MD&A disclosure and investment efficiency: evidence from Chinese listed firms

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MD&A Disclosure and Investment Efficiency: Evidence from Chinese Listed Firms

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Abstract

In this study, we investigate the relationship between a firm's forward-looking tone of the Management Discussion & Analysis (MD&A) section and its investment efficiency. Using a sample of Chinese listed firms from 2010 to 2019, our main findings show that firms with a more optimistic MD&A tone tend to present higher subsequent investment efficiencies. We further find that this positive link is stronger in firms that disclose higher text quality of MD&A, are non-state owned, and have fewer common owners. In addition, compared to their rival firms, firms with a more optimistic MD&A tone show higher investment efficiency. By contrast, their investment efficiency is not affected by rival firms' MD&A tone.

Keywords: MD&A; Information disclosure; Forward-looking text information; Investment efficiency; Text analysis

JEL: G11, G30, M41

Declaration of interest: None

1.Introduction

Corporate financial disclosure is key in alleviating information asymmetry and promoting efficient capital allocation. In recent decades, the Management Discussions and Analysis (MD&A) section, which is intended to explain a firm's financial statements for an information edge (Hoberg, 2016), has raised more attention among investors. Indeed, investors use MD&As as a significant supplement to firms' financial information in forming their expectations of the firm (Muslu et al., 2015), as MD&As play a vital role in conveying managers' prospects and strategic plans of a firm to the public (Eli and Baruch, 1996). Empirical studies show that the effective use of textual disclosures helps reduce information asymmetries between firms and stakeholders, which may lead to reduced firm risk (Kothari et al. 2009), improved market value (Wu et al. 2021), quicker capital structure adjustments (Wang et al. 2021), etc. However, managers' disclosure tones may not always contain incremental information. On the contrary, managers might opportunistically disclose low-quality MD&As for their self-interests (e.g., career development), or they might be "overconfident", reducing the predictive value of the information content (Gong, 2023; Arslan-Ayaydin et al., 2016).

Although a strand of literature on textual disclosure tone has emerged in the past several years, the majority of them explored the US context (Wu et al., 2021). Our study aims to test the relationship between firms' MD&A tones and their subsequent investment efficiencies. China provides a unique context to study this relationship for the following reasons. Despite China being the second-largest economy in the world, its financial regulations are less comprehensive compared with developed markets (Jiang and Kim, 2015). Specifically, requirements for MD&As are quite recent in China. In 2001, the China Securities Regulatory Commission (CSRC) set out the requirements for MD&As for the first time in the "Information Disclosure Content and Format Guidelines for Companies That Offer Securities to the Public No. 3 – Semi-annual Report". In comparison, the US Securities and Exchange Commission (SEC) first made a disclosure request for MD&As in 1968[1], and the UK in 1992[2]. Even though the Chinese government have made continuous efforts in improving the MD&A disclosure system over the past two decades[3], research studies have criticised its lack of consistent and sub-industry requirements (Jiang, 2014), insufficiency of forward-looking information (He et al., 2013), readability (Jiang, 2014), and so on. The under-regulation of MD&A disclosure deepens the information asymmetry between firm managers and stakeholders, which further leads to moral hazard and adverse selection problems. Considering the financial risks of biased or even manipulative MD&A disclosure in China, and the contagion risk it might bring to the global economy, it is important to provide more timely research evidence on MD&A disclosure in such an institutional background.

By utilising a sample of 1675 A-share listed firms in China from 2010 to 2019, our baseline results show that a firm's optimistic tone in MD&A disclosure is positively associated with its efficient investment level. Specifically, we find that an optimistic MD&A tone significantly reduces firms' levels of investment inefficiencies. This finding may indicate that MD&As effectively convey incremental information about the firm and should not merely be perceived as a secondary interpretation of quantitative information. Moreover, this association is stronger for firms that disclose a higher quality of MD&A, are non-state owned, and have fewer "common owners".

This research makes the following contributions to the literature. First, we contribute to the ongoing

debate between the informativeness perspective and the opportunism or overconfidence perspective. Our empirical findings endorse the informativeness perspective, which suggests that firms' forward-looking information disclosure significantly improves their information transparency and conveys their strategic plans effectively (Muslu et al. 2015; Huang et al. 2022). Specifically, while the majority of studies in this strand of literature focus on developed economies, we enrich the literature by adding empirical evidence from China (e.g., Wu, et al., 2021). While a recent study by Zhou et al. (2024) also explores the association between MD&A tone and investment efficiency in the Chinese context, we offer new contributions by using an updated and broader dataset, applying refined textual analysis and more robust identification strategies, and extending the focus beyond tone to also examine MD&A text quality (e.g., readability and specificity). Moreover, we explore additional heterogeneity, such as differences between over- and under-investment and the moderating roles of governance and financial constraints. These enhancements ensure that our findings provide novel and distinct insights into the MD&A-investment efficiency relationship. Second, this research also contributes to the literature that examines the determinants of investment efficiency which has previously studied corporate property rights, senior management characteristics, corporate financial conditions, environmental, social and governance (ESG) disclosure transparency, etc (Sun and Li, 2016; Dai and Kong, 2017; Chen and Xie, 2011; Hammami and Hendijani Zadeh, 2020). However, being limited by text analysis techniques (e.g., data mining), few studies have identified the relationship between firms' forward-looking textual disclosures and their investment efficiency. Our focus on MD&A tone provides an interesting yet underexplored perspective to the current literature.

The remainder of this article is organised as follows. Section 2 reviews relevant literature and presents the proposed hypotheses. Section 3 introduces our research design, samples, and data sources. Section 4 discusses empirical results and analysis. Section 5 tests the endogeneity and robustness of the model and analyses the results. Section 6 conducts extended research and Section 7 summarises the conclusion and enlightenment.

2. Theoretical Framework and Empirical Predictions

2.1 Information Asymmetry and Capital Investment Efficiency

Investment efficiency is a critical factor in a firm's future performance and competitive advantage. In the neoclassical framework, a firm's investment opportunities, measured by Tobin's Q, should be the sole determinant in its investment policy (Tobin, 1969). However, in practice, firms may deviate from the optimal level of investment due to information asymmetries between managers and stakeholders, which further leads to moral hazard and adverse selection (Myers, 1984). Models of moral hazard suggest that managers with private information may be inclined to maximise their personal welfare instead of acting in the interests of shareholders (Jensen and Meckling, 1976). Moreover, models of adverse selection suggest that even when managers act in the best interests of shareholders, they may still utilise their information advantage about the firm's prospects over investors and issue overvalued securities to maximise shareholders' value, resulting in *ex-post* over-investment of the capital raised (Baker et al., 2003). On the one hand, as a result of these

divergences in principal-agent incentives, managers may invest in risky or over-valued projects. For example, motives in "empire-building" and career development lure managers with free cash flow to overinvest (Jensen, 1986). On the other hand, investors are likely to understand this behaviour and ration capital investment, leading to under-investment (Stiglitz and Weiss, 1981; Lambert et al., 2007).

The endogenous relation between disclosure quality and information asymmetry is well recognised in the disclosure literature (e.g., Chen et al., 2007). Extant literature suggests that higher levels of disclosure quality can improve firms' investment efficiency by alleviating adverse selection and reducing moral hazard (Bushee et al., 2010; Bushman et al., 2011). For example, high-quality financial reporting information can be used by shareholders to monitor managers' investment behaviours and reduce sub-optimal levels of investment caused by moral hazard (e.g., Lambert, 2001). In addition, investors are less likely to capital ration or discount firms' securities when high-quality firm-specific information is disclosed to the public (e.g., Kanodia and Lee, 1998). Accordingly, firms' investment efficiencies may be improved via two channels: First, as the adverse selection costs reduce, firms' costs in raising external capital will also be reduced, resulting in higher levels of investment efficiencies. Second, managers are not likely to be successful in raising excess funds via issuing overvalued securities. This will reduce the levels of over-investment and *ex-post* under-investment following investors' adverse selection.

2.2 Forward-looking MD&A Tone

In recent decades, as a response to investors' growing needs for more forward-looking and "private" information in listed firms, governments across the globe have mandated and prioritised textual information disclosure. Indeed, textual information, in particular MD&As that are intended to explain a firm's financial statements (Muslu et al., 2015), is seen as an important supplement to firms' financial data and reflects the management's review and predictions of market trends and corporate strategic planning (Bochkay and Dimitrov, 2014Bradshaw, 2011; Guay, 2016). Stakeholders heavily rely on the MD&A section and perceive it as a rich depository of narrative disclosures.

Early studies on the information value of MD&As mainly use survey and rating methods in analysing MD&A information (Khlif and Souissi, 2010). It gives rise to two competing perspectives on MD&A disclosure: the "informativeness perspective" and the "impression management perspective". The informativeness perspective praises the predictive value and incremental information of MD&As in firms' performance, market reaction, and analyst forecasts (e.g., Barron et al., 1999; Clarkson et al., 1999). Optimistic language, under this view, reflects actual positive expectations rather than manipulation, which could improve market transparency and reduce information asymmetry (Li et al., 2023). More recently, researchers utilise text analysis technologies and provide timely evidence in the literature. For example, within the UK context where disclosure is not mandated by regulators, Bassyouny and Machokoto (2024) find that negative tone can convey genuine and important information about a firms' true prospects. So far, MD&A tone has been found to predict returns around financial statement fillings (Feldman et al., 2010; Li et al., 2019; Berns et al., 2022), operating performance (Davis and Tama-Sweet, 2012; Al Lawati et al., 2023), and peer firms' investment decisions (Durnev and Mangen, 2020; Cho and Muslu, 2021).

However, even though MD&As are mandatorily disclosed in a standardised format, managers still have some discretion in presenting the content (e.g., tone and readability) (Davis and Tama-Sweet 2012; Lo et al., 2017). In contrast to the informativeness perspective, the signalling theory, along with the impression management theory (e.g., Aerts, 2005; Merkl-Davies and Brennan, 2007; Rahmawati, 2025), suggests that corporate disclosures are not purely informative but may also serve as a tool to mitigate negative market reactions, sustain investor confidence, or promote managerial self-interest. In other words, MD&A tone is not always a neutral reflection of managerial outlooks. Instead, it may be shaped by signalling strategies, wherein managers selectively disclose information or adjust linguistic features to influence stakeholders' perceptions. Impression management manifests in MD&A disclosures in multiple ways, which include emphasising positive outcomes, minimising negative information, strategic obfuscation, and excessive optimism (Godfrey et al., 2003; Clatworthy and Jones, 2006). In a similar vein, the opportunism or overconfidence perspective argues that managers' discretion in voluntary information disclosures may lead to a biased tone, regardless of their intentions. Moreover, the impression management theory aligns closely with studies that employ the agency theory and suggest that managers may be incentivised to manipulate MD&A tone, especially in forward-looking statements. For example, managers are more likely to inflate tone when they are under equity-based compensation schemes (Arslan-Ayaydin et al., 2016) or before important events (Chen et al., 2024). Lee and Park (2019) add empirical evidence to this strand of literature and show that the financial expertise of audit committees curtails managerial opportunism in the form of an inflated MD&A tone. In addition, the psychology literature demonstrates that an individual's assessments of current and future events may be affected by their cognitive or dispositional characteristics (e.g., optimism), which in turn result in an overly positive or negative use of language in public statements (Scheier and Carver, 1993; Plomin et al., 1992). In regard to optimism in corporate disclosures, studies show that managers' disclosure tone can be unintentionally biased due to early career experiences (Davis et al., 2015), overconfidence (Gong, 2023), cultural background (Brochet et al., 2018), etc. Other characteristics that may affect MD&A tone include, for example, the age and gender of top management (Martikainen and Miihkinen, 2019).

Therefore, whether forward-looking MD&A tones are effective and accurate in conveying useful information to investors remains an empirical question. This leads us to two opposite hypotheses:

H1a Firms with an optimistic forward-looking MD&A tone have better subsequent investment efficiency, *ceteris paribus*.

H1b Firms with an optimistic forward-looking MD&A tone have lower subsequent investment efficiency, *ceteris paribus*.

Text quality refers to the amount of effective information contained in the text content. Previous studies show that self-serving managers are incentivised to obfuscate stakeholders via repetitive disclosures and strategic use of language in an MD&A, e.g., complex and vague expressions (Li et al. 2008). Repetitive disclosures are considered to be redundant and overwhelming for investors' information processing (SEC, 2003). Instead of conveying incremental information to investors, repetition may obscure non-repeated value-

relevant information and impair investment decisions (SEC, 2020), as a result of managerial opportunism. Moreover, high readability is conducive to promoting information transparency between firms and investors (Courtis, 1998). Managers may be incentivised to conceal negative information by adjusting the readability of MD&As (Li et al. 2008; Lo et al., 2017), and therefore, mislead investors' analysis (Tan et al., 2014) and delay market reactions (Arnold et al., 2012; Davis and Tama-Sweet, 2012; Ren and Wang, 2018; Li et al. 2008). Due to the hidden internal risks, firms with lower text quality face higher future stock price crash risk (Ertugrul et al., 2017), higher borrowing costs (Ertugrul et al., 2017), and a decline in investment efficiency (Aerts, 2001; Kim and Zhang, 2016; Meng et al., 2017). Therefore, we expect that when firms disclose higher-quality MD&As, the influence of optimistic forward-looking MD&A tone on subsequent corporate investment efficiency will be enhanced. On the basis of the above discussion, we propose the following hypothesis:

H2 The association between optimistic forward-looking MD&A tone and subsequent corporate investment efficiency is more pronounced with higher text quality (less repetition and higher readability).

In China, state-owned enterprises (SOEs) tend to have monopolistic power in terms of their market positions and information resources in an industry (Xiang and Yu, 2020; Han and Shi, 2020). SOEs also face higher reputational costs as their public images are linked with the government. To echo the government interventions in promoting disclosure quality, SOE managers are expected to disclose the firm's outlook in a neutral and objective tone. In addition, compared with non-state-owned enterprises (non-SOEs), SOE managers are restricted by government control in corporate strategies, including investment decisions. Therefore, we expect that in SOEs, managers' MD&A tone will have a weaker influence on investment efficiency.

H3 State control weakens the relationship between optimistic forward-looking MD&A tone and subsequent corporate investment efficiency

"Common ownership" refers to when large investors own shares in multiple firms in the same industry. On the one hand, common owners (i.e., diversified shareholders) have an information advantage in industry prospects (He et al., 2019), which may help managers to make better investment decisions. Common owners are also experienced in corporate governance and can monitor managerial opportunism in tone manipulation and investment decisions (Kang et al., 2012; Brooks, 2018). On the other hand, agency theory suggest that common owners prioritise their portfolio value maximisation over the firm's value maximisation (Hansen and Lott, 1996). In other words, common owners desire a corporate policy of internalisation of between-firm externalities (Hansen and Lott, 1996). Under the influence of common owners, firms are likely to arrive at a "market collusion" and reduce direct competition between them (Azar et al., 2018; Hansen and Lott, 1996). This may lead to lower incentives in investment activities (Akdoğu and MacKay, 2012), which may reduce investment efficiencies. Therefore, we expect common owners to weaken the relationship between optimistic forward-looking MD&A tone and subsequent corporate investment efficiency.

H4 The relationship between MD&A's forward-looking tone and the efficiency of corporate investment

is weaker in firms with more common owners.

3. Research design

3.1. Measure of forward-looking statements

We divide the disclosure content of the MD&A part into corporate development review and prospects. We refer to the 2016 China Securities Regulatory Commission's revised version of *Public Securities Disclosure Content and Format Guidelines No. 2: The Content and Format of the Annual Report* and Li et al. (2008). We also categorise the forward-looking information in the future outlook as: (1) the industry development prospects and market competition pattern; (2) listed firms' future business plans; (3) their capital requirements and capital sources; and (4) the risks, opportunities, and countermeasures in the development of listed firms. Appendix A is an example of the four types of forward-looking statements in MD&A.

The next step requires dividing the future outlook section of MD&A into five categories, i.e., four categories of forward-looking statements and a non-forward-looking statement. Each type of forward-looking statement is generally one or two sentences that belong to the typical short-text sentence classification. However, the support vector machine (SVM) model and term frequency-inverse document frequency (TF-IDF) classification methods have low accuracy when classifying short-text information. Accordingly, we use the most suitable short-text classification with the highest accuracy - the BERT model (Devlin et al., 2019) - to classify forward-looking statements. First, we mark the training samples. Specifically, we randomly select a total of 300 MD&A text data from different industries, manually judge whether each sentence of text information is a forward-looking sentence and mark the forward-looking sentences to ensure their correct categorisation. The sentence classification training set is no less than 1000 sentences, and the test set is no less than 500 sentences. Next, we train the classification model. The BERT model is a two-way encoding representation based on the depth transformer. The training principle is to calculate the relationship between each word in a sentence and other words, adjusting the significance of each word to obtain a context-related word vector (Vaswani, 2017). After classifying and training the training set, we introduce it to the test set for verification. It is generally believed that the classification accuracy is greater than 90%, and the classification accuracy of the training model can be accepted (Devlin et al., 2019). Since the classification accuracy of the test set in this paper is 95.3%, the trained model can be used for the text classification of MD&A forward-looking sentences.

3.2. Definition and calculation of the main variables

(1) Dependent variable ($INE_{i,t}$). On the basis of Richardson's (2006) corporate investment efficiency model, we calculate the expected normal investment level of listed firms and use the regression residuals of the model to measure the listed firms' investment efficiency. The estimated model is

$$\begin{aligned} Invest_{i,t} &= \beta_0 + \beta_1 Growth_{i,t-1} + \beta_2 Cash_{i,t-1} + \beta_3 Age_{i,t-1} + \beta_4 Size_{i,t-1} + \\ &\beta_5 Return_{i,t-1} + \beta_6 Invest_{i,t-1} + \sum_t Year_t + \sum_j Indu_j + v_{i,t} \end{aligned} \quad (1)$$

$Invest_{i,t}$ is the expected investment in Formula (1), and its calculation formula is as follows:

$$Invest_{i,t} = [Capex_{i,t} + Aquisition_{i,t} + R\&D_{i,t} - SalePPE_{i,t} - InvestMaintain_{i,t}] / A_{i,t-1} \quad (2)$$

where, $Capex_{i,t}$ is the capital expenditure, including the sum of net cash paid for fixed assets, intangible assets, and other long-term investments of enterprises. $Aquisition_{i,t}$ denotes spending for M&A, and $R\&D_{i,t}$ indicates R&D expenditure. $SalePPE_{i,t}$ refers to liquidation proceeds for assets, including the sum of net cash received from the disposal of fixed assets, intangible assets, and other long-term assets. $InvestMaintain_{i,t}$ is replacement investment, including depreciation of fixed assets, depletion of oil and gas assets, depreciation of productive biological assets, amortisation of intangible assets, and long-term deferred expenses. $A_{i,t-1}$ is the total assets at the beginning of the period.

The meaning of other variables in Model (1) is as follows: $Growth_{i,t-1}$ is the growth rate of a firm's operating income in the previous period used to indicate its possible investment opportunities (Richardson, 2006); $Cash_{i,t-1}$ is the cash assets of the previous period. $InvAge_{i,t-1}$ indicates the firm age lagged by one period; $Size_{i,t-1}$ is the log value of a firm's total assets in the previous period. A value of 1 is added to the variable to indicate a firm's asset size; $Return_{i,t-1}$ is the annual return on stocks in the previous period; $Invest_{i,t-1}$ is new investment in the previous period; $Year_t$ is an annual dummy variable; and $Indu_j$ is an industry dummy variable.

We refer to the model combination of Richardson (2006) and selects two dependent variable indicators: inefficient investment level ($ABS\_INE_{i,t}$) and underinvestment ($U\text{nder}_{i,t}$). $ABS\_INE_{i,t}$ takes the absolute value of the residual error after OLS regression for model (1) and uses it as the inefficient investment degree of the firm. A higher value of it indicates higher levels of investment inefficiencies. Because most of the listed firms in China have reduced investment efficiency due to insufficient investment, we define the variable underinvestment ($U\text{nder}_{i,t}$) as follows: if the regression residual of the model (1) is less than 0, then the value of $U\text{nder}_{i,t}$ is 1, 0 otherwise. The degree of inefficient investment ($ABS\_INE_{i,t}$) is a continuous variable, and underinvestment ($U\text{nder}_{i,t}$) is a dummy variable. Thus, we use the OLS method and the Logit method to estimate the degree of inefficient investment ($ABS\_INE_{i,t}$) and underinvestment ($U\text{nder}_{i,t}$).

(2) Independent variable ($FLS_{i,t}$). We build a measure of the tone of forward-looking statements on the basis of sentiment dictionary matching ($FLS_{i,t}$). Specifically, we calculate the text's sentiment orientation value by matching the vocabulary in the forward-looking statements with the sentiment dictionary. If the score obtained is positive, the text's sentiment is considered as positive; otherwise, it is considered negative. If the score obtained is zero, its sentimental tendency is neutral.

We use the BosonNLP semantic emotional dictionary[①], which contains positive and negative vocabularies and employs big data statistics and machine learning technologies. It analyses and calculates each word's sentiment score and accurately measures the sentiment value of text information. We constructed a sentiment dictionary on the basis of the BosonNLP semantic sentiment dictionary, negative word dictionary,

[①] It is a semantic analysis of commonly used sentiment words provided by the Boson Chinese Semantic Open Platform (https://bosonnlp.com/).

and degree adverb dictionary. Please see Appendix B for some examples of emotional words identified in this study.

We take the following steps in measuring MD&A tones:

First, we read the text data after word segmentation and calculate each word's initial sentiment score using the constructed sentiment dictionary. Next, when a degree adverb precedes an emotional word, we multiply its weight with the sentiment score. Corresponding to the weights of degree adverbs, we multiply the sentiment score by −1 when there is a negative word before the emotional word. Finally, we calculate and record the sentiment value of all clauses with an array (list). We determine the positive and negative sentiment scores of all texts by adding up each sentence's sentiment scores. The calculations are as follows

$$w_{p,i,t} = \sum_{q}^{n} sentiment\_word_{q,i,t} * deny_{q,i,t} * \deg ree_{q,i,t} \tag{3}$$

$$posS_{p,i,t} = posS_{p-1,i,t} + 1 * w_{p,i,t} \tag{4}$$

$$negS_{p,i,t} = negS_{p-1,i,t} + 1 * w_{p,i,t} \tag{5}$$

Where, w_p is the weight value of the sentence. $posS_p$ is the positive score of the p sentence, whereas $negS_t$ is the negative score of the p sentence. $sentiment\_word_q$ denotes the score of the q emotional word. $deny_q$ refers to the negative word before the q emotional word, and the value of $deny_q$ is −1. We multiply the sentiment score by $deny_q$ if a negative word exists before the emotional word. $degree_q$ represents the degree of adverb before the emotional word. We multiply the sentiment score if a degree adverb exists before the emotional word.

On the basis of prior studies (e.g., Li et al., 2014), we introduce the net affective tone to reflect the sentiment of forward-looking sentences. The measure of the forward-looking statements' tone ($FLS_{i,t}$) is structured as follows:

$$FLS_{i,t} = \frac{posS_{p,i,t} - \left| negS_{p,i,t} \right|}{posS_{p,i,t} + \left| negS_{p,i,t} \right|}. \tag{6}$$

(3) Additional independent variables ($StudyVar_{i,t}$). We construct several additional independent variables to test the Hypotheses H2, H3, and H4. It represents repetitive disclosure ($Sim_{i,t}$), text readability ($Read_{i,t}$), common ownership ($Cross_{i,t}$), and corporate ownership nature ($Nature_{i,t}$).

We calculate repetitive disclosure ($Sim_{i,t}$) using the TF-IDF method of the space vector model (VSM) as follows: First, after word segmentation, we calculate the TF-IDF value of the text term in the MD&A forward-looking sentence and represent the text as a vector. Each vector element corresponds to the weighted frequency of a term. Specifically, we transform each text into the vector form: $w_i = (w_{i1}, w_{i2}, \ldots w_{in-1}, w_{in})$, where w_i is the MD&A text, and w_{n1} is the occurrence frequency of a word in the text. Next, we compare the similarity of the MD&A in the previous two years by calculating the cosine angle between the vectors defined as follows:

$$v_t = (w_{i1}, w_{i2}, \ldots w_{in-1}, w_{in}) \tag{7}$$

$$v_{t-1} = (\varphi_{i1}, \varphi_{i2}, ...\varphi_{in-1}, \varphi_{in}) \tag{8}$$

We calculate the similarity ($Sim_{i,t}$) score as follows:

$$\begin{aligned} Sim_{i,t} &= wf \times VectSim(v_t, v_{t-1}) \\ &= wf \times \cos(v_t, v_{t-1}) \\ &= wf \times \frac{v_t}{\|v_t\|} \times \frac{v_{t-1}}{\|v_{t-1}\|} = wf \times \frac{v_t . v_{t-1}}{\|v_t\| . \|v_{t-1}\|} \end{aligned} \tag{9}$$

Where, wf represents the weighting factor of the similarity between word vector v_t in *t* and word vector $v_{t\text{-}1}$ in $t-1$. $Sim_{i,t}$ represents the similarity of the MD&A between years *t* and $t-1$.

Loughran and McDonald (2014) and Lo et al. (2017) suggest that factors such as the number of sentences, number of characters, text length, sentence length, and the number of professional terms used all affect text readability ($Read_{i,t}$). Based on this literature, we introduce two indicators - professional financial vocabulary ($Profession$) and complex Chinese words ($Complex$). Specifically, we utilise Python 3.6 to count the relevant vocabulary that appears in MD&A statistically and calculate the number of professional financial vocabulary and complex vocabulary used in the MD&A sections. Then, we calculate the memory size ($Length$) of each MD&A electronic file and use it as a proxy for text length and the number of sentences. Based on these measures, we calculate the text readability index as follows:

$$READ_{i,t} = \frac{Profession_{i,t} + Complex_{i,t}}{Length_{i,t}}. \tag{10}$$

We determine the nature of the business ($Nature_{i,t}$) based on data from the Chinese Stock Market Research (CSMAR) database, which provides information on listed firms' direct controlling shareholders. Firms identified as non-state-owned enterprises (non-SOEs) are coded as 1, while state-owned enterprises (SOEs) are coded as 0.

To identify common owners ($Cross_{i,t}$), we follow He and Huang (2017), Jones and Sharma (2001), and Pan et al. (2020). Specifically, shareholders holding at least 5% of a firm's shares are classified as "major shareholders." A shareholder is identified as a common owner if they are also a major shareholder in other listed firms within the same industry. We take the logarithm of the number of common owners of each listed company (plus one) annually to construct the index "common owners ($Cross_{i,t}$)" .

(4) Control variables ($Controls_{i,t}$). Following Pan et al. (2020) and Rahman (2023) , we include firm size ($Size_{i,t}$), debt-to-asset ratio ($Lev_{i,t}$), return on assets ($ROA_{i,t}$), fixed asset ratio ($PPE_{i,t}$), cash ratio ($Cash_{i,t}$), market value to book ratio Tobin's Q ($TQ_{i,t}$). We also control for ownership structure by including the shareholding ratio of the top ten shareholders on the board of directors (Ratio). In addition, to account for management characteristics, we include the average age (Age) and educational background (Edu) of the company's management team. Detailed definitions of all control variables are provided in Appendix 3. To further mitigate potential confounding effects from industry-specific or macroeconomic factors, we control for industry and year fixed effects.

3. 3. Empirical model

This study examines the impact of forward-looking tone in MD&A sections on corporate investment efficiency, while accounting for firm-specific factors such as distinctive strategic plans and internal governance structures. Drawing on the research methods of Pan et al. (2020), we employ a panel data regression model for the analysis, based on the following considerations. First, panel data allows us to control for unobservable firm-specific characteristics that are constant over time but may influence investment efficiency. Second, it enables us to account for time-varying macroeconomic conditions by including year fixed effects. Third, panel data enhances the robustness of our results by increasing the variability of the data, improving efficiency in estimation compared to purely cross-sectional analyses.

To test Hypotheses H1a and H1b, we construct the following panel data model:

$$INE_{i,t} = \alpha_0 + \alpha_1 FLS_{i,t} + \gamma Controls_{i,t} + \sum_t Year_t + \sum_j Indu_j + \varepsilon_{i,t} \quad (11)$$

Specifically, the dependent variable, investment efficiency ($INE_{i,t}$), is measured using two indicators: the level of inefficient investment ($ABS\_INE_{i,t}$) and under-investment ($U\text{nder}_{i,t}$). $ABS\_INE_{i,t}$ captures the degree to which a firm's investment deviates from its optimal investment level, while $U\text{nder}_{i,t}$ reflects whether a firm experiences insufficient investment. Together, these two measure the state of a firm's investment efficiency from different perspectives.

Since each type of forward-looking statement contains relatively limited text information, we aggregate the net sentiment tone across the four classified types of forward-looking statements in the MD&A to construct $FLS_{i,t}$. $Controls_{i,t}$ represents the set of all control variables, $Year_t$ is year fixed effects, and $Indu_j$ is industry fixed effects.

To verify H2–H4, we establish the following model:

$$INE_{i,t} = \alpha_0 + \alpha_1 FLS_{i,t\text{-}1} + \alpha_2 FLS_{i,t\text{-}1} \times StudyVar_{i,t\text{-}1} + \alpha_3 StudyVar_{i,t\text{-}1} + \gamma Controls_{i,t} + \sum_t Year_t + \sum_j Indu_j + \varepsilon_{i,t} \quad (12)$$

Where, $StudyVar_{i,t-1}$ is a set of additional independent variables constructed on the basis of H2–H4, which respectively represent the quality of MD&A text of the previous year ($Sim_{i,t-1}$,$Read_{i,t-1}$), the number of common owners ($Cross_{i,t-1}$), and the corporate ownership nature ($Nature_{i,t-1}$). The other variables in Model 12 are same as those in Model 11.

3.4. Data and samples

Our sample includes annual reports of 1,675 China's A-share listed firms from 2010 to 2019, focusing on the years after the 2008 financial crisis and before the COVID-19 pandemic. The MD&A sections analysed in this study are extracted from the "Board Report" section of the listed firms' annual reports. We use Python 3.6 to write regular expressions and retrieve MD&A text content through keyword-based filtering. The sample is refined through the following screening process: we exclude firms operating in the financial and real estate sectors, firms with liability ratios greater than or equal to 1 or less than 0, and firms with missing data. After applying these filters, the sample is composed of 1,113 listed companies and 10,002 firm-year observations. Corporate financial data, information on the ten largest shareholders, and data on the nature of

controlling shareholders are obtained from the CSMAR and Wind databases. MD&A text data are sourced from the annual reports disclosed by the firms. We mainly collected the annual reports from the Shanghai Stock Exchange and the Shenzhen Stock Exchange official websites. Then, we supplement the annual reports of some missing firms using their corresponding official websites and Sina Finance.

4. Empirical results analysis

4.1. Descriptive statistics

Table 1 shows the descriptive statistics. In terms of the dependent variables, the mean value of the inefficient investment (ABS_INE) indicator is 0.0466, the median is 0.030, and the standard deviation is 0.0641. The minimum and maximum values are 0.0001 and 0.9853, respectively, indicating substantial variation in inefficient investment across listed firms. The mean value of ($Under$) is 0.6571, and the standard deviation is 0.4747, indicating that only approximately 34% of the sample companies have made sufficient investments, while the majority exhibit signs of under-investment. In terms of the independent variables, the mean value of forward-looking sentences' (FLS) sentiment is 0.6168, with a standard deviation of 0.1278, and a minimum value and maximum value of −0.0940 and 1.000, respectively. This implies a strong overall positive bias in the sentiment of forward-looking disclosures. For the additional set of independent variables, the minimum and maximum values of Sim are 0.000 and 0.7818, and the readability index $Read$ ranges from 0.1131 to 24.7908, indicating significant heterogeneity in the quality of MD&A disclosures. $Nature$ has an average value of 0.7599, indicating that approximately 76% of the sample firms are private enterprises. $Cross$ has a maximum value of 1.9459, indicating that some listed firms have up to six chain shareholders. The average shareholding ratio of the top ten shareholders on the board (*Ratio*) is 54.945, with a standard deviation of 15.011, indicating a significant variation and a wide overall distribution range. The average age of the firm's management team (*Age*) is 49.314, with team ages mainly concentrated between 47 and 51 years old, ranging from a minimum of 35.600 years to a maximum of 61.000 years. The average education level *(Edu*) of the firm's management is 3.356, falling between junior high and senior high school levels, with a standard deviation of 0.486. The 25%-75% percentile range is 3.043-3.666, indicating that the majority have an education level between junior high and senior high school.

Table 1. Descriptive statistics results

	Mean	Std.	Median	P25	P75	Min	Max
ABS_INE	0.046	0.064	0.030	0.016	0.052	0.0001	0.9853
$Under$	0.657	0.474	1.000	0.000	1.000	0.000	1.000
FLS	0.616	0.127	0.575	0.497	0.651	-0.094	1.000
$Size$	21.87	2.038	22.211	21.446	23.080	1.0261	27.038
Lev	0.398	0.234	0.451	0.289	0.609	-0.002	8.611
ROA	0.046	0.340	0.033	0.012	0.063	-17.16	10.844
PPE	0.194	0.176	0.149	0.053	0.284	0.000	0.844
$Cash$	0.172	0.256	0.151	0.090	0.247	0.000	11.099
TQ	0.587	0.249	0.576	0.394	0.774	0.025	1.521
Sim	0.163	0.111	0.148	0.084	0.225	0.000	0.781
$Read$	6.194	2.060	6.172	4.843	7.575	0.113	24.790
$Nature$	0.759	0.427	1.000	1.000	1.000	0.000	1.000
$Cross$	1.098	0.788	1.234	0.639	1.602	0.000	1.945
$Ratio$	54.945	15.011	55.250	44.300	65.560	1.320	94.670

Age	49.314	2.982	49.363	47.354	51.312	35.600	61.000
Edu	3.356	0.486	3.411	3.043	3.666	1.000	6.000

4.2. Correlation Coefficient Matrix

Table 2 presents the correlation coefficient matrix of the independent variables. Among them, the correlation coefficient between firm size (Size) and liability ratio (Lev) is 0.44, indicating a strong positive relationship between them. This implies that during the expansion process, firms may rely more heavily on debt financing to support business growth. The correlation coefficient between firm size (Size) and the market-to-book ratio (TQ) is 0.58. This may suggest that larger firms generally have higher market valuations, or that the market holds more optimistic expectations regarding their future prospects. The correlation coefficient between the liability ratio (Lev) and the return on total assets (ROA) is - 0.26, indicating that higher leverage may negatively affect firms' operating performance. Higher liabilities may increase a firm's financial risks and interest expenses, thus squeezing the profit margin. Overall, the absolute values of the correlation coefficients among most variables are relatively small.

Table 2 Correlation Coefficient Matrix

	FLS	*Size*	Lev	*ROA*	*PPE*	*Cash*	*TQ*	*Tone*	*Sim*	*Read*	*Cross*	*Ratio*	*Age*	*Edu*
FLS	1.00													
Size	0.02	1.00												
Lev	-0.03	0.44	1.00											
ROA	0.01	0.00	-0.26	1.00										
PPE	0.02	-0.04	0.03	0.00	1.00									
Cash	0.01	-0.04	-0.11	0.07	0.02	1.00								
TQ	-0.04	0.58	0.37	-0.20	-0.05	-0.11	1.00							
Tone	0.30	-0.07	-0.09	-0.03	0.02	0.00	-0.09	1.00						
Sim	0.05	0.05	0.00	-0.04	0.02	0.01	0.00	0.09	1.00					
Read	-0.01	-0.01	0.00	-0.01	0.00	0.00	0.00	0.00	-0.02	1.00				
Cross	-0.04	0.17	0.00	0.15	-0.02	0.02	-0.03	-0.08	-0.09	-0.02	1.00			
Ratio	0.00	0.24	-0.04	0.11	-0.02	0.08	0.17	-0.02	0.02	-0.01	0.07	1.00		
Age	-0.03	0.36	0.14	0	-0.02	-0.04	0.2	-0.08	0.03	-0.01	0.11	0.08	1.00	
Edu	0.05	0.16	0.01	0.01	-0.01	0.04	-0.04	0.02	0.04	-0.02	0.05	0.07	0.06	1.00

4.3. Empirical regression results

In Table 3, we test H1a and H1b by examining the effects of forward-looking text tone (*FLS*) on inefficient investment (*ABS_INE*) and underinvestment (*Under*). The influence coefficient of FLS on ABS_INE is -0.0221, and the influence coefficient of *FLS* on $Under$ is -0.2853, both of which are statistically significant. The results show that optimistic forward-looking tone are associated with lower levels of inefficient investment, which confirms H1a. This may indicate that the information contained in forward-looking statements have incremental value and can reflect managers' analysis of market trends and predictions of the firm's future development. In terms of firm scale ($Size$) and debt ratio (Lev), the estimated coefficient of inefficient investment is significantly negative, whereas the underinvestment is significantly positive. This finding is consistent with the existing literature (Pan et al., 2020; Zhao et al., 2020). In the

regression results, the shareholding ratio of the top ten shareholders on the board of directors (Ratio) shows a significant positive association with both the firm's inefficient investment (ABS_INE) and under-investment (Under), with regression coefficients of 0.0003 and 0.0011 respectively. This suggests that when the equity is overly concentrated among the top ten board shareholders, the firm is highly likely to experience inefficient investment. Excessive equity concentration may enable major shareholders to gain absolute dominance in the decision-making process, resulting in a lack of diversity and rigor in decision-making. The regression coefficients of the average age of the corporate management (Age) on inefficient investment (ABS_INE) and under- investment (Under) are - 0.0031 and -0.0072 respectively, and both are statistically significant. This finding indicates that senior management with rich experience, in-depth industry insights, and mature decision- making abilities, can help reduce under-investment and effectively improve the firm's investment efficiency. In contrast, the impact of the average educational background of the management (Edu) on inefficient investment (ABS_INE) is only marginally significant at the 10% significance level, and its impact on under- investment (Under) is statistically weaker. This result implies that there may not be a strong linear relationship between the average educational background of the management and firms' investment efficiency.

Table 3. Impact of forward-looking statements on investment efficiency

	ABS_INE	*Under*
FLS	-0.0221***	-0.2853***
	(-2.69)	(-4.12)
Size	0.0051***	0.0022**
	(3.34)	(2.33)
Lev	-0.0042**	-0.5160
	(-1.86)	(-0.93)
ROA	-0.0013	0.0113
	(-0.99)	(0.77)
PPE	0.0341**	0.1370**
	(2.53)	(2.17)
Cash	0.0103**	-0.2030**
	(2.27)	(-2.11)
TQ	-0.0170**	0.1808***
	(-2.16)	(3.98)
Ratio	0.0003***	0.0011***
	(4.56)	(3.12)
Age	-0.0031***	-0.0072***
	(-6.52)	(-3.58)
Edu	-0.003*	-0.012**
	(-1.69)	(-2.03)

$Constant$	0.1351***	6.1120***
	(7.52)	(3.91)
$Indu$	YES	YES
$Year$	YES	YES
R^2	0.0557	0.0201
N	10002	10002

Note: *, **, and *** are significant at the 10%, 5%, and 1% levels, respectively. When Under is the explained variable, we use the Logit method to perform regression; otherwise, we use the z value in parentheses. The next estimation method is OLS and the t-value in parentheses. When Under is the explained variable, we report the pseudo R^2 of Logit regression in the R^2 column; otherwise, we report the adjusted R^2 of OLS regression. The same for the following tables.

Table 4 shows the empirical results of H2, in which the MD&A text disclosure quality variables ($StudyVar$) is replaced by text similarity (Sim) and text readability ($Read$). Forward-looking statements' (FLS) tone remains negatively associated with both investment inefficiencies (ABS_INE) and underinvestment ($Under$). The interaction term of *Sim* and *FLS* yields negative and significant coefficients for both inefficient investment (-0.0050) and underinvestment (-0.1025). The results show that the negative association is less pronounced for firms with more repetitive disclosures.

The estimated coefficients of the interaction term between inefficient and sufficient investment ($FLS \times Read$) are both significantly negative. This means that the readability of the text weakens the association between forward-looking tone and inefficient investment and underinvestment. Therefore, the empirical results in Table 4 are in line with our expectations and support H2. The higher quality of text disclosure indicates more incremental information in forward-looking statements and a more obvious investment efficiency promotion. It suggests that managers may be concealing negative information about the firm via repetitive disclosures of non-repeated value-relevant information and strategically adjusting the readability of their disclosures. Overall, the results support H2, i.e., higher text quality strengths the negative relationship between forward-looking tone and investment inefficiency.

Table 4. Impact of MD&A text disclosure quality

	Sim		*Read*	
	ABS_INE	*Under*	*ABS_INE*	*Under*
FLS	-0.0142**	-0.7223***	-0.0032**	-1.5172***
	(-2.30)	(-2.68)	(-2.43)	(-3.56)
$FLS \times StudyVar$	-0.0050***	-0.1025*	-0.0017***	-0.0788***
	(-2.60)	(-1.68)	(-3.10)	(-2.89)
$StudyVar$	0.0154***	-0.2344**	0.0010*	-0.0447***
	(3.85)	(-2.04)	(1.77)	(-2.89)
$Size$	-0.0126***	0.0227*	-0.0012***	0.0449**
	(-2.64)	(1.87)	(-2.66)	(2.14)
Lev	-0.0139**	0.1203	-0.0124***	0.0106
	(-2.56)	(1.13)	(-2.67)	(0.83)
ROA	-0.0012	0.0825	-0.0001	0.0106
	(-1.50)	(1.00)	(-0.80)	(0.60)

PPE	0.0117**	0.1867*	0.0130**	0.3907**
	(2.34)	(1.66)	(2.58)	(2.06)
$Cash$	0.0107***	0.1628	0.0143	0.1312
	(4.86)	(0.54)	(1.36)	(0.96)
TQ	-0.0212**	-0.0106**	0.0211**	-0.0018**
	(-2.15)	(-2.79)	(2.18)	(-2.67)
$Ratio$	0.0004***	0.0060**	0.0004***	0.0010***
	(4.57)	(2.39)	(4.55)	(4.83)
Age	-0.0030***	0.0476***	-0.0030***	0.0096***
	(-6.52)	(3.61)	(-6.49)	(4.98)
Edu	-0.0036*	0.0281	-0.0035*	0.0012
	(-1.72)	(1.38)	(-1.68)	(1.40)
$Constant$	0.0674***	-0.8430*	0.0643***	-0.9521**
	(7.60)	(-1.91)	(7.18)	(-2.00)
$Indu$	YES	YES	YES	YES
$Year$	YES	YES	YES	YES
R^2	0.0916	0.0204	0.0558	0.0206
N	9188	9188	10002	10002

Table 5 shows the empirical results of H3. We use the nature of the enterprise ($NATURE_{i,t}$) to indicate whether a listed firm is state-owned or non-state owned. The coefficients of forward-looking statements' (FLS) tone on inefficient investment (ABS_INE) and underinvestment ($Under$) remain significantly negative. By contrast, the interaction term's ($FLS \times N$ature) coefficients are significantly positive. SOEs are more restricted in their disclosure tones and are expected to be neutral and objective in communicating with the public. Hence, the results indicate that the negative association between forward-looking tone and investment inefficiencies is weaker in SOEs, supporting H3.

Table 5. Impact of corporate nature of listed firms

	ABS_INE	*Under*
FLS	-0.0082*	-1.2581***
	(-1.87)	(-5.56)
$FLS \times N$ature	0.0057**	0.4721***
	(2.01)	(4.41)
Nature	-0.0034**	-0.1365**
	(-1.96)	(-2.42)
$Size$	-0.0013***	0.0314**
	(-2.79)	(2.01)
Lev	-0.0128***	0.0966
	(-2.76)	(0.71)
ROA	-0.0001	0.0101
	(-0.80)	(0.60)
PPE	0.0127**	0.3740**
	(2.52)	(1.98)
$Cash$	0.0141***	0.1252**
	(4.35)	(2.54)
TQ	-0.0214**	-0.0018**
	(-2.17)	(-2.67)
$Ratio$	0.0004***	0.0001***
	(4.58)	(4.81)
Age	-0.0030***	0.0010***
	(-6.51)	(5.04)
Edu	-0.0034*	0.0012

	(-1.65)	(1.38)
$Constant$	0.0723***	-0.6662*
	(12.97)	(-1.85)
$Indu$	YES	YES
$Year$	YES	YES
R^2	0.0562	0.0212
N	10002	10002

Table 6 shows the empirical results of the tests of H4. The key explanatory variable is the interaction term between the number of chain shareholders ($Cross$) and the tone of forward-looking statements. The estimated coefficients of forward-looking tone (FLS) on inefficient investment (*ABS_INE*) and underinvestment (*Under*) remain significantly negative. The interaction term's ($FLS \times Cross$) estimated coefficients on inefficient investment and sufficient investment are both significantly negative, supporting H4. The results support the "market collusion" hypothesis, suggesting that common owners are more interested in maximising their portfolio value and may be incentivised to reduce investment activities to reduce direct competition between firms (Hansen and Lott, 1996).

Table 6. Impact of the number of common owners

	ABS_INE	*Under*
FLS	-0.0236**	-1.3401***
	(-2.12)	(-3.69)
$FLS \times Cross$	-0.0083**	-0.4114**
	(-2.07)	(-2.49)
$Cross$	0.0067*	-0.3792*
	(1.77)	(-1.71)
$Size$	0.0012**	-0.0352*
	(2.43)	(-1.81)
Lev	0.0126***	-0.1262***
	(2.70)	(-4.98)
ROA	0.0001*	0.0104
	(1.78)	(0.62)
PPE	0.0132***	0.3564**
	(2.61)	(1.98)
$Cash$	0.0142	-0.1274
	(1.33)	(-0.91)
TQ	-0.1001*	-0.5118**
	(-1.81)	(-2.43)
$Ratio$	0.0004***	0.0002***
	(4.46)	(4.78)
Age	-0.0029***	0.0009***
	(-6.45)	(4.83)
Edu	-0.0033	0.0014
	(-1.58)	(1.55)
$Constant$	0.0683***	-0.8134*
	(7.83)	(-1.88)
$Indu$	YES	YES
$Year$	YES	YES
R^2	0.0559	0.0211
N	10002	10002

5. Endogeneity and robustness tests

5.1. Endogeneity tests

The above empirical results show that optimistic MD&A tone is positively associated with higher investment efficiency. However, our results may have endogenous problems. One possible endogenous source is that listed firms with high investment efficiency and sufficient investment capacity are willing to disclose positive, forward-looking information, leading to sample self-selection bias. Another potential endogenous problem is that we may have disregarded other related factors. These factors may affect the content disclosed in forward-looking statements and their investment efficiency, resulting in biased regression results. On the basis of these two aspects, we use Heckman two-stage regression and instrumental variable method to test the above problems as follows:

(1) Heckman tests in two stages. To solve the estimation bias caused by the sample self-selection, we use Heckman's two-stage regression to eliminate this endogeneity problem. First, we construct a Probit regression model to calculate how a firm's financial conditions and corporate governance in the previous period affect their disclosure of optimistic forward-looking statements (FLS_Next) in the next period. The proposed model is as follows:

$$FLS\_Next_{i,t} = \theta_0 + \varphi Lag\_Controls_{i,t} + \mu_{i,t}. \quad (13)$$

The above model indicates whether a company disclosed a positive text tone in year *i*. Since firms tend to disclose positive tones, we take the average of all firms' forward-looking tones each year and define an above-average value as a positive tone; otherwise, we identify it as a non-positive tone. $Lag\_Controls_{i,t}$ is a collection of the following firm-level lagged variables: lagged firm size ($Lag\_Size_{i,t}$), lagged asset–liability ratio ($Lag\_Lev_{i,t}$), lagged profitability ($Lag\_ROA_{i,t}$), lagged growth ability ($Lag\_Growth_{i,t}$), and lagged fixed asset ratio ($Lag\_PPE_{i,t}$). Lagged cash ratio ($Lag\_Cash_{i,t}$) and lagged MD&A tone ($Lag\_Tone_{i,t}$) $\mu_{i,t}$are regression residuals. These variables are lagged because the management team releases forward-looking textual information on the basis of their financial condition and corporate governance in the previous period. Using Model (13), we construct an inverse Mills ratio (IMR) to capture the influence of the financial and corporate governance variables of the previous period on whether the company discloses positive and forward-looking text tone ($FLS\_Next_{i,t}$) and use it as a control variable. We add it to the model regression to correct the interference of potential selectivity bias on our results.

Columns (1) and (2) of Table 7 present the test results. From the results in Table 7, the inverse Mills ratio (IMR) has a significant impact on inefficient investment and underinvestment at the 5% significance level, indicating the presence of sample selection bias related to the management's disclosure of positive and forward-looking tone. Therefore, it is necessary to account for potential estimation bias that may be caused by sample self-selection. The influence coefficient of forward-looking statements' (FLS) emotional tone on inefficient investment and underinvestment remains significantly negative, consistent with the regression results in Table 3. Thus, even after controlling the selection bias, our conclusion still holds.

(2) Instrumental variable regression. Considering that we may have disregarded other related factors, which may affect the emotional tone of management's forward-looking statements and corporate investment efficiency, we apply the two-stage least squares method to alleviate such endogeneity concerns. We follow

the selection of instrumental variables in Xu et al. (2014) and Zeng et al. (2018). We employ the mean values of the forward-looking tone in the same industry and province in the same year (IND_year_FLS and PRV_year_FLS) as the instrumental variables of FLS. Furthermore, in order to avoid the impact of the forward-looking text tone disclosed by rivals in the same industry on corporate investment efficiency, we select the average forward-looking tone of firms that belong to the same primary industry classification and different secondary industry classifications as an industry's forward-looking intonation. These two variables meet the requirements of exogeneity and correlation at the same time. From the perspective of exogeneity, the forward-looking tone of the management of other firms in the same industry or the same province will not affect a firm's investment behaviours. From the perspective of correlation, because listed firms in the same industry and province face the same market trend and external environment, the forward-looking tone disclosed by the management is correlated, to a certain extent.

Columns (3), (4), and (5) of Table 7 show the test results, of which Column (3) is the first-stage regression result. The results show that a firm's forward-looking tone optimism is positively related with its rival firms' forward-looking tone in the same industry and province. Columns (4) and (5) are classified as the second-stage regressions. The regression coefficient of the forward-looking statements' (FLS) tone on inefficient investment and underinvestment remains significantly negative. Thus, our baseline results are supported.

Table 7. Endogeneity test: Heckman regression and instrumental variable regression

	ABS_INE	$Under$	FLS	ABS_INE	$Under$
	(1)	(2)	(3)	(4)	(5)
FLS	−0.0212**	−0.7155**		−0.1025***	−0.4077***
	(−2.32)	(−2.12)		(−8.33)	(−2.92)
IMR	0.0137**	0.6022*			
	(2.34)	(2.08)			
IND_year_FLS			0.0004***		
			(2.65)		
PRV_year_FLS			0.0008***		
			(9.58)		
$Constant$	0.3114**	−2.6584**	0.6555***	0.0754**	−0.0358**
	(2.57)	(−2.17)	(9.66)	(2.22)	(−2.30)
$Controls$	YES	YES	YES	YES	YES
$Indu$	YES	YES	YES	YES	YES
$Year$	YES	YES	YES	YES	YES
R^2	0.2367	0.0314	0.3088	0.1038	0.2531
N	8757	8757	10002	10002	10002

5.2. Robustness test

(1) Separate tests for overinvestment and underinvestment

Following prior studies (Chen and Xie, 2011; Dai and Kong, 2017), we define overinvestment as the absolute value of the positive (negative) residual of the Richardson (2006) model and underinvestment. If the regression residual in Model (1) is greater than 0, overinvestment (OVE_INE) is considered a residual value. Otherwise, it is a missing value. If the regression residual in Model (1) is less than 0, underinvestment (UND_INE) is considered an absolute value of the residual. Otherwise, it is a missing value. Table 8 shows

the regression results. A forward-looking tone does not affect overinvestment. Yet, it significantly negatively affects underinvestment at the 5% level. It indicates that the more optimistic a firm's forward-looking tone is, the less likely that the firm will over-invest. Consistent with the empirical results of this article, the conclusions are robust. The above empirical results verify the robustness of our conclusion.

Table 8. Test results of overinvestment and underinvestment

	OVE_INE	*UND_INE*
FLS	0.0038 (0.60)	−0.0073** (−2.51)
Constant	0.2511** (2.74)	0.0533*** (7.81)
Controls	YES	YES
Indu	YES	YES
Year	YES	YES
R^2	0.2155	0.1032
N	3429	6573

(2) Placebo test

We find that optimistic tones in forward-looking statements significantly reduces the firm's inefficient investment and underinvestment. However, it remains possible that this observed correlation is driven by random factors — for example, concurrent market events at the time of annual report release could independently influence firms' investment decisions. To address this concern, we conduct a placebo test. Following Ma et al. (2019), we extract the textual information released by MD&A in the part of future business outlook but cannot be considered forward-looking statements and define it as "pseudo-forward-looking statements." Accordingly, we construct two variables: (1) False emotional tone of forward-looking sentences ($Tone\_Pseudo\_FLS$) is obtained by calculating the net emotional value of pseudo-forward-looking sentences. (2) The proportion of pseudo-forward-looking sentences ($Rate\_Pseudo\_FLS$) is obtained by calculating the proportion of the total number of pseudo-forward-looking sentences in the MD&A outlook. We replace FLS in Model (11) with $Tone\_Pseudo\_FLS$ and $Rate\_Pseudo\_FLS$ for regression. The results of Model (11) may be driven by unobserved concurrent events. In this case, replacing variable FLS with pseudo-forward-looking statements cannot eliminate the events' impact on the regression results. The estimated results of $Tone\_Pseudo\_FLS$ and $Rate\_Pseudo\_FLS$ should be significantly negative. On the contrary, if the results are not affected by other concurrent events, the estimated coefficients of $Tone\_Pseudo\_LS$ and $Rate\_Pseudo\_FLS$ are not significant because the pseudo-forward-looking statements do not convey the management's analysis of market trend forecasts and company development. Thus, they do not affect the firm' future investment impact. Table 9 shows the placebo test results. The influence coefficients of $Tone\_Pseudo\_FLS$ and $Rate\_Pseudo\_FLS$ on inefficient investment and underinvestment are not significant, consistent with our expectations. Our empirical results are not affected by other concurrent events, and the research conclusions are robust.

Table 9. Placebo test results

	ABS_INE	*Under*	*ABS_INE*	*Under*
Tone_Pseudo_FLS	−0.0001 (−0.13)	−0.0001 (−0.05)		
Rate_Pseudo_FLS			−0.0001 (−1.01)	−0.1024 (−1.33)
Constant	0.1081*** (5.33)	−0.6788* (−1.72)	0.1022*** (6.71)	−0.6955* (−1.20)
Controls	YES	YES	YES	YES
Indu	YES	YES	YES	YES
Year	YES	YES	YES	YES
R^2	0.0933	0.1023	0.1053	0.0209
N	10002	10002	10002	10002

(3) Replace the independent variable

To eliminate the influence of potential optimism bias on our empirical results, we construct a revised forward-looking emotional tone (Adj_FLS) to replace the forward-looking emotional tone in Model (11) for regression testing. We calculate the revised forward-looking tone (Adj_FLS) by subtracting the average of all firms' annual forward-looking tone (Avg_FLS) from forward-looking tone (FLS). Table 10 shows the regression results. The impact of modifying the forward-looking tone (Adj_FLS) on inefficient investment and underinvestment is significantly negative at the 1% level. Even after excluding the optimism bias, positive tones are still negatively linked with corporate investment inefficiency and underinvestment. Thus, our conclusion is robust and reliable.

Table 10. Test results of replacement independent variables

	ABS_INE	*Under*
Adj_FLS	−0.0233* (−1.73)	−0.6988* (−1.81)
Constant	0.1020*** (6.88)	−0.8966** (−2.66)
Controls	YES	YES
Indu	YES	YES
Year	YES	YES
R^2	0.1221	0.0517
N	10002	10002

(4) Replace the dependent variable

When estimating investment efficiency on the basis of the Richardson's (2006) mode, we use two main methods to calculate investment opportunity indicators in the existing literature: the business income growth rate of listed firms used in the benchmark regression analysis and the use of their Tobin's q value (Dai and Kong, 2017). To increase our conclusions' robustness, we use the listed firms' Tobin's q value as a proxy indicator of investment opportunities. Then, we re-estimate the Richardson model and calculate the listed firms' inefficient investment (ABS_INE1) and underinvestment ($Under1$). Table 11 shows the re-regression results. The coefficients of positive, forward-looking text tone (FLS) on inefficient investment (ABS_INE1) and underinvestment ($Under1$) remain significantly negative at the 1% level, supporting and validating our

conclusions.

Table 11. Test results of replacement dependent variables

	*ABS_INE*1	*Under*1
FLS	−0.0171*	−0.7756*
	(−1.78)	(−1.81)
Cons tan t	0.8843***	−0.7130*
	(4.88)	(−1.76)
Controls	YES	YES
Indu	YES	YES
Year	YES	YES
R^2	0.7554	0.1558
N	10002	10002

6. Additional tests

6.1 Financing constraint mechanism test

A firm's capital holding largely determines its investment behaviours and decisions. Compared with firms with less financing constraints, firms with more financing constraints may suffer more from insufficient investment (Guo and Liu, 2019). Therefore, in order to clarify the mechanism between forward-looking tone and investment efficiency, and explore whether optimistic forward-looking tone can convey positive information about the firm to the capital market, so as to better obtain external financing to alleviate inefficient investment, this paper will further measure the degree of financing constraints of enterprises, and test whether the positive forward-looking tone can alleviate the financing constraints and reduce inefficient investment. The measurement methods of financing constraints mainly include cash-cash flow sensitivity, investment-cash flow sensitivity, KZ index, WW index, SA index and FI index, and so on. In comparison, the SA index contains the least endogenous financial variables, which can effectively avoid the endogenous interference of the model (Ju et al., 2013). FI index considers the institutional constraints of equity financing, and the effectiveness of the evaluation results is higher (Zhai et al., 2012). Therefore, this paper selects SA index and FI index to test the financing constraint mechanism.

The estimation results of SA index model are as follows:

$$SA_{i,t} = -0.737Size_{i,t} + 0.043Size^2_{i,t} - 0.040Age_{i,t} \quad (14)$$

Where, the larger the SA index, the lower the degree of financing constraints. The company size is the logarithm of the total assets of the firm at the end of each year. Enterprise age = current year of the firm - year of establishment of the firm.

The estimation results of FI index model are as follows:

$$FI_{i,t} = -8.530658\Delta PR_{i,t} - 0.4599886SIZE_{i,t} - 0.0030249SLACK_{i,t} - 2.453183CF_{i,t} / A_{i,t} - 1.304857SGR_{i,t} \quad (15)$$

Where, the smaller FI index, the lower the degree of corporate financing constraints. Changes in dividend per share (ΔPR) equals cash dividend per share of the current year minus cash dividend per share of the previous year. Firm size is the logarithm of the total assets at the end of each year; Slack = (cash+trading

financial assets+0.5)×inventory+0.7×accounts receivable (short-term borrowings)/net value of fixed assets; The proportion of cash flow to total assets (CF/A) is calculated by dividing the cash flow from operating activities by total assets; Operating revenue increment rate (SGR) = (operating revenue of this year - operating revenue of last year)/operating revenue of last year.

In order to test whether the financing constraint has an intermediary effect between a firm's forward-looking tone and investment efficiency, the following models are constructed:

$$FC_{i,t} = \alpha_0 + \alpha_1 FLS_{i,t-1} + \gamma Controls_{i,t} + \sum_t Year_t + \sum_j Indu_j + \varepsilon_{i,t} \quad (16)$$

$$INE_{i,t} = \eta_0 + \eta_1 FLS_{i,t-1} + \eta_2 FC_{i,t} + \gamma Controls_{i,t} + \sum_t Year_t + \sum_j Indu_j + \varepsilon_{i,t} \quad (17)$$

Where, FC is the financing constraint index, including SA index and FI index. The other variables are the same as before. In models (16) and (17), the main regression coefficients are α_1, η_1 and η_2. If α_1 is significant, and η_2 is significant, it indicates that the financing constraint mechanism has a partial or complete intermediary impact on MD&A tone and investment efficiency. The intermediary effect test results are shown in Table 12. Table 12 (1) shows that proactive MD&A tone has a significant impact on corporate financing constraints, indicating that a more optimistic forward-looking tone is associated with less financing constraints. The regression results in Columns (2) and (3) of Table 12 show that the regression coefficients of SA are significantly negative, indicating that lower levels of financing constraints reduce the levels of inefficient investment. When the FI index is used to measure enterprise financing constraints, the test results are shown in Columns (4), (5) and (6) of Table 12, which are the same as the conclusion of the SA index. Therefore, financing constraints play an intermediary role between firms' forward-looking tone and investment efficiency.

Table 12. Test results of intermediary effect of financing constraints

	SA (1)	*ABS_INE* (2)	*Under* (3)	*FI* (4)	*ABS_INE* (5)	*Under* (6)
SA		-0.0313***	- 0.3655***			
		(-5.03)	(-3.32)			
FI					0.0611***	0.0001***
					(5.01)	(22.01)
FLS	0.2168***	-0.0215**	-0.1788**	-0.0088*	-0.0204**	-0.7668*
	(3.12)	(-2.33)	(-2.65)	(-1.97)	(-2.61)	(-1.91)
Constant	-7.6588***	-2.1209***	3.4698***	1.2203*	0.0618*	8.0125***
	(-16.33)	(-4.28)	(9.33)	(1.87)	(1.95)	(8.66)
Controls	YES	YES	YES	YES	YES	YES
Indu	YES	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES	YES
R^2	0.8447	0.3255	0.1025	0.0066	0.2550	0.1203
N	10002	10002	10002	10002	10002	10002

Further, this paper tests whether MD&A forward-looking tone has a moderating effect on the impact of corporate financing constraints on corporate investment efficiency. The model is constructed as follows:

$$INE_{i,t} = \alpha_0 + \alpha_1 FC_{i,t} + \alpha_2 FC_{i,t} \times FLS_{i,t} + \alpha_3 FLS_{i,t} + \gamma Controls_{i,t} + \sum_t Year_t + \sum_j Indu_j + \varepsilon_{i,t} \quad (18)$$

The moderated effect test results of financing constraints and MD&A forward-looking tone are shown

in Table 13. It can be seen from Columns (1) - (4) of Table 13 that the regression coefficients of SA are significantly negative, and the cross-multiplication term (SA) and regression coefficient of financing constraint and forward-looking tone ($SA \times FLS$) are significantly negative, indicating that financial constraints weaken the relationship between forward-looking tone and investment efficiency. When the FI index is used to measure financing constraints, the test results are shown in Columns (5) - (8) of Table 13, which is the same as the conclusion of the SA index.

Table 13. Test results of moderated effect of financing constraints

	ABS_INE	*Under*	*ABS_INE*	*Under*
	(1)	(2)	(3)	(4)
SA	-0.0047***	-0.0579*	-0.0041**	-0.1618***
	(-3.77)	(-1.88)	(-2.01)	(-2.52)
$SA \times FLS$			0.0021*	0.0255*
			(1.72)	(1.81)
FLS			-0.0093*	-0.6542*
			(-2.01)	(-2.05)
$Constant$	0.0633***	-0.8669**	0.0635***	0.0553**
	(5.13)	(-2.33)	(3.78)	(2.21)
$Controls$	YES	YES	YES	YES
$Indu$	YES	YES	YES	YES
$Year$	YES	YES	YES	YES
R^2	0.0845	0.0113	0.1455	0.2015
N	10002	10002	10002	10002
	ABS_INE	*Under*	*ABS_INE*	*Under*
	(5)	(6)	(7)	(8)
FI	0.0033***	0.0069***	0.0075*	0.0331*
	(11.51)	(7.99)	(1.86)	(1.91)
$FI \times FLS$			-0.0208*	-0.0382*
			(-1.88)	(-1.82)
FLS			-0.0201***	-0.5443***
			(-3.55)	(-3.01)
$Constant$	0.1991***	-2.0355***	0.1073***	-1.2016**
	(6.81)	(-4.02)	(6.35)	(-2.86)
$Controls$	YES	YES	YES	YES
$Indu$	YES	YES	YES	YES
$Year$	YES	YES	YES	YES
R^2	0.1322	0.0445	0.0224	0.1445
N	10002	10002	10002	10002

The empirical results suggest that the forward-looking tone moderates the relationship between financing constraints and investment efficiency. A more optimistic forward-looking tone helps firms convey credible information to the market, easing access to external financing and significantly reducing financing constraints. Building on this, firms with a more positive forward-looking tone experience a stronger improvement in investment efficiency and a greater reduction in under-investment when financing constraints are alleviated. These findings indicate that positive disclosure tone not only facilitates external financing but also enhances firms' ability to invest adequately and efficiently once financial constraints are relaxed.

6.2 Competition mechanism test

In addition to the forward-looking statements of their own management on market judgement, the investment behaviours of enterprises may also be affected by the forward-looking statements of industry rivals MD&A. On the one hand, the MD&A disclosed by industry rivals conveys their financial information, corporate development, and investment plans to the corporate management, which may affect the focal company's next investment behaviours and plan (Durnev and Mangen, 2020). On the other hand, investors' attention and analytical capabilities are extremely limited (Egeth, 1973; Libby et al., 2002). When investing in the same industry, they tend to be biased toward market trends and companies that are confident in their future development (Xie and Lin, 2015). Therefore, if a firm is more optimistic than the MD&A disclosed by its industry rivals, it is likely to more easily obtain external financing and have more capital for investment. Some scholars also pointed out that corporate management usually seeks out the areas they have not been involved in from the MD&A information disclosed by rivals for future investment. In this way, they can avoid excessive commercial competition (Scharfstein and Stein, 2000), indicating that rival companies' MD&A text information usually does not affect an enterprise's investment efficiency.

We construct two variables to examine the impact of rivals' MD&A forward-looking statements on corporate investment efficiency: the industry forward-looking statement tone (IND_FLS) and the industry-mean-adjusted forward-looking tone ($CPT\_\_FLS$). We use the average value of all firms' forward-looking tone in the industry in the same year to obtain the former. We calculate the latter by subtracting the industry's average forward-looking tone from an enterprise's forward-looking tone. In particular, we use the three-level code of the National Economic Industry Classification to classify all listed companies. We consider those belonging to the same classification code as "rivals." We ensure that at least two listed companies belong to the same classification. The empirical model used is as follows:

$$INE_{i,t} = \alpha_0 + \alpha_1 \text{Competition}_{i,t} + \gamma Controls_{i,t} + \sum_t Year_t + \sum_j Indu_j + \varepsilon_{i,t} \quad (14)$$

The model includes the industry's forward-looking tone (IND_FLS) and the industry mean-adjusted forward-looking tone ($CPT\_\_FLS$). The remaining variables are similar to those in the other models.

Columns (1) and (2) of Table 14 show the impact of the tone of the industry's forward-looking statements (IND_FLS) on corporate investment efficiency. The variable does not significantly affect inefficient investment (ABS_INE) but has a negative effect on underinvestment ($Under$). The reason may be that the positive forward-looking tone of industry rivals will not only reduce the under-investment, but also lead to over-investment, and the over-investment of enterprises will increase the level of inefficient investment. However, a firm's certain investment behaviours may be adjusted by its rivals' forward-looking tone. Columns (3) and (4) of Table 12 show the impact of industry rivals' forward-looking tone ($CPT\_\_FLS$) on corporate investment efficiency. The rivals' forward-looking tone ($CPT\_\_FLS$) produces significantly negative effects on enterprises' inefficient investment (ABS_INE) and underinvestment ($Under$). The estimated coefficient of CPT_FLS in the regression for inefficient investment (ABS_INE) is −0.0125, which is slightly larger than in Table 3. An enterprise has a higher corporate investment efficiency when its forward-looking tone is more optimistic than its rivals. More optimistic firms may receive considerable attention from investors and have easier access to external funding for their investment activities. Corporate managers may

discover new investment opportunities when they compare their firms with rivals. This action may disclose more positive and optimistic forward-looking statements, increasing corporate investment efficiency. Therefore, the MD&A forward-looking text information of a firm's rivals will not affect its investment efficiency. If a firm's forward-looking text tone is significantly higher than its rivals in the same industry, its investment efficiency will be better.

Table 14. Empirical results of extended research

	ABS_INE	*Under*	*ABS_INE*	*Under*
	(1)	(2)	(3)	(4)
IND_FLS	-0.0168	−1.9114***		
	(−0.33)	(−3.11)		
CPT__FLS			−0.0125***	−0.6744***
			(−2.86)	(−3.21)
Constant	0.0677***	−0.0737	0.0776***	−0.1215
	(6.72)	(−0.56)	(5.72)	(−0.35)
Controls	YES	YES	YES	YES
Indu	YES	YES	YES	YES
Year	YES	YES	YES	YES
R^2	0.0225	0.0266	0.0553	0.0535
N	10002	10002	10002	10002

6.3 The Interaction Effect between Ownership Concentration and MD&A Information Content

The empirical results in Section 4.3 indicate that in firms with fewer chain shareholders (Cross), the positive association between the forward-looking tone in MD&A and investment efficiency is more pronounced. Considering that firms with fewer common owners are often accompanied by higher ownership concentration, this section further examines whether ownership concentration moderates the relationship between the forward-looking tone and investment efficiency by influencing the information content of MD&A disclosure, so as to deepen the mechanistic explanation of this phenomenon.

The test results of the interaction effect between ownership concentration (Ratio) and forward-looking tone (FLS) are presented in Table 15. As shown in Table 15, the impact coefficients of the forward-looking tone (FLS) on inefficient investment (ABS_INE) and under-investment (Under) are -0.0175 and -1.0113, respectively, both significantly negative. These findings are consistent with the earlier results, indicating that an optimistic forward-looking tone can play a meaningful role in keeping investment decisions efficient, thus confirming the fundamental information value of forward-looking information in MD&A.

The coefficients of the core interaction term ($FLS \times Ratio$) are 0.0003 and 0.0001, respectively, which are significantly positive. This suggests that ownership concentration enhances the relationship between the forward-looking tone and investment efficiency. With the increase in ownership concentration, the inhibitory effect of the optimistic tone on inefficient investment and under-investment becomes more pronounced. This implies that in firms with more concentrated ownership, the information content of the forward-looking tone in MD&A is higher. That is, the optimistic tone can more accurately reflect the firm's investment opportunities and business prospects, thereby providing more effective guidance for investment decisions.

In addition, the coefficient of ownership concentration (Ratio) itself is significantly positive, indicating that ownership concentration may inherently have a potential negative impact on investment efficiency due

to issues such as rigid decision-making or expropriation of minority shareholders' interests. However, the significantly positive result of the interaction term shows that the "governance effect" generated by ownership concentration through improving the information content of MD&A predominates. Concentrated ownership provides major shareholders with a stronger motivation to monitor, prompting more credible forward-looking disclosures, which in turn weakens the direct negative effect of ownership concentration on investment efficiency.

Table 15. Impact of the number of common owners

	ABS_INE	*Under*
FLS	-0.0175**	-1.0113***
	(-1.98)	(-3.16)
$FLS \times Ratio$	0.0003**	0.0001**
	(2.07)	(2.49)
$Ratio$	0.0004***	0.0002***
	(3.77)	(3.71)
$Constant$	0.0487***	-0.7132***
	(5.77)	(-3.91)
$Controls$	YES	YES
$Indu$	YES	YES
$Year$	YES	YES
R^2	0.0546	0.0223
N	10002	10002

7. Conclusion

In the context of Chinese listed firms, this study aims to test the relationship between a firm's MD&A forward-looking tone and its subsequent investment efficiency. We find that firms with a more optimistic tone in disclosures are associated with higher levels of investment efficiencies subsequently. Our findings endorse the informative value of MD&A's forward-looking tone for the firm's subsequent investment efficiency. In another word, MD&A's forward-looking tone is more likely to reflect managers' rational predictions about the firm's investment strategies rather than overconfidence or opportunistic behaviours. In addition, we find that the impact of MD&A's forward-looking tone on firm investment efficiency is weakened by lower text quality, state ownership, and more common owners. Furthermore, we find no association between peer firms' forward-looking tone and the firm's investment efficiency. However, the impact of a forward-looking tone on subsequent investment efficiency is more pronounced when the firm's tone is more optimistic than peer firms. Meanwhile, concentrated ownership strengthens the oversight of major shareholders, which increases the credibility of forward-looking disclosures in MD&A. This offers a clear explanation for the stronger relationship observed when common ownership is limited. In other words, ownership concentration serves as a boundary condition that raises the information content of MD&A and improves the effectiveness of forward-looking tone as a signal.

Furthermore, this study attempts to analyse the theoretical logic underlying the research by integrating signalling theory and agency theory. The positive association between an optimistic, forward-looking tone and investment efficiency is consistent with signalling theory. In the presence of information asymmetry

between management and external stakeholders, the forward-looking tone in the MD&A serves as a credible signal through which management conveys information about the firm's prospects. An optimistic tone communicates management's rational judgments regarding future investment opportunities, operational trends, and strategic plans, thereby reducing the degree of information asymmetry and alleviating the problem of adverse selection in the capital market (Muslu et al., 2015). This mechanism is validated by the results of this study.

Agency theory explains the boundary conditions of the aforementioned relationship by focusing on conflicts: (1) between management and shareholders. (2) among different types of owners. H3 (the moderating effect of state-owned ownership) reflects the unique agency dynamics inherent in state-owned enterprises (SOEs). Constrained by political objectives and administrative supervision, SOE management faces limitations in its ability to use tone as a strategic signal. This weakens the relationship between tone and investment efficiency, as the tone in such contexts is more likely to be neutral or symbolic. H4 (the moderating effect of common ownership) is consistent with the predictions of agency theory. Common owners prioritise the value of their investment portfolios over the efficiency of individual firms. They may therefore suppress competitive signals—such as an optimistic tone—to avoid disrupting industry collusion (Azar et al., 2018), which reduces the informational content of tone with respect to investment efficiency. In addition, the extended analysis on ownership concentration further supports agency theory. Higher ownership concentration strengthens the supervisory role of major shareholders, inhibiting management's opportunistic behaviours. This ensures that the optimistic tone reflects the firm's actual prospects rather than being manipulated, thereby enhancing the association between tone and investment efficiency.

Our findings offer several important practical implications. First, our results support regulatory initiatives that promote the disclosure of forward-looking textual information in MD&As. Regulators are encouraged not only to require the disclosure of forward-looking statements but also to establish more detailed guidelines on the content, scope, and quality standards for MD&As. Specifically, regulatory bodies should strengthen oversight mechanisms to reduce excessive optimism and ensure that disclosures are sufficiently informative rather than promotional (Cole and Jones, 2005; Su et al., 2023). Second, investors are advised to incorporate forward-looking tone analysis as part of their investment decision-making process. Given that a more optimistic MD&A tone predicts higher investment efficiency, sophisticated investors and analysts could develop systematic approaches (e.g., textual sentiment analysis) to extract meaningful signals from narrative disclosures (Loughran and McDonald, 2011). Third, our findings on text quality suggest that firms aiming to enhance investor trust and capital market outcomes should invest in improving the clarity and quality of narrative disclosures (Bonsall and Miller, 2017; Ertugrul et al., 2017). Fourth, our results regarding state ownership imply that government-linked firms may face unique disclosure challenges. Policymakers could consider designing differentiated disclosure standards for SOEs to enhance transparency and mitigate the potential political and reputational incentives that distort disclosure quality. Fifth, given the weakening effect of common ownership on the MD&A tone–investment efficiency relationship, antitrust regulators may need to closely monitor the influence of large institutional shareholders across competing firms. Recent studies (Azar et al., 2018; He and Huang, 2017) suggest that common ownership can reduce

competitive incentives, which may have spillover effects on corporate disclosures and investment behaviour. Regulatory discussions on common ownership disclosure requirements (e.g., in the U.S. and Europe) should thus also consider its impact on firms' disclosure credibility.

It is also important to point out the limitations. First, our empirical results should be carefully interpreted as they can only infer association instead of causality between forward-looking MD&A tones and subsequent investment efficiencies. Second, previous studies have criticised the low power of dictionary-based tone measures (Li et al., 2023). Therefore, similar to other studies that apply natural language text analysis techniques, our selection of MD&A tone measures and their reliability may affect empirical results. Lastly, in the depth in this paper, we did not further examine the effect of managerial characteristics and corporate governance mechanisms on the relationship between forward-looking MD&A tones and subsequent investment efficiencies. Future research could extend our study by incorporating board characteristics, CEO traits, or industry competition intensity to better understand the boundary conditions of the MD&A tone–investment efficiency relationship.

Notes

1. In Article 22 of the “Financial Data” section in the “Guides for Preparation and Filing of Registration Statements” issued by the SEC.
2. The Accounting Standard Board (ASB) proposed large firms to voluntarily include “Operating and Financial Review” in annual reports, which is of similar functionality to MD&As.
3. For example, in 2006, the “Information Disclosure Contents and Format Guidelines for Companies Offering Securities to the Public No. 11 – Prospectus for Issuing New Shares by Listed Companies” included additional requirements on MD&As. And in 2011, the Shanghai Stock Exchange published the “Working Memorandum on the 2011 Annual Report of Listed Companies - No. 5 - Requirements for Management Discussion and Analysis” and highlighted the importance of forward-looking information disclosure.

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Appendix A: Statistics of some emotional dictionaries

Positive emotion words	Fraction	Negative emotion words	Fraction	Negative words	Adverbs of degree	Weights
Investment	2.112	Insufficient	−0.927	Do not	100%	2
Increase	1.061	Loan	−0.813	Is not	Doubled	2
Competitiveness	1.305	Arrears	−0.943	Not	Very much	1.5
Income	3.303	Slow	−1.086	No	More	1
Advantage	1.185	Freeze	−2.143	Do not	Only	0.6
…		…		…	…	

Appendix B Examples of forward-looking statements

Information	Example	Source
Industry development prospects and market competition pattern	During the "Twelfth Five-Year Plan" period, coal work will clarify the "four major principles" of "large groups, large bases, large mines, and large passages." It will continue to promote mergers and reorganisations and develop large-scale enterprise groups as key tasks to increase billion-ton enterprises from five to ten. Increasing the utilisation and development of coalbed methane and improving the localization of coal mine equipment are also the key development directions of the "Twelfth Five-Year Plan."	Asia Union Development (002316.SZ) 2011 company annual report
Listed companies' future business plan	Deepen industrial reform and innovation and promote the high-quality development of various business sectors. Each business sector follows the layout of "stabilising the foundation, cultivating the core, and promoting association" to strengthen synergy and integration and drive new technology applications and independent innovation to promote business development. A quality upgrade is also required to move toward a new stage of high-quality development. We aim to make smart transportation construction the starting point, improve highway service level, focus on "smart logistics," deepen park management and business innovation, and explore the growth of e-commerce and small loan businesses in the direction of synergy and integration. Space emphasises land vitalization, the principle of real estate destocking, and the principle of steady expansion. The increase in trading business profit with innovative channels is the start of breaking through the bottleneck of risky projects.	Guodian Nanzi (600346.SH) 2018 annual report
Listed companies' capital needs and sources	In 2014, the estimated sales revenue was 4.320 billion yuan, the cost was 3.510 billion yuan, and the expenses were 505 million yuan. These values represent a year-on-year increase of 22.53%, 23.85%, and 2.01% compared with the previous year. The funds are planned to be put into use from 2014 to 2016. Future funding source arrangement: fixed assets depreciation and after-tax profit retained funds drawn by the company and equity or debt financing and other multi-channel financing channels to raise funds.	Ultrasonic Electronics (000823.SZ) 2013 company annual report
Risks, opportunities,	Medical service risk companies are engaged in medical	ST Hengkang

and countermeasures in the development of listed companies	services. Different diagnosis and treatment services are inevitably risky due to many factors. For example, medical career development is limited, patients have individual differences, medical conditions are diverse, doctors' quality has varying levels, and other force majeure factors. Moreover, the relationship between doctors and patients may become relatively tense. Once an unexpected situation occurs, the medical institution will bear the responsibility. This burden brings certain risks to medical service development. Given the population growth, the accelerated ageing process, and the implementation of new medical reform policies, the initial formation of the universal medical insurance system, the enhancement of residents' ability to pay, and the gradual release of the people's increasing health needs have gradually expanded the pharmaceutical consumption market. China has become one of the fastest-growing regions for pharmaceutical consumption and is expected to become the world's second-largest pharmaceutical market after the US.	(002219.SZ) 2014 company annual report

Appendix C Variable Definition

Variable name	Definition
Investment efficiency variables:	
ABS_INE	The absolute value of the regression residual of Model (1)
Under	When the regression residual of Model (1) is less than 0, it is 1. Otherwise, it is 0.
OVE_INE	If the regression residual of Model (1) is greater than 0, it is a residual value. Otherwise, it is a missing value.
UND_INE	If the residual of Model (1) is less than 0, it is the absolute value of the residual. Otherwise, it is a missing value.
*ABS_INE*1	Tobin's q value is the absolute value of the regression residual brought into Model (1) as a proxy indicator of investment opportunities.
*Under*1	Tobin's q value as a proxy indicator of investment opportunities is brought into Model (1). If the regression residual is less than 0, it is 1. Otherwise, it is 0.
Forward-looking statement variables:	
FLS	Calculated using Model (6)
FLS_Next	When the tone of the positive and forward-looking text is disclosed in the next issue, it is 1. Otherwise, it is 0.
*IND_*year*_FLS*	The average forward-looking tone of the same industry in the same year
PRV_year_FLS	Mean forward-looking intonation in the same year and province
Tone_Pseudo_FLS	Calculated by determining the net sentiment value of pseudo-forward-looking statements
Rate_Pseudo_FLS	Calculated by determining the total number of pseudo-forward-looking statements as a percentage of the total number of MD&A's outlook.
Avg_FLS	The average forward-looking emotional tone of all listed companies for the year
Adj_FLS	$FLS - Avg\_FLS$, where Avg_FLS is the annual average of FLS released.

IND _ FLS	The average forward-looking tone of all companies in the industry in the same year
CPT __ FLS	Calculated by subtracting the forward-looking tone of the company from the forward-looking tone of the industry
Interest variables:	
Sim	Calculated using Model (9)
Re*ad*	Calculated using Model (10)
*N*ature	Private enterprises are marked as 1, whereas SOEs are marked as 0.
Cross	Calculated by determining the number of shareholders of each company in the same year, only including those holding no less than 5% of shares in the company and companies in the same industry. A value of 1 is added to this data to obtain the logarithm.
Control variables:	
Size	Logarithm of total average assets
Lev	Total average liabilities divided by total average assets
ROA	Net interest rate
PPE	Fixed assets ratio
Cash	Cash ratio
TQ	Book-to-market ratio
Ratio	Proportion of equity held by the top ten shareholders before the board meeting
Age	The average age of the company's management team
Edu	The average education level of the company's management is: 1. Not attending school, 2. Elementary school, 3. Junior high school, 4. High school, 5. University, 6. Graduate school

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