# Media Coverage and Investment Efficiency

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## Abstract

We examine the effect of media coverage on firm-level investment efficiency. We find that media coverage reduces under-investment but increases over-investment. The negative effect of media coverage on under-investment is more pronounced in firms affected by greater information asymmetry and poorer corporate governance. The positive effect of media coverage on over-investment is driven by media-induced CEO overconfidence. Additional results show that both investment- and non-investment-related news coverage decrease under-investment, while non-investment-related news coverage is more influential in increasing over-investment. In general, higher news optimism is associated with less under-investment but more over-investment. Moreover, media coverage affects investment efficiency through its information dissemination rather than information creation function. Collectively, our results suggest that firms' media visibility promotes more over-investment than under-investment.



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**Keywords:** Media coverage; investment efficiency; information asymmetry; corporate governance; CEO overconfidence.

## 1. Introduction

Investment decisions are important for firms' growth and development, which in turn have great implications for firm value and investor wealth. In theory, managers are expected to choose projects with positive net present values and make efficient investment decisions (Modigliani & Miller 1958). In real financial markets with frictions, inefficient investments, namely, under-investment and over-investment, could arise from various sources, such as adverse selection (e.g., Myers & Majluf 1984), agency problem (e.g., Jensen & Meckling 1976), and managerial overconfidence (e.g., Malmendier & Tate 2005). The former two are attributed to information asymmetry between managers and outside investors, while the last is a behavioral bias. Prior literature suggests that high-quality financial information can improve investment efficiency by mitigating information asymmetry (Biddle *et al.* 2009; Chen *et al.* 2011). Private information acquisition and interpretation by external market participants, such as institutional investors (Cao *et al.* 2020), foreign investors (Chen *et al.* 2017a), and financial analysts (Chen *et al.* 2017b; Choi *et al.* 2020), has been found to be associated with high investment efficiency. However, the media, as an important external information intermediary, is surprisingly ignored by the existing literature. Our paper fills this gap by studying the effect of the media on U.S. firms' investment efficiency.

Our first conjecture is that media coverage improves investment efficiency by discouraging both under-investment and over-investment. First, as an essential information intermediary, the media provides important information about firms' future prospects and investment conditions to investors and the general public. Due to consumer heterogeneity, the media has incentives to produce and disseminate accurate news articles (Mullainathan & Shleifer 2005), which can mitigate information asymmetry between corporate insiders and outside investors (Tetlock *et al.* 2008; Fang & Peress 2009; Bushee *et al.* 2010). As a result, firms suffer less from the lemons problem in financial markets and can more easily raise funds at proper prices to finance profitable investment projects, which suggests less under-investment. Second, the media analyzing firms' financial ratios, researching real operational conditions, and offering insights into firms' future prospects may involve direct interactions with managers (e.g., company visits and interviews with executives), which allows the media to discover

and expose managerial opportunism and irregularities to public attention and oversight. Corporate managers, who care about the firm's and their personal reputation, are motivated to reduce suboptimal, inefficient investment in pursuit of sustainable, long-term firm value. As such, the media's monitoring role can improve firms' internal governance and alleviate potential agency problems (e.g., Miller 2006; Dyck *et al.* 2008; Joe *et al.* 2009; You *et al.* 2018), thereby reducing both under- and over-investment.

However, the information role fulfilled by the media has negative consequences for managerial behavior, such as inducing celebrity culture and managerial overconfidence. "Superstar" CEOs, who are publicized by broad media coverage, tend to subsequently underperform, incurring wealth losses for their firm's shareholders (Malmendier & Tate 2009). Hayward and Hambrick (1997) show that the media's praise of CEOs amplifies their overconfidence and distorts their decisions around mergers and acquisitions (e.g., overbidding for their acquisition targets). Therefore, it is reasonable to predict an alternative, positive relation between media coverage and over-investment.

Using a sample of U.S. firms over the period from 2001 to 2018, we examine the effect of media coverage on firm-level investment efficiency. We define inefficient investment as the deviation of actual investment from the expected level of investment estimated as a function of sales growth (Biddle *et al.* 2009). We use the absolute value of the negative deviation to measure the magnitude of under-investment, while the positive deviation represents the magnitude of over-investment. We quantify media coverage as the natural logarithm of one plus the number of news articles released in a firm-year. The ordinary least squares (OLS) regression results show that media coverage significantly attenuates the magnitude of under-investment but aggravates the magnitude of over-investment.

We carefully address endogeneity concerns in two ways. First, we incorporate firm-fixed effects into the regressions to address the omitted variable bias associated with time-invariant unobservables. Second, we adopt two-stage least squares (2SLS) regressions and use the firm headquarters' geographic proximity to Dow Jones branches as an instrumental variable for media coverage, as firms located closer to the branches are expected to receive higher media coverage. We show that the *instrumented* media coverage reduces the magnitude of under-investment but increases the magnitude of over-investment, consistent with our previous results. However, one may worry that firms located close to the branches

("low distance") may have fundamentally different characteristics from firms located far away from the branches ("high distance"). These differences may influence their investment efficiency through channels other than media coverage. To address this concern, we use the propensity score matching technique to match each high-distance firm to its nearest neighbor low-distance firm. Using the matched sample, we re-run the 2SLS regressions and draw similar inferences. Moreover, geographic proximity to media outlets may be correlated with other geographic factors that could influence investment efficiency. To control for potential omitted geographic factors, we incorporate city-fixed effects and time-varying state-level macro-socioeconomic control variables into the 2SLS regressions in the matched sample. The results remain unchanged.

We perform several robustness tests. First, following Biddle *et al.* (2009), we estimate a multinomial logit model and find that media coverage significantly reduces the likelihood of under-investment but increases the likelihood of over-investment. Second, Biddle *et al.* (2009) estimate the expected level of investment as a function of sales growth. We use two alternative growth opportunity proxies—assets growth and Tobin's Q—as substitutes for sales growth. We also apply Chen *et al.*'s (2011) model that takes into account the varying relation between investment and sales growth across sales increase and sales decrease. Third, we adopt alternative samples by excluding firm-years without media coverage to avoid distortion of firms barely followed by news providers, removing the financial crisis period to avoid corporate investment being distorted by extreme market turbulence during this period, and excluding firm-years with missing G-index instead of assigning a value of zero for these instances. The results remain robust.

Our cross-sectional analysis reveals that information asymmetry and corporate governance are two moderators to the relation between media coverage and under-investment. Due to higher media coverage, outside investors experience less information asymmetry and can more easily identify firms with profitable investment opportunities and offer capital to them at more reasonable prices, which leads to less under-investment. Consistent with this argument, we find that media coverage reduces under-investment to a greater extent in firms with higher information asymmetry (proxied by lower analyst following and higher earnings opacity). The media also acts as a corporate governance

mechanism by exposing managerial actions to public attention and monitoring. This motivates risk-averse managers to pursue shareholders' interests and undertake profitable investment projects, which results in less under-investment. In line with this idea, we find that media coverage has a larger negative impact on under-investment in firms with poorer corporate governance (proxied by lower board independence and an absence of Big 4 auditors). In addition, media coverage can fuel celebrity culture and boost CEO overconfidence, which in turn increases over-investment. We employ the moneyness of CEOs' vested stock options and the CEOs' net purchase of the firms' stocks as two alternative measures of overconfidence. We perform a mediation analysis and find that CEO overconfidence is the mediator through which media coverage exacerbates over-investment.

In additional analyses, we differentiate investment- and non-investment-related news to clarify whether the media's impact on investment efficiency is confined to a certain category of news. We show that both investment- and non-investment-related news coverage discourage under-investment. However, only non-investment-related news coverage is found to significantly increase over-investment, indicating that dissemination of news of broader topics is influential in boosting managerial overconfidence and encouraging excessive investment. Further analysis about news sentiment shows that more optimistic news disclosure is associated with less under-investment but more over-investment, irrespective of whether the news is directly related to investment.

In light of Drake *et al.* (2014), who point out that the media's information intermediary role in financial markets operates through the media's information creation and/or information dissemination function, we distinguish between breaking news and repeated news coverage. We find little evidence that investment efficiency is associated with coverage of breaking news, which is the first news released specifically on an event and is an indication of the creation of new information. Coverage of repeated news, which is an array of similar news articles spreading information on a single event to a wide audience, has significant and expected effects on both under- and over-investment. This evidence indicates that the media influences investment efficiency mainly through information dissemination rather than information creation.

In addition to investment *efficiency*, we study the effect of media coverage on the *level* of different types of corporate investment. Investment is deemed efficient only if it responds appropriately to a firm's growth opportunities. We document a positive and significant relation between media coverage and total investment. With respect to different types of investment, we find that media coverage has significantly positive effects on capital expenditure, research and development (R&D) expenditure, and acquisition expenditure. The media-induced increase in acquisition expenditure reinforces the notion that media coverage stimulates managerial overconfidence and thus causes over-investment. Overconfidence is a behavioral motive for managers making acquisitions (Roll 1986). However, acquisitions on average diminish shareholder value (Agrawal *et al.* 1992) and are often viewed as over-investment.

This paper has two main contributions. First, it adds to the strand of literature on the determinants of firm-level investment efficiency. Existing literature has investigated the impact of firm-level transparency on investment efficiency. Most of these studies focus on the quality of a firm's financial reporting (e.g., Biddle & Hilary 2006; Biddle *et al.* 2009; Chen *et al.* 2011), while corporate transparency due to enhanced information acquisition and analysis by external market participants is less investigated. The very few studies on financial analysts (Chen *et al.* 2017b; Choi *et al.* 2020) and institutional investors (Chen *et al.* 2017a; Cao *et al.* 2020) show that these external information intermediaries play a significant role in shaping investment efficiency. Different from analysts, who mostly produce information targeting professional investors, and from institutional investors, who have more access to private information but little incentive to share that information with outside small investors, we find that the media, as an important information intermediary that gathers and disseminates information to the general public, has a significant influence on firm-level investment efficiency. More specifically, the media's informational role in determining investment efficiency operates primarily through the media's broad dissemination of information.

Second, our paper extends existing studies on the relation between media and financial market activities. Previous literature has documented pervasive impacts of the media on stock returns (Fang & Peress 2009; Peress 2014), insider trading profitability (Dai *et al.* 2015), cost of debt (Gao *et al.* 2020),

detection of accounting fraud (Miller 2006), and correction of corporate governance violation (Dyck *et al.* 2008). There is evidence that corporate investment in the form of merger and acquisition is also influenced by the media (Liu & McConnell 2013; Ahern & Sosyura 2014; Yang *et al.* 2019). Our study shows that media coverage increases the level of other forms of investment, including capital expenditure and R&D expenditure. Related, Dai *et al.* (2021) document that media coverage is negatively associated with patent filing and citation, suggesting that media coverage impedes firm innovation. Patents, as a type of intellectual property, are one output of a firm's R&D expenditure. The increased R&D expenditure that fails to generate sufficient innovation outputs (e.g., patents) following media coverage can be thought of as over-investment. Thus, Dai *et al.*'s (2021) evidence is generally consistent with our finding of media coverage increasing over-investment. However, innovation is only one facet of corporate investment policy. Our study focuses on total investment and its efficiency. We examine not only the media's relation with over-investment, but also with under-investment. In fact, both under- and over-investment that are not compatible with firms' growth opportunities are inefficient and costly for shareholders.

The remainder of this paper is organized as follows. Section 2 reviews the literature and develops the hypotheses. Section 3 describes the research methodology and sample selection. Sections 4-6 present the empirical results. Section 7 concludes the paper.

## 2. Literature review and hypotheses development

### 2.1. Determinants of investment efficiency

Investment has considerable influence on the future development of corporations. In a neoclassical framework, a capital investment decision is determined by the marginal Q ratio, and firms invest until the marginal benefit of capital investment equals the marginal cost (e.g., Yoshikawa 1980; Hayashi 1982; Abel 1983). Managers are expected to invest efficiently by undertaking projects with positive net present values (Modigliani & Miller 1958). However, extant literature recognizes that firms are likely to under-invest or over-invest in real-world scenarios. The inefficiency of investment is measured as the deviation of actual investment from the optimal investment level that is estimated as a

function of a firm's sales growth (e.g., Richardson 2006; Biddle *et al.* 2009). A large body of literature has attributed investment inefficiency to adverse selection (e.g., Myers & Majluf 1984), agency problem (e.g., Jensen & Meckling 1976), and managerial overconfidence (e.g., Malmendier & Tate 2005). The first two are due to information asymmetry between managers and outside investors, while the last one is related to managers' behavioral bias.

Existing literature explains that under-investment can occur for three possible reasons. First, in adverse selection models, managers possess more information about firms' actual conditions and prospects compared to outside investors, which increases the likelihood of overpriced securities being sold in financial markets (i.e., the lemons problem). To offset the negative effects induced by information asymmetry with managers, outside investors will demand higher returns or discount securities' prices *ex-ante* (Stiglitz & Weiss 1981; Whited 1992; Lambert *et al.* 2007). As such, managers could refuse to raise the cost of external capital or to discount share prices even if that means forgoing profitable investment opportunities, leading to *ex-post* under-investment (Myers & Majluf 1984; Fazzari *et al.* 1988). Second, agency problems arising from information asymmetry between managers and investors can cause *ex-post* under-investment. Ross (1973) argues that risk-averse managers could reject profitable projects to avoid potential failure, which is, however, detrimental to shareholder value. Managers, when they are not closely monitored, prefer a "quiet life" to active "empire building" (Bertrand & Mullainathan 2003), leading to a downward deviation from firms' optimal investment level. Third, it has been recognized that a moderate level of optimism motivates managers to achieve optimal investment levels, while optimism below the internal optimum could cause under-investment (Campbell *et al.* 2011; Pikulina *et al.* 2017).

Previous literature provides two primary explanations for corporate over-investment. First, agency-theory-based literature assumes that managers always make an accurate assessment of the intrinsic value of investment opportunities. But, to derive private benefits, they may deliberately over-invest at the expense of shareholders if firms have additional resources to invest (Jensen & Meckling 1976; Morck *et al.* 1990; Lang *et al.* 1991; Richardson 2006). For instance, Jensen (1986) argues that managers prefer large-scale projects to profitable ones because they will enjoy more perquisites as a

result of firm expansion. Blanchard *et al.* (1994) discuss that firms that receive cash windfalls strive to keep the resources inside the firms in pursuit of long-term survival, and thus could invest the cash in unattractive projects to avoid giving it up. Second, managerial overconfidence, as a behavioral trait, can lead to over-investment. Overconfidence refers to the tendency for individuals to over-estimate their abilities and chances for success while under-estimating potential risks. Prior literature in finance suggests that senior executives as a group are subject to overconfidence bias, which affects their investment decisions. Roll (1986) first introduced the notion of overconfidence to corporate takeovers as an explanation for the phenomenon of bidding firms overpaying for targets. Further evidence provided by Hayward and Hambrick (1997) and Malmendier and Tate (2008) reveals that the premiums paid for targets are positively associated with CEO overconfidence, and that overconfidence distorts CEOs' investment decision-making and drives them to undertake acquisitions that turn out to destroy shareholder value. Campbell *et al.* (2011) broaden prior acquisition-centric studies to general types of investment and show that CEO overconfidence gives rise to over-investment.

### 2.2. Media and investment efficiency

The above discussions indicate that investment efficiency can be improved by enhanced information transparency. Various factors influence firms' information environments. The first is financial reporting quality (FRQ). Evidence suggests that high-quality financial reporting contributes to information transparency and results in higher investment efficiency. For instance, Biddle *et al.* (2009) find that FRQ is negatively associated with both under- and over-investment, based on a sample of U.S. public companies. Chen *et al.* (2011) extend this study to private firms in emerging markets and report a similar association between FRQ and investment efficiency. In addition, Cheng *et al.* (2013) document an improvement in investment efficiency in U.S. firms after they address financial reporting problems subsequent to disclosure of internal control weaknesses. Firm-level information transparency is also affected by private information acquisition and interpretation of outside market participants, such as institutional investors and financial analysts. For example, institutional investors are found to improve firms' disclosure quality (Shleifer & Vishny 1997) and increase investment efficiency (Cao *et al.* 2020). Relying on an international sample, Chen *et al.* (2017a) show that foreign ownership in privatized firms

is positively associated with investment efficiency. Moreover, Chen *et al.* (2017b) document that high-quality analyst forecasts improve firms' investment efficiency. Choi *et al.* (2020) find that firms that receive analysts' capital expenditure forecasts are associated with better investment efficiency.

Notwithstanding the existing evidence from institutional investors and financial analysts, the media, as an integral information intermediary of the society and economy, is largely overlooked by previous studies on investment efficiency. To date, a large body of literature has documented profound impacts of the media on various corporate decisions and outcomes, such as mergers and acquisitions (Ahern & Sosyura 2014, 2015; Yang *et al.* 2019), corporate innovation (Dai *et al.* 2021), cost of equity (Fang & Peress 2009), cost of debt (Gao *et al.* 2020), forced CEO turnover (You *et al.* 2018), accounting fraud (Miller 2006), and insider trading profitability (Dai *et al.* 2015). Our paper links the media to efficiency of corporate investment and examines how media coverage shapes investment efficiency.

Our first hypothesis is that media coverage enhances investment efficiency by reducing the magnitude of both under- and over-investment. The media plays two types of roles in financial markets. First, by serving as an information intermediary between firms and outsiders, the media enables investors to access information about firms' current conditions and future prospects. According to Mullainathan and Shleifer (2005), reader heterogeneity helps improve the accuracy of disseminated news more than peer competition in the media sector, suggesting that investors' demand for information forces news providers to deliver accurate information. A growing body of literature has shown that the media plays a crucial information intermediary role in financial markets. Dyck and Zingales (2003) examine stock price reactions to announcements of two types of earnings and find that whether stock prices are more sensitive to GAAP earnings or "street" earnings depends on which measure is reported first in the media. Fang and Peress (2009) document that stocks with higher media coverage earn significantly lower returns in the cross-section, consistent with the view that the media's broad dissemination of information broadens investor recognition and reduces investors' demand for compensation for holding the stocks. Bushee *et al.* (2010) show that greater media coverage during earnings announcement periods is associated with lower bid-ask spreads and higher market depth, suggesting reduced information asymmetry around earnings announcements as a result of media

coverage. More recently, Chen *et al.* (2020) show that higher media coverage prior to initial public offerings leads to lower IPO initial returns. We expect that intensive media coverage communicates firms' inside information to outside investors and narrows information asymmetry faced by investors. This increases investors' willingness to offer capital at reasonable prices to those firms with profitable investment opportunities, leading to less under-investment by the firms.

Second, the media serves as an external monitoring mechanism for corporations. The media capturing and analyzing information of a firm allows managerial opportunism and irregularities to be discovered and exposed to the public, which facilitates corporate governance improvements and lessens agency conflicts. For example, Dyck *et al.* (2008) find that media coverage of corporate governance violations in the Anglo-American press forces firms to take corrective action, because negative news coverage about these violations damages the reputation of both managers and their firms. Liu and McConnell (2013) argue that managers risk reputational capital when making corporate capital allocation decisions, so that they are likely to abandon value-destroying acquisition attempts when these acquisitions are intensively and negatively reported by the media. A body of literature (e.g., Diamond 1989; Gomes 2000; Cao *et al.* 2015) documents that a manager's (or a firm's) reputation in financial markets determines the cost of raising capital in financial markets, which in turn impacts the firm's profitability and its ability to exploit future investment opportunities. Managers concerned about their reputation have a strong motivation to make efficient investments. In addition, Joe *et al.* (2009) show that media coverage of board ineffectiveness improves board quality and shareholder value; for example, by replacing incompetent CEOs or board chairs and by appointing outsiders as board members. It is reasonable to expect that managers' poor investment decisions, if uncovered by the media, will increase their propensity to be dismissed (You *et al.* 2018), giving them a strong incentive to reduce the magnitude of both under- and over-investment. Taken together, we formulate our hypotheses as follows:

***Hypothesis 1:*** *Media coverage is negatively associated with under-investment.*

***Hypothesis 2a:*** *Media coverage is negatively associated with over-investment.*

However, there exists the possibility that media coverage exacerbates over-investment due to media-induced celebrity culture and managerial overconfidence. The media's intensive exposure of corporations can make their CEOs become public figures and cultivate the CEOs' celebrity-type self-perception. Malmendier and Tate (2009) find that "superstar" CEOs who receive broad media coverage subsequently underperform, which suggests that the CEOs' media-induced celebrity status distorts their behavior. Public visibility following intensive media coverage could trigger managerial overconfidence. Kubick and Lockhart (2017) exploit media awards as a shock to CEO overconfidence and find that media-induced CEO overconfidence engenders aggressive corporate tax policies. Hayward and Hambrick (1997) find that CEOs praised by the media are prone to overbid for acquisition targets. A logical expectation would be that media coverage leads managers to under-estimate potential risks but over-estimate their ability to select good investment projects and generate returns—that is, to become overconfident. CEOs affected by overconfidence tend to make excess investments that are value-diminishing *ex-post* (Goel & Thakor 2008; Campbell *et al.* 2011). Thus, we conjecture that media coverage fosters managerial overconfidence, which in turn increases the magnitude of over-investment. We propose the below alternative hypothesis:

***Hypothesis 2b:*** *Media coverage is positively associated with over-investment.*

## 3. Research design and sample selection

### 3.1. Measurement of investment efficiency

According to Biddle *et al.* (2009), firm-specific inefficient investment is measured as the deviation of actual investment from the expected level of investment. We estimate expected investment as a function of sales growth using the following model:

$$Investment_{i,t+1} = \beta_0 + \beta_1 Sales\ Growth_{i,t} + \varepsilon_{i,t+1} \qquad (1)$$

where $Investment_{i,t+1}$ is the total investment for firm $i$ in year $t$+1, calculated as the sum of R&D expenditure,[1] capital expenditure, and acquisition expenditure less cash receipts from sale of property, plant, and equipment, scaled by lagged total assets, then times 100. $Sales\ Growth_{i,t}$ is the annual sales growth rate for firm $i$ from year $t$-1 to year $t$. The residual term $\varepsilon_{i,t+1}$ is the investment that is not explained by growth opportunities, and thus represents the magnitude of inefficient investment.

We estimate Eq. (1) annually for each industry based on the Fama and French 48-industry classification and require at least 20 observations to be available in an industry-year for estimation. We extract the residuals from the regression estimates and separate under-investing and over-investing firm-years based on whether the residual is negative or positive. Specifically, a negative (positive) $\varepsilon_{i,t+1}$ signifies under-investment (over-investment). Two variables are created as measures of investment inefficiency. $Inv\_Under$ quantifies the magnitude of under-investment and is set to the absolute value of the negative residuals. $Inv\_Over$ gauges the magnitude of over-investment and equals the positive residuals. A higher value of $Inv\_Under$ or $Inv\_Over$ is associated with a higher degree of investment inefficiency.

### 3.2. Model specification

Following Bae *et al.* (2017), Choi *et al.* (2020), and Gomariz and Ballesta (2014), we examine the effect of media coverage on investment (in)efficiency by estimating the following regression model:

$$Inv\_Ineff_{i,t+1} = \beta_0 + \beta_1 Media\ Coverage_{i,t} + \sum \beta_j\ Control_{j,i,t} + \varepsilon_{i,t+1} \qquad (2)$$

where $i$ indexes firm and $t$ indexes year. $Inv\_Ineff$ denotes the magnitude of under-investment ($Inv\_Under$) or over-investment ($Inv\_Over$). All the independent variables are lagged by one year relative to the dependent variable in order to mitigate reverse causality bias. The key explanatory variable $Media\ Coverage_{i,t}$ is defined as the natural logarithm of one plus the number of news articles released on firm $i$ in year $t$.[2] The regression model includes industry dummies based on the

[1] We set R&D expenditure to zero if it is missing in Compustat.

[2] We set the number of news articles to zero if a firm that has ever been recorded in RavenPack has no news release in a given year.

Fama and French 48-industry classifications and year dummies to control for industry-wide and yearly fluctuations in investment inefficiency, respectively. The regression model is estimated using OLS regressions with robust standard errors corrected for heteroskedasticity and firm-level clustering (Petersen 2009). The coefficient estimate ($\beta_1$) reflects the extent to which media coverage is associated with under- or over-investment.

Consistent with the existing literature (e.g., Biddle *et al.* 2009; Gomariz & Ballesta 2014; Choi *et al.* 2020), we include a battery of firm-level control variables in the regression model. First, we control for the volatility of cash flow from operations ($\sigma(CFO)$) and the volatility of sales ($\sigma(Sales)$) over the past five years as proxies for operating volatilities. Second, to ensure that our results do not simply reflect a relation between investment inefficiency and investment volatility, we control for the volatility of investment ($\sigma(Investment)$). Third, as firms in different stages of the business cycle may have different investment strategies, we include firm age ($Age$), length of operating cycle ($Operating\_Cycle$), and profitability ($ROA$) to account for firms' stages in the business cycle. Fourth, we add two corporate governance control variables. Gompers *et al.* (2003) develop a G-index to proxy for the number of anti-takeover provisions. A firm with a higher score of G-index is associated with more anti-takeover provisions that restrict shareholder rights but strengthen managerial entrenchment. Because the G-index provided by Gompers *et al.* (2003) is available for the years leading up to 2006, we follow the steps adopted by Kieschnick and Moussawi (2018) to update the G-index.[3] We multiply the updated G-index by -1 to create a variable $Neg\_Gscore$, which reflects stronger corporate governance. Since the G-index is missing for 66% of our firm-year sample, we follow the procedure implemented by Biddle *et al.* (2009), who set missing G-index to zero and include a dummy indicator ($G\_dummy$) that equals one if the G-index is missing in a firm-year, and zero otherwise. In addition, we include institutional blockholding ($Institutions$) to control for institutional blockholders'

[3] Our updated G-index is highly correlated with the original G-index provided by Gompers *et al.* (2003), with a correlation coefficient of 0.8391.

oversight.[4] Fifth, analyst coverage ($Analysts$) controls for the degree of a firm's information transparency as a result of financial analysts' investigation and analysis. Lastly, we control for a range of firm characteristics that are commonly used as control variables in investment efficiency literature, including firm size ($Size$), market-to-book ratio ($MB$), financial health ($Z\_Score$), tangibility ratio ($Tangibility$), firm-level leverage ($K\_Structure$), industry-level leverage ($Ind.K\_Structure$), ratio of cash flow to sales ($CFO/Sale$), ratio of cash to property, plant, and equipment ($Slack$), and dividend payout ($Dividend$). All the variable definitions are summarized in Appendix A.

### 3.3. Sample selection

We collect media news data from RavenPack—a leading global news analytics database widely used in accounting and finance literature (e.g., Dai *et al.* 2015; Chen *et al.* 2020; Dai *et al.* 2021). RavenPack gathers and tracks news articles about more than 180,000 entities across over 200 countries starting from 2000, covering more than 98% of investable global markets. RavenPack sources real-time, firm-specific news from a wide range of publishers and web aggregators, including Dow Jones Newswires, Wall Street Journal, Barron's, MarketWatch, MT Newswires, industry and business publications, regional and local newspapers, government and regulatory updates, and other press release distribution networks. RavenPack constructs a news relevance score, which enables us to assess the relevance of news articles to a specific firm. Following Dai *et al.* (2015), we restrict our analysis to news articles that have a relevance score of 100, representing news most relevant to the given firm.

We obtain financial statement data from Compustat, stock price data from CRSP, analyst coverage from I/B/E/S, institutional ownership from Thomson Reuters Institutional (13f) Holdings, and anti-takeover provisions from the Institutional Shareholder Services (ISS) Governance database. We exclude financial firms (SIC codes 6000-6999) due to their distinct nature of investment and different financial account structure. To mitigate the distortion of outliers, we winsorize all continuous variables at the 1% and 99% levels. After combining different data sets and removing missing observations, we

[4] An institutional blockholder is an institutional investor who owns at least 5% of the firm's shares outstanding. We use institutional blockholding rather than institutional shareholding because institutions with minor stakes may not have sufficient incentive to monitor.

are left with a sample of 30,281 firm-years from 4,686 U.S. firms over the period from 2001 to 2018 in the baseline sample.[5]

## 4. Main results

### 4.1. Descriptive statistics

Panel A of Table 1 reports the descriptive statistics of our main variables. $Inv\_Ineff$ is the absolute value of investment inefficiency in the full sample, without dividing firm-years into the under- and over-investing groups. $Inv\_Under$ and $Inv\_Over$ report the magnitude of investment inefficiency in the separate groups. The mean value of $Inv\_Under$ ($Inv\_Over$) reflects that the level of under-investment (over-investment) on average represents 9.6297% (15.8940%) of the previous year's assets, comparable to the statistics reported in Chen *et al.* (2011). Our sample firms have an average log-transformed media coverage of 4.4921, which is approximately equivalent to 88 news articles released in a firm-year. The descriptive statistics of our control variables are generally consistent with those reported in Biddle *et al.* (2009) and García Lara *et al.* (2016).

*[Insert Table 1 here]*

Panel B of Table 1 reports univariate test results. We partition each of the under- and over-investment samples into two sub-samples based on the median value of $Media\ Coverage$ within the respective sample in a given year. In the under-investment sample, the mean value of $Inv\_Under$ in the $High\ Media\ Coverage$ group is significantly lower than the mean in the $Low\ Media\ Coverage$ group, suggesting a negative relation between media coverage and under-investment, consistent with *Hypothesis 1*. In the over-investment sample, the mean value of $Inv\_Over$ in the $High\ Media\ Coverage$ group is significantly higher than the mean in the $Low\ Media\ Coverage$ group. This provides some indication that media coverage exacerbates over-investment, lending support to *Hypothesis 2b*.

[5] Our media coverage data from RavenPack span from 2000 to 2017. As media coverage is lagged by one year relative to the dependent variable of investment efficiency, our sample period is from 2001 to 2018.

Panel C of Table 1 reports the Pearson correlation coefficients between our main variables in the under-investment sample (the bottom-left half of the matrix) and over-investment sample (the top-right half of the matrix). In the under-investment sample, $Media\ Coverage$ is negatively correlated with $Inv\_Under$, consistent with *Hypothesis 1*. In the over-investment sample, the correlation between $Media\ Coverage$ and $Inv\_Over$ is negative, seemingly supporting *Hypothesis 2a*. However, our untabulated results[6] show that this negative correlation is driven by the high correlation between $Media\ Coverage$ and $Size$ (correlation coefficient = 0.46). The existing literature documents a negative association between firm size and over-investment (e.g., Biddle *et al.* 2009; Bae *et al.* 2017). Without isolating the effect of firm size, the correlation between media coverage and over-investment may pick up some of the relation between firm size and over-investment. Thus, we proceed to carry out a multivariate regression analysis.

### 4.2. Baseline regression results

In Table 2, we present the OLS regression results for the relation between media coverage and investment (in)efficiency. In column 1, we find that $Media\ Coverage$ is negatively and statistically associated with the magnitude of under-investment, lending support to *Hypothesis 1* that intensive media exposure attenuates under-investment. In column 2, we observe a significant and positive impact of media coverage on the magnitude of over-investment, which suggests that media coverage aggravates the intensity of over-investment, supporting *Hypothesis 2b*. Because media coverage has countervailing effects on under-investment and over-investment, the overall effect of media coverage on the absolute value of investment inefficiency ($Inv\_Ineff$) in the full sample is statistically insignificant, as shown in column 3.

*[Insert Table 2 here]*

[6] If we regress $Inv\_Over$ on $Media\ Coverage$ without additional covariates, we observe a negative coefficient on $Media\ Coverage$, consistent with the inference drawn from the correlation. We then include $Size$ as an additional explanatory variable for $Inv\_Over$. We find that the sign of the coefficient of $Media\ Coverage$ flips and becomes significantly positive, while the coefficient of $Size$ is negative and statistically significant, as expected.

For corporate governance control variables, we find $Neg\_Gscore$ and $Institutions$ to be negatively associated with the degree of both under-investment and over-investment, implying that strong corporate governance curbs inefficient investment, consistent with findings in previous literature (Chen *et al.* 2017a; Cao *et al.* 2020; Choi *et al.* 2020). $Analysts$ is shown to reduce both under-investment and over-investment, indicating that firms with higher analyst following have better investment efficiency, in alignment with the implication of Chen *et al.* (2017b). Our results on the other control variables are generally consistent with the existing literature (Gomariz & Ballesta 2014; Bae *et al.* 2017; Choi *et al.* 2020). First, sales volatility captured by $\sigma(Sales)$ significantly increases under-investment, and investment volatility proxied by $\sigma(Investment)$ exacerbates over-investment. These results suggest that operating uncertainty worsens investment inefficiency. Second, a firm's stage in the business cycle and the operating performance in the related stage influence investment efficiency. We find that a firm's longer operating cycle ($Operating\_Cycle$) increases under-investment but decreases over-investment, and that higher operating profitability ($ROA$) attenuates under-investment but aggravates over-investment. Lastly, we show that several firm characteristics, such as larger scale ($Size$), lower growth potential ($MB$), and higher leverage ($K\_Structure$), are associated with higher under-investment and lower over-investment.

### 4.3. Endogeneity tests

The observed impact of media coverage on investment efficiency may be subject to endogeneity bias. For example, some news providers intend to publish sensational news. Firms with unique investment characteristics (e.g., rapid expansion) attract attention from these news providers. This section addresses endogeneity problems by using firm-fixed effects and an instrumental variable approach.

#### 4.3.1. Firm-fixed effect estimation

In Table 3, we augment the baseline OLS regression model with firm-fixed effects in order to mitigate the omitted variable bias associated with time-invariant unobserved factors, such as corporate culture shaping corporate investment decisions (Pan *et al.* 2020). The results suggest a significantly

negative (positive) effect of media coverage on under-investment (over-investment), which reinforces our baseline findings. However, firm-fixed effects cannot address the omitted variable bias associated with time-varying factors. Thus, the results based on firm-fixed effects should be interpreted with caution.

*[Insert Table 3 here]*

**4.3.2. Instrumental variable approach**

To further mitigate endogeneity concerns, we employ an instrumental variable (IV) for media coverage. Following Dai *et al.* (2015) and Chen *et al.* (2020), we instrument media coverage using the geographic proximity of a firm's headquarters to the closest Dow Jones branch. Dow Jones is a major business news provider in the U.S. The instrument, $Distance\_DJ$, is calculated as the minimum distance measured in increments of 100 km between a firm's headquarters and the nearest Dow Jones branch.[7] Gurun and Butler (2012) suggest that the proximity of corporations to media outlets influences the number of news articles reported. Specifically, a firm receives less media coverage if its headquarters are farther away from media outlets, because it is more costly (e.g., time and transportation costs) for media reporters to track and report on a distant firm. In addition, there is no direct evidence that a firm's geographic distance to Dow Jones branches would affect its investment policy.

In Panel A of Table 4, columns 1 and 2 report the 2SLS regressions of $Inv\_Under$ on $Media\ Coverage$ and control variables in the under-investment sample. In column 1, the first-stage regression result reports a significantly negative coefficient on $Distance\_DJ$, indicating that firms that are more distant from Dow Jones branches receive less media coverage. The weak instrument diagnostic test is placed at the bottom of the panel. The Kleibergen-Paap rk LM Wald *F*-statistic exceeds the Stock-Yogo critical value at the 5% significance level, which provides us with confidence that the instrument

[7] We obtain each firm's headquarters' and Dow Jones branches' zip codes with latitude and longitude data from the U.S. Census Bureau's Gazetteer Place and Zip Code database. We then calculate the distance using the "geodist" command in Stata.

is not weak. In column 2, the *instrumented* media coverage significantly reduces under-investment, consistent with our previous results.

*[Insert Table 4 here]*

There is a concern that firms located close to Dow Jones branches may have fundamentally different characteristics from firms located far away from the branches. These differences in firm characteristics may influence the firms' investment efficiency through channels other than media coverage. To mitigate the endogeneity bias associated with differences in observed characteristics between firms with high and low distance to Dow Jones branches, we use the propensity score matching (PSM) technique. In the under-investment sample, we define a dummy variable $Distance\_Dummy$, which equals one if $Distance\_DJ$ is above the sample's median, and zero otherwise. We then classify each firm-year into either the treatment ($Distance\_Dummy$ = 1) or control ($Distance\_Dummy$ = 0) group. To estimate the propensity score of each observation being treated, we estimate a probit model that regresses $Distance\_Dummy$ on the control variables included in Eq. (2). Using the propensity scores, we perform one-to-one nearest neighbor matching without replacement, with a caliper distance set to 0.25 times the standard deviation of the estimated propensity scores (Rosenbaum & Rubin 1985). As shown in Panel A of Appendix B, none of the mean values of firm characteristics are significantly different between the matched high- and low-distance firms. Using the matched sample, we re-run the 2SLS regressions and report the results in columns 3 and 4 in Panel A of Table 4. Our inferences remain similar.

Geographic proximity to media outlets may be correlated with other geographic factors that could influence corporate investment. For example, firms located near a media outlet may be close to technology centers (e.g., Silicon Valley) and thus have different investment efficiencies, and at the same time have hot products that garner great media attention.[8] To control for time-invariant unobserved geographic factors, we augment the 2SLS regressions in the matched sample with the addition of city-fixed effects and report the results in columns 5 and 6 of Panel A. The findings do not change. In

[8] We thank the editor for proposing this argument.

columns 7 and 8 of Panel A, we add additional controls for time-varying macro-socioeconomic factors in different geographic regions through a series of state-level variables: (1) we control for different customer base using annual employment growth ($GEmployment$), annual wage growth ($GWages$), and annual consumer consumption expenditure growth ($GConsumption$), sourced from the Bureau of Labor Statistics and the Bureau of Economic Analysis; (2) to measure population size and composition, we use annual population growth ($GPopulation$), log-transformed total population ($Population$), the proportion of the population aged 65 years and over ($Aged\_65$), and the proportion of women in the population ($Female$), collected from the Census Bureau; and (3) to represent broader macroeconomic factors, we control for GDP growth ($GGDP$) and log-transformed GDP per capita ($GDP\_Capita$), collected from the Bureau of Economic Analysis. After including these macro-socioeconomic controls in columns 7 and 8, our findings are still valid. Collectively, our results suggest that media coverage attenuates the intensity of under-investment.

In Panel B of Table 4, we repeat the above analysis for the over-investment sample. In column 1, the negative and significant coefficient on $Distance\_DJ$ in the first-stage result suggests that firms that are more distant from Dow Jones branches receive less media coverage. The Kleibergen-Paap rk LM Wald *F*-statistic reported at the bottom of the panel indicates that the instrument is not weak. The second-stage result presented in column 2 shows that the *instrumented* media coverage significantly increases the magnitude of over-investment. We then carry out PSM to match observed characteristics between high- and low-distance firms in the over-investment sample. The statistics reported in Panel B of Appendix B show that the two groups of firms share similar firm-level characteristics after matching. Using the matched sample, we perform further analysis in Panel B of Table 4. Columns 3 and 4 report the 2SLS regression results from the matched sample, columns 5 and 6 further include city-fixed effects, and columns 7 and 8 include additional time-varying macro-socioeconomic state-level control variables. The empirical results point to a uniform conclusion that media coverage aggravates over-investment.

### 4.4. Robustness tests

#### 4.4.1. Alternative regression model

Following Biddle *et al.* (2009), we use a multinomial logit model and create a categorical dependent variable $Inv\_Group$, which is set equal to one for the under-investment group, two for the benchmark normal investment group, and three for the over-investment group. We form the three groups by sorting residuals in Eq. (1) annually into quartiles: the under-investment group for residuals in the bottom quartile, the over-investment group for residuals in the top quartile, and the benchmark group for residuals in the middle two quartiles. The multinomial logit model tests the likelihood of a firm falling into the under-/over-investment group as opposed to the benchmark normal investment group and is specified as follows:

$$Inv\_Group_{i,t+1} = \beta_0 + \beta_1 Media\ Coverage_{i,t} + \sum \beta_j\ Control_{j,i,t} + \varepsilon_{i,t+1} \qquad (3)$$

where $i$ indexes firm and $t$ indexes year. As shown in Panel A of Table 5, the coefficient of $Media\ Coverage$ in column 1 is negative and statistically significant, indicating that firms with higher media coverage are less likely to under-invest. The positive and significant coefficient of $Media\ Coverage$ in column 2 suggests that media coverage increases firms' propensity to over-invest. Overall, our conclusion is unchanged when using the multinomial logit model.

*[Insert Table 5 here]*

**4.4.2. Alternative models to derive deviations from expected investment**

We apply alternative estimation models to compute the deviation of actual investment from expected investment. First, as accounting and finance literature often employs asset growth and Tobin's Q as proxies for growth opportunities (Hubbard 1998; McNichols & Stubben 2008), we use each of them as a substitute for $Sales\ Growth$ in Eq. (1). Second, Chen *et al.* (2011) suggest that the relation between investment and sales growth could differ between sales decrease and sales increase. We augment Eq. (1) with the product of $Sales\ Growth$ and a dummy indicator $Negative$ that equals one for negative sales growth and zero otherwise.[9] We extract the residuals from an annual regression of the above models and re-calculate the continuous dependent variables $Inv\_Under$ and $Inv\_Over$.

[9] The augmented model is specified as: $Investment_{i,t+1} = \beta_0 + \beta_1 Sales\ Growth_{i,t} + \beta_2 Negative_{i,t} + \beta_3 Sales\ Growth_{i,t} \times Negative_{i,t} + \varepsilon_{i,t+1}$.

Using these variables, we re-run the baseline OLS regressions and draw similar inferences, as shown in Panel B of Table 5.

#### 4.4.3. Alternative samples

We estimate the baseline regression model in Eq. (2) using three alternative samples. First, to ensure that our results are not distorted by firms that are barely followed by news providers, we exclude 798 firm-year observations with zero media coverage and re-estimate the baseline OLS regressions. Second, we drop the firm-year observations spanning the 2008-2009 financial crisis to eliminate the distortion to corporate investment introduced by the extreme capital market turbulence during that period. Third, in the baseline regressions, we use zero for missing values in the G-index. As a robustness test, we exclude these missing observations and re-estimate the regressions after dropping the control variable of $G\_dummy$. As presented in Panel C of Table 5, our findings are still valid.

## 5. Moderation and mediation analyses

### 5.1. The moderating effect of information asymmetry and corporate governance

Thus far, we have documented a negative impact of media coverage on under-investment, consistent with the predictions from the media's information intermediary role and watchdog role. According to the first role, the media serves as an information intermediary disseminating firm-specific information to the public, reducing information asymmetry faced by outside investors (Bushee *et al.* 2010; Peress 2014). This increases investors' willingness to offer capital at reasonable prices to firms possessing profitable investment opportunities, leading to less under-investment. Therefore, we expect that the negative impact of media coverage on under-investment is more pronounced for firms facing greater information asymmetry with outside investors. The watchdog role argues that the media disciplines managerial actions and improves corporate governance by discovering and revealing managerial opportunism and irregularities to the public (Miller 2006; Dyck *et al.* 2008; Joe *et al.* 2009). Due to the strengthened external monitoring from the media, risk-averse managers are motivated to

pursue shareholders' interests and undertake profitable investment projects,[10] leading to less under-investment. If the media acts as a watchdog, we expect media coverage to reduce under-investment to a greater extent for firms with poorer corporate governance.

We employ analyst following ($Analysts$) and earnings opacity ($Opacity\_DD$) as measures of information asymmetry. $Analysts$ is the number of analysts following a firm. Evidence suggests that firms with higher analyst coverage are associated with lower information asymmetry (Lang & Lundholm 1996; Bowen *et al.* 2008). $Opacity\_DD$ is a measure of accrual quality, calculated as the absolute value of residuals from an annual cross-sectional regression within an industry that models the extent to which a firm's working capital accruals map into its operating cash flow realizations (Dechow & Dichev 2002). A higher value of $Opacity\_DD$ reflects poorer information quality in the firm's financial statements (Bhattacharya *et al.* 2013).

To proxy for corporate governance quality, we rely on the negative of the updated G-index ($Neg\_Gscore$). A higher value of $Neg\_Gscore$ reflects stronger shareholder rights. For this cross-sectional test, we delete firm-years with missing G-index, instead of assigning a value of zero for these observations. Accordingly, we drop the control variable $G\_dummy$ that is included in the baseline regression model to indicate the observations for which missing G-index is replaced by zero. As an additional proxy for corporate governance, $Outdir$ is defined as the proportion of independent directors on the board. A board with greater representation of independent directors is more effective at monitoring management (Dey 2008). $Big4$ is a dummy variable equal to one if a firm is audited by a Big 4 auditor, and zero otherwise. External auditors are an independent monitoring device to reduce agency conflicts between managers and outsiders through verification of managers' reported accounting numbers (Allee & Wangerin 2018), which helps to discover and reveal managers' breaches of contract

[10] We find that media coverage also alters the impact of equity-based compensation on investment efficiency. Equity-based compensation incentivizes risk-averse managers to undertake riskier investment projects (e.g., Coles *et al.* 2006; Low 2009). In Appendix C, we use $EquityComp_{CEO}$ to proxy for a CEO's equity-based compensation and $EquityComp_{executives}$ to proxy for the average equity-based compensation of all senior executives in a firm. We find that equity-based compensation itself reduces under-investment but increases over-investment. These effects are weakened by media coverage. Media coverage exposes managers' opportunistic or overly risky investment strategies to public attention and scrutiny, and thus offsets the effects of equity-based compensation.

or violations of generally accepted accounting principles (Chen *et al.* 2000). Previous literature suggests that audit quality is positively associated with auditor size (DeAngelo 1981; Teoh & Wong 1993). Thus, the presence of $Big4$ auditors indicates better monitoring from external auditors.

Panel A of Table 6 reports the moderating effect of information asymmetry on the relation between media coverage and investment efficiency. We find that lower information asymmetry as proxied by higher analyst following ($Analysts$) in column 1 and lower earnings opacity ($Opacity\_DD$) in column 3 is associated with less under-investment. Turning to the interaction terms $Media\ Coverage \times Analysts$ and $Media\ Coverage \times Opacity\_DD$ in columns 1 and 3, the results show that media coverage has a larger negative impact on under-investment for firms facing greater information asymmetry (lower $Analysts$ in column 1 and higher $Opacity\_DD$ in column 3). In columns 2 and 4, we find no evidence of the interaction terms affecting over-investment. In Panel B, we use corporate governance proxies as a moderator. We find that stronger shareholder rights ($Neg\_Gscore$) in column 1, higher board independence ($Outdir$) in column 3, and the presence of Big 4 auditors ($Big4$) in column 5 significantly reduce under-investment. The coefficients of the interaction terms $Media\ Coverage \times Neg\_Gscore$, $Media\ Coverage \times Outdir$, and $Media\ Coverage \times Big4$ in columns 1, 3, and 5 are positive and significant, suggesting that media coverage has a smaller effect on reducing under-investment for firms with stronger corporate governance. In columns 2, 4, and 6, the interactions do not significantly affect over-investment. Jointly, our results demonstrate that information asymmetry and corporate governance are two moderators to the relation between media coverage and under-investment, but not over-investment.

*[Insert Table 6 here]*

**5.2. The mediating effect of overconfidence**

Our results have shown that media coverage aggravates over-investment, lending credence to *Hypothesis 2b*. Existing evidence suggests that media coverage can fuel celebrity culture and induce CEO overconfidence (Hayward & Hambrick 1997). Overconfident CEOs tend to over-estimate their ability to pick profitable investment projects but under-estimate the risks involved in these projects

(Malmendier & Tate 2005, 2008). As such, overconfident CEOs tend to over-invest (Goel & Thakor 2008; Campbell *et al.* 2011). To validate the above reasoning, we assess a chain of relations, where media coverage (i.e., the source variable) affects CEO overconfidence (i.e., the mediator), which in turn affects the magnitude of over-investment (i.e., the outcome variable).

Following Hammersley (2006), Lang *et al.* (2012), and Deng *et al.* (2018), we carry out a mediation analysis by specifying the following three OLS regression models:

$$OverConfidence_{i,t} = \alpha_0 + \alpha_1 Media\ Coverage_{i,t} + \sum \alpha_j\ Control_{j,i,t} + \varepsilon_{i,t} \quad (4)$$

$$Inv\_Ineff_{i,t+1} = \beta_0 + \beta_1 Media\ Coverage_{i,t} + \sum \beta_j\ Control_{j,i,t} + \varepsilon_{i,t+1} \quad (5)$$

$$Inv\_Ineff_{i,t+1} = \gamma_0 + \gamma_1 Media\ Coverage_{i,t} + \gamma_2 OverConfidence_{i,t} + \sum \gamma_j\ Control_{j,i,t} + \varepsilon_{i,t+1} \quad (6)$$

where $OverConfidence$ denotes CEO overconfidence, and $Inv\_Ineff$ represents the magnitude of under-investment ($Inv\_Under$) or over-investment ($Inv\_Over$). Eq. (4) tests whether the source variable ($Media\ Coverage$) significantly affects the mediator ($OverConfidence$). Eq. (5) models the effect of $Media\ Coverage$ on $Inv\_Ineff$ without the inclusion of the mediator but using the restricted sample that excludes missing observations of $OverConfidence$. Eq. (6) augments Eq. (5) with the inclusion of the mediator ($OverConfidence$) and tests whether the mediator significantly affects the outcome variable ($Inv\_Ineff$). If $\alpha_1$ in Eq. (4) and $\gamma_2$ in Eq. (6) are statistically significant, that suggests CEO overconfidence mediates the effect of media coverage on investment inefficiency.

We measure $OverConfidence$ using two continuous variables constructed based on CEOs' stock option exercises and stock purchases. $Confidence$ describes the moneyness of a CEO's vested stock options. If a CEO chooses to hold deep in-the-money stock options after the vesting period, this signals the CEO's confidence about the firm's prospects. Following Banerjee *et al.* (2015), we calculate the value per in-the-money option by dividing the value of all unexercised exercisable options by the number of options. We then scale the value per option by the stock price at the end of the fiscal year. The other overconfidence measure is the CEO's net purchase of the firm's equity shares ($NetBuy$) (Malmendier & Tate 2005), calculated as the natural logarithm of the number of shares purchased less

the number of shares sold by the firm's CEO. Higher values of $Confidence$ and $NetBuy$ are associated with greater CEO overconfidence.

Panel A of Table 7 presents the mediation analysis results using the option-based CEO overconfidence measure ($Confidence$) as the mediator. In columns 1 and 4, we find that media coverage significantly increases CEO overconfidence, consistent with our expectation. Column 3 augments the model in column 2 with the addition of CEO overconfidence ($Confidence$) and shows no evidence that CEO overconfidence mediates the effect of media coverage on under-investment. Moving to column 6, we observe a positive and significant impact of $Confidence$ on over-investment, consistent with the notion that overconfident CEOs tend to over-invest (Campbell *et al.* 2011). This result also suggests that CEO overconfidence is the mediator through which media coverage exacerbates over-investment. To gauge the size of the effect via the mediator, we decompose the total effect of media coverage on over-investment (the coefficient of 0.7726 reported in column 5) into the direct effect and the indirect effect. The magnitude of media coverage's direct effect is the coefficient of 0.6120 reported in column 6. The size of media coverage's indirect effect via the mediator ($Confidence$) is 0.1606 (= 0.0295*5.4447, where 0.0295 is the coefficient of $Media\ Coverage$ reported in column 4, and 5.4447 is the coefficient of $Confidence$ reported in column 6). The indirect effect via the mediator accounts for 20.787% (= 0.1606/0.7726) of the total effect and is statistically significant at the 1% level according to the Sobel (1982) test reported at the bottom of the panel. In Panel B of Table 7, we repeat the mediation analysis using CEOs' net purchases of the firms' shares ($NetBuy$) as a measure of CEO overconfidence. Our inferences are unchanged. Taken together, our results suggest that media coverage amplifies CEO overconfidence, which in turn increases over-investment.

*[Insert Table 7 here]*

## 6. Additional analyses

### 6.1. News category, news sentiment, and investment efficiency

In a similar vein to Dai *et al.* (2015), we study whether the media's impact on investment efficiency is restricted to investment-related news. We disentangle investment-related news from other categories of news using RavenPack's proprietary event taxonomy that provides six detailed elements for labeling news articles.[11] We select news items tagged under the "business" macro-category and identify three sub-categories as being directly related to investment: (1) the "acquisitions-mergers" group with "acquirer" property; (2) the "assets" group as related to transactions of capital assets, establishment or closing of facilities, and patent filing; and (3) the "equity-actions" group with "capex," "capex-guidance," or "investment" types. We define $Media\ Coverage_{inv}$ as the natural logarithm of one plus the number of investment-related news articles. $Media\ Coverage_{noninv}$ is constructed analogously for news articles that are not directly related to investment.

News articles reporting on firms' different types of policies or events occurring within a year may convey different sentiments. Prior literature suggests that news sentiment captures the tone of news content and communicates incremental information to financial market participants beyond the breadth of news coverage (e.g., Tetlock *et al.* 2008). Yang *et al.* (2019) show that news sentiment is the source of the media's power for explaining acquirers' post-acquisition stock return performance. Thus, it is possible that news sentiment affects investment efficiency. RavenPack provides a composite sentiment score (CSS) using proprietary sentiment analytic techniques that rely on the modeling of stock price reactions to the textual content in a news article. The CSS ranges from 0 to 100, with a score below, equal to, and above 50 representing negative, neutral, and positive news, respectively. We calculate the yearly average CSS for investment-related news ($CSS\_Average_{inv}$) and non-investment-related news ($CSS\_Average_{noninv}$). Higher $CSS\_Average_{inv}$ and $CSS\_Average_{noninv}$ signal more optimistic (less pessimistic) news exposure.

[11] The RavenPack taxonomy file includes the following elements: (1) "Topic," a subject or theme of event; (2) "Group," a collection of related events; (3) "Type," a class of event, the constituents of which share similar characteristics; (4) "Sub_type," a subdivision of a particular class of event; (5) "Property," a named attribute of an event, such as an entity, role, number, or string extracted from a specific event type; and (6) "Category," a tag to label, identify, or recognize a particular type and property of an event.

In Panel A of Table 8, columns 1-3 show that both investment-related and non-investment-related news coverage reduce under-investment. Non-investment-related news (e.g., news about revenues, liabilities, and credit rating) provides valuable information that assists investors in deciding their capital supply to firms seeking external financing for funding profitable investment opportunities, which in turn leads to less under-investment. Columns 4-6 report that, within both types of news, more optimistic news exposure (higher $CSS\_Average$) attenuates under-investment.

*[Insert Table 8 here]*

In Panel B of Table 8, columns 1-3 show that non-investment-related news coverage significantly increases over-investment. One interpretation of the result is that dissemination of news of broader topics (e.g., news about individual managers and corporate social responsibility) plays a significant role in the formation of celebrity culture and stimulation of managerial overconfidence, leading to excessive investment. In columns 4-6, we find that higher news optimism (higher $CSS\_Average$) heightens over-investment. Collectively, our findings suggest that the relation between media and investment efficiency is not solely driven by investment-related news.

### 6.2. The media's information creation versus information dissemination function

Drake *et al.* (2014) discuss that the media serves as an information intermediary in financial markets via two functions. First, the media can create and produce new information or editorials on specific events for the general public. Second, the media can disseminate and publicize information through replication. This section investigates whether the media's effect on investment efficiency operates through its information creation or information dissemination function.

RavenPack provides an event novelty score (ENS) that assesses how novel, or new, a news article is. The ENS ranges from 0 to 100. Breaking news, which is the first released article specific to a categorized event, is assigned an ENS of 100. Subsequent repeated news, which is a chain of similar articles disseminated for a single event, has an ENS below 100. Following Dai *et al.* (2015), we disentangle breaking news from repeated news. $Media\ Coverage_{first}$ is the natural logarithm of one

plus the number of breaking news articles. $Media\ Coverage_{repeated}$ is the natural logarithm of one plus the number of repeated news articles.

In Table 9, we find that breaking news coverage and repeated news coverage, when examined in isolation in columns 1 and 2, generally reduce under-investment (Panel A) but increase over-investment (Panel B). When both are included in column 3, only the coefficients on repeated news coverage are statistically significant and with expected signs, while the coefficients on breaking news coverage are insignificant. This finding reveals that the association between media coverage and investment efficiency is driven by the media's information dissemination function—that is, the media attracts investor attention by spreading a large amount of similar news to financial market participants.

*[Insert Table 9 here]*

**6.3. Media coverage and investment level**

Our study of investment efficiency is distinct from prior studies that examine total investment. Investment is deemed efficient only if it expands or contracts in response to growth opportunities. To shed more light on the role of media coverage in firms' investment decisions, we investigate the relation between media coverage and different types of corporate investment. In Table 10, total investment ($Investment$) is the aggregate investment level that we use to model the degree of inefficient investment in Eq. (1). We decompose total investment into capital expenditure ($Capex$), R&D expenditure ($R\&D$), and acquisition expenditure ($Acquisition$). Consistent with Biddle *et al.* (2009), $Capex$ is computed as capital expenditure scaled by lagged net property, plant, and equipment, then times 100. $R\&D$ ($Acquisition$) is research and development expenditure (acquisition expenditure) scaled by lagged total assets, times 100.

Table 10 presents the results of OLS regressions of the levels of different types of investment on media coverage and control variables. In column 1, we observe a positive and significant relation between media coverage and total investment. In columns 2-4, we find that media coverage exerts significant and positive impacts on $Capex$, $R\&D$, and $Acquisition$. Our finding of the media-induced increment in acquisition expenditure lends further support to the argument that the media's association

with over-investment is at least partially attributable to managerial overconfidence. Acquisitions, as a means for managers to achieve rapid empire-building, are a manifestation of managers' overconfidence (Roll 1986). On average, acquisitions destroy firm value for acquirers' shareholders (Agrawal *et al.* 1992) and are an indication of over-investment.

*[Insert Table 10 here]*

## 7. Conclusion

Our research examines the effect of media coverage on firm-level investment efficiency over the period from 2001 to 2018. Our empirical results provide robust evidence that media coverage reduces the magnitude of under-investment but increases the magnitude of over-investment. In the cross-section, media coverage has a larger negative impact on under-investment among firms with greater information asymmetry and poorer corporate governance. For over-investment, we find that media coverage boosts CEO overconfidence, which in turn increases the intensity of over-investment. Additional analysis shows that the relation between media coverage and investment efficiency is not limited to investment-related news. Both investment- and non-investment-related news coverage reduce under-investment, while only non-investment-related news coverage significantly increases over-investment. More optimistic news disclosure attenuates under-investment but heightens over-investment. Furthermore, we find that media coverage affects investment efficiency through the media's information dissemination rather than information creation function. Finally, we document significantly positive effects of media coverage on total investment, capital expenditure, R&D expenditure, and acquisition expenditure.

Our findings of the media's influences on investment efficiency have significant implications for investors and policymakers. Investors are supposed not only to assess financial statement information disclosed in company filings, but also to make use of media news in order to identify potential investees that have better investment efficiency. Policymakers should support the development of the media sector as an important information intermediary and essential governance mechanism for financial

markets, and also take action to prevent exaggerated or unfounded media news' dissemination in the markets.

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## Table 1 Summary statistics, univariate analysis, and correlation matrix

This table presents summary statistics (Panel A), univariate test results (Panel B), and Pearson correlation matrix (Panel C) for the variables included in the baseline regressions. In Panel B, we separate under-investing (over-investing) firm-years into the high or low group based on the median value of $Media\ Coverage$ in the under-investment (over-investment) sample in a given year. In Panel C, the bottom-left (top-right) half of the matrix presents correlation coefficients for the under-investment (over-investment) sample. See Appendix A for variable definitions. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Panel A: Summary statistics**

| *Variable* | *N* | *Mean* | *SD* | *25%* | *Median* | *75%* |
|---|---|---|---|---|---|---|
| *Inv_Ineff* | 30,281 | 11.6670 | 14.0860 | 3.8490 | 8.0426 | 14.3891 |
| *Inv_Under* | 20,433 | 9.6297 | 7.3153 | 4.2189 | 8.0466 | 13.4047 |
| *Inv_Over* | 9,848 | 15.8940 | 21.7397 | 3.0999 | 8.0303 | 19.1217 |
| *Media Coverage* | 30,281 | 4.4921 | 1.3607 | 3.7612 | 4.6052 | 5.4424 |
| *Size* | 30,281 | 5.4944 | 1.8470 | 4.1750 | 5.4198 | 6.7371 |
| *MB* | 30,281 | 3.1251 | 5.5118 | 1.1971 | 2.0932 | 3.7728 |
| *σ(CFO)* | 30,281 | 0.0973 | 0.1179 | 0.0336 | 0.0601 | 0.1109 |
| *σ(Sales)* | 30,281 | 0.2100 | 0.2191 | 0.0761 | 0.1420 | 0.2616 |
| *σ(Investment)* | 30,281 | 0.1700 | 0.3350 | 0.0287 | 0.0665 | 0.1601 |
| *Z_Score* | 30,281 | 0.8303 | 2.1378 | 0.3578 | 1.1821 | 1.9000 |
| *Tangibility* | 30,281 | 0.2164 | 0.2115 | 0.0596 | 0.1396 | 0.3014 |
| *K_Structure* | 30,281 | 0.1338 | 0.1924 | 0.0000 | 0.0403 | 0.1997 |
| *Ind.K_Structure* | 30,281 | 0.1471 | 0.1010 | 0.0722 | 0.1075 | 0.1950 |
| *CFO/Sale* | 30,281 | -0.4811 | 2.6753 | -0.0126 | 0.0646 | 0.1359 |
| *Slack* | 30,281 | 5.9505 | 13.9111 | 0.2202 | 1.0881 | 4.8105 |
| *Dividend* | 30,281 | 0.2834 | 0.4506 | 0.0000 | 0.0000 | 1.0000 |
| *Age* | 30,281 | 2.4962 | 0.9193 | 1.9459 | 2.6391 | 3.1781 |
| *Operating_Cycle* | 30,281 | 4.6074 | 0.8459 | 4.1751 | 4.6971 | 5.1425 |
| *ROA* | 30,281 | -0.0595 | 0.2639 | -0.0974 | 0.0262 | 0.0786 |
| *Neg_Gscore* | 30,281 | -2.3347 | 3.6244 | -5.0000 | 0.0000 | 0.0000 |
| *G_dummy* | 30,281 | 0.6650 | 0.4720 | 0.0000 | 1.0000 | 1.0000 |
| *Institutions* | 30,281 | 0.1720 | 0.1482 | 0.0532 | 0.1500 | 0.2701 |
| *Analysts* | 30,281 | 6.2188 | 7.1996 | 1.0000 | 4.0000 | 9.0000 |

**Panel B: Univariate analysis**

| | High media coverage | | | Low media coverage | | | *t*-statistic for difference in means |
|---|---|---|---|---|---|---|---|
| | *N* | *Mean* | *SD* | *N* | *Mean* | *SD* | (High minus Low) |
| *Inv_Under* | 10,226 | 9.1524 | 7.1215 | 10,207 | 10.1080 | 7.4743 | -9.3557*** |
| *Inv_Over* | 4,945 | 16.4598 | 22.3869 | 4,903 | 15.3234 | 21.0537 | 2.5944*** |

**Panel C: Correlation matrix**

| | | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] | [20] | [21] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Inv_Under/Inv_Over* | [1] | **1.00** | -0.02 | -0.19 | 0.08 | 0.19 | 0.03 | 0.15 | -0.26 | -0.06 | -0.07 | -0.11 | -0.15 | 0.08 | -0.07 | -0.08 | -0.05 | -0.22 | 0.09 | 0.10 | -0.08 | -0.11 |
| *Media Coverage* | [2] | -0.01 | **1.00** | 0.46 | 0.05 | -0.14 | -0.12 | -0.09 | 0.09 | -0.03 | 0.02 | -0.06 | 0.03 | 0.02 | 0.13 | 0.21 | -0.06 | 0.12 | -0.39 | -0.34 | 0.23 | 0.49 |
| *Size* | [3] | -0.13 | 0.53 | **1.00** | -0.06 | -0.46 | -0.22 | -0.18 | 0.49 | 0.30 | 0.30 | 0.29 | 0.29 | -0.25 | 0.35 | 0.27 | -0.07 | 0.52 | -0.53 | -0.54 | 0.28 | 0.71 |
| *MB* | [4] | 0.03 | 0.09 | 0.03 | **1.00** | 0.11 | 0.02 | 0.06 | -0.05 | -0.10 | -0.17 | -0.12 | -0.08 | 0.08 | -0.04 | -0.09 | 0.01 | -0.07 | 0.02 | 0.04 | -0.03 | 0.06 |
| *σ(CFO)* | [5] | 0.12 | -0.14 | -0.34 | 0.09 | **1.00** | 0.32 | 0.46 | -0.50 | -0.26 | -0.19 | -0.25 | -0.34 | 0.32 | -0.22 | -0.25 | 0.01 | -0.52 | 0.26 | 0.27 | -0.18 | -0.22 |
| *σ(Sales)* | [6] | 0.02 | -0.17 | -0.24 | -0.01 | 0.33 | **1.00** | 0.18 | 0.03 | -0.18 | -0.08 | -0.06 | 0.10 | 0.04 | -0.11 | -0.18 | -0.09 | -0.02 | 0.17 | 0.18 | -0.11 | -0.14 |
| *σ(Investment)* | [7] | 0.06 | -0.08 | -0.05 | 0.03 | 0.34 | 0.15 | **1.00** | -0.30 | -0.07 | -0.01 | -0.10 | -0.21 | 0.16 | -0.14 | -0.28 | -0.03 | -0.32 | 0.16 | 0.17 | -0.09 | -0.09 |
| *Z_Score* | [8] | -0.14 | 0.05 | 0.23 | -0.03 | -0.32 | 0.08 | -0.28 | **1.00** | 0.18 | 0.07 | 0.25 | 0.51 | -0.26 | 0.26 | 0.18 | -0.06 | 0.87 | -0.24 | -0.24 | 0.18 | 0.23 |
| *Tangibility* | [9] | -0.14 | -0.05 | 0.15 | -0.07 | -0.19 | -0.14 | -0.02 | 0.02 | **1.00** | 0.41 | 0.55 | 0.16 | -0.39 | 0.22 | 0.10 | -0.27 | 0.23 | -0.08 | -0.09 | 0.03 | 0.15 |
| *K_Structure* | [10] | -0.06 | -0.01 | 0.27 | -0.15 | -0.18 | -0.07 | 0.06 | -0.03 | 0.38 | **1.00** | 0.47 | 0.10 | -0.20 | 0.12 | 0.12 | -0.11 | 0.10 | -0.06 | -0.07 | 0.10 | 0.03 |
| *Ind.K_Structure* | [11] | -0.24 | -0.09 | 0.20 | -0.11 | -0.18 | -0.02 | -0.05 | 0.12 | 0.47 | 0.52 | **1.00** | 0.17 | -0.28 | 0.22 | 0.11 | -0.21 | 0.26 | -0.08 | -0.10 | 0.06 | 0.03 |
| *CFO/Sale* | [12] | -0.09 | 0.02 | 0.16 | -0.04 | -0.27 | 0.05 | -0.16 | 0.38 | 0.10 | 0.07 | 0.12 | **1.00** | -0.34 | 0.13 | 0.13 | -0.08 | 0.55 | -0.14 | -0.15 | 0.10 | 0.14 |
| *Slack* | [13] | 0.18 | 0.01 | -0.19 | 0.07 | 0.31 | 0.07 | 0.09 | -0.20 | -0.34 | -0.22 | -0.24 | -0.27 | **1.00** | -0.18 | -0.17 | -0.02 | -0.28 | 0.14 | 0.14 | -0.03 | -0.11 |
| *Dividend* | [14] | -0.08 | 0.17 | 0.31 | 0.01 | -0.21 | -0.14 | -0.13 | 0.24 | 0.12 | 0.04 | 0.16 | 0.11 | -0.14 | **1.00** | 0.35 | -0.04 | 0.26 | -0.31 | -0.30 | 0.05 | 0.13 |
| *Age* | [15] | -0.04 | 0.23 | 0.23 | -0.05 | -0.27 | -0.19 | -0.27 | 0.24 | 0.10 | 0.04 | 0.08 | 0.14 | -0.17 | 0.34 | **1.00** | 0.07 | 0.23 | -0.36 | -0.36 | 0.09 | 0.12 |
| *Operating_Cycle* | [16] | 0.10 | -0.05 | -0.09 | -0.01 | 0.01 | -0.15 | -0.05 | -0.07 | -0.27 | -0.15 | -0.26 | -0.09 | -0.01 | -0.04 | 0.07 | **1.00** | -0.06 | 0.00 | 0.00 | -0.05 | -0.07 |
| *ROA* | [17] | -0.08 | 0.13 | 0.33 | 0.00 | -0.36 | -0.07 | -0.28 | 0.79 | 0.06 | -0.03 | 0.08 | 0.43 | -0.15 | 0.23 | 0.26 | -0.02 | **1.00** | -0.26 | -0.28 | 0.18 | 0.27 |
| *Neg_Gscore* | [18] | 0.06 | -0.46 | -0.55 | -0.05 | 0.22 | 0.19 | 0.11 | -0.16 | -0.02 | -0.01 | -0.02 | -0.10 | 0.11 | -0.29 | -0.32 | 0.02 | -0.22 | **1.00** | 0.91 | -0.19 | -0.42 |
| *G_dummy* | [19] | 0.06 | -0.41 | -0.56 | -0.05 | 0.22 | 0.19 | 0.11 | -0.15 | -0.02 | 0.00 | -0.01 | -0.10 | 0.09 | -0.27 | -0.30 | 0.02 | -0.22 | 0.91 | **1.00** | -0.18 | -0.42 |
| *Institutions* | [20] | -0.07 | 0.24 | 0.31 | -0.02 | -0.15 | -0.14 | -0.04 | 0.09 | 0.00 | 0.11 | 0.06 | 0.05 | -0.04 | 0.06 | 0.06 | -0.03 | 0.11 | -0.23 | -0.21 | **1.00** | 0.16 |
| *Analysts* | [21] | -0.09 | 0.52 | 0.72 | 0.14 | -0.16 | -0.16 | -0.01 | 0.06 | 0.04 | 0.01 | -0.03 | 0.07 | -0.06 | 0.15 | 0.11 | -0.06 | 0.17 | -0.45 | -0.46 | 0.16 | **1.00** |

## Table 2 Media coverage and investment efficiency

This table presents the OLS regression results for the impact of media coverage on the magnitude of under-investment ($Inv\_Under$), over-investment ($Inv\_Over$), and overall investment inefficiency ($Inv\_Ineff$). $Inv\_Under$ is the absolute value of the negative residual in the expected investment estimation model specified in Eq. (1). $Inv\_Over$ is the positive residual. $Inv\_Ineff$ is the absolute value of the residual, irrespective of whether it is positive or negative. All the independent variables are lagged by one year relative to the dependent variable. See Appendix A for variable definitions. Intercepts are included but not reported. Cluster-robust *t*-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

| | [1] | [2] | [3] |
|---|---|---|---|
| ***Dependent variable =*** | ***Inv_Under*** | ***Inv_Over*** | ***Inv_Ineff*** |
| *Media Coverage* | -0.4833*** | 0.6260** | 0.0610 |
| | (-4.96) | (2.21) | (0.48) |
| *Size* | 0.1449** | -0.8607*** | -0.4509*** |
| | (2.07) | (-2.95) | (-4.29) |
| *MB* | -0.0435*** | 0.1473*** | 0.0846*** |
| | (-3.55) | (3.44) | (3.59) |
| *σ(CFO)* | -2.0622** | 4.6673 | 2.9282* |
| | (-2.41) | (1.51) | (1.95) |
| *σ(Sales)* | 2.0365*** | 1.6479 | 1.5134*** |
| | (7.06) | (1.20) | (2.91) |
| *σ(Investment)* | -0.2456 | 3.4421*** | 1.1938*** |
| | (-1.03) | (3.79) | (2.82) |
| *Z_Score* | 0.2304*** | -1.8084*** | -0.9333*** |
| | (2.82) | (-5.27) | (-5.05) |
| *Tangibility* | -2.6563*** | -2.9468* | -1.1860* |
| | (-5.89) | (-1.65) | (-1.76) |
| *K_Structure* | 3.7167*** | -4.1930** | -0.4892 |
| | (11.34) | (-2.52) | (-0.96) |
| *Ind.K_Structure* | -0.2316 | 0.1116 | 0.3067 |
| | (-0.34) | (0.03) | (0.24) |
| *CFO/Sale* | 0.3082*** | -0.1024 | 0.0192 |
| | (7.43) | (-0.95) | (0.29) |
| *Slack* | -0.0042 | -0.1064*** | -0.0533*** |
| | (-0.54) | (-4.10) | (-4.71) |
| *Dividend* | 0.8051*** | 1.3591** | 0.8802*** |
| | (5.47) | (2.05) | (3.68) |
| *Age* | 0.3002*** | -0.1659 | -0.0459 |
| | (3.72) | (-0.54) | (-0.35) |
| *Operating_Cycle* | 0.6247*** | -1.7877*** | -0.6689*** |
| | (5.48) | (-4.76) | (-3.58) |
| *ROA* | -0.9363* | 6.4601*** | 2.6702** |
| | (-1.69) | (3.01) | (2.51) |
| *Neg_Gscore* | -0.0702* | -0.3231** | -0.1739*** |
| | (-1.76) | (-2.11) | (-3.01) |
| *G_dummy* | 0.4573 | 1.9349* | 1.0064** |
| | (1.48) | (1.71) | (2.32) |
| *Institutions* | -2.6760*** | -3.3940** | -2.2878*** |
| | (-6.19) | (-2.06) | (-3.56) |
| *Analysts* | -0.1021*** | -0.1050** | -0.0588*** |
| | (-8.04) | (-2.13) | (-3.10) |
| *Industry-fixed effect* | Yes | Yes | Yes |
| *Year-fixed effect* | Yes | Yes | Yes |
| *N* | 20,433 | 9,848 | 30,281 |
| *Adj. $R^2$* | 0.399 | 0.117 | 0.136 |

## Table 3 Firm-fixed effect estimation

This table presents the firm-fixed effect OLS regression results for the impact of media coverage on the magnitude of under-investment ($Inv\_Under$) and over-investment ($Inv\_Over$). All the independent variables are lagged by one year relative to the dependent variable. See Appendix A for variable definitions. Intercepts are included but not reported. Cluster-robust *t*-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

| | [1] | [2] |
|---|---|---|
| ***Dependent variable =*** | ***Inv_Under*** | ***Inv_Over*** |
| *Media Coverage* | -0.3116*** | 1.6105*** |
| | (-3.05) | (2.85) |
| *Size* | 1.2821*** | -8.8097*** |
| | (9.97) | (-10.66) |
| *MB* | -0.0187* | 0.0850* |
| | (-1.66) | (1.73) |
| *σ(CFO)* | 0.3624 | 2.9928 |
| | (0.39) | (0.69) |
| *σ(Sales)* | 0.4225 | -5.7913*** |
| | (1.37) | (-2.80) |
| *σ(Investment)* | 0.0735 | -1.9466 |
| | (0.29) | (-1.21) |
| *Z_Score* | -0.2366** | -2.0445*** |
| | (-2.47) | (-4.70) |
| *Tangibility* | -2.3319*** | -4.9181 |
| | (-2.78) | (-1.15) |
| *K_Structure* | 3.0722*** | -23.7394*** |
| | (7.73) | (-7.75) |
| *Ind.K_Structure* | -3.8219*** | -8.6569 |
| | (-4.59) | (-1.55) |
| *CFO/Sale* | 0.1641*** | 0.1096 |
| | (2.96) | (0.72) |
| *Slack* | 0.0316*** | -0.1105** |
| | (3.97) | (-2.40) |
| *Dividend* | 0.0937 | 0.7284 |
| | (0.63) | (0.70) |
| *Age* | 0.0330 | -1.4036 |
| | (0.16) | (-1.35) |
| *Operating_Cycle* | 0.1651 | -1.4527** |
| | (1.11) | (-2.38) |
| *ROA* | 0.0926 | 9.7003*** |
| | (0.16) | (3.49) |
| *Neg_Gscore* | 0.0144 | -0.1146 |
| | (0.38) | (-0.44) |
| *G_dummy* | -0.2921 | -1.6955 |
| | (-0.90) | (-0.82) |
| *Institutions* | -0.5661 | -5.7587** |
| | (-1.35) | (-2.13) |
| *Analysts* | -0.0280* | 0.1741** |
| | (-1.92) | (1.99) |
| *Firm-fixed effect* | Yes | Yes |
| *Year-fixed effect* | Yes | Yes |
| *N* | 20,433 | 9,848 |
| *Adj. $R^2$* | 0.601 | 0.340 |

## Table 4 Instrumental variable estimation

This table presents the 2SLS regression results for the impact of media coverage on the magnitude of under-investment ($Inv\_Under$) in Panel A and over-investment ($Inv\_Over$) in Panel B. The instrument variable used for media coverage is $Distance\_DJ$, which is calculated as the minimum distance measured in increments of 100 km between a firm's headquarters and the nearest Dow Jones branch. Columns 7 and 8 include additional state-level macro-socioeconomic control variables: annual employment growth ($GEmployment$), annual wage growth ($GWages$), annual consumer consumption expenditure growth ($GConsumption$), annual population growth ($GPopulation$), log-transformed total population ($Population$), the proportion of the population aged 65 years and over ($Aged\_65$), the proportion of women in the population ($Female$), GDP growth ($GGDP$), and log-transformed GDP per capita ($GDP\_Capita$). All the independent variables are lagged by one year relative to the dependent variable. See Appendix A for variable definitions. Intercepts are included but not reported. Cluster-robust *t*-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Panel A: Under-investment**

| | Full sample | | Propensity score matched sample | | | | | |
|---|---|---|---|---|---|---|---|---|
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |
| | 1st stage | 2nd stage | 1st stage | 2nd stage | 1st stage | 2nd stage | 1st stage | 2nd stage |
| ***Dependent variable =*** | ***Media Coverage*** | ***Inv_Under*** | ***Media Coverage*** | ***Inv_Under*** | ***Media Coverage*** | ***Inv_Under*** | ***Media Coverage*** | ***Inv_Under*** |
| *Distance_DJ* | -0.0001*** | | -0.0001*** | | -0.0003*** | | -0.0004*** | |
| | (-8.25) | | (-6.52) | | (-7.07) | | (-12.28) | |
| $\widehat{Media\ Coverage}$ | | -2.4494*** | | -2.4686*** | | -0.7870** | | -1.0266*** |
| | | (-4.93) | | (-3.90) | | (-2.15) | | (-3.32) |
| *GEmployment* | | | | | | | 1.2444 | 4.1436 |
| | | | | | | | (1.02) | (0.47) |
| *GWages* | | | | | | | 0.0910 | -3.0412 |
| | | | | | | | (0.14) | (-0.68) |
| *GConsumption* | | | | | | | -0.1827 | 4.7428 |
| | | | | | | | (-0.19) | (0.62) |
| *GPopulation* | | | | | | | 0.9736 | -44.0678** |
| | | | | | | | (0.47) | (-2.40) |
| *Population* | | | | | | | 0.0004 | -0.0087*** |
| | | | | | | | (0.91) | (-3.10) |
| *Aged_65* | | | | | | | -2.5796 | -31.0183** |
| | | | | | | | (-1.31) | (-1.97) |
| *Female* | | | | | | | -0.9610 | 61.3368** |
| | | | | | | | (-0.26) | (2.18) |
| *GGDP* | | | | | | | -0.5735 | 3.2905 |
| | | | | | | | (-1.39) | (1.01) |
| *GDP_Capita* | | | | | | | -0.0014 | -1.6843* |
| | | | | | | | (-0.01) | (-1.87) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Controls* | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *Industry-fixed effect* | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *Year-fixed effect* | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *City-fixed effect* | No | No | No | No | Yes | Yes | Yes | Yes |
| *N* | 20,433 | 20,433 | 18,260 | 18,260 | 18,260 | 18,260 | 16,964 | 16,964 |
| *Adj. $R^2$* | 0.683 | 0.356 | 0.681 | 0.356 | 0.751 | 0.465 | 0.751 | 0.453 |
| ***Weak instrument test (H0: weak instrument)*** | | | | | | | | |
| Kleibergen-Paap rk LM Wald *F* statistic | 68.071 | | 42.453 | | 50.047 | | 59.704 | |
| Stock-Yogo 5% critical value | 16.38 | | 16.38 | | 16.38 | | 16.38 | |

**Panel B: Over-investment**

| | Full sample | | Propensity score matched sample | | | | | |
|---|---|---|---|---|---|---|---|---|
| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |
| | 1st stage | 2nd stage | 1st stage | 2nd stage | 1st stage | 2nd stage | 1st stage | 2nd stage |
| ***Dependent variable =*** | ***Media Coverage*** | ***Inv_Over*** | ***Media Coverage*** | ***Inv_Over*** | ***Media Coverage*** | ***Inv_Over*** | ***Media Coverage*** | ***Inv_Over*** |
| *Distance_DJ* | -0.0001*** | | -0.0001*** | | -0.0003*** | | -0.0003*** | |
| | (-5.90) | | (-5.68) | | (-3.63) | | (-3.75) | |
| $\widehat{Media\ Coverage}$ | | 4.0679** | | 4.6590** | | 4.9662** | | 4.2024** |
| | | (2.40) | | (2.55) | | (2.19) | | (2.02) |
| *GEmployment* | | | | | | | -3.6349* | -17.4159 |
| | | | | | | | (-1.94) | (-0.42) |
| *GWages* | | | | | | | 0.5868 | -15.6778 |
| | | | | | | | (0.57) | (-0.74) |
| *GConsumption* | | | | | | | -1.1967 | -43.2738 |
| | | | | | | | (-0.77) | (-1.14) |
| *GPopulation* | | | | | | | 3.0609 | 55.4279 |
| | | | | | | | (0.92) | (0.62) |
| *Population* | | | | | | | -0.0020*** | -0.0028 |
| | | | | | | | (-2.58) | (-0.20) |
| *Aged_65* | | | | | | | -4.8998* | 26.4636 |
| | | | | | | | (-1.72) | (0.36) |
| *Female* | | | | | | | 10.8048* | 59.2052 |
| | | | | | | | (1.72) | (0.42) |
| *GGDP* | | | | | | | -0.4393 | 13.9860 |
| | | | | | | | (-0.60) | (0.88) |
| *GDP_Capita* | | | | | | | 0.3338 | -0.2571 |
| | | | | | | | (1.56) | (-0.05) |
| *Controls* | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Industry-fixed effect* | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *Year-fixed effect* | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *City-fixed effect* | No | No | No | No | Yes | Yes | Yes | Yes |
| *N* | 9,848 | 9,848 | 8,816 | 8,816 | 8,816 | 8,816 | 8,152 | 8,152 |
| *Adj.* $R^2$ | 0.652 | 0.100 | 0.636 | 0.0899 | 0.713 | 0.152 | 0.708 | 0.165 |
| ***Weak instrument test (H0: weak instrument)*** | | | | | | | | |
| Kleibergen-Paap rk LM Wald *F* statistic | 34.796 | | 32.308 | | 22.307 | | 23.421 | |
| Stock-Yogo 5% critical value | 16.38 | | 16.38 | | 16.38 | | 16.38 | |

## Table 5 Robustness tests

This table presents robustness test results. In Panel A, we use a multinomial logit regression model. The dependent variable is a categorical variable equal to one if a firm-year is classified into the under-investment group, two if a firm-year is classified into the benchmark normal investment group, and three if a firm-year is classified into the over-investment group. In Panel B, we estimate alternative models to derive the deviation of actual investment from expected investment. In Panel C, we employ alternative samples to re-run the regressions. All the independent variables are lagged by one year relative to the dependent variable. See Appendix A for variable definitions. Cluster-robust *t*/*z*-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Panel A: Multinomial logit regression model**

| ***Dependent variable =*** | [1] ***Under-investment versus normal investment*** | [2] ***Over-investment versus normal investment*** |
|---|---|---|
| *Media Coverage* | -0.1121*** | 0.1210*** |
| | (-3.79) | (3.99) |
| *Controls* | Yes | Yes |
| *Industry-fixed effect* | Yes | Yes |
| *Year-fixed effect* | Yes | Yes |
| *N* | 30,281 | |
| *Pseudo $R^2$* | 0.159 | |

**Panel B: Alternative models to derive deviations from expected investment**

| | Sales growth replaced by asset growth | | Sales growth replaced by Tobin's q | | Chen's model by interacting sales growth with negative dummy | |
|---|---|---|---|---|---|---|
| | [1] | [2] | [3] | [4] | [5] | [6] |
| ***Dependent variable =*** | ***Inv_Under*** | ***Inv_Over*** | ***Inv_Under*** | ***Inv_Over*** | ***Inv_Under*** | ***Inv_Over*** |
| *Media Coverage* | -0.5473*** | 0.7494** | -0.3994*** | 0.6578** | -0.3767*** | 0.5256* |
| | (-4.96) | (2.32) | (-4.16) | (2.28) | (-3.69) | (1.93) |
| *Controls* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Industry-fixed effect* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Year-fixed effect* | Yes | Yes | Yes | Yes | Yes | Yes |
| *N* | 21,402 | 8,879 | 20,256 | 9,953 | 19,825 | 10,456 |
| *Adj. $R^2$* | 0.478 | 0.112 | 0.423 | 0.111 | 0.321 | 0.115 |

**Panel C: Alternative samples**

| | Exclude firm-years with zero media coverage | | Exclude the financial crisis period | | Exclude firm-years with missing G-index | |
|---|---|---|---|---|---|---|
| | [1] | [2] | [3] | [4] | [5] | [6] |
| ***Dependent variable =*** | ***Inv_Under*** | ***Inv_Over*** | ***Inv_Under*** | ***Inv_Over*** | ***Inv_Under*** | ***Inv_Over*** |
| *Media Coverage* | -0.8065*** | 1.3795*** | -0.4705*** | 0.6405** | -0.8010*** | 1.4539** |
| | (-7.41) | (2.96) | (-4.72) | (2.18) | (-3.80) | (2.54) |
| *Controls* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Industry-fixed effect* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Year-fixed effect* | Yes | Yes | Yes | Yes | Yes | Yes |
| *N* | 19,933 | 9,550 | 18,256 | 8,677 | 7,058 | 3,086 |
| *Adj. $R^2$* | 0.399 | 0.118 | 0.390 | 0.107 | 0.498 | 0.0807 |

## Table 6 The moderating effect of information asymmetry and corporate governance

This table presents the OLS regression results testing how the effect of media coverage on the magnitude of under-investment ($Inv\_Under$) and over-investment ($Inv\_Over$) varies depending on the degree of information asymmetry and corporate governance. In Panel A, information asymmetry is proxied by the number of analysts following a firm ($Analysts$) and the absolute value of residual accruals estimated using the Dechow and Dichev (2002) model ($Opacity\_DD$). In Panel B, we use the negative of the updated G-index ($Neg\_Gscore$), the proportion of independent directors on the board ($Outdir$), and the presence of Big 4 auditors ($Big4$) as proxies for corporate governance. All the independent variables are lagged by one year relative to the dependent variable. See Appendix A for variable definitions. Intercepts are included but not reported. Cluster-robust *t*-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

**Panel A: Information asymmetry**

| | [1] | [2] | [3] | [4] |
|---|---|---|---|---|
| ***Dependent variable =*** | ***Inv_Under*** | ***Inv_Over*** | ***Inv_Under*** | ***Inv_Over*** |
| *Media Coverage* | -0.6088*** | 0.7653*** | -0.4506*** | 0.6633** |
| | (-6.15) | (2.70) | (-4.55) | (2.30) |
| *Analysts* | -0.3026*** | 0.1036 | | |
| | (-8.56) | (0.69) | | |
| *Media Coverage × Analysts* | 0.0350*** | -0.0364 | | |
| | (5.81) | (-1.50) | | |
| *Opacity_DD* | | | 0.2298** | 0.2901 |
| | | | (2.04) | (0.73) |
| *Media Coverage × Opacity_DD* | | | -0.0522** | -0.0750 |
| | | | (-2.06) | (-0.92) |
| *Controls* | Yes | Yes | Yes | Yes |
| *Industry-fixed effect* | Yes | Yes | Yes | Yes |
| *Year-fixed effect* | Yes | Yes | Yes | Yes |
| *N* | 20,433 | 9,848 | 20,250 | 9,772 |
| *Adj. $R^2$* | 0.401 | 0.117 | 0.401 | 0.117 |

**Panel B: Corporate governance**

| | [1] | [2] | [3] | [4] | [5] | [6] |
|---|---|---|---|---|---|---|
| ***Dependent variable =*** | ***Inv_Under*** | ***Inv_Over*** | ***Inv_Under*** | ***Inv_Over*** | ***Inv_Under*** | ***Inv_Over*** |
| *Media Coverage* | -0.4555 | 0.8380 | -0.7669*** | 0.5804 | -0.5841*** | 0.5231 |
| | (-1.62) | (0.88) | (-5.44) | (1.38) | (-4.66) | (1.47) |
| *Neg_Gscore* | -0.6110*** | 0.2721 | | | | |
| | (-4.16) | (0.59) | | | | |
| *Media Coverage × Neg_Gscore* | 0.0526* | -0.0834 | | | | |
| | (1.78) | (-0.87) | | | | |
| *Outdir* | | | -2.6487** | -0.0590 | | |
| | | | (-2.14) | (-0.02) | | |
| *Media Coverage × Outdir* | | | 0.5710** | 0.0662 | | |
| | | | (2.11) | (0.08) | | |
| *Big4* | | | | | -2.5081*** | -0.0067 |
| | | | | | (-5.24) | (-0.00) |
| *Media Coverage × Big4* | | | | | 0.2474** | 0.1480 |
| | | | | | (2.27) | (0.38) |
| *Controls* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Industry-fixed effect* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Year-fixed effect* | Yes | Yes | Yes | Yes | Yes | Yes |
| *N* | 7,058 | 3,086 | 16,141 | 7,701 | 20,433 | 9,848 |
| *Adj. $R^2$* | 0.513 | 0.0786 | 0.407 | 0.112 | 0.405 | 0.117 |

## Table 7 The mediating effect of overconfidence

This table presents the OLS regression results examining how CEO overconfidence mediates the relation between media coverage and the magnitude of under-investment ($Inv\_Under$) and over-investment ($Inv\_Over$). Panel A uses the option-based CEO overconfidence ($Confidence$) as a measure of overconfidence. Panel B uses the CEO's net purchase of the firm's equity shares ($NetBuy$) as a measure of overconfidence. See Appendix A for variable definitions. Intercepts are included but not reported. Cluster-robust *t*-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

| **Panel A: Option-based CEO overconfidence** | | | | | | |
|---|---|---|---|---|---|---|
| | Under-investment sample | | | Over-investment sample | | |
| | [1] | [2] | [3] | [4] | [5] | [6] |
| ***Dependent variable =*** | ***Confidence*** | ***Inv_Under*** | ***Inv_Under*** | ***Confidence*** | ***Inv_Over*** | ***Inv_Over*** |
| *Media Coverage* | 0.0213*** | -0.4915*** | -0.4847*** | 0.0295*** | 0.7726** | 0.6120* |
| | (11.36) | (-4.70) | (-4.61) | (10.20) | (2.48) | (1.93) |
| *Confidence* | | | -0.3193 | | | 5.4447*** |
| | | | (-1.18) | | | (4.46) |
| *Controls* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Industry-fixed effect* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Year-fixed effect* | Yes | Yes | Yes | Yes | Yes | Yes |
| *N* | 15,472 | 15,472 | 15,472 | 6,802 | 6,802 | 6,802 |
| *Adj. $R^2$* | 0.250 | 0.429 | 0.429 | 0.239 | 0.102 | 0.106 |
| Indirect effect | | | -0.0068 | | | 0.1606 |
| Indirect/total | | | 1.384% | | | 20.787% |
| Sobel test *p*-value | | | 0.2405 | | | 0.0000 |
| **Panel B: CEO's net purchase of stocks** | | | | | | |
| | Under-investment sample | | | Over-investment sample | | |
| | [1] | [2] | [3] | [4] | [5] | [6] |
| ***Dependent variable =*** | ***NetBuy*** | ***Inv_Under*** | ***Inv_Under*** | ***NetBuy*** | ***Inv_Over*** | ***Inv_Over*** |
| *Media Coverage* | 0.7804*** | -0.7006*** | -0.7040*** | 1.0630*** | 0.9538** | 0.8826** |
| | (7.93) | (-5.33) | (-5.34) | (5.95) | (2.54) | (2.33) |
| *NetBuy* | | | 0.0043 | | | 0.0670** |
| | | | (0.57) | | | (2.24) |
| *Controls* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Industry-fixed effect* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Year-fixed effect* | Yes | Yes | Yes | Yes | Yes | Yes |
| *N* | 15,034 | 15,034 | 15,034 | 6,371 | 6,371 | 6,371 |
| *Adj. $R^2$* | 0.0988 | 0.422 | 0.422 | 0.126 | 0.105 | 0.106 |
| Indirect effect | | | 0.0034 | | | 0.0712 |
| Indirect/total | | | -0.485% | | | 7.465% |
| Sobel test *p*-value | | | 0.5697 | | | 0.0361 |

## Table 8 News category, news sentiment, and investment efficiency

This table presents the OLS regression results for the impact of news category and news sentiment on the magnitude of under-investment ( $Inv\_Under$ ) and over-investment ( $Inv\_Over$ ). $Media\ Coverage_{inv}$ ( $Media\ Coverage_{noninv}$ ) is media coverage of investment-related (non-investment-related) news. $CSS\_Average_{inv}$ ($CSS\_Average_{noninv}$) is the yearly average composite sentiment score of investment-related (non-investment-related) news. See Appendix A for variable definitions. Intercepts are included but not reported. Cluster-robust *t*-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

| **Panel A: Under-investment** | | | | | | |
|---|---|---|---|---|---|---|
| | [1] | [2] | [3] | [4] | [5] | [6] |
| ***Dependent variable =*** | ***Inv_Under*** | ***Inv_Under*** | ***Inv_Under*** | ***Inv_Under*** | ***Inv_Under*** | ***Inv_Under*** |
| *Media Coverage* $_{inv}$ | -0.2627*** | | -0.1746*** | | | |
| | (-5.41) | | (-3.56) | | | |
| *Media Coverage* $_{noninv}$ | | -0.5643*** | -0.5107*** | | | |
| | | (-6.13) | (-5.45) | | | |
| *CSS_Average* $_{inv}$ | | | | -0.2044*** | | -0.1934*** |
| | | | | (-6.35) | | (-6.03) |
| *CSS_Average* $_{noninv}$ | | | | | -0.1204*** | -0.1103*** |
| | | | | | (-4.57) | (-4.19) |
| *Controls* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Industry-fixed effect* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Year-fixed* | Yes | Yes | Yes | Yes | Yes | Yes |
| *N* | 20,433 | 20,433 | 20,433 | 20,433 | 20,433 | 20,433 |
| *Adj.* $R^2$ | 0.398 | 0.400 | 0.400 | 0.398 | 0.397 | 0.399 |
| **Panel B: Over-investment** | | | | | | |
| | [1] | [2] | [3] | [4] | [5] | [6] |
| ***Dependent variable =*** | ***Inv_Over*** | ***Inv_Over*** | ***Inv_Over*** | ***Inv_Over*** | ***Inv_Over*** | ***Inv_Over*** |
| *Media Coverage* $_{inv}$ | 0.1803 | | 0.1102 | | | |
| | (0.77) | | (0.47) | | | |
| *Media Coverage* $_{noninv}$ | | 0.5860** | 0.5702** | | | |
| | | (2.13) | (2.06) | | | |
| *CSS_Average* $_{inv}$ | | | | 0.4992*** | | 0.4629*** |
| | | | | (3.56) | | (3.28) |
| *CSS_Average* $_{noninv}$ | | | | | 0.3838*** | 0.3567*** |
| | | | | | (3.10) | (2.87) |
| *Controls* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Industry-fixed effect* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Year-fixed* | Yes | Yes | Yes | Yes | Yes | Yes |
| *N* | 9,848 | 9,848 | 9,848 | 9,848 | 9,848 | 9,848 |
| *Adj.* $R^2$ | 0.119 | 0.117 | 0.119 | 0.118 | 0.118 | 0.118 |

## Table 9 Information creation or information dissemination

This table presents the OLS regression results testing whether the impact of media coverage on the magnitude of under-investment ($Inv\_Under$) and over-investment ($Inv\_Over$) operates through the media's information creation or information dissemination function. $Media\ Coverage_{first}$ is media coverage of breaking news. $Media\ Coverage_{repeated}$ is media coverage of repeated news. All the independent variables are lagged by one year relative to the dependent variable. See Appendix A for variable definitions. Intercepts are included but not reported. Cluster-robust *t*-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

| **Panel A: Under-investment** | | | |
|---|---|---|---|
| | [1] | [2] | [3] |
| ***Dependent variable =*** | ***Inv_Under*** | ***Inv_Under*** | ***Inv_Under*** |
| *Media Coverage* $_{first}$ | -0.7063*** | | -0.0620 |
| | (-2.91) | | (-0.26) |
| *Media Coverage* $_{repeated}$ | | -0.4959*** | -0.4859*** |
| | | (-6.54) | (-6.84) |
| *Controls* | Yes | Yes | Yes |
| *Industry-fixed effect* | Yes | Yes | Yes |
| *Year-fixed effect* | Yes | Yes | Yes |
| *N* | 20,433 | 20,433 | 20,433 |
| *Adj.* $R^2$ | 0.397 | 0.399 | 0.399 |
| **Panel B: Over-investment** | | | |
| | [1] | [2] | [3] |
| ***Dependent variable =*** | ***Inv_Over*** | ***Inv_Over*** | ***Inv_Over*** |
| *Media Coverage* $_{first}$ | 0.2880 | | -0.0852 |
| | (1.41) | | (-0.41) |
| *Media Coverage* $_{repeated}$ | | 2.2278*** | 2.2536*** |
| | | (7.36) | (7.51) |
| *Controls* | Yes | Yes | Yes |
| *Industry-fixed effect* | Yes | Yes | Yes |
| *Year-fixed effect* | Yes | Yes | Yes |
| *N* | 9,848 | 9,848 | 9,848 |
| *Adj.* $R^2$ | 0.117 | 0.123 | 0.123 |

## Table 10 Media coverage and investment level

This table presents the OLS regression results for the impact of media coverage on different types of investment. The dependent variable is the level of total investment ($Investment$), capital expenditure ($Capex$), research and development expenditure ($R\&D$), and acquisition expenditure ($Acquisition$) in columns 1-4. All the independent variables are lagged by one year relative to the dependent variable. See Appendix A for variable definitions. Intercepts are included but not reported. Cluster-robust *t*-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

| | [1] | [2] | [3] | [4] |
|---|---|---|---|---|
| ***Dependent variable =*** | ***Investment*** | ***Capex*** | ***R&D*** | ***Acquisition*** |
| *Media Coverage* | 0.0105*** | 0.7542** | 0.5550*** | 0.2221** |
| | (5.48) | (2.32) | (4.24) | (2.44) |
| *Size* | -0.0106*** | -1.0804*** | -1.0788*** | 0.2386*** |
| | (-7.27) | (-3.88) | (-10.28) | (3.47) |
| *MB* | 0.0024*** | 0.5375*** | 0.1466*** | 0.0197* |
| | (7.77) | (9.30) | (7.05) | (1.83) |
| *σ(CFO)* | 0.1021*** | 16.6160*** | 9.8953*** | -2.9613*** |
| | (5.18) | (4.25) | (6.44) | (-5.02) |
| *σ(Sales)* | -0.0308*** | 3.9027*** | -2.6892*** | 0.2441 |
| | (-4.33) | (2.62) | (-5.47) | (0.74) |
| *σ(Investment)* | 0.0184*** | 2.3559** | 0.1110 | 0.9856*** |
| | (3.33) | (2.14) | (0.29) | (4.62) |
| *Z_Score* | -0.0148*** | 0.5334* | -1.0382*** | -0.2520*** |
| | (-7.69) | (1.69) | (-7.51) | (-4.59) |
| *Tangibility* | 0.0593*** | -32.6300*** | -4.3392*** | -3.7857*** |
| | (5.85) | (-17.99) | (-7.57) | (-8.77) |
| *K_Structure* | -0.1218*** | -15.6897*** | -4.6742*** | -1.8393*** |
| | (-17.85) | (-12.53) | (-10.53) | (-5.55) |
| *Ind.K_Structure* | -0.0170 | 2.6124 | 1.3524 | -1.1256 |
| | (-0.91) | (0.77) | (1.48) | (-1.06) |
| *CFO/Sale* | -0.0051*** | -0.0234 | -0.4311*** | 0.0092 |
| | (-6.14) | (-0.14) | (-6.82) | (0.52) |
| *Slack* | -0.0004*** | 0.7227*** | 0.0130 | -0.0171*** |
| | (-2.84) | (17.81) | (1.20) | (-3.31) |
| *Dividend* | -0.0112*** | -2.5501*** | -0.8480*** | 0.0047 |
| | (-3.58) | (-4.53) | (-4.42) | (0.03) |
| *Age* | -0.0146*** | -5.3226*** | -0.2130* | -0.4328*** |
| | (-7.94) | (-15.05) | (-1.72) | (-4.82) |
| *Operating_Cycle* | -0.0260*** | 0.5039 | -2.0218*** | -0.2473*** |
| | (-11.25) | (1.10) | (-11.36) | (-2.90) |
| *ROA* | 0.0132 | 13.5415*** | -7.2689*** | 5.2461*** |
| | (1.03) | (5.65) | (-7.95) | (11.91) |
| *Neg_Gscore* | -0.0003 | -0.2381* | 0.1375** | -0.1134*** |
| | (-0.38) | (-1.76) | (2.32) | (-2.66) |
| *G_dummy* | 0.0010 | 4.3177*** | -1.1986** | 0.5083 |
| | (0.15) | (3.86) | (-2.51) | (1.59) |
| *Institutions* | 0.0310*** | -0.2717 | 2.8631*** | 0.4821 |
| | (3.57) | (-0.17) | (4.67) | (1.13) |
| *Analysts* | 0.0021*** | 0.3012*** | 0.1841*** | -0.0296** |
| | (7.86) | (5.86) | (10.08) | (-2.22) |
| *Industry-fixed effect* | Yes | Yes | Yes | Yes |
| *Year-fixed effect* | Yes | Yes | Yes | Yes |
| *N* | 30,281 | 30,281 | 30,281 | 30,281 |
| *Adj. $R^2$* | 0.269 | 0.249 | 0.569 | 0.0390 |

## Appendix A: Variable definitions and data sources

| Variable | Definition | Source |
|---|---|---|
| **Panel A: Investment-related variables** | | |
| $Investment$ | The sum of research and development expenditure, capital expenditure, and acquisition expenditure less cash receipts from sale of property, plant, and equipment, scaled by lagged total assets, times 100. | Compustat |
| $Capex$ | Capital expenditure scaled by lagged net property, plant, and equipment, times 100. | Compustat |
| $R\&D$ | Research and development expenditure scaled by lagged total assets, times 100. | Compustat |
| $Acquisition$ | Acquisition expenditure scaled by lagged total assets, times 100. | Compustat |
| $Inv\_Under$ | The absolute value of the negative firm-year residual from an annual regression of the expected investment estimation model specified in Eq. (1) within each industry. | Compustat |
| $Inv\_Over$ | The positive firm-year residual from an annual regression of the expected investment estimation model specified in Eq. (1) within each industry. | Compustat |
| $Inv\_Ineff$ | The absolute value of the firm-year residual. | Compustat |
| $Inv\_Group$ | A categorical variable that equals one for the under-investment group, two for the benchmark normal investment group, and three for the over-investment group. To form the three groups, we sort the residuals in Eq. (1) annually into quartiles: the under-investment group for the residuals in the bottom quartile, the over-investment group for the residuals in the top quartile, and the benchmark group for the residuals in the middle two quartiles. | Compustat |
| **Panel B: Media variables** | | |
| $Media\ Coverage$ | The natural logarithm of one plus the number of news articles. | RavenPack |
| $Media\ Coverage_{inv}$ | The natural logarithm of one plus the number of news articles that are directly related to corporate investment. | RavenPack |
| $Media\ Coverage_{noninv}$ | The natural logarithm of one plus the number of news articles that are not directly related to corporate investment. | RavenPack |
| $CSS\_Average_{inv}$ | The average of composite sentiment scores of news articles that are directly related to corporate investment. | RavenPack |
| $CSS\_Average_{noninv}$ | The average of composite sentiment scores of news articles that are not directly related to corporate investment. | RavenPack |
| $Media\ Coverage_{first}$ | The natural logarithm of one plus the number of breaking news articles. | RavenPack |
| $Media\ Coverage_{repeated}$ | The natural logarithm of one plus the number of repeated news articles. | RavenPack |
| **Panel C: Firm-level control variables** | | |
| $Size$ | The natural logarithm of total assets. | Compustat |
| $MB$ | The ratio of market value to book value of equity. | Compustat |
| $\sigma(CFO)$ | The standard deviation of cash flow from operations deflated by average total assets from year $t$-4 to $t$. | Compustat |
| $\sigma(Sales)$ | The standard deviation of sales deflated by average total assets from year $t$-4 to $t$. | Compustat |

| | | |
|---|---|---|
| $\sigma(Investment)$ | The standard deviation of investment from year $t$-4 to $t$. | Compustat |
| $Z\_Score$ | A measure of financial health developed by Altman (1968), calculated as 3.3 * pretax income + net sales + 0.25 * retained earnings + 0.5 * (current assets - current liabilities) / total assets. | Compustat |
| $Tangibility$ | The ratio of property, plant, and equipment to total assets. | Compustat |
| $K\_Structure$ | The ratio of long-term debt to the sum of long-term debt and market value of equity. | Compustat |
| $Ind.K\_Structure$ | The average K-structure for firms within the same SIC 3-digit industry. | Compustat |
| $CFO/Sale$ | The ratio of cash flow from operations to sales. | Compustat |
| $Slack$ | The ratio of cash to property, plant, and equipment. | Compustat |
| $Dividend$ | A dummy variable equal to one if a firm pays a dividend in a year, and zero otherwise. | Compustat |
| $Age$ | The natural logarithm of one plus the number of years a firm has appeared in CRSP. | CRSP |
| $Operating\_Cycle$ | The natural logarithm of *receivables to sales* plus *inventory to cost of goods sold* multiplied by 360. | Compustat |
| $ROA$ | Net income divided by total assets. | Compustat |
| $Neg\_Gscore$ | The G-index developed by Gompers *et al.* (2003) to proxy for the number of anti-takeover provisions, then times -1. We update the G-index using the Institutional Shareholder Services (ISS) Governance database following the steps adopted by Kieschnick and Moussawi (2018). | ISS Governance |
| $G\_dummy$ | A dummy variable equal to one if $Neg\_Gscore$ is missing, and zero otherwise. | ISS Governance |
| $Institutions$ | The proportion of shares held by institutional blockholders. An institutional blockholder is an institutional investor who owns at least 5% of the firm's shares outstanding. | Thomson Reuters 13F |
| $Analysts$ | The number of analysts following a firm in a one-month window prior to the EPS announcement date. | I/B/E/S |
| **Panel D: Other variables** | | |
| $Distance\_DJ$ | The minimum distance measured in increments of 100 km between a firm's headquarters and the nearest Dow Jones branch. | Compustat |
| $Opacity\_DD$ | The absolute value of residuals from an annual cross-sectional regression within each industry that models the extent to which a firm's working capital accruals map into its past, present, and future operating cash flows (Dechow & Dichev 2002). | Compustat |
| $Outdir$ | The proportion of independent directors on the board. | BoardEx |
| $Big4$ | A dummy variable equal to one if a firm is audited by a Big 4 auditor, and zero otherwise. | Compustat |
| $Confidence$ | The moneyness of the CEO's vested stock options. We obtain the value per in-the-money option by dividing the value of all unexercised exercisable options by the number of options. Then, we scale the value per option by the stock price at the end of the fiscal year. | Execucomp |
| $NetBuy$ | The CEO's net purchase of the firm's equity shares, calculated as the natural logarithm of the number of shares purchased less the number of shares sold by the firm's CEO. | Thomson Reuters Insiders |
| $EquityComp_{CEO}$ | The natural logarithm of the CEO's equity-based compensation in the forms of stock and options (valued using grant date fair value). | Execucomp |
| $EquityComp_{executives}$ | The natural logarithm of the average equity-based compensation of all senior executives in a firm. | Execucomp |

## Appendix B: Post-matching mean differences

This table reports the post-matching mean differences in firm-level characteristics between high- and low-distance firms in the respective sample. We classify each firm-year into the high- or low-distance group based on the median value of $Distance\_DJ$ in the respective sample. $Distance\_DJ$ is the minimum distance measured in increments of 100 km between a firm's headquarters and the nearest Dow Jones branch. See Appendix A for variable definitions.

| **Panel A: Under-investment sample** | | | | | |
|---|---|---|---|---|---|
| | ***Mean*** | | ***Difference in means*** | ***t-test*** | |
| | High distance firms | Low distance firms | High minus Low | *t*-statistic | *p*-value |
| *Size* | 5.5647 | 5.5840 | -0.0193 | -0.71 | 0.479 |
| *MB* | 2.6795 | 2.7492 | -0.0697 | -1.15 | 0.252 |
| *σ(CFO)* | 0.0829 | 0.0847 | -0.0018 | -1.30 | 0.192 |
| *σ(Sales)* | 0.1994 | 0.2044 | -0.0050 | -1.64 | 0.101 |
| *σ(Investment)* | 0.1442 | 0.1453 | -0.0011 | -0.27 | 0.788 |
| *Z_Score* | 1.0631 | 1.0660 | -0.0029 | -0.12 | 0.902 |
| *Tangibility* | 0.2081 | 0.2069 | 0.0012 | 0.40 | 0.687 |
| *K_Structure* | 0.1509 | 0.1522 | -0.0013 | -0.42 | 0.672 |
| *Ind.K_Structure* | 0.1499 | 0.1492 | 0.0007 | 0.45 | 0.649 |
| *CFO/Sale* | -0.2295 | -0.2264 | -0.0031 | -0.12 | 0.903 |
| *Slack* | 5.1158 | 5.1675 | -0.0517 | -0.27 | 0.786 |
| *Dividend* | 0.3083 | 0.3085 | -0.0002 | -0.03 | 0.977 |
| *Age* | 2.5998 | 2.5844 | 0.0154 | 1.15 | 0.248 |
| *Operating_Cycle* | 4.6709 | 4.6563 | 0.0146 | 1.20 | 0.229 |
| *ROA* | -0.0344 | -0.0343 | -0.0001 | -0.03 | 0.978 |
| *Neg_Gscore* | -2.3679 | -2.4173 | 0.0494 | 0.90 | 0.369 |
| *G_dummy* | 0.6599 | 0.6539 | 0.0061 | 0.84 | 0.398 |
| *Institutions* | 0.1766 | 0.1774 | -0.0008 | -0.34 | 0.733 |
| *Analysts* | 5.6171 | 5.6820 | -0.0649 | -0.64 | 0.525 |
| **Panel B: Over-investment sample** | | | | | |
| | ***Mean*** | | ***Difference in means*** | ***t-test*** | |
| | High distance firms | Low distance firms | High minus Low | *t*-statistic | *p*-value |
| *Size* | 5.2631 | 5.2887 | -0.0256 | -0.66 | 0.510 |
| *MB* | 3.8757 | 3.7830 | 0.0927 | 0.65 | 0.516 |
| *σ(CFO)* | 0.1132 | 0.1120 | 0.0012 | 0.41 | 0.679 |
| *σ(Sales)* | 0.2129 | 0.2118 | 0.0011 | 0.23 | 0.815 |
| *σ(Investment)* | 0.2016 | 0.1995 | 0.0021 | 0.26 | 0.794 |
| *Z_Score* | 0.5368 | 0.4997 | 0.0371 | 0.67 | 0.501 |
| *Tangibility* | 0.2401 | 0.2414 | -0.0013 | -0.25 | 0.800 |
| *K_Structure* | 0.0952 | 0.0936 | 0.0016 | 0.48 | 0.629 |
| *Ind.K_Structure* | 0.1448 | 0.1450 | -0.0002 | -0.09 | 0.928 |
| *CFO/Sale* | -0.7276 | -0.7458 | 0.0182 | 0.26 | 0.796 |
| *Slack* | 5.8784 | 5.9025 | -0.0241 | -0.09 | 0.931 |
| *Dividend* | 0.2368 | 0.2472 | -0.0104 | -1.10 | 0.271 |
| *Age* | 2.3294 | 2.3240 | 0.0054 | 0.26 | 0.794 |
| *Operating_Cycle* | 4.5082 | 4.4788 | 0.0294 | 1.52 | 0.130 |
| *ROA* | -0.0961 | -0.0995 | 0.0034 | 0.48 | 0.632 |
| *Neg_Gscore* | -2.0730 | -2.1357 | 0.0627 | 0.82 | 0.411 |
| *G_dummy* | 0.6981 | 0.6895 | 0.0085 | 0.84 | 0.400 |
| *Institutions* | 0.1683 | 0.1681 | 0.0002 | 0.07 | 0.942 |
| *Analysts* | 6.4263 | 6.4214 | 0.0049 | 0.03 | 0.974 |

## Appendix C: The role of managers' equity-based compensation

This table presents the OLS regression results for the interaction effect of media coverage and managers' equity-based compensation on the magnitude of under-investment ($Inv\_Under$) and over-investment ($Inv\_Over$). $EquityComp_{CEO}$ is the natural logarithm of a CEO's equity-based compensation in the forms of stock and options. $EquityComp_{executives}$ is the natural logarithm of the average equity-based compensation of all senior executives in a firm. All the independent variables are lagged by one year relative to the dependent variable. See Appendix A for variable definitions. Intercepts are included but not reported. Cluster-robust *t*-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

| | [1] | [2] | [3] | [4] |
|---|---|---|---|---|
| ***Dependent variable =*** | ***Inv_Under*** | ***Inv_Over*** | ***Inv_Under*** | ***Inv_Over*** |
| *Media Coverage* | -0.5249*** | 1.0260*** | -0.5254*** | 0.9955*** |
| | (-5.12) | (3.57) | (-5.13) | (3.46) |
| *EquityComp $_{CEO}$* | -0.3463*** | 1.5156*** | | |
| | (-3.10) | (5.32) | | |
| *Media Coverage × EquityComp $_{CEO}$* | 0.0574*** | -0.2396*** | | |
| | (3.13) | (-5.70) | | |
| *EquityComp $_{executives}$* | | | -0.6258*** | 2.1446*** |
| | | | (-3.61) | (6.87) |
| *Media Coverage × EquityComp $_{executives}$* | | | 0.1029*** | -0.3611*** |
| | | | (3.78) | (-8.16) |
| *Controls* | Yes | Yes | Yes | Yes |
| *Industry-fixed effect* | Yes | Yes | Yes | Yes |
| *Year-fixed effect* | Yes | Yes | Yes | Yes |
| *N* | 15,688 | 6,912 | 15,692 | 6,919 |
| *Adj. $R^2$* | 0.430 | 0.105 | 0.430 | 0.105 |