated to provide quantitative disclosures of their investment efficiency. This implies that narrative assessments of how well the firm manages its investments are not readily verifiable by concurrently reported numbers (Durnev & Mangen, 2020). Consistent with the management obfuscation hypothesis, managers have incentives to engage in narrative hype or spin to mislead the users if they perceive the benefits to outweigh the costs (Lang & Lundholm, 1993; Li, 2008; Merkl-Davies & Brennan, 2007). If managers predominantly disclose incrementally informative (misleading) narratives on their investment activities, then the tone is expected to be positively (negatively) associated with investment efficiency. When the investment outcomes do not align with managers' interests, their incentives to disclose misleading investment efficiency narratives are expected to be higher (Huang et al., 2014; Rahman, 2019). In accordance with the management obfuscation hypothesis, we examine four such conditions.

The first condition is related to the size of the investment, which in turn is related to the firm's earnings, and consequently, to managers' performance evaluation and payoffs (Al Ani & Chavali, 2023; Park, 2022). This implies, the larger the investment amount, the higher are the "stakes" for the firm and its managers (Bushee, 1998; Bushman & Smith, 2001). Given this, we hypothesize that managers have greater incentives to disclose misleading investment efficiency narratives if they undertake large vis a vis small investments.

The second condition is related to the undertaking of new investments. In accounting periods when firms undertake new investments (henceforth 'NIU firms'), they operate under heightened conditions of uncertainty, as new investments are expected to disrupt normal course of business (Abel, Dixit, Eberly, & Pindyck, 1996; Bulan, 2005; Pindyck, 1993). In comparison, in accounting periods when firms do not undertake new investments (henceforth 'Non-NIU firms'), they benefit from less disruptive operating processes and from the hindsight of continuing older investments, allowing them to avoid challenges encountered previously (Roychowdhury et al., 2019). Market participants may also be more speculative about the prospects of NIU firms relative to Non-NIU firms (Abel et al., 1996; Leahy & Whited, 1996). Therefore, we hypothesize that managers of NIU firms are more likely to disclose misleading investment efficiency narratives than managers of Non-NIU firms.

The third condition is related to the type of investment inefficiency. Managers devoted to shareholder wealth maximization have incentives to minimize both overinvestment and underinvestment. However, while the former implies "wasting the investors' money" in unprofitable projects (Jensen & Meckling, 1976; Stulz, 1990), the latter implies that potentially profitable opportunities are not exploited (Brito & John, 2002; Myers, 1977). While overinvestment affects the actual profits reported, underinvestment leads to idle capacity (Brito & John, 2002; Stulz, 1990). Risk-averse investors may also consider an overinvestment to be more detrimental to their cause than an underinvestment (Rocca, Rocca, & Cariola, 2007). Taken together, we hypothesize that managers have greater incentives to disclose misleading investment efficiency narratives for overinvestment firms as opposed to underinvestment firms.

The fourth condition is related to how well the investments are handled. Investment efficiency is linked to managers' performance appraisal and payoffs (Bushman & Smith, 2001; Gomariz & Ballesta, 2014; Roychowdhury et al., 2019). Increases in investment

efficiency indicate managerial excellence, whereas decreases in investment efficiency imply managerial incompetence (Biddle, Hilary, & Verdi, 2009). Therefore, we hypothesize that managers have more incentives to disclose misleading investment efficiency narratives when their investment efficiency decreases vis a vis when their investment efficiency increases.

To examine these hypotheses, we measure the tone of a sample of 10-K disclosures based on the positive and negative word dictionaries developed by Loughran and McDonald (2011) (henceforth 'LM') and Henry (2008). Our multivariate analysis suggests, first, that the tone is positively associated with the investment level. Replacing the tone with separate measures of positive tone and negative tone reveals that positive (negative) tone is positively (negatively) associated with the investment level. This suggests that both tonal components represent incremental information on the investment level. Second, we find that the association between the tone and investment efficiency is more negative for large investments relative to small investments, NIU firms relative to Non-NIU firms, overinvestment firms relative to underinvestment efficiency. In each case, we find that the tone and investment efficiency are negatively (positively) associated for the former (latter) group. Substituting the tone with separate measures of positive tone and negative tone indicates that both tonal components represent misleading (incremental) investment efficiency information for the former (latter) group. LM (2011) and Henry (2008) wordlists yield similar results.

We make several important contributions to the currently sparse literature on the relationship between the narrative tone and investments. First, we examine the association between the tone and the reported investment level. While prior research examines the predictive ability of the tone for future investments (e.g., Berns et al., 2022), we argue that the current-period investment is important to financial statement users in estimating firms'

future earnings, which in turn, facilitates market capital allocation decisions. Our results suggest that the tone represents incremental information on current-period's investments.

Second, our investigation of the link between the tone and investment efficiency identifies four investment outcomes when managers have incentives to use the tone to misinform users of their investment efficiency – large investment firms, NIU firms, overinvestment firms and when investment efficiency decreases. To our best knowledge, this is the first paper to examine conditions under which managers have differential incentives to disclose incrementally informative and misleading narratives on their investment efficiency information for small investment firms, Non-NIU firms, underinvestment firms and when investment firms, underinvestment firms and when investment efficiency are also for small investment firms, Non-NIU firms, underinvestment firms and when investment efficiency increases. Our findings suggest that managers disclose investment efficiency arratives opportunistically based on whether the investment outcomes align with their interests.

Third, this is the first study to document an association between the level tone and the firms' capital investments. Prior studies employ the periodic change in tone to proxy for current-period sentiment (e.g., Berns et al., 2022; Durnev & Mangen, 2020). However, based on an examination of the nature of the tonal words, we argue that the level tone represents incremental current-period sentiment and is unlikely to accumulate static firm characteristics from prior periods. Consequently, we posit that measuring the change in tone is unnecessary. To explain, we observe that a considerable number of tonal words are verbs and adverbs. Verbs imply a change or motion from a prior state or condition, and thus, already represent incremental sentiment. Similarly, adverbs are incremental in nature as they modify or qualify a sentiment. The remaining tonal words are typically adjectives, which also represent incremental sentiment if they are narrated with an explicit benchmark (e.g., time,

performance, or degree of outcome). We discuss these arguments in greater detail in our Methodology section, with supporting examples.

The rest of this paper is organized as follows. Section 2 discusses the background on the link between tone and investments and develops the hypotheses. Section 3 discusses the sample selection, textual analysis and variable measurements. Sections 4 and 5 report the results of our univariate and multivariate analyses respectively. Section 6 concludes.

2. Background and hypotheses

2.1. Narrative tone, capital investments and related literature

A flourishing stream of textual analysis research suggests that managers use the tone of annual and interim reports, earnings press releases, trading updates and other financial disclosures to signal their assessments of the firm's financial performance to the market (Arslan-Ayaydin, Thewissen, & Torsin, 2021; Boudt, Thewissen, & Torsin, 2018; Davis et al., 2012; Demers & Vega, 2014; Henry, Thewissen, & Torsin, 2023; Price, Doran, Peterson, & Bliss, 2012; Rahman, 2023). These studies argue that managers primarily supplement their quantitative disclosures with textual narratives to lower information asymmetry and provide decision-useful information absent in the financial statements. Hence the narrative tone is generally consistent with concurrently disclosed accounting numbers, resulting in a positive association between the tone and reported firm-fundamentals (Davis et al., 2012, 2015; Henry et al., 2023; Hutton et al., 2003; Price et al., 2012). In turn, investors in semi-strong form efficient markets respond to these tonal signals by adjusting their buy-hold-and-sell decisions, resulting in a positive association between the tone and short-window announcement period abnormal market returns around the disclosure of the financial information (Boudt et al., 2018; Davis et al., 2012; Henry, 2008; Henry & Leone, 2016; Loughran & McDonald, 2011; Price et al., 2012). An alternative stream of textual analysis research segregates the tone into

a normal (abnormal) component that is proportionate (disproportionate) to the reported financial information and finds that the abnormal tone is negatively associated with distant future performance (Huang et al., 2014), but not necessarily with more immediate future performance (Rahman, 2019). These studies suggest that the less readily verifiable the narrative information, the more likely are managers to use the abnormal tone to mislead outsiders of firm-fundamentals.

Capital investments are expenditures by the firm to acquire or maintain its physical assets (Biddle et al., 2009; Bushman & Smith, 2001; Roychowdhury et al., 2019; Verdi, 2006). Managers have a variety of motivations to invest in capital, ranging from exploiting profitable opportunities for maximizing shareholder wealth to empire building for perceived personal gains (Jensen & Meckling, 1976; Myers, 1977; Roychowdhury et al., 2019; Stulz, 1990). Financial statement users have incentives to learn about these investment decisions, as it allows them to assess the firm's economic activities and growth potential, which in turn is used to estimate its future earnings (Durnev & Mangen, 2020; Li, 2010). Financial statements address this need by reporting the investments undertaken during a period, which serves as a mechanism for shareholders to monitor managers' investment decisions (Biddle et al., 2009; Bushman & Smith, 2001). In addition, financial disclosures contain textual narratives on the firm's investment, trading and operating activities.³ For instance, several annual report sections including the MD&A, Chairman and CEO's Statements, Directors' Report, Financial Review, Business Highlights and Strategy, Statement on Corporate Governance, etc. may contain narratives on the firm's investment and business operations. Depending on their incentives, managers may disclose either incrementally informative investment narratives which lowers information asymmetry and optimizes capital allocation, or misleading

³ In line with prior research (Berns et al., 2022; Cho & Muslu, 2021; Durnev & Mangen, 2020), we argue that narratives on firms' trading and operating activities are relevant in assessing their investments – to identify investment activities undertaken or to assess the efficiency of investments in revenue generation.

investment narratives which exacerbates information asymmetry and distorts capital allocation (Davis et al., 2012; Huang et al., 2014; Kimbrough & Wang, 2014; Rahman, 2019). Given this, research on the link between firms' investments and narrative content sheds light on the decision-usefulness of narratives for financial statement users.

Extant research examines linkages between firm-level investments and the disclosure content of the firm in question and its peer firms. In this connection, Durnev and Mangen (2020) suggest that the tone of MD&A section of 10-K disclosures have spillover effects for its peers' investments. Their basic argument is that when faced with inadequate information from the firms' internal sources, managers look at peer disclosures to make investment decisions. Using a sample of 10-Ks for the years 1996 - 2016, they document that changes in the firms' investments is positively associated with changes in the tone of their peers' MD&As, and that the level of industry competition moderates this relationship. Similarly, Cho and Muslu (2021) argue that firms' future investments are associated with the tone of its peers' MD&As. On the one hand, managers may invest in line with peer narratives if they provide information on industry-wide challenges and opportunities. On the other hand, managers may invest contrary to peer narratives if they provide information about peers' competitiveness. Using a sample of 10-Ks between 1996 – 2014, they provide evidence that one-year ahead changes in firms' investment levels are positively (negatively) associated with the changes in the tonal positivity (negativity) of peer firms' MD&As, after controlling for the positivity (negativity) of the firms' MD&A. More recently, Berns et al. (2022) examine the relationship between firms' investments and their MD&A tone. They argue that managers change the MD&A tone to signal changes in the firms' prospects. They employ a sample of 10-Ks for the years 2003 - 2019 and find that changes in the MD&A tone is positively associated with the changes in firms' one-year ahead capital expenditures. They conclude that the MD&A tone contains incremental information on firms' future investments. Our paper differs from the aforementioned studies in several ways. First, we measure the tone of full 10-K disclosures instead of restricting our analysis to the tone of the MD&A section only. Second, we advance the expectations-adjustment argument missing in prior literature to make a case for the linkage between the narrative tone and firms' investment level. Third, prior studies do not examine the conditions under which managers may use the tone to mislead financial statement users of their firms' investments. Grounded on the management obfuscation hypothesis, we identify four investment-related conditions when managers have incentives to use the tone to mislead the users. Fourth, unlike prior studies (e.g., Cho & Muslu, 2021; Durnev & Mangen, 2020) we use the level tone to proxy for incremental current-period sentiment.

2.2. Hypothesis development

Our first hypothesis examines the relationship between the tone of financial disclosures and the reported investment level. Investment level implies the dollar-amount of investment made during a period (Rahman, 2023). Managers devoted to shareholder wealth maximization choose the investment level that maximizes the net present value (NPV) of future cash flows (Durnev & Mangen, 2020), by accepting (rejecting) investment opportunities that generate a positive (negative) rate of return. Financial reporting regulations mandate firms to report their investments, by periodically disclosing the values of property, plant and equipment, intangible assets, R&D expenses, acquisitions, divestitures, trading activities and business operations (Hoberg & Phillips, 2010; Li, 2010; Roychowdhury et al., 2019). The expectations-adjustment hypothesis suggests that managers have motivations to supplement these quantitative disclosures with narrative commentary – to signal their private assessments of firms' investment activities to outsiders, free from the reporting constraints of the quantitative financial statements (Hutton et al., 2003; Kimbrough & Wang, 2014). As

such, narratives help managers to align outsider assessments of the firms' investments with their own (Davis et al., 2012, 2015). If the narratives are consistent (inconsistent) with concurrently disclosed investment numbers, then the tone is expected to be positively (negatively) associated with the investment level. We posit that managers are unlikely to provide narrative information that are inconsistent with or easily refutable by concurrently disclosed numbers – to preserve their credibility (Mercer, 2005) and to avoid adverse managerial and market consequences (Kimbrough & Wang, 2014). Therefore, we argue that the tone is positively associated with the investment level.

H1: Tone is positively associated with the investment level.

The tone is measured as the net of positive tonal sentiment over negative tonal sentiment, namely positivity and negativity, within a defined text corpus. Managers can increase (decrease) the tone by either increasing (decreasing) the positivity or by decreasing (increasing) the negativity of the narratives (Rahman, 2023). Thus, an alternative test of H1 is to examine the association of investment level with positivity and negativity. Replacing the tone with separate measures of positivity and negativity also sheds light on how managers use positive and negative sentiment for narrating investment activities. If the tone and investment level are positively associated, as hypothesized in H1, then we expect the positivity (negativity) to be positively (negatively) associated with the investment level.

In our subsequent hypotheses, we examine the relationship between the tone and investment efficiency. Investment efficiency indicates how well the managers use an investment to generate revenue (Biddle et al., 2009; Garcia Lara, Garcia Osma, & Penalva, 2016; Giao, Goncalves, & Cardoso, 2023; Gomariz & Ballesta, 2014; Verdi, 2006). Unlike investment level, investment efficiency is not directly reported in the financial statements. Thus, commentary on investment efficiency is not readily verifiable from concurrent quantitative disclosures, providing managers with more leeway in using their narratives

opportunistically. The management obfuscation hypothesis suggests that managers may engage in narrative spin to mislead financial statement users if they perceive the benefits to outweigh the costs (Lang & Lundholm, 1993; Li, 2008; Merkl-Davies & Brennan, 2007). This implies, if managerial incentives to narrate incremental investment information override their incentives to mislead the users, then the tone is expected to be positively associated with investment efficiency. However, if managerial incentives to mislead the users on their investment activities override their incentives to disclose incremental information, then the tone is expected to be negatively associated with investment efficiency. When the investment outcomes do not align with managerial interests, their incentives to disclose misleading investment efficiency narratives are heightened (Huang et al., 2014; Rahman, 2019). In accordance with the management obfuscation hypothesis, we propose the following such investment conditions.

First, we argue that managers have fewer incentives to narrate incremental information when "the stakes of the investment are high". The size of an investment is related to the magnitude of the firm's bottom-line, which in turn is related to managers' payoffs and performance appraisal (Al Ani & Chavali, 2023; Bushman & Smith, 2001; Park, 2022). For instance, larger investments typically require greater resource deployment and commitment from the part of the management, and consequently, have greater effect on the firm's earnings. In other words, larger investments have higher "stakes" for the firm (and managers) than smaller investments (Bushee, 1998; Bushman & Smith, 2001). As a result, we argue that managers have greater incentives to overstate positive outcomes and understate negative outcomes related to large vis a vis small investments. This leads to a more negative association between the tone and the efficiency of large vis a vis small investments. **H2a**: The association between the tone and investment efficiency is more negative for large investments than for small investments.

Supplementary to H2a, we postulate that managerial incentives to disclose misleading investment narratives increases with the "stakes", and thus, the size of the investment. This implies that with increasing investment level, the association between the tone and investment efficiency becomes more negative.

H2b: The association between the tone and investment efficiency is more negative for increased investment levels.

We develop two separate hypotheses related to investment size (H2a and H2b) instead of just H2b because it is possible that managers only initiate opportunistic narration after surpassing a threshold level of "stakes", when their incentives to provide incremental investment information is sufficiently diminished. If this is the case, then classifying investments as large and small in H2a allow us to examine if the tone represents incremental investment information, or simply noise, when the "stakes" are sufficiently low.

Second, we argue that managers are less likely to disclose incrementally informative narratives in accounting periods when new investments are undertaken ('NIU firms') as opposed to accounting periods when new investments are not undertaken ('Non-NIU firms'). Undertaking a new investment is more likely to disrupt the normal course of business, arguably leading to greater uncertainty in NIU firms on how best to manage them (Abel et al., 1996; Bulan, 2005; Pindyck, 1993). In contrast, performing routine operations in Non-NIU firms may be less disruptive. Non-NIU firms are also more likely to benefit from the learnings of managing older investments, allowing them to avoid challenges encountered previously (Roychowdhury et al., 2019). Investors and analysts are also more speculative about the prospects of new investments compared to continuing investments (Abel et al., 1996; Leahy & Whited, 1996). Consequently, NIU firm managers are under greater pressure to justify their undertakings (Roychowdhury et al., 2019). Given this, we argue that NIU firm

managers are more likely to disclose misleading investment narratives relative to Non-NIU firm managers, leading to a more negative association between the tone and investment efficiency for NIU firms than Non-NIU firms.

H3: The association between the tone and investment efficiency is more negative for NIU firms than Non-NIU firms.

Third, we argue that managers have fewer incentives to narrate incremental investment information when they are seen to "waste the investors' money". The investment literature often distinguishes between two types of investment inefficiency – underinvestment and overinvestment (Rocca et al., 2007). Underinvestment implies that managers have failed to exploit profitable investment opportunities, perhaps resulting in idle cash and unused firm capacity (Brito & John, 2002; Myers, 1977). In contrast, overinvestment implies that managers have invested in value-destroying projects, leading to resource misallocation and a decline in reported profits (Jensen & Meckling, 1976; Rocca et al., 2007; Stulz, 1990)). While maximizing shareholder wealth requires that managers minimize both underinvestment and overinvestment, we conjecture that the latter may be viewed more unfavourably by riskaverse investors, as it implies directly spending the investors' money in value-destroying projects (Brito & John, 2002; Jensen & Meckling, 1976; Myers, 1977; Stulz, 1990). It may also be less detrimental to the managers' credibility to explain why an apparently profitable opportunity was not exploited than to explain why a loss-making investment was selected (Rocca et al., 2007). Accordingly, we argue that managers have greater incentives to disclose misleading narratives on overinvestment than on underinvestment, leading to a more negative association between the tone and the efficiency of overinvestment vis a vis underinvestment. H4: The association between the tone and investment efficiency is more negative for overinvestment firms than for underinvestment firms.

Fourth, we argue that managers are less likely to disclose incrementally informative narratives when the investments are "managed poorly". Prior research suggests that managers are more likely to take credit for positive organizational outcomes than for negative organizational outcomes (Merkl-Davies & Brennan, 2007; Kimbrough & Wang, 2014). Investment efficiency represents managers' decision-making ability, perceived changes to which may affect their payoffs (Bushman & Smith, 2001; Gomariz & Ballesta, 2014; Roychowdhury et al., 2019). Related to this, Biddle et al. (2009) imply that increases in investment efficiency represent managerial excellence. Thus, managers have greater incentives to narrate incremental investment information - to attract capital providers and reap the managerial and market rewards of their efficient investment decisions (Kimbrough & Wang, 2014). Conversely, decreases in investment efficiency imply managerial incompetence. This heightens managerial incentives to downplay or obfuscate their handling of investments - to avoid, delay or minimize the adverse consequences of their inefficient investment decisions (Kimbrough & Wang, 2014; Merkl-Davies & Brennan, 2007). Therefore, we argue that the association between the tone and investment efficiency is more negative for firms with decreasing vis a vis increasing investment efficiency. H5: The association between the tone and investment efficiency is more negative for firms with decreasing investment efficiency than increasing investment efficiency.

As alternative tests of H2 – H5, we replace the tone with separate measures of positivity and negativity to achieve a better understanding on managers' use of sentiment for describing investment efficiency. Accordingly, we expect that the association between the positivity (negativity) and investment efficiency is more negative (positive) for: (a) large vis a vis small investments [H2a]; (b) increased investment levels [H2b]; (c) NIU vis a vis Non-NIU firms [H3]; (d) overinvestment vis a vis underinvestment [H4]; and (e) firms with decreasing vis a vis increasing investment efficiency [H5].

3. Methodology

3.1. Sample selection

In this study, we examine the tone of a sample of 10-K filings. While prior studies primarily measure the tone of the MD&A section of 10-K filings (e.g., Berns et al., 2022; Cho & Muslu, 2021; Durnev & Mangen, 2020), we conjecture that firms also discuss their investment, trading and operating activities elsewhere in the 10-K report, including (but not limited to) the Chairman's, CEO's and Directors' Statements, Financial Review, Business Highlights and Strategy, etc. This lends the tone of full 10-K filings suitable for our study.

We collect all 10-K filings of S&P 500 firms available in the *Mergent Online* database for the years 2010 – 2022. Due to greater visibility and public interest, 10-K filings of S&P 500 firms are expected to provide more extensive narrative disclosures of their investment, trading and operating activities than other firms. For variable measurement, we collect data from *Mergent Online* and *Refinitiv* databases for the years 2007 – 2022. We obtain an initial tally of 5785 10-K reports for the thirteen-year sampling period 2010 – 2022. From this tally, we delete all observations for which: (a) matching variable information is absent in *Mergent Online* or *Refinitiv* and (b) 10-K filings are unreadable in *WordStat8* (typically due to formatting issues). This leaves us with a final tally of 5681 firm-year observations with a complete series of tone scores and matching variable information.

A break-down of the sample by years reveal an almost even representation of firmyears across the thirteen-year sample period (nearly 7.7% observations per year). A breakdown of the sample by industry indicates the following industry representation (from largest to smallest) – *Financials* (14.4%), *Information Technology* (14.0%), *Industrials* (13.7%), *Consumer Discretionary* (12.8%), *Healthcare* (12.5%), *Consumer Staples* (6.6%), *Real Estate* (6.4%), *Utilities* (6.2%), *Materials* (5.7%), *Energy* (4%) and *Communications* (3.7%).

3.2. Textual analysis

3.2.1. Tone measurement

For tone measurement, we use the positive and negative word dictionaries of two keyword lists – LM (2011) and Henry (2008) and report their tone scores separately. We believe using two wordlists improve the generalizability of our results. Both the LM (2011) and Henry (2008) wordlists are specialized for research in the domain of corporate financial communications and demonstrate greater efficacy in capturing the lexical features of financial disclosures than non-domain specific wordlists (Henry & Leone, 2016; Loughran & McDonald, 2011). Consequently, both wordlists are regularly used in the textual analysis of earnings press releases, conference calls, trading updates, annual reports and other financial disclosures (e.g., D'Augusta & DeAngelis, 2020; Davis et al., 2012, 2015; Henry, 2008; Henry & Leone, 2016; Huang et al., 2014; Henry et al., 2023; Rahman, 2023). The LM (2011) wordlist contains 354 positive words and 2355 negative words while the Henry (2008) wordlist contains 105 positive words and 85 negative words. For textual analysis, we employ *WordStat8* which returns the number of positive and negative tonal words in a 10-K document that matches with our wordlists.

Following Henry and Leone (2016), we tally the number of positive and negative keywords in each 10-K document and measure the level tone, *TONE*, as follows: $TONE_{LM} = (POSITIVE_{LM} - NEGATIVE_{LM}) / (POSITIVE_{LM} + NEGATIVE_{LM})$ (1) $TONE_{HENRY} = (POSITIVE_{HENRY} - NEGATIVE_{NEHRY}) / (POSITIVE_{HENRY} + NEGATIVE_{NEHRY})$ (2)

where $POSITIVE_{LM}$ and $NEGATIVE_{LM}$ ($POSITIVE_{HENRY}$ and $NEGATIVE_{HENRY}$) are the number of positive and negative tonal words from the LM (2011) [Henry (2008)] wordlist that matches a 10-K document. By construction, $TONE_{LM}$ and $TONE_{HENRY}$ range from -1 to 1, with higher values representing more optimistic sentiment.

We also measure the level tonal positivity and negativity of each 10-K disclosure, *POS* and *NEG*, as follows:

$$POS_{LM} (POS_{HENRY}) = POSITIVE_{LM} (POSITIVE_{HENRY}) / TOTALWORDS$$
(3)
$$NEG_{LM} (NEG_{HENRY}) = NEGATIVE_{LM} (NEGATIVE_{HENRY}) / TOTALWORDS$$
(4)

where *TOTALWORDS* is the total number of words in the 10-K document.⁴ By construction, *POSLM* (*POSHENRY*) and *NEGLM* (*NEGHENRY*) range from 0 to 1, with higher values representing increased tonal positivity and negativity respectively.

3.2.2. Choice of tone measure: level tone or change in tone?

In this study, we employ the level tone to estimate current-period narrative sentiment. Some studies use the periodic change in tone to proxy for current-period sentiment, based on the assumption that the level tone may partially accumulate sentiment from static firm characteristics (Berns et al., 2022; Cho & Muslu, 2021; Durnev & Mangen, 2020; Lee et al., 2017). We agree that an unbiased measure of the tone should not carry forward sentiment arising from static firm characteristics. However, a limitation of using the periodic change in tone is that narratives are not always time-specific in nature. Instead, we argue that the level tone is already an incremental figure, and thus, estimating the change in tone is unnecessary. To explain, our level tone is based on the difference between the number of the positive and negative words in the LM (2011) and Henry (2008) word dictionaries. We observe that a considerable number of these tonal words are verbs or adverbs while the remainder are adjectives. Verbs indicate a change or motion from a prior state or condition. As such, tonal verbs already represent incremental sentiment (e.g., *accomplish, decline, deteriorates,*

⁴ Unlike our *TONE* variables, we do not employ the sum of the number of positive and negative tonal words as the denominator of our *POS* and *NEG* variables to avoid linear combinations in regressions that include both *POS* and *NEG* together. This is consistent with Rahman (2023), and it also ensures that *POS* and *NEG* provide alternative approaches to variable measurement than *TONE*, thus improving the generalizability of our findings.

enjoying, *grew*, *rise*). For instance, the verbs *decline* in the clause "We attribute our recent sales *decline* to the *decline* in customer demand for our product" imply incremental changes (downward) to sales and customer demand respectively. Similarly, the verb *grew* in the clause "Investments in our core business segments *grew* by 5%" imply incremental changes (upward) to the investment level. We posit that measuring the change in tone in these cases leads to 'double computation' of sentiment. Adverbs modify or qualify verbs, adjectives, other adverbs or a word group, and thus, also represents incremental sentiment (e.g., *adversely*, *dangerously*, *down*, *strongly*, *up*). For instance, the modifying adverb *up* in the clause "Our investment level, akin to a tonal verb. Similarly, the qualifying adverb *adversely* in the clause "Our investment level, akin to a tonal verb. Similarly, the qualifying adverb *adversely* in the clause "Our investments have been *adversely* affected by challenging market conditions" describes the incremental effects (of market conditions) on investments.

We further argue that adjectives that are benchmarked by time, performance or degree of outcome imply incremental sentiment (e.g., *excellent*, *high*, *lower*, *robust*, *solid*, *weak*). Examples of benchmarks include managerial or analyst expectations, market consensus, previous expectations, full-year guidance, etc. For instance, the adjective *excellent* in the clause "We made *excellent* progress with our investments this period, relative to prior expectations" describes incremental progress in investments as it is benchmarked with prior expectations. Similarly, the adjective *lower* in the clause "Reported earnings per share is marginally *lower* than consensus analyst forecasts" compares earnings with analyst guidance, and thus represents incremental outcome. Finally, we argue that adjectives narrated without explicit benchmarks may also imply incremental sentiment. For instance, although the clause "Investments for the period were *solid*" does not apply an explicit benchmark for the adjective *solid*, we argue that a rational manager describes an outcome relative to an implied standard, which includes other descriptions of investments besides *solid*. Overall, we posit

that due to their incremental nature, tonal words rarely carry forward sentiment from static firm characteristics, and therefore, the level tone is a more appropriate measure of currentperiod sentiment than the change in tone.

3.3. Variable measurement

3.3.1. Measuring investment level and investment efficiency

Consistent with prior research (Biddle et al., 2009; Garcia Lara et al., 2016; Gomariz & Ballesta, 2014), we measure the investment level, *IVL*, as the annual change in the sum of property, plant and equipment and intangible assets (scaled by total assets) and the annual research and development expense (scaled by total assets). This approach ensures that the investment level represents the incremental amount of investment undertaken during the year.⁵ Higher values of *IVL* signal higher investment levels.

Investment efficiency exists when the firm's actual investment level is equal to its expected investment level and there is no overinvestment or underinvestment (Biddle et al., 2009; Garcia Lara et al., 2016; Rahman, 2023; Verdi, 2006). Firms overinvest (underinvest) when the actual investment is higher (lower) than the expected investment. Following prior research (Biddle et al., 2009; Garcia Lara et al., 2016; Gomariz & Ballesta, 2014), we develop the following model to estimate firms' expected investment level:

$$IVL_{it} = -\alpha + \beta_1 CHSALES_{it-1} + \varepsilon_{it}$$
(5)

where $CHSALES_{t-1}$ is the lagged sales growth. Deviations from the expected investment level, ε , represent investment inefficiency. Our measure of investment efficiency, *IVEF*, is the absolute value of the residual error term, ε , multiplied by -1, so that higher values represent

⁵ Our variable specifications ensure that both investment variables in the left-hand side and tone variables in the right-hand side of the regression models represent incremental figures.

more efficient investments. Given that *IVEF* is based on the residuals of *IVL* regression, it represents the efficiency of incremental investment for the year.

3.3.2. Other variables

Consistent with prior research (Beatty et al., 2013; Biddle et al., 2009; Durnev & Mangen, 2020; Gomariz & Ballesta, 2014; Giao et al., 2023; Garcia Lara et al., 2016; Rahman, 2023), we measure several variables to control for firm-characteristics. We control for firm's profitability by EARN, measured as annual earnings before extraordinary items (scaled by total assets) and CHEARN, measured as the one-year change in EARN. We control for earnings variability, STDEARN, as the standard deviation of EARN over the previous four years, and for the profitability status, LOSS, as a dummy variable taking the value of 1 if operating income is negative, 0 otherwise. We control for firm size, SIZE, measured as the natural logarithm of total assets; leverage, LEV, as total debt divided by total equity; firmgrowth opportunities, TOBINSQ, as equity market value divided by equity book value; and annual share returns, RET, as the annual buy-and-hold return. In addition, we control for cash holdings, CASH, measured as cash and marketable securities (scaled by total assets), and noncash current assets, CUTTA, measured as total current assets minus cash and marketable securities, divided by total assets. Finally, for comparing investment efficiency across investment-related groups, we create the following dummy variables – LARGE, which takes the value of 1 for large investments, 0 otherwise; NIU, which takes the value of 1 if the firm undertakes new investments in the year, 0 otherwise; OVINV, which takes the value of 1 for overinvestments, 0 otherwise; and DECIVEF, which takes the value of 1 if investment efficiency decreases from the previous year, 0 otherwise. All variables are defined in the Appendix.

4. Univariate analysis

4.1. Descriptive statistics and correlations

Table 1 reports the descriptive statistics of the variables used in this study. The mean of *IVL* is greater than the median, suggesting right-skewness in distribution and that the sample mean is affected by a small number of firms with very large investments. In contrast, the mean of *IVEF* is lower than the median, suggesting the prevalence of a few firms with considerably lower investment efficiency than the rest of the sample. The means of both NEGATIVE variables are higher than their corresponding POSITIVE variables, suggesting that 10-Ks disclose more negative than positive tonal words. However, while the median of *NEGATIVE*_{LM} is twice as large as that of *POSITIVE*_{LM}, the median of *NEGATIVE*_{HENRY} is lower than the median of *POSITIVE*_{HENRY}. We attribute this difference to the relative number of negative and positive words in the LM (2011) vis a vis Henry (2008) lists. Comparing the means, medians and quartile values suggest that TONE_{HENRY} provides a more optimistic measure of the sentiment than $TONE_{LM}$. The mean of $TONE_{LM}$ ($TONE_{HENRY}$) is higher (lower) than its third quartile (median), suggesting right- (left-) skewness in distribution. TONELM also has a lower coefficient of variation and a narrower interquartile range than TONE_{HENRY}, suggesting a greater clustering of its values towards the median. POSLM (POSHENRY) and *NEG_{LM}* (*NEG_{HENRY}*) are left-(right-) skewed, with mean values lower (higher) than median (third quartile) values. Overall, it appears that the distributions of $TONE_{LM}$ (POS_{LM} , NEG_{LM}) are quite different from that of TONE_{HENRY} (POS_{HENRY}, NEG_{HENRY}). We posit that this difference adds strength to our analysis.

With regards to the other variables, comparing the means and medians of *EARN*, *CHEARN*, *SIZE*, *LEV*, *CASH*, *RET* and *CUTTA* suggest that the distributions of earnings, annual earnings change, firm size, leverage, cash holdings, annual buy-and-hold returns and current assets are all right-skewed. The median values of *EARN* and *RET* are both positive, suggesting that most firms report an annual profit and experience an increase in share price over the year. *LEV* and *RET* also have higher coefficient of variation (>2) and a wider interquartile range than the other variables. 6.64% of the firms report an annual loss.

[Table 1 near here]

Table 2 reports the Spearman's rank correlations of the investment and tone variables with other variables of the study. We find that IVL is negatively correlated with IVEF (r=-0.178), suggesting that the efficiency of larger investments is lower. IVL is positively correlated with both TONELM (r=0.024) and TONEHENRY (r=0.091). This constitutes prima facie evidence in support of H1 and suggests that firms with higher investment levels disclose more optimistic 10-Ks. We find that IVL and IVEF are both positively correlated with EARN (r=0.130, r=0.155) but negatively correlated with LOSS (r=-0.148, r=-0.164). This implies that firms that make larger investments or have higher investment efficiency report higher annual earnings and are less likely to incur a loss. IVL is also positively correlated with annual market returns, RET (r=0.078). TONE_{LM} (TONE_{HENRY}) exhibits a stronger negative correlation with NEG_{LM} (NEG_{HENRY}) [r=-0.933 (r=-0.759)] than with POS_{LM} (POS_{HENRY}) [r=-0.792 (r=-0.643)]. This implies that tone values are often increased (decreased) by a greater reduction (increase) of negative words in 10-Ks relative to positive words. EARN is positively correlated with both TONELM (r=0.073) and TONEHENRY (r=0.093), consistent with prior literature that firms that report higher profits disclose more optimistic narratives (Davis et al., 2012, 2015; Price et al., 2012; Demers & Vega, 2014). In some cases, the $TONE_{LM}$ correlations differ from corresponding TONE_{HENRY} correlations, arguably due to differences in their distributions. For instance, $TONE_{HENRY}$ is positively correlated with RET (r=0.096) and negatively correlated with LOSS (r=-0.060) but TONE_{LM} does not exhibit a significant

correlation with either of these variables (r=-0.010, r=0.009). Unreported intra-variable correlations are typically low (r<0.5) and provide no indication of multi-collinearity.

[Table 2 near here]

4.2. Comparing the descriptive statistics of tone and investment variables

Panels A and B of Table 3 compare the mean and median values of investment and tone variables in each IVL decile respectively. Each decile comprises 568 firm-year observations, excluding the median observation from the full sample of 5681 observations ranked by IVL. In Panels A and B, we find that mean and median IVEF steadily increase from the 1st to the 7th *IVL* decile, and then falls sharply from the 8th to the 10th decile. This suggests that investment efficiency continues to improve with the investment levels up until the 7th decile and then starts to deteriorate, akin to an inverse V-shaped, right-skewed line graph. In Panels A and B, we also find that higher IVL deciles often have greater mean and median TONE_{HENRY} values but not TONE_{LM} values. This is consistent of a greater positive alignment between IVL and TONE_{HENRY} vis a vis TONE_{LM}. At higher IVL deciles, we typically find higher (lower) mean and median POS_{LM} (NEG_{HENRY}) values, consistent with a positive association between tone and the investment level. However, the pattens for mean and median of NEGLM (POSHENRY) are unremarkable. Across all ten IVL deciles, the mean values of POSLM (POSHENRY) and NEGLM (NEGHENRY) are lower (higher) than their corresponding median values. Supplementary to our findings in Table 1, this implies that all decile distributions of LM (2011) [Henry (2008)] positivity and negativity are left-(right-) skewed.

[Table 3 near here]

4.3. Comparing the tone variables of investment-related subsamples

Table 4 presents the means, medians and standard deviations of all investment and tone variables across the following subsamples of firms: (i) small vs large investments, (ii) NIU vs Non-NIU, (iii) underinvestment vs overinvestment and (iv) increasing vs decreasing investment efficiency. For brevity, we discuss the variable means only. Panel A ranks our full sample (OBS = 5681) by the investment level and creates two equal subsamples (after excluding the median observation) to denote small investments (OBS = 2840) and large investments (OBS = 2840). We find that large investments have higher mean *IVL* and *TONE*_{HENRY} but lower mean *IVEF* than small investments. The juxtaposition of increased Henry (2008) tone with lower investment efficiency provides some prima facie evidence in favour of H2a. In addition, large (small) investments have higher mean *POSLM* (*POSHENRY*) and *NEGLM* (*NEGHENRY*) than small (large) investments.

Panel B divides the full sample into NIU firms (OBS = 2933) and Non-NIU firms (OBS = 2748). We observe that NIU firms have higher mean *IVL* but lower mean *IVEF* than Non-NIU firms. NIU firms also have higher (lower) mean *TONE*_{HENRY} (*TONE*_{LM}) than Non-NIU firms. This constitutes mixed preliminary evidence on H3. Similarly, NIU firms have higher (lower) mean *POS*_{LM} (*POS*_{HENRY}) and *NEG*_{LM} (*NEG*_{HENRY}) than Non-NIU firms.

Panel C divides the full sample into underinvestment (OBS = 3537) and overinvestment (OBS = 2144) firms. We find that overinvestment firms have higher mean *IVL* and *TONE*_{*HENRY*} but lower mean *IVEF* than underinvestment firms. Additionally, we find that overinvestment firms have higher mean *POS*_{*LM*} and lower mean *NEG*_{*HENRY*} than underinvestment firms. Taken together, these results provide some preliminary evidence in support of H4.

Panel D divides the full sample into firms with increasing (OBS = 2918) and decreasing (OBS = 2763) investment efficiency. We find that firms with decreasing investment efficiency have higher (lower) mean IVL (*IVEF*) than firms with increasing

investment efficiency. However, there is no difference between the tonal means of the two subsamples. In Panels A to D, we find that the variable medians values across different subsamples are often consistent with their corresponding mean values.

[Table 4 near here]

5. Multivariate analysis

5.1. Test of H1

H1 predicts that the tone is positively associated with the investment level. To test H1, we devise the following regression models of the investment level on tone (before adding industry and year fixed-effects):⁶

$$IVL_{it} = \alpha + \beta_1 TONE_{it} + \beta_2 EARN_{it} + \beta_3 CHEARN_{it} + \beta_4 STDEARN_{it} + \beta_5 SIZE_{it} + \beta_6 LEV_{it} + \beta_7 TOBINSQ_{it} + \beta_8 LOSS_{it} + \beta_9 CASH_{it} + \beta_{10} RET_{it} + \beta_{11} CUTTA_{it} + \varepsilon_{it}$$
(6a)

$$IVL_{it} = \alpha + \beta_1 POS_{it} + \beta_2 NEG_{it} + \beta_3 EARN_{it} + \beta_4 CHEARN_{it} + \beta_5 STDEARN_{it} + \beta_6 SIZE_{it} + \beta_7 LEV_{it} + \beta_8 TOBINSQ_{it} + \beta_9 LOSS_{it} + \beta_{10} CASH_{it} + \beta_{11} RET_{it} + \beta_{12} CUTTA_{it} + \varepsilon_{it}$$
(6b)

In Eq. (6a), our main variable of interest is *TONE*. For H1 to hold, the coefficients of *TONE* in Eq. (6a) need to be positive. Eq. (6b) provides an alternative regression model to test H1 where we replace the variable *TONE* of Eq. (6a) with separate variables for positivity (*POS*) and negativity (*NEG*). For H1 to hold with Eq. (6b), the coefficients of *POS* and *NEG* should be positive and negative respectively.

Columns (1) and (3) of Table 5 report the full sample regression results of Eq. (6a) for $TONE_{LM}$ and $TONE_{HENRY}$ respectively. In both columns, we find that the coefficients of TONE are positive and statistically significant at the 1% level. This is consistent with H1 and

⁶ Our multivariate analysis does not directly examine causality between the independent and the dependent variables, nor do we make a causal claim in interpreting our results. Consistent with our hypotheses, our research design is devised to only test associations between the independent and dependent variables.

suggests that the tone of 10-Ks is positively associated with the investment level. Columns (2) and (4) of Table 5 report the results of Eq. (6b) using LM (2011) and Henry (2008) lists respectively. In both columns, we find that the coefficients of *POS* are positive (p<0.01) while the coefficients of *NEG* are negative (p<0.01). This suggests that as the investment level goes up, managers increase (decrease) the positivity (negativity) of their 10-Ks. This supports H1.

Across Columns (1) - (4), we find that the coefficients of *EARN*, *CHEARN* and *RET* are positive (p<0.10 in all cases), suggesting that annual earnings, change in earnings and annual returns are positively associated with the investment level. We observe that the coefficients of *LOSS*, *CASH* and *CUTTA* are negative (p<0.05 in all cases). Firstly, this implies that loss firms invest less. Secondly, it suggests that firms that hold more cash and more (non-cash) current assets make less investments. These results are largely consistent with prior research (Garcia Lara et al., 2016; Gomariz & Ballesta, 2014; Rahman & Aghayeva, 2023).

[Table 5 near here]

5.2. Tests of H2a and H2b

To examine the link between tone and investment efficiency, we devise the following regressions (before adding industry and year fixed-effects):

 $IVEF_{it} = \alpha + \beta_1 TONE_{it} + \beta_2 EARN_{it} + \beta_3 CHEARN_{it} + \beta_4 STDEARN_{it} + \beta_5 SIZE_{it} + \beta_6 LEV_{it} + \beta_7 TOBINSQ_{it} + \beta_8 LOSS_{it} + \beta_9 CASH_{it} + \beta_{10} RET_{it} + \beta_{11} CUTTA_{it} + \varepsilon_{it}$ (7a)

$$IVEF_{it} = \alpha + \beta_1 POS_{it} + \beta_2 NEG_{it} + \beta_3 EARN_{it} + \beta_4 CHEARN_{it} + \beta_5 STDEARN_{it} + \beta_6 SIZE_{it} + \beta_7 LEV_{it} + \beta_8 TOBINSQ_{it} + \beta_9 LOSS_{it} + \beta_{10} CASH_{it} + \beta_{11} RET_{it} + \beta_{12} CUTTA_{it} + \varepsilon_{it}$$
(7b)

H2a predicts that the association between the tone and investment efficiency is more negative for large investments than for small investments. Before directly testing H2a, we estimate Eqs. (7) separately in subsamples of small investment (OBS = 2840) and large investment (OBS = 2840). Panel A of Table 6 report the results of Eqs. (7) for small investments.⁷ For both LM (2011) and Henry (2008) lists, we find that investment efficiency is positively associated with *TONE* and *POS* but negatively associated with *NEG* (p<0.05 in all cases). Panel B of Table 6 report the regression results for large investments. In contrast to Panel A, we find in Panel B that investment efficiency is negatively associated with *TONE* and *POS* but positively associated with *NEG* (p<0.05 in all cases). Overall, it appears that managers use the tone (positivity, negativity) to inform (misinform) investors of the efficiency of small (large) investments. These results are consistent with an opportunistic use of the tone when the "stakes of the investment are high".

To directly test H2a, we first add to Eqs. (7) the indicator variable *LARGE*. We also add to Eq. (7a) the interaction of *LARGE* with *TONE*, namely *TONE* × *LARGE*, and to Eq. (7b), the interactions of *LARGE* with *POS* and *NEG*, namely *POS* × *LARGE* and *NEG* × *LARGE* respectively. For H2a to hold, the coefficients of *TONE* × *LARGE* and *POS* × *LARGE* should be negative, while the coefficients of *NEG* × *LARGE* should be positive.

Panel C of Table 6 report the full sample results of these regressions (OBS = 5681). Across all columns in Panel C, the coefficients of *LARGE* are negative (p<0.01 in all cases), suggesting that large investments are less efficient, after controlling for tone. In addition, we find that for both the LM (2011) and Henry (2008) wordlists, the coefficients of *TONE* × *LARGE* and *POS* × *LARGE* are negative, while the coefficients of *NEG* × *LARGE* are positive (p<0.05 in all cases). We conclude from these results that the association between the

⁷ In Tables 6 - 9, we only report the tone, positivity and negativity variables of Eqs. (7). The remaining variables in Eqs. (7) are included in our regression estimates but un-tabulated for brevity.

tone (positivity, negativity) and investment efficiency is more negative (negative, positive) for large investments than for small investments. This is consistent with H2a.

Supplementary to H2a, H2b predicts that the association between the tone and investment efficiency is more negative for higher investment levels. To examine H2b, we add to Eq. (7a) the indicator variable *IVL* and its interaction with *TONE*, *TONE* × *IVL*. Next, we add to Eq. (7b) the indicator variable *IVL* and its interaction with *POS* and *NEG*, namely *POS* × *IVL* and *NEG* × *IVL* respectively. For H2b to hold, the coefficients of *TONE* × *IVL* and *POS* × *IVL* should be negative, while the coefficients of *NEG* × *IVL* should be positive.

Panel D of Table 6 report the full sample results of these regressions. Panel D reports negative coefficients for both $TONE \times IVL$ and $POS \times IVL$ variables and positive coefficients for both $NEG \times IVL$ variables (p<0.05 in all cases). Consistent with H2b, these results suggest that with increasing investment levels, the tone (positivity, negativity) becomes more negatively (negatively, positively) associated with investment efficiency. Unreported control variables across Panels A to D of Table 6 suggest that IVEF is positively aligned with *EARN*, *CHEARN*, *CASH* and *CUTTA* and negatively aligned with *STDEARN*, *TOBINSQ* and *LOSS* (p<0.10 in all cases). These results are consistent with the findings of prior research (Garcia Lara et al., 2016; Gomariz & Ballesta, 2014).

[Table 6 near here]

5.3. Test of H3

H3 predicts the association between the tone and investment efficiency is more negative for NIU firms than Non-NIU firms. We begin the test of H3 by first repeating Eqs. (7) separately on the NIU (OBS = 2933) and Non-NIU (OBS = 2748) subsamples. Panel A of Table 7 reports the results of Non-NIU subsample. The results suggest that $TONE_{HENRY}$ increases with higher investment efficiency (p<0.05). In addition, using both LM (2011) and Henry (2008) wordlists, *POS* (*NEG*) depicts positive (negative) associations investment efficiency (p<0.10 in all cases). Panel B of Table 7 reports the results of NIU subsample. For both wordlists, we find that *TONE* and *POS* are negatively associated while *NEG* is positively associated with investment efficiency (p<0.10 in all cases). Overall, the contrasting findings of Panels A and B suggest that managers use the tone (positivity, negativity) of Non-NIU (NIU) firms to inform (misinform) investors of the investment efficiency.

For a direct test of H3 we add to Eqs. (7) the indicator variable *NIU*, and further to Eq. (7a) its interaction term with *TONE*, namely *TONE* × *NIU*, and to Eq. (7b) its interaction terms with *POS* and *NEG*, namely *POS* × *NIU* and *NEG* × *NIU* respectively. For H3 to hold, the coefficients of *TONE* × *NIU* and *POS* × *NIU* should be negative, while the coefficients of *NEG* × *NIU* should be positive.

Panel C of Table 7 presents the full sample results of these regressions. We find that the coefficients of *NIU* in all columns in Panel C are negative (p<0.01 in all cases), indicating that *NIU* firms are less efficient, after controlling for tone. In addition, we find that all coefficients of *TONE* × *NIU* and *POS* × *NIU* are negative, while all coefficients of *NEG* × *NIU* are positive (p<0.01 in all cases), suggesting that the association between the tone (positivity, negativity) and investment efficiency is more negative (negative, positive) for NIU firms than Non-NIU firms. This supports H3.

[Table 7 near here]

5.4. Test of H4

H4 predicts that the association between the tone and investment efficiency is more negative for overinvestment than for underinvestment. To examine H4, we first estimate Eq. (7) separately for subsamples of underinvestment (OBS = 3537) and overinvestment (OBS = 2144). Panel A of Table 8 reports the results for the underinvestment subsample. For both LM (2011) and Henry (2008) lists, we find that the efficiency of underinvestment is positively associated with *TONE* and *POS* but negatively associated with *NEG* (p<0.10 in all cases). Panel B of Table 8 reports the results for the overinvestment subsample. Contrary to Panel A, using both wordlists, we find that the efficiency of overinvestment is negatively associated with *TONE* and *POS* but positively associated with *NEG* (p<0.10 in all cases). In sum, it appears that when firms underinvest (overinvest), the tone discloses incremental (misleading) information on investment efficiency, consistent with managers using the tone opportunistically based on whether they are seen to "waste the investors' money".

To directly test H4, we add to Eqs. (7) the indicator variable *OVINV*. We then add to Eq. (7a) its interaction term with *TONE*, namely *TONE* × *OVINV*, and to Eq. (7b) its interaction terms with *POS* and *NEG*, namely *POS* × *OVINV* and *NEG* × *OVINV* respectively. For H4 to hold, the coefficients of *TONE* × *OVINV* and *POS* × *OVINV* should be negative, while the coefficients of *NEG* × *OVINV* should be positive.

Panel C of Table 8 presents the full sample results of these regressions. Across all columns in Panel C, we find that the coefficients of OVINV are negative (p<0.01), indicating that overinvestment firms are less investment efficient than underinvestment firms, after controlling for tone. We also find that both coefficients of $TONE \times OVINV$ and $POS \times OVINV$ are negative while both coefficients of $NEG \times OVINV$ are positive (p<0.05 in all cases). Consistent with H4, this implies that the tone (positivity, negativity) is more negatively (negatively, positively) associated with the efficiency of overinvestment than underinvestment.

[Table 8 near here]

5.5. Test of H5

H5 predicts that the association between the tone and investment efficiency is more negative for firms with decreasing vis a vis increasing investment efficiency. We first estimate Eqs. (7) separately for firms with increasing (OBS = 2918) and decreasing (OBS = 2763) investment efficiency. Panel A of Table 9 reports the results of firms with increasing investment efficiency. For these firms, we find that *TONE (POS, NEG)* is positively (positively, negatively) associated with investment efficiency (p<0.05 in all cases). Panel B of Table 9 reports the results of firms with increasing investment efficiency. In this case, we find that *TONE (POS, NEG)* is negatively (negatively, positively) associated with investment efficiency. In this case, we find that *TONE (POS, NEG)* is negatively (negatively, positively) associated with investment efficiency (p<0.01 in all cases). The contradictory results of Panels A and B suggest that managers use the tone to inform (misinform) investors when the investment efficiency increases (decreases), consistent with an opportunistic use of the tone when investments are managed "poorly".

Subsequently, we test H5 directly by first adding to Eqs. (7) the indicator variable *DECIVEF*. Then we add to Eq. (7a) its interaction term with *TONE*, namely *TONE* × *DECIVEF*, and to Eq. (7b) its interaction terms with *POS* and *NEG*, namely *POS* × *DECIVEF* and *NEG* × *DECIVEF* respectively. For H5 to hold, the coefficients of *TONE* × *DECIVEF* and *POS* × *DECIVEF* should be negative, while the coefficients of *NEG* × *DECIVEF* should be positive.

Panel C of Table 9 reports the full sample results of these regressions. Across all columns in Panel C, *DECIVEF* depicts negative coefficients (p<0.01). Using both LM (2011) and Henry (2008) wordlists, the coefficients of *TONE* × *DECIVEF* and *POS* × *DECIVEF* are negative, while the coefficient of *NEG* × *DECIVEF* is positive (p<0.05 in all cases). These results suggest that the tone (positivity, negativity) is more negatively (negatively, positively) associated with firms of decreasing as opposed to increasing investment efficiency. This supports H5.

[Table 9 near here]

6. Conclusions

We examine the association between the tone of 10-Ks and firms' capital investments. Our paper contributes to the currently sparse research on the role of the textual tone in conveying firms' investment behaviour (e.g., Berns et al., 2022; Cho & Muslu, 2021; Durnev & Mangen, 2020), by exploring scenarios when managers have differential incentives to disclose incrementally informative vis a vis misleading narratives. First, consistent with the expectations-adjustment hypothesis, we hypothesize and find that the tone is positively associated with the reported investment level. This suggests that the tone signals incremental investment level information, which is relevant for estimating firms' growth potential and future earnings (Li, 2010; Roychowdhury et al., 2019). Our finding adds to the corpus of research which suggests that the tone improves capital allocation in the market by lowering the information asymmetry between managers and capital providers (e.g., Davis et al., 2012; Henry, 2008; Loughran & McDonald, 2011; Price et al., 2012). Second, consistent with the management obfuscation hypothesis, we identify four investment outcomes when the tone misleads users on investment efficiency – when firms: (a) undertake large investments (b) undertake new investments (c) overinvest and (d) decrease investment efficiency. On the contrary, we find that the tone provides incremental information on investment efficiency when firms: (a) undertake small investments (b) do not undertake new investments (c) underinvest and (d) increase investment efficiency. In essence, these results suggest that managers may disclose misleading investment efficiency narratives if the investment outcomes misalign with their interests. Replacing the tone with separate measures of tonal positivity and negativity provides sheds further light on the use of positive and negative tonal words in information signalling. In addition to these theoretical contributions, based on an

examination of the nature of the positive and negative tonal words, we make the case for the level tone as a proxy for incremental current-period sentiment.

Our findings should be interpreted with at least two caveats. First, we do not make claims of direct causality between the explanatory and dependent variables in our regression models. Consistent with our hypothesis, our research design only tests associations between the tone and firms' investments. Second, while we focus on investment outcomes only, the list of conditions we explore in this study not exhaustive. For instance, when faced with financial performance outcomes that hamper their interests, managerial incentives to disclose misleading investment narratives may also exacerbate.

There are a number of avenues for future research. If the narrative tone signals current and future investments, it is plausible that other lexical features of financial disclosures also represent decision-relevant investment information. Therefore, one line of research can examine the link between firms' investment decisions and associated lexical features such as textual length, readability, attributions, uncertainty or forward-looking narratives. Another line of research can examine conditions related to firm and market conditions (performance, liquidity, efficiency, competition, industry attributes, etc.) when managers have incentives to disclose misleading investment narratives. A related line of research may wish to segregate the tone into non-discretionary and discretionary components (e.g., Huang et al., 2014; Rahman, 2019) to examine their information content for investments. Future studies can also examine conditions under which firms' investment choices are mislead by the linguistic content of peer firms' financial disclosures.

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Declaration of Interests

We, the authors, declare that we have no competing financial interests or personal relationships that could potentially affect the work reported in this paper.

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Data Availability

All data used in this paper have been obtained from publicly available sources identified in the

paper. Data used in this study will be provided upon reasonable request.

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Table 1
Descriptive statistics.

Variables	Mean	Std. Dev	1 st Pct	1 st Qrt	Median	3 rd Qrt	99 th Pct
IVL	0.0417	0.1265	-0.2472	-0.0049	0.0239	0.0674	0.5223
IVEF	-0.0705	0.1050	-0.5242	-0.0737	-0.0417	-0.0206	-0.0004
$POSITIVE_{LM}$	1801.5	1404.2	210.6	883.0	1587.0	2278.0	7218.0
$NEGATIVE_{LM}$	3520.1	2933.5	153.8	1568.0	3215.0	4739.0	13639.8
POSITIVE _{HENRY}	905.0	1002.7	112.8	402.0	562.0	972.0	4761.8
NEGATIVE _{HENRY}	1307.3	2221.0	66.8	240.0	345.0	1080.0	9530.2
TOTWORDS	75552.4	48341.8	13333.0	47529.0	64180.0	89289.0	265550.6
$TONE_{LM}$	-0.2227	0.2348	-0.4661	-0.3676	-0.3242	-0.2282	0.3963
POS_{LM}	0.0239	0.0090	0.0046	0.0237	0.0273	0.0295	0.0369
NEG_{LM}	0.0461	0.0227	0.0025	0.0461	0.0557	0.0606	0.0750
TONEHENRY	0.0884	0.2800	-0.4423	-0.1270	0.1772	0.3005	0.5130
POSHENRY	0.0134	0.0139	0.0038	0.0064	0.0079	0.0121	0.0613
NEGHENRY	0.0198	0.0321	0.0019	0.0040	0.0051	0.0087	0.1239
EARN	0.0684	0.0772	-0.1353	0.0251	0.0567	0.1029	0.2852
CHEARN	0.0081	0.0580	-0.1711	-0.0058	0.0046	0.0225	0.1921
STDEARN	0.0266	0.0372	0.0003	0.0061	0.0145	0.0315	0.1850
SIZE	9.8654	1.5598	6.3135	8.8752	9.8263	10.7361	13.9334
LEV	1.4369	7.2067	0.0000	0.3100	0.6600	1.2300	12.1720
TOBINSQ	0.9412	1.8010	0.0000	0.9673	0.9992	1.0335	1.6814
LOSS	0.0664	0.2489	0.0000	0.0000	0.0000	0.0000	1.0000
CASH	0.0941	0.0967	0.0012	0.0240	0.0651	0.1301	0.4304
RET	0.1487	0.3225	-0.4713	-0.0327	0.1255	0.3003	1.0653
CUTTA	0.2480	0.1848	-0.0251	0.1076	0.2168	0.3491	0.8040
LARGE	0.4999	0.5000	0.0000	0.0000	0.0000	1.0000	1.0000
NIU	0.5163	0.4998	0.0000	0.0000	1.0000	1.0000	1.0000
OVINV	0.3774	0.4848	0.0000	0.0000	0.0000	1.0000	1.0000
DECIVEF	0.4864	0.4999	0.0000	0.0000	0.0000	1.0000	1.0000
				Number o	f Observation	s = 5681 (all	l variables)

Notes: This table reports descriptive statistics of variables used in the study from 5681 firm-year observations of S&P500 firms during the period 2010 - 2022. *TONE*, *POS* and *NEG* variables are reported prior to standardization. Std. Dev = Standard Deviation. All variables are defined as in Appendix.

Table 2
Correlations.

Variables	IVL	IVEF	TONE _{LM}	POS _{LM}	NEG _{LM}	TONE _{HENRY}	POS _{HENRY}	NEG _{HENRY}
IVL	1.000							
IVEF	-0.178	1.000						
$TONE_{LM}$	0.024	-0.005	1.000					
POS_{LM}	0.050	-0.004	-0.792	1.000				
NEG_{LM}	-0.001	0.004	-0.933	0.920	1.000			
TONE _{HENRY}	0.091	-0.013	-0.726	0.797	0.764	1.000		
POSHENRY	-0.005	0.024	0.731	-0.573	-0.714	-0.643	1.000	
NEGHENRY	-0.025	0.019	0.770	-0.664	-0.779	-0.759	0.971	1.000
EARN	0.130	0.155	0.073	0.001	-0.041	0.093	0.049	0.017
CHEARN	0.170	0.095	0.012	0.024	0.014	0.035	-0.005	-0.014
STDEARN	-0.062	-0.179	0.077	-0.083	-0.074	-0.065	0.042	0.056
SIZE	-0.029	0.005	0.057	-0.168	-0.118	-0.310	0.097	0.143
LEV	-0.003	0.001	0.019	-0.008	-0.015	0.003	0.016	0.014
TOBINSQ	0.003	-0.005	-0.017	0.027	0.024	0.025	-0.010	-0.019
LOSS	-0.148	-0.164	0.009	-0.062	-0.032	-0.060	0.005	0.023
CASH	-0.007	0.016	-0.020	0.022	0.021	-0.003	-0.001	-0.005
RET	0.078	0.013	-0.010	0.097	0.087	0.096	-0.060	-0.070
CUTTA	-0.150	0.131	-0.095	0.052	0.092	0.007	-0.021	-0.024
					Numbe	er of Observation	cons = 5681 (a)	ll variables)

Notes: This table reports correlation coefficients of investment and tone with the other variables used in the study based on 5681 firm-year observations of S&P500 firms during the period 2010 – 2022. *TONE*, *POS* and *NEG* variables are reported prior to standardization. Coefficients in bold indicate p<0.05. All variables are defined as in Appendix.

Panel A: Means by IVL decile rank									
Deciles	IVL	IVEF	TONE _{LM}	$\mathrm{POS}_{\mathrm{LM}}$	NEG _{LM}	TONE _{HENRY}	POS _{HENRY}	NEG _{HENRY}	
1	-0.1288	-0.1703	-0.2250	0.0224	0.0449	0.0226	0.0134	0.0216	
2	-0.0230	-0.0645	-0.2209	0.0234	0.0454	0.0708	0.0143	0.0222	
3	-0.0050	-0.0465	-0.2214	0.0237	0.0462	0.0656	0.0135	0.0207	
4	0.0061	-0.0356	-0.2152	0.0233	0.0453	0.0633	0.0136	0.0205	
5	0.0178	-0.0240	-0.2200	0.0238	0.0458	0.0752	0.0140	0.0210	
6	0.0308	-0.0110	-0.2328	0.0243	0.0471	0.1048	0.0132	0.0189	
7	0.0469	-0.0064	-0.2480	0.0248	0.0487	0.1119	0.0127	0.0176	
8	0.0683	-0.0265	-0.2232	0.0244	0.0467	0.1086	0.0133	0.0192	
9	0.1084	-0.0666	-0.2206	0.0242	0.0463	0.1294	0.0131	0.0179	
10	0.2939	-0.2521	-0.2001	0.0245	0.0449	0.1318	0.0133	0.0186	
						Number of Obs	ervations = 5	68 per decile	

 Table 3

 Comparing means and medians of tone variables by decile investment levels.

Panel B: Medians by IVL decile rank

Deciles	IVL	IVEF	TONE _{LM}	POS _{LM}	NEG _{LM}	TONE _{HENRY}	POSHENRY	NEG _{HENRY}
1	-0.0715	-0.1133	-0.3342	0.0266	0.0570	0.0939	0.0073	0.0055
2	-0.0221	-0.0639	-0.3246	0.0271	0.0556	0.1688	0.0077	0.0051
3	-0.0049	-0.0466	-0.3274	0.0272	0.0561	0.1568	0.0078	0.0053
4	0.0061	-0.0353	-0.3225	0.0271	0.0552	0.1588	0.0082	0.0055
5	0.0179	-0.0240	-0.3229	0.0274	0.0557	0.1659	0.0083	0.0054
6	0.0307	-0.0109	-0.3240	0.0272	0.0557	0.2090	0.0080	0.0050
7	0.0468	-0.0054	-0.3310	0.0276	0.0566	0.1835	0.0078	0.0050
8	0.0674	-0.0252	-0.3221	0.0274	0.0558	0.1895	0.0079	0.0048
9	0.1046	-0.0632	-0.3227	0.0274	0.0552	0.2197	0.0082	0.0048
10	0.2423	-0.2008	-0.3059	0.0280	0.0542	0.2247	0.0078	0.0045
					-	Number of Obs	ervations $= 56$	58 per decile

Notes: This table reports descriptive statistics of variables used in the study of S&P500 firms during the period 2010 - 2022. Each decile consists of 568 firm-year observations, excluding the median observation ranked by IVL from the full sample of 5861 observations. *TONE*, *POS* and *NEG* variables are reported prior to standardization. All variables are defined as in Appendix.

Table 4			
Descriptive statistics of key	variables compared	across investment-	related subsamples.

	Small in	Small investment (OBS = 2840)			Large investment (OBS = 2840)			
Variables	Mean	Std. Dev.	Median	Mean	Std. Dev.	Median	p-value	
IVL	-0.027	0.095	-0.005	0.110	0.117	0.067	0.000	
IVEF	-0.069	0.095	-0.047	-0.073	0.114	-0.026	0.100	
$TONE_{LM}$	-0.221	0.238	-0.326	-0.225	0.232	-0.322	0.500	
POSLM	0.023	0.009	0.027	0.024	0.009	0.028	0.000	
NEG_{LM}	0.046	0.024	0.056	0.047	0.022	0.056	0.046	
TONE _{HENRY}	0.060	0.281	0.149	0.117	0.277	0.207	0.000	
POSHENRY	0.014	0.014	0.008	0.013	0.013	0.008	0.091	
NEGHENRY	0.021	0.033	0.005	0.018	0.031	0.005	0.001	

Panel A. Com	narino	small vs	large	investments
I and A. Com	paring	sinan vs	large	mvestments

Panel B: Comparing NIU Firms vs Non-NIU Firms

Non-NIU Firms (OBS = 2748)

NIU Firms (OBS = 2933)

T-Test (Mean)

Variables	Mean	Std. Dev.	Median	Mean	Std. Dev.	Median	p-value
IVL	-0.009	0.106	0.002	0.089	0.126	0.053	0.000
IVEF	-0.064	0.098	-0.043	-0.077	0.111	-0.039	0.000
$TONE_{LM}$	-0.211	0.243	-0.323	-0.234	0.227	-0.325	0.000
POS_{LM}	0.023	0.009	0.027	0.025	0.009	0.028	0.000
NEG_{LM}	0.045	0.024	0.055	0.048	0.022	0.056	0.000
$TONE_{HENRY}$	0.063	0.287	0.157	0.112	0.272	0.195	0.000
POSHENRY	0.014	0.014	0.008	0.013	0.013	0.008	0.000
NEGHENRY	0.022	0.035	0.005	0.018	0.030	0.005	0.000

Panel C: Comparing underinvestment vs overinvestment firms

	Underinvestment (OBS = 3537)			Overinv	vestment (OE	T-Test (Mean)	
Variables	Mean	Std. Dev.	Median	Mean	Std. Dev.	Median	p-value
IVL	-0.015	0.088	0.002	0.135	0.125	0.088	0.000
IVEF	-0.057	0.088	-0.040	-0.093	0.125	-0.046	0.000
$TONE_{LM}$	-0.225	0.235	-0.327	-0.219	0.235	-0.319	0.357
POS_{LM}	0.023	0.009	0.027	0.024	0.009	0.028	0.001
NEG_{LM}	0.046	0.023	0.056	0.046	0.022	0.055	0.591
$TONE_{HENRY}$	0.070	0.280	0.159	0.119	0.277	0.208	0.000
POSHENRY	0.014	0.014	0.008	0.013	0.014	0.008	0.414
NEG_{HENRY}	0.021	0.033	0.005	0.019	0.031	0.005	0.030

Panel D: Comparing increasing vs decreasing investment efficiency

	Increasing investment efficiency (OBS = 2918)			Dec	T-Test (Mean)		
Variables	Mean	Std. Dev.	Median	Mean	Std. Dev.	Median	p-value
IVL	-0.006	0.104	0.004	0.092	0.129	0.054	0.000
IVEF	-0.062	0.096	-0.043	-0.079	0.113	-0.040	0.000

$TONE_{LM}$	-0.225	0.233	-0.325	-0.220	0.237	-0.323	0.359
POS_{LM}	0.024	0.009	0.027	0.024	0.009	0.027	0.815
NEG_{LM}	0.046	0.023	0.056	0.046	0.023	0.056	0.392
TONEHENRY	0.090	0.280	0.178	0.086	0.280	0.176	0.573
POSHENRY	0.013	0.013	0.008	0.014	0.015	0.008	0.176
NEG_{HENRY}	0.019	0.030	0.005	0.020	0.034	0.005	0.292

Notes: This table reports the summary statistics of key variables across investment-related subsamples. Panel A compares small and large investments. Panel B compares NIU and Non-NIU firms. Panel C compares underinvestment and overinvestment firms. Panel D compares increasing and decreasing investment efficiency. *TONE*, *POS* and *NEG* variables are reported prior to standardization. Std. Dev: standard deviation. OBS: number of firm-year observations. All variables are defined in Appendix.

	Dependent Variable: IVL _{it}				
	Tone using	LM	Tone using H	IENRY	
Variable	(1) Coeff.	(2) Coeff.	(3) Coeff.	(4) Coeff.	
INTERCEPT _{it}	0.0881***	0.0844***	0.0580***	0.0713***	
$TONE_{it}$	0.0231***		0.0343***		
POS_{it}		0.0287***		0.0373***	
NEG _{it}		-0.0404***		-0.0432***	
EARN _{it}	0.0891*	0.0854*	0.0656	0.0858*	
CHEARN _{it}	0.2748***	0.2821***	0.2849***	0.2778***	
STDEARN _{it}	-0.1325	-0.1236	-0.1075	-0.1232	
$SIZE_{it}$	-0.0001	-0.0002	0.0015	-0.0002	
LEV _{it}	-0.0001	-0.0001	-0.0001	-0.0000	
<i>TOBINSQ</i> _{it}	-0.0003	-0.0003	-0.0004	-0.0004	
LOSS _{it}	-0.0381***	-0.0370***	-0.0406***	-0.0397***	
CASH _{it}	-0.0322**	-0.0421**	-0.0290	-0.0428**	
RET_{it}	0.0170***	0.0168***	0.0160***	0.0181***	
CUTTA _{it}	-0.1284***	-0.1263***	-0.1271***	-0.1318***	
INDUSTRY FE	YES	YES	YES	YES	
YEAR FE	YES	YES	YES	YES	
F-VALUE	17.97***	18.37***	19.90***	17.41***	
ADJ R-SQ	0.0898	0.0942	0.0989	0.0895	
OBS	5681	5681	5681	5681	

Table 5Tone and investment level.

Notes: This table reports regressions of firm-specific investment level on the tone, positivity and negativity of 10-K disclosures of S&P500 firms for 5681 firm-year observations during the period 2010 - 2022. *TONE*, *POS* and *NEG* are standardized to have a mean of 0 and standard deviation of 1. *INDUSTRY FE* = industry fixed-effects. *YEAR FE* = year fixed-effects. OBS = number of firm-year observations. P-values are based on robust standard errors clustered two ways at the year-level and firm-level. All variables are defined in Appendix. *, **, *** indicate significance at the p < 0.10, 0.05, 0.01 level respectively.

Table 6

INDUSTRY FE

YEAR FE

YES

YES

YES

YES

YES

YES

		Dependent	Variable: IVEF _{it}	
	Tone using	g LM	Tone using	HENRY
Variable	(1) Coeff.	(2) Coeff.	(3) Coeff.	(4) Coeff.
Panel A: Small investment	subsample			
INTERCEPT _{it}	-0.0550***	-0.0576***	-0.0636***	-0.0604***
<i>TONE</i> _{it}	0.0076*		0.0115**	
POS _{it}		0.0120***		0.0185**
NEG _{it}		-0.0124*		-0.0181**
CONTROL VARIABLES	YES	YES	YES	YES
INDUSTRY FE	YES	YES	YES	YES
YEAR FE	YES	YES	YES	YES
F-VALUE	14.49***	14.23***	14.71***	14.18***
ADJ R-SQ	0.1356	0.1368	0.1375	0.1364
OBS	2840	2840	2840	2840
Variable	(5)	(6)	(7)	(8)
	Coeff.	Coeff.	Coeff.	Coeff.
Panel B: Large investment	subsample			
INTERCEPT _{it}	-0.1379***	-0.1347***	-0.1160***	-0.1263***
$TONE_{it}$	-0.0180***		-0.0221***	
POS_{it}		-0.0220**		-0.0171*
NEG _{it}		0.0344***		0.0254**
CONTROL VARIABLES	YES	YES	YES	YES
INDUSTRY FE	YES	YES	YES	YES
YEAR FE	YES	YES	YES	YES
F-VALUE	11.61***	11.64***	11.96***	11.10***
ADJ R-SQ	0.1098	0.1130	0.1130	0.1079
OBS	2840	2840	2840	2840
Variable	(9) Coeff	(10) Coeff.	(11) Coeff	(12) Coeff
Panel C: Full sample – Larg	ge investment inter	action term		
<i>INTERCEPT</i> _{it}	-0.0799***	-0.0806***	-0.0755***	-0.0762***
TONE _{it}	-0.0008		-0.0015	
POS _{it}		0.0180***		0.0178**
NEG _{it}		-0.0118**		-0.0124*
LARGE _{it}	-0.0082***	-0.0078***	-0.0077***	-0.0082***
$TONE_{it} \times LARGE_{it}$	-0.0095***		-0.0060**	
$POS_{it} \times LARGE_{it}$		-0.0458***		-0.0341***
$NEG_{it} \times LARGE_{it}$		0.0490***		0.0313***
CONTROL VARIABLES	YES	YES	YES	YES

Tone and investment efficiency - size of investment.

YES

YES

F-VALUE ADJ R-SQ OBS	16.13*** 0.0853 5681	16.47*** 0.0916 5681	15.88*** 0.0840 5681	15.17*** 0.0845 5681
Variable	(13) Coeff.	(14) Coeff.	(15) Coeff.	(16) Coeff.
Panel D: Full sample – the n	noderating role of ir	nvestment level		
INTERCEPT _{it} TONE _{it}	-0.0677*** 0.0052	-0.0637***	-0.0700*** 0.0093*	-0.0595***
POS_{it}		0.0344***		0.0492***
NEG _{it}		-0.0275***		-0.0405***
IVL _{it}	-0.1883***	-0.1768***	-0.1607**	-0.2039***
$TONE_{it} \times IVL_{it}$	-0.1476**		-0.1675***	
$POS_{it} \times IVL_{it}$		-0.6262 * * *		-0.9165***
$NEG_{it} \times IVL_{it}$		0.6796***		0.8447***
CONTROL VARIABLES INDUSTRY FE YEAR FE	YES YES YES	YES YES YES	YES YES YES	YES YES YES
F-VALUE ADJ R-SQ OBS	29.55*** 0.1496 5681	50.15*** 0.2425 5681	31.29*** 0.1573 5681	37.31*** 0.1913 5681

Notes: This table reports regressions of investment efficiency on the tone, positivity and negativity of 10-K disclosures of S&P 500 firms during the period 2010 – 2022. Panels A and B report the regressions of small and large investment subsamples, each based on 2840 firm-year observations. Panels C and D report full sample regressions of 5681 firm-year observations, interacted by large investment dummy and investment level respectively. *TONE*, *POS* and *NEG* are standardized to have a mean of 0 and standard deviation of 1. *INDUSTRY FE* = industry fixed-effects. *YEAR FE* = year fixed-effects. OBS = number of firm-year observations. P-values are based on robust standard errors clustered two ways at the year-level and firm-level. All variables are defined in Appendix. *, **, *** indicate significance at the p < 0.10, 0.05, 0.01 level respectively.

	Dependent Variable: IVEF _{it}			
	Tone using	LM	Tone using l	HENRY
Variable	(1) Coeff.	(2) Coeff.	(3) Coeff.	(4) Coeff.
Panel A: Non-NIU subsamp	ole			
INTERCEPT _{it} TONE _{it}	-0.0656*** 0.0045	-0.0644***	-0.0714*** 0.0135**	-0.0683***
POS_{it}		0.0129***		0.0140**
NEG _{it}		-0.0159*		-0.0120*
CONTROL VARIABLES	YES	YES	YES	YES
INDUSTRY FE	YES	YES	YES	YES
YEAR FE	YES	YES	YES	YES
F-VALUE	15.79***	15.58***	16.14***	15.46***
ADJ R-SQ	0.1509	0.1529	0.1539	0.1518
OBS	2748	2748	2748	2748
Variable	(5) Coeff.	(6) Coeff.	(7) Coeff.	(8) Coeff.
Panel B: NIU subsample				
INTERCEPT _{it} TONE _{it}	-0.1296*** -0.0215***	-0.1265***	-0.1032*** -0.0216***	-0.1156***
POS_{ii}		-0.0217***		-0.0221*
NEG		0.0344***		0.0299**
CONTROL VARIARIES	VES	VES	VES	VES
INDUSTRY FF	VES	YES	VES	VES
YEAR FE	YES	YES	YES	YES
F-VALUE	10 53***	10 59***	10 85***	9 97***
ADJ R-SO	0.0968	0.1001	0.0998	0.0942
OBS	2933	2933	2933	2933
Variable	(9) Coeff.	(10) Coeff.	(11) Coeff.	(12) Coeff.
Panel C: Full sample – NIU	interaction term			
INTERCEPT _{it}	-0.0790*** -0.0014	-0.0781***	-0.0714*** -0.0011	-0.0733***
POS	0.0011	0 0198***	0.0011	0 0163***
NEG		-0.0156**		-0.0106
	0 0162***	0.0150	0 0150***	0.0160***
$TONF \times NIII$		-0.0101	0.0155	-0.0100
$POS \times NIII$	-0.0070	0.0477***	-0.000	0 0200***
$r \cup S_{it} \wedge NI \cup_{it}$		-0.04//		-0.0377***
$IVEG_{it} \times IVIU_{it}$		0.0312***		0.0339***
CONTROL VARIABLES	YES	YES	YES	YES
INDUSTRY FE	YES	YES	YES	YES
IEAK FE	YES	YES	YES	YES

 Table 7

 Tone and investment efficiency – additions to investment level.

F-VALUE	16.97***	17.43***	16.74***	16.06***
ADJ R-SQ	0.0896	0.0967	0.0884	0.0893
OBS	5681	5681	5681	5681

Notes: This table reports regressions of investment efficiency on the tone, positivity and negativity of 10-K disclosures of S&P 500 firms during the period 2010 – 2022. Panels A and B report the regressions of new investments undertaken (NIU) and new investments not undertaken (Non-NIU) subsamples, based on 2748 and 2933 firm-year observations respectively. Panel C reports the full sample regressions of 5681 firm-year observations interacted by new investments undertaken dummy. *TONE*, *POS* and *NEG* are standardized to have a mean of 0 and standard deviation of 1. *INDUSTRY FE* = industry fixed-effects. *YEAR FE* = year fixed-effects. OBS = number of firm-year observations. P-values are based on robust standard errors clustered two ways at the year-level and firm-level. All variables are defined in Appendix. *, **, *** indicate significance at the p < 0.10, 0.05, 0.01 level respectively.

	Dependent Variable: IVEF _{it}			
	Tone using	LM	Tone using l	HENRY
Variable	(1) Coeff.	(2) Coeff.	(3) Coeff.	(4) Coeff.
Panel A: Underinvestment f	irms subsample			
INTERCEPT _{it} TONE _{it}	-0.0444^{***} 0.0058^{*}	-0.0466***	-0.0528*** 0.0121***	-0.0489***
POS_{it}		0.0100***		0.0182***
NEG _{it}		-0.0098*		-0.0181***
CONTROL VARIABLES INDUSTRY FE YEAR FE	YES YES YES	YES YES YES	YES YES YES	YES YES YES
F-VALUE ADJ R-SQ OBS	17.84*** 0.1358 3537	17.49*** 0.1369 3537	18.27*** 0.1388 3537	17.52*** 0.1371 3537
Variable	(5) Coeff.	(6) Coeff.	(7) Coeff.	(8) Coeff.
Panel B: Overinvestment fir	ms subsample			
INTERCEPT _{it} TONE _{it}	-0.1482*** -0.0177***	-0.1424***	-0.1274*** -0.0228***	-0.1371***
POS _{it}		-0.0215**		-0.0148
NEG _{it}		0.0317***		0.0247*
CONTROL VARIABLES INDUSTRY FE YEAR FE	YES YES YES	YES YES YES	YES YES YES	YES YES YES
F-VALUE ADJ R-SQ OBS	10.16*** 0.1237 2144	10.06*** 0.1257 2144	10.43*** 0.1268 2144	9.77*** 0.1222 2144
Variable	(9) Coeff.	(10) Coeff.	(11) Coeff.	(12) Coeff.
Panel C: Full sample – Over	investment interac	tion term		
INTERCEPT _{it} TONE _{it}	-0.0625*** -0.0007	-0.0630***	-0.0614*** 0.0019	-0.0605***
POS_{it}		0.0142***		0.0164***
NEG_{it}		-0.0078		-0.0127***
$OVINV_{it}$ TONE _{it} × OVINV _{it}	-0.0397*** -0.0066**	-0.0387***	-0.0393*** -0.0078***	-0.0397***
$POS_{it} \times OVINV_{it}$	-	-0.0425***	-	-0.0285**
$NEG_{it} \times OVINV_{it}$		0.0436***		0.0286**
CONTROL VARIABLES	YES	YES	YES	YES
INDUSTRY FE YEAR FE	YES YES	YES YES	YES YES	YES YES

 Table 8

 Tone and investment efficiency – type of investment inefficiency.

F-VALUE	21.79***	21.68***	21.83***	20.70***
ADJ R-SQ	0.1135	0.1187	0.1138	0.1137
OBS	5681	5681	5681	5681

Notes: This table reports regressions of investment efficiency on the tone, positivity and negativity of 10-K disclosures of S&P 500 firms during the period 2010 – 2022. Panels A and B report the regressions of underinvestment and overinvestment subsamples, based on 3537 and 2144 firm-year observations respectively. Panel C reports the full sample regressions of 5681 firm-year observations interacted by overinvestment firm dummy. *TONE, POS* and *NEG* are standardized to have a mean of 0 and standard deviation of 1. *INDUSTRY FE* = industry fixed-effects. *YEAR FE* = year fixed-effects. OBS = number of firm-year observations. P-values are based on robust standard errors clustered two ways at the year-level and firm-level. All variables are defined in Appendix. *, **, *** indicate significance at the p < 0.10, 0.05, 0.01 level respectively.

Table 9

DECIVEF_{it}

 $TONE_{it} \times DECIVEF_{it}$

 $POS_{it} \times DECIVEF_{it}$

 $NEG_{it} \times DECIVEF_{it}$

INDUSTRY FE

YEAR FE

CONTROL VARIABLES

-0.0179***

-0.0050**

YES

YES

YES

	Dependent Variable: IVEF _{it}				
	Tone usin	g LM	Tone using	g HENRY	
Variable	(1) Coeff.	(2) Coeff.	(3) Coeff.	(4) Coeff.	
Panel A: Increasing investr	nent efficiency sub	osample			
INTERCEPT _{it} TONE _{it}	-0.0486^{***} 0.0087^{**}	-0.0555***	-0.0619*** 0.0164***	-0.0539***	
POS_{it}		0.0171***		0.0222***	
NEG _{it}		-0.0140**		-0.0186**	
CONTROL VARIABLES	YES	YES	YES	YES	
INDUSTRY FE	YES	YES	YES	YES	
YEAR FE	YES	YES	YES	YES	
F-VALUE	15.22***	15.09***	15.74***	15.00***	
ADJ R-SQ	0.1385	0.1410	0.1429	0.1403	
OBS	2918	2918	2918	2918	
Variable	(5) Coeff.	(6) Coeff.	(7) Coeff.	(8) Coeff.	
Panel B: Decreasing invest	ment efficiency su	bsample			
INTERCEPT _{it} TONE _{it}	-0.1233*** -0.0210***	-0.1256***	-0.0973^{***} -0.0291^{***}	-0.0978***	
POS_{it}		-0.0241***		-0.0393***	
NEG _{it}		0.0406***		0.0597***	
CONTROL VARIABLES	YES	YES	YES	YES	
INDUSTRY FE	YES	YES	YES	YES	
YEAR FE	YES	YES	YES	YES	
F-VALUE	10.85***	11.05***	11.62***	10.37***	
ADJ R-SO	0.1053	0.1101	0.1126	0.1034	
OBS	2763	2763	2763	2763	
Variable	(9)	(10)	(11)	(12)	
v ariable	Coeff.	Coeff.	Coeff.	Coeff.	
Panel C: Full sample – Dec	creasing investmen	t efficiency interaction	n term		
INTERCEPT _{it}	-0.0772***	-0.0827***	-0.0733***	-0.0732***	
$TONE_{it}$	-0.0041		0.0013		
POS_{it}		0.0253***		0.0254***	
NEG_{it}		-0.0135**		-0.0185**	

-0.0278***

-0.0548***

0.0517***

YES

YES

YES

-0.0178***

-0.0141***

YES

YES

YES

Tone and investment efficiency – changes in investment efficiency.

-0.0178***

-0.0564***

0.0566***

YES

YES

YES

F-VALUE	16.96***	17.93***	17.71***	16.67***
ADJ R-SQ	0.0951	0.0993	0.0934	0.0926
OBS	5681	5681	5681	5681

Notes: This table reports regressions of investment efficiency on the tone, positivity and negativity of 10-K disclosures of S&P 500 firms during the period 2010 – 2022. Panels A and B report the regressions of increasing and decreasing investment efficiency subsamples, based on 2918 and 2763 firm-year observations respectively. Panel C reports the full sample regressions of 5681 firm-year observations, interacted by decreasing investment efficiency dummy. *TONE, POS* and *NEG* are standardized to have a mean of 0 and standard deviation of 1. *INDUSTRY FE* = industry fixed-effects. *YEAR FE* = year fixed-effects. OBS = number of firm-year observations. P-values are based on robust standard errors clustered two ways at the year-level and firm-level. All variables are defined in Appendix. *, **, *** indicate significance at the p < 0.10, 0.05, 0.01 level respectively.

Appendix.	Variable	definitions.
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Variable	Definition
IVL	Annual change in the sum of property, plant and equipment and intangible assets (scaled by total assets), plus research and development expenses (divided by total assets).
IVEF	Absolute value of the residual of regressing IVL on lagged annual sales growth, multiplied by -1 .
$POSITIVE_{LM}$	The total number of positive keywords from the Loughran and McDonald (2011) list that matches a 10-K disclosure.
$NEGATIVE_{LM}$	The total number of negative keywords from the Loughran and McDonald (2011) list that matches a 10-K disclosure.
POSITIVE _{HENRY}	The total number of positive keywords from the Henry (2008) list that matches a 10-K disclosure.
NEGATIVE _{HENRY}	The total number of negative keywords from the Henry (2008) list that matches a 10-K disclosure.
TOTWORDS	The total number of words in a 10-K disclosure.
TONE _{LM}	The difference between the total number of positive and negative words from the Loughran and McDonald (2011) list that matches a 10-K disclosure, divided by the sum of positive and negative words in that disclosure.
POS_{LM}	The total number of positive words from the Loughran and McDonald (2011) list that matches a 10-K disclosure, divided by the total number of words in that disclosure.
NEG _{LM}	The total number of negative words from the Loughran and McDonald (2011) list that matches a 10-K disclosure, divided by the total number of words in that disclosure.
TONE _{HENRY}	The difference between the total number of positive and negative words from the Henry (2008) list that matches a 10-K disclosure, divided by the sum of positive and negative words in that disclosure.
POSHENRY	The total number of positive words from the Henry (2008) list that matches a 10-K disclosure, divided by the total number of words in that disclosure.
NEG _{HENRY}	The total number of negative words from the Henry (2008) list that matches a 10-K disclosure, divided by the total number of words in that disclosure.
EARN	Annual earnings before extraordinary items, divided by total assets.
CHEARN	Annual change in <i>EARN</i> .
STDEARN	Standard deviation of EARN over the past four years.
SIZE	Natural logarithm of total assets.
LEV	Total debt divided by total equity.
TOBINSQ	Equity market value divided by equity book value.
LOSS	Indicator variable taking the value of 1 if operating income is negative, 0 otherwise.
CASH	Cash and marketable securities divided by total assets.
RET	12-month buy-and-hold returns.
CUTTA	Total current assets minus cash and marketable securities, divided by total assets.
LARGE	Indicator variable taking the value of 1 for large investments, 0 otherwise.
NIU	Indicator variable taking the value of 1 if the firm undertakes new investments, 0 otherwise.
OVINV	Indicator variable taking the value of 1 if the firm overinvests relative to its expected investment level, 0 otherwise.
DECIVEF	Indicator variable taking the value of 1 for deceasing investment efficiency, 0 otherwise.

Notes: This appendix table provides the definitions of the variables used in the study.