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Article

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The interplay of real earnings management and investment efficiency: Evidence from the U.S.

Nedal Assad^{1*}, Aziz Jaafar¹ and Panagiotis D. Zervopoulos²

Abstract: The main objective of this study is to empirically examine the impact of REM on various aspects of investment efficiency, including overinvestment and underinvestment. By examining the interplay between these complex constructs, this research endeavors to provide deeper insights and contribute to a more comprehensive understanding of the intricate effects of real earnings management on investment efficiency. This study utilizes a sample of 11,172 firm-year observations from publicly listed companies domiciled in the U.S. The study employs two empirical techniques to examine the research hypotheses: the generalized method of moments (GMM) and multinomial logit with two-way dimensional clustering. By employing robust analytical techniques, this research contributes to the scholarly discourse surrounding REM and its effect in shaping present and future investment. The results demonstrate a robust negative relationship between these two variables. Specifically, a negative association exists between a controlled or low-level of real earnings management with underinvestment and overinvestment. These findings imply that REM is a critical determinant of investment efficiency. Therefore, reducing REM can enable firms to optimize their investments more effectively.

Subjects: Accounting; Business, Management and Accounting; Financial Accounting

Keywords: investment efficiency; real earnings management; underinvestment; overinvestment; agency theory

1. Introduction

Investment decisions are among companies' most important decisions, as they determine their growth, profitability, and long-term success. To make effective investment decisions, firms must take into account certain critical factors, including the presence of proficient and committed management teams, as well as access to sufficient capital (Biddle et al., 2009; Firth et al., 2015; He et al., 2019; Roychowdhury et al., 2019). Companies would make efficient investments by pursuing projects that yield positive net present values if all circumstances are ideal, and with no market frictions (Modigliani & Miller, 1958). However, in reality, managers make over- or under-investments when their private interests deviate from those of shareholders. These private interests could be related to real earnings management practice. Earnings management refers to the intentional actions taken by managers to alter the timing or structure of an operation, investment, or financing transaction with the aim of influencing the output of the accounting system (K. A. Gunny, 2010).



Real earnings management practices may fall under two contrasting theoretical viewpoints. First, the signalling perspective (efficiency theory of real earnings management (REM)) proposes that managers involved in REM convey confidential or private information to capital market participants to exemplify promising futuristic operating performance (K. A. Gunny, 2010). Second, the opportunistic managerial perspective is rooted in agency theory, where management tends to depart from the normative course of operational practices, driven by the managers' aspirations to mislead some stakeholders into perceiving that certain financial reporting targets have been achieved during the normal business process (Roychowdhury, 2006). REM can be shown in the form of intentional overproduction with the objective of diminishing the cost of goods sold and the deliberate reduction in research and development (R&D) spending to amplify earnings in the current financial timeframe. The ability of the firm to maintain a low-level earnings management can help the firm to mitigate investment inefficiency concerning both overinvestment and underinvestment.

By drawing on the above, the study examines the relationship between REM and its effect on investment efficiency by considering both overinvestment and underinvestment. In particular, the objective of the research is to examine this association to determine the impact of REM on investment efficiency by conducting a thorough analysis focusing on publicly listed U.S. firms using 11,172 firm-year observations covering the period 2000–2020. Prior studies have examined the impact of REM on investment efficiency under different settings but have not been comprehensively studied; hence, the theoretical motivation of this study aims to bridge this gap in order to enhance the knowledge of how REM and earnings manipulation can affect the decision of investment.

Our main results suggest that REM plays a crucial role in determining investment efficiency by testing the negative connection between REM and investment efficiency. Thus, the ability of firms to control and reduce the practice of REM could lead to more effective optimization of investments. Investment efficiency is an essential aspect as it reflects the ability of a firm to invest its resources effectively. REM could refer to manipulating financial statements to create an illusion of better earnings. The present study suggests that REM significantly impacts investment efficiency, which is consistent with prior research in this area. The results further demonstrate that a low level of REM is associated with better investment efficiency, and firms engaging in REM tend to underinvest in profitable projects. This is likely due to the misallocation of resources as a cause of the manipulation of financial statements. On the other hand, the results show that firms engaging in REM tend to overinvest in unprofitable projects. This is likely due to the overestimation of earnings resulting from the manipulation of financial statements. Overall, this study provides compelling evidence that REM is a critical determinant of investment efficiency. The findings suggest that reducing the practice of REM can enable firms to optimize their investments more effectively. Therefore, it is recommended that firms focus on improving their financial reporting practices to enhance investment efficiency.

The current paper seeks to make the following contributions to the existing literature on REM and investment efficiency. First, it assesses the influence of REM on a firm's performance in using its own resources. Second, it provides a basis for protecting investors and guiding them toward the correct investments. Third, a lower REM could allow constrained firms to attract capital by making their performance more visible to investors, thus enabling them to generate positive net present value (NPV) projects. Finally, regarding firms with ample capital, controlling and limiting REM can reduce adverse selection, limit managers' involvement in empire-building activities, and enable investors to monitor managerial decisions to prevent inefficient investments.

2. Background

Understanding the effect of earnings management on investment efficiency is vital for assessing the quality of investment decisions and the integrity of the financial market. In this paper, we chose to study the effect of real earnings management on investment efficiency because it has not been widely studied. REM occurs when managers choose to deviate from best practices in order to increase or decrease reported earnings (K. Gunny, 2005).

The decision to make the right investment is a crucial factor in determining the firm's growth and profitability. It is also crucial because it will impact the shareholders. On the other hand, earnings management has a great negative effect not only on the firms and shareholders but may go beyond that and impact the whole country's economy, for example, the WorldCom and Enron scandals.

The consequences of real earnings management can vary based on its impact, i.e., creating misleading financial statements that do not reflect the accurate financial position, which can mislead investors, creditors, and other stakeholders who may rely on it to make investment decisions, and providing a false image of a firm's growth, stability, and profitability.

If real earnings management is discovered, it can erode the confidence of the investors and their trust in the firms as they rely on accurate information to evaluate the firm's financial position, which can make them either less likely to invest in the company or withdraw their current investment in the firms, which may cause a fall in the stock price. Real earnings management practices can be considered unethical or illegal based on the country's jurisdiction, which may result in penalties or criminal charges against the involved manager. Real earnings management can damage the firm's reputation and public image and make it difficult to regain the trust of customers, investors, and suppliers, which can eventually lead to a reduction in sales and a decrease in the firm's market value. The cost of raising capital will increase as investors and lenders will require high-interest rates and more restrictive terms and conditions because of expected risk, and this may limit the firm's ability to access liquidity.

Distortion of the efficiency of investment will result in overinvestment or underinvestment based on the availability of liquidity, and this happens because of information asymmetry between firms and capital providers, causing adverse selections and moral hazard (Shen et al., 2015). Information asymmetry may increase because of earnings management, where the firm's activities are managed by managers, where the latest have more internal and sensitive information than the capital providers, giving them a chance to use these resources to serve their own interests (Bhutta et al., 2022).

Our study focuses on the U.S. stock market because it is the largest stock market in terms of market value and the number of listed firms. Second, the U.S. is the most diverse economy concerning the range of industries and sectors. Last but not least, the U.S. has a robust regulatory framework, transparency, and standards, such as the requirement of the Securities and Exchange Commission (SEC) and Sarbanes-Oxley Act (SOX), which enforced stringent punishments and penalties on lawbreakers.

3. Theoretical framework

This study adopts a number of theoretical frameworks, i.e., agency theory, accelerator theory, efficiency theory, and opportunistic theory, in explaining the link between earnings management and investment efficiency. Agency costs arise in firms operating under the separation of ownership and control setup due to conflicts between managers acting as agents and shareholder representatives acting as principals. The issue arises when such conflicts lead to a misalignment of incentives between these two groups, generally leading to inefficient investment outcomes characterized by overinvestment or by retaining non-profitable projects. This type of action stems from what is known as agency theory, where representatives (agents) responsible for managing a company prioritize their personal interests over and before representing principals succinctly Jensen and Meckling (1976).

Agency cost may result in different ways. First, moral considerations may impact investment risk choices, which may arise among insiders seeking to obtain private benefits of control in addition to economic factors such as ownership and compensation Uddin (2023). Managers might prioritize personal goals over shareholders' interests when rejecting risky investments affecting their returns, which ultimately lowers the firm's value (John et al., 2008). Furthermore, managers may

be incentivized not to stop loss-making projects primarily because of potential negative impacts on reputation or status; such behavior is harmful because it limits profitable opportunities for firms that potentially reduce shareholder value in proportion, according to Francis and Martin (2010). Second, information asymmetry between entities seeking funding seems problematic when external parties who lack sufficient knowledge devalue stocks prescribed at discounted prices requiring higher returns, as highlighted by Myers and Majluf (1984). As external capital providers perceive these entities as lacking quality and integrity, they would constrain funding, which may result in underinvestment.

The framework of accelerator theory assumes that as output levels rise, the level of capital formation increases. Firms are likely to adjust their investment level according to variations in demand if they are using capital at optimal levels. Hence, businesses considering investing decisions usually hinge on their expectations about future output based on current production and output rates (Gao & Yu, 2020). To make efficient decisions about investments, organizations must carefully weigh their financing options. When there is no market friction, the cost of both internal and external funding expenses remains the same. Therefore, the availability of internal capital resources would not influence or dictate how firms choose their investments.

Real earnings management can also be examined from two theoretical perspectives: the signalling perspective and the opportunistic managerial perspective. The signalling perspective suggests that managers convey confidential or private information to communicate positive future performance to stakeholders. While the opportunistic managerial perspective suggests that managers depart from the normative course of operation in order to mislead stakeholders and perceive the achievement of targets, this practice can be manifest as deliberate action, such as intentional overproduction to achieve a reduction in the cost of goods sold, strategic cuts in research and development (R&D) expenditure to inflate earnings within the current financial period, or by increasingly giving discount sales to increase the cash flow (Roychowdhury, 2006).

4. Literature review and hypotheses development

4.1. Investment efficiency

To make effective investment decisions, firms must consider certain critical factors, including the presence of skilled and committed management teams and access to sufficient capital (Firth et al., 2015). The notion of investment efficiency for a firm can be interpreted as the endeavor to engage in investments that possess a positive net present value, given the absence of economic friction (Biddle et al., 2009). This raises fundamental questions about the nature of efficiency and the suitable conditions for its attainment in the realm of economic activity. Despite the aforementioned considerations, it is worth noting that managers in practice may act in a manner that runs counter to the interests of shareholders, resulting in instances of either overinvestment or underinvestment that diverge from the optimal investment decisions. According to the prior literature, underinvestment exhibits the deliberate choice to forgo investment opportunities that display a positive net present value in the absence of adverse selection, which may cause a decline in the firm's value (Biddle et al., 2009; Jensen & Meckling, 1976). On the other hand, overinvestment demonstrates the decision to pursue projects with negative net present value (NPV) according to our earlier definition (Biddle et al., 2009).

The influence on investment risk choices stems not only from economic factors, such as ownership and compensation but also from the moral considerations of insiders seeking to obtain private benefits of control (Uddin, 2023). Managers' inclination to reject risky investment projects that could benefit shareholders may be due to their desire to prioritize their own private benefits over the interests of others (John et al., 2008). Eventually, managers' avoidance of higher-risk investments may eventually stem from their self-interest motivation and losing the potential to increase the firm's value. According to Francis and Martin (2010), managers may be incentivized to persist with operating loss-making projects due to the potential negative consequences of

discontinuing them, such as a reduction in current earnings or damage to the managers' reputation or status. The existence of information asymmetry between firms and investors can create an adverse selection problem that affects the cost of acquiring capital and investment decisions, as information asymmetry is a crucial factor that affects a firm's ability to raise funds and acquire capital to finance its investment decisions. The existence of information asymmetry between firms and their investors can have significant consequences. When investors possess only partial knowledge of a firm's financial condition, they may undervalue its stock by funding it at a discounted price and demand higher returns on investment, as highlighted by Myers and Majluf (1984). Limited access to information by external capital providers may cause them to perceive the entity seeking funds as lacking in quality or integrity, resulting in higher return demands and, ultimately, financial constraints that may lead to underinvestment.

4.2. Real earnings management

According to K. A. Gunny (2010), real earnings management refers to the intentional actions taken by managers to alter the timing or structure of an operation, investment, or financing transaction to influence the output of the accounting system. The comprehension of managers' tendency to use REM can be understood through at least two contrasting theoretical viewpoints. First, the signalling perspective (also called the efficiency theory of REM) proposes that managers involved in REM convey confidential or private information to capital market participants, which can be seen through promising future operating performance and diminishing debt and financing costs (K. A. Gunny, 2010). Al-Shattarat et al. (2022) and K. A. Gunny (2010) both argue that firms with the potential to exhibit superior future performance use REM as a means to signify such potential to the capital markets. Considering the costly nature of REM and its association with exorbitant expense, managers employ these practices in situations where the positive gains from communicating this information to the capital markets surpass the negative repercussions of REM (Zhao et al., 2012). Second, the opportunistic managerial perspective stems from agency theory. The notion of REM here lies as a departure from the normative course of operational practices, driven by the managers' aspirations to mislead some stakeholders into perceiving the achievement of specific financial reporting targets during normal business proceedings (Roychowdhury, 2006). An illustration of REM can take the form of intentional overproduction to diminish the cost of goods sold and the deliberate reduction in R&D spending to amplify earnings in the current financial timeframe and relax the credit terms to boost reported revenues Bimo et al. (2022). Taking into consideration that this illustration of REM can take different forms yet extend beyond our examples. Habib et al. (2022) posit that real earnings management masks the actual performance of the firm and diminishes the effectiveness of accounting metrics as an instrument for assessing and monitoring the firm.

Managers may shift between opportunistic behavior and efficient contracting theory depending on the circumstances. Ewert and Review (2005) argue that earnings management can be reduced by utilizing stricter accounting standards and presenting more relevant information to the capital market. The standard setter can influence only accounting earnings management based on the strictness level of the standard. The tighter the standards, the higher the enhancement of earnings quality. There are also potential drawbacks associated with adopting an efficient contracting theory. First, managers may resort to costlier real earnings management because higher earnings quality increases the benefits derived from such practices. Second, stricter standards may increase both expected accounting and total earnings management. Lastly, there may be an anticipation of a rise in the total costs of earnings management, which could result in inefficient investment decisions.

4.3. Real earnings management and investment efficiency

The presence of information asymmetry between firms and capital providers can significantly affect the relationship between REM and investment efficiency. This asymmetry can create a situation where moral hazards and adverse selections may arise, which will result in either overinvestment or underinvestment, depending on the availability of capital. For instance, firms

tend to overinvest where significant resources are available. On the contrary, capital suppliers may recognize this issue and restrict capital ex-ante, leading to underinvestment. Thus, the enhancement of financial reporting quality may help mitigate the impact of information asymmetry, which eventually leads to improved investment efficiency (Biddle et al., 2009). The phenomenon of accruals management impact investment decisions through the external financing channel. Empirical evidence suggests that firms engage in discretionary accrual management to procure financing by demonstrating abnormally high levels of positive accruals in the periods leading up to stock issuances (DuCharme et al., 2004; Shivakumar, 2000). Firms engaging in REM are in a state where their actions deviate from the normative practices that define the essence of a business entity. Consequently, this departure can trigger a decline in its subsequent operational performance (Ewert & Review, 2005).

Managers may manipulate firms' earnings by selectively reporting pension assets to the capital markets. This manipulation may involve altering investment decisions to provide a justification for the misrepresentation of pension assets (Bergstresser et al., 2006). In other words, managers may manipulate how they present or disclose information about their pension assets to make them appear more favorable or valuable than they actually are, either by overstating the value of their pension assets or by understating the association of their costs or risks. This may lead to a misrepresentation of the firm's true financial health and performance, which can affect investment decisions made by the capital markets.

The information asymmetry arising from REM can result in an adverse selection problem between managers and capital providers, leading to investors' inefficient allocation of resources. The absence of monitoring of the agents' behavior by the principal creates a moral hazard, where managers can exploit information asymmetry scenarios to induce achieving earnings benchmarks for personal gains in private contractual agreements instead of maximizing the firm's value (D. A. Cohen & Zarowin, 2010; Kothari et al., 2016; Roychowdhury, 2006). As a result, a decrease in REM will reduce information asymmetry, and as Biddle and Hilary (2006) demonstrate, diminishing information asymmetry between managers and suppliers results in a decline in cash flow sensitivity, which in turn enhances investment efficiency. Roychowdhury (2006) also reports that the opportunistic deployment of aggressive price discounts to augment sales volumes engenders the expectation among customers' anticipation of future discounts and ultimately undermines long-term cash flow. Consequently, REM heightens information risk and lowers the caliber of the all-encompassing information milieu, culminating in significant unfavorable effects with negative consequences. This practice undermines long-term cash flow; eventually, it will result in underinvestment. Furthermore, García Lara et al. (2016) argue that financial reporting quality can limit opportunistic behaviors. Additionally, in cases where firms tend to underinvest, financial reporting quality can improve their access to financial resources, thereby decreasing the likelihood of underinvestment. Considering the above, we develop the following hypothesis:

H1: There is a negative association between controlled or low levels of REM and underinvestment

Biddle et al. (2009) posit that high-quality financial reporting may serve as a deterrent for managerial behaviors that diminish value, such as empire-building, in companies with abundant cash leading to overinvestment. Additionally, McNichols and Stubben (2008) examine intentional misreporting and its influence on investment efficiency. Specifically, firms are subject to accusations of earnings manipulation and later misrepresentation of their financial statements. By looking at the effect of substandard financial reporting on investment decisions, they found that firms may engage in unwarranted investment and are more likely to engage in excessive investment. Agency theory suggests that managers may engage in overinvestment practices with the intention of safeguarding their personal interests. This

achievement is made possible through the allocation of available cash reserves toward negative net present value projects (Jensen & Meckling, 1976). Drawing on this line of arguments, we develop our second hypothesis:

H2: There is a negative association between controlled or low levels of REM and overinvestment.

5. Research design

5.1. Data sample and selection

The current study uses data from U. S. public companies, covering a time frame ranging from 2000 to 2020, and the accounting data is downloaded from the Refinitiv Eikon database. Our dataset does not include financial institutions such as banks and insurance companies (SIC codes from 6000 to 6799), public administration organizations (SIC codes from 4311 and above 9000), and firms operating in regulated industries (SIC codes from 4400 to 5000). We exclude from our sample firms with activities categorized in the SIC above in alignment with previous research (Burgstahler et al., 2006; Van Tendeloo & Vanstraelen, 2011). The exclusion of these firms is due to their distinct investment characteristics in comparison with the remaining firms in the dataset. The final sample size comprises 11,172 firm-year observations after eliminating missing values during the sample period. Table 1 shows the sample selection criteria, and Table 2 includes the variables' description and measurement.

5.2. Dependent variable -investment

In this study, we investigate the relationship between REM and investment. Specifically, we examine the impact of a controlled or low level of real earnings management LREM¹ on the likelihood of firms engaging in either overinvestment or underinvestment. To measure this relationship, we employ Biddle et al. (2009) model to test whether a negative or positive association occurs between LREM and the probability of overinvestment or underinvestment. This model reads as follows:

$$\begin{aligned}
 INV_{i,t+1} = & \alpha + \beta_1 LREM_{i,t} + \beta_2 LREM_{i,t} * OF_{i,t+1} + \beta_3 OF_{i,t+1} + \beta_4 Gov_{i,t} \\
 & + \beta_5 Gov_{i,t} * OF_{i,t+1} + \sum_{j=1}^{11} \gamma_j Cntrl_{j,i,t} + \epsilon_{i,t+1}
 \end{aligned} \tag{1}$$

where $INV_{i,t+1}$ refers to the total investment made by a firm, which is the net increase in both tangible and intangible assets. This measure is then scaled by the lagged total assets suggested by Gomariz and Ballesta (2014). $LREM_{i,t}$ is one of three different measures of REM put forth by Roychowdhury (2006) (see Section 5.3.1). Higher value LREM represents operating under normative level while lower value would present deviation from the norm, which may indicate high REM practice. $OF_{i,t+1}$ is a rank variable that is used to differentiate between overinvestment and underinvestment. In particular, when a firm engages in overinvestment, the value of OF increases. Conversely, when a firm engages in underinvestment,

Table 1. Sample selection

Publicly listed firms in the U.S. stock market	5,917
Less: Financial companies	(1,143)
Total Non-Financial firms listed	4,774
Less: Public administration and regulated Industries	(397)
Less: Firms with incomplete information	(3,845)
Total sample (Firms)	532
Observation period (Year)	21
Number of observations (Firm- Year)	11172

Table 2. Variable description and measurement

Variables	Function	Description
$INV_{i,t+1}$	Dependent variable in equation models (1), (5), and (6)	Total investment is defined as the net increase in both tangible and nontangible assets and scaled by lagged total assets.
$LREM_{i,t}$	Independent variable in equation models (1), (5), and (7)	one of three different measures of REM result used in equation models (2), (3), and (4).
$OF_{i,t+1}$	Independent variable in equation models (1) and (5)	Over Firm proxy consist of two partitioning variable, liquidity, and leverage; increases at a high level of cash and low leverage and decreases at a low level of cash and high level of leverage.
$Gov_{i,t}$	Independent variable in equation models (1) and (5)	Governance measure represents the average of two variables: the percentage of institutional investors who invest in the firm and the number of financial analysts who track and follow the firm, according to IBES.
$PRD_{i,t}$	Dependent variable in equation model (2)	The production represents the sum of the cost of goods sold and the change in the inventory.
$Asst_{i,t-1}$	Scaling factor is used to normalize or rescale the equation used in equation models (2), (3), and (4).	Lagged total assets for firm in the year ().
$Sale_{i,t}$	Independent variable in equation models (2),(3), and (4)	Annual sales for firm for year .
$\Delta Sale_{i,t}$	Independent variable in equation models (2) and (4)	Change in annual sales from to .
$\Delta Sale_{i,t-1}$	Independent variable in equation model (2)	Change in annual sales from to .
PR	Residual from equation model (2) and one of the three LREM measures in equations (1), (5), and (7)	Proxy for measuring the abnormal level of production, a lower PR represents a higher level of REM and abnormal level of production and vice versa
$DIS_EXP_{i,t}$	Dependent variable in equation model (3)	The sum of advertising, research and development, and selling, general and administrative expenses (SG&A), according to D. Cohen et al. (2020).
DI	Residual from equation model (3) and one of the three LREM measures in equation (1), (5), and (7)	Proxy for measuring the abnormal level of discretionary expenses, a lower DI represents a higher level of REM and an abnormal level of discretionary accrual and vice versa.
$CFO_{i,t}$	Dependent variable in equation model (4)	Cash from operating activities.
CF	Residual from equation model (4) and one of the three LREM measures in equations (1), (5), and (7)	Proxy for measuring the abnormal level of cash flow. A lower CF represents a higher level of REM and an abnormal level of cash flow and vice versa.
$SGrowth_{i,t}$	Independent variable in equation model (6)	Sales growth represents the percentage change in sales from year $t-1$ to t .

(Continued)

Variables	Function	Description
MTB	Control variable in equation models (1),(5), and (7)	The ratio of the market value of total assets divided by the book value of total assets.
DIV	Control Variable in equation models (1),(5), and (7)	A binary variable equals one when the company distributed dividend and zero otherwise.
AGE	Control Variable in equation models (1),(5), and (7)	The time gap between the initial year of the firm's appearance in Eikon and the calculated year.
K_S	Control Variable in equation models (1),(5), and (7)	K-Structure expresses the proportion of long-term debt to the total of long-term debt to the market value of equity.
IND_K_S	Control Variable in equation models (1),(5), and (7)	Industrial K-Structure represents the average K-Structure for companies belonging to the identical SIC code of each industry.
BNKRUPT	Control Variable in equation models (1),(5), and (7)	Bankruptcy is measured by deploying Taffler's (1983) z-score as a proxy (ZSCORE).
CFOTSALE	Control Variable in equation models (1),(5), and (7)	The ratio of cash flow from operation to revenue sales.
S_SALE	Control Variable in equation models (1),(5), and (7)	The standard deviation of sales is based on five years divided by average total assets.
S_I	Control Variable in equation models (1),(5), and (7)	The standard deviation of cash flow from investing is based on five years divided by average total assets.
S_CFO	Control Variable in equation models (1),(5), and (7)	The standard deviation of cash from operating activities is divided by the average total assets.
OPCYCLE	Control Variable in equation models (1),(5), and (7)	The operating cycle is expressed by the logarithm of accounts receivable to sales plus inventory to cost of goods sold multiplied by 360.

the value of OF decreases (see Section 5.3.2). $Gov_{i,t}$ is a corporate governance variable that is expressed by two proxies (see Section 5.3.3). $Cntrl_{j,i,t}$ represents a set of control variables (i.e., we incorporate 11 control variables in the analysis—see Section 5.4).

To evaluate the validity of the first hypothesis (H1) that postulates a negative relation between LREM and investment when underinvestment is most likely, we utilize the sign (positive or negative) of the coefficient assigned to LREM. Specifically, we expect a positive sign (H1: $\beta_1 > 0$), which indicates that LREM will increase investment when underinvestment is more likely to occur. This coefficient measures the strength of the association between investment and REM in scenarios where underinvestment is more probable to occur. Specifically, we examine the causal relationship between investment and LREM in situations where underinvestment is most likely to occur.

The coefficient β_2 captures the extent of incremental relation between LREM and investment when overinvestment is likely to occur, while the joint effect of the main interaction coefficients

$(\beta_1 + \beta_2)$ measures the relationship between LREM and investment during periods of heightened overinvestment. Thus, we use the collective impact of these coefficients to examine the hypothesized relationship in H2 (i.e., H2: $\beta_1 + \beta_2 < 0$). Ultimately, the coefficient of the interaction between overinvestment and LREM is expected to be negative (i.e., $\beta_2 < 0$).

In evaluating the link between investment and LREM, we turn to the coefficients β_1 and $\beta_1 + \beta_2$. The coefficient β_1 reflects the relationship between REM and investment for companies with significant leverage and insufficient cash, whereas $\beta_1 + \beta_2$ assesses the association between LREM and investment for firms with ample cash and minimal debt. By testing H1 and H2, which propose a negative relationship between LREM and underinvestment (H1: $\beta_1 > 0$) and overinvestment (H2: $\beta_1 + \beta_2 < 0$), we can determine the interplay between these concepts. In particular, the coefficient β_2 provides insight into the relation between REM and investment in situations of heightened overinvestment Biddle et al. (2009).

5.3. Independent variables

5.3.1. Real earnings management

To measure REM, we employ the following three proxies stemming from Roychowdhury (2006), which are as follows:

The first measure of REM (i.e., |PR|) is built on the premise that measures the normal baseline level of production costs using the following equation:

$$\frac{PRD_{i,t}}{Asst_{i,t-1}} = \beta_0 + \beta_1 \left(\frac{1}{Asst_{i,t-1}} \right) + \beta_2 \left(\frac{Sale_{i,t}}{Asst_{i,t-1}} \right) + \beta_3 \left(\frac{\Delta Sale_{i,t}}{Asst_{i,t-1}} \right) + \beta_4 \left(\frac{\Delta Sale_{i,t-1}}{Asst_{i,t-1}} \right) + \varepsilon_t \quad (2)$$

where $PRD_{i,t} = COGS_{i,t} + \Delta IN_{i,t}$, which stands for the sum of the cost of goods sold and the change in inventory from $t - 1$ to t . $Sale_{i,t}$ represents the annual sales, and $\Delta Sale_{i,t}$ denotes the change in sales from period $t - 1$ to period t , while $\Delta Sale_{i,t-1}$ is the change in the sales from $t - 2$ to $t - 1$. $Asst_{i,t-1}$ are the lagged total assets.

We multiply the absolute value of the residuals obtained from expression (2) by -1 to calculate |PR|, which measures the abnormal production level. A higher level of |PR| indicates LREM. On the contrary, a lower |PR| represents a higher level of REM, which is exhibited by firms with higher production levels that seek to reduce per-unit fixed costs and show higher profit margins.

The second proxy (|DI|) measures the normal level of discretionary expenses. Drawing on Roychowdhury's (2006), we deploy the following equation:

$$\frac{DIS_EXP_{i,t}}{Asst_{i,t-1}} = \beta_0 + \beta_1 \left(\frac{1}{Asst_{i,t-1}} \right) + \beta_2 \left(\frac{Sale_{i,t}}{Asst_{i,t-1}} \right) + \varepsilon_{i,t} \quad (3)$$

where $DIS_EXP_{i,t}$ represents the sum of advertising, R&D, and selling general and administrative expenses (SG&A) as per D. Cohen et al. (2020). $Sale_{i,t}$ represents the annual sales, and $Asst_{i,t-1}$ are the lagged total assets.

For measuring the abnormal discretionary expenses, the absolute value of the residuals from the equation is multiplied by -1 to reveal the underlying reality of REM. A higher value of (|DI|) indicates a low level of REM and a normal level of discretionary expenses. Consequently, a lower value of (|DI|) signifies a higher level of REM, and an abnormal level of discretionary expenses, indicating the manipulation of discretionary expenses to present an inflated(deflated) picture of earnings.

Finally, to measure the normal level of cash flow from operating activities ($|CF|$), Roychowdhury (2006) uses the following expression:

$$\frac{CFO_{i,t}}{Asst_{t-1}} = \beta_0 + \beta_1 \left(\frac{1}{Asst_{t-1}} \right) + \beta_2 \left(\frac{Sale_t}{Asst_{t-1}} \right) + \beta_3 \left(\frac{\Delta Sale_t}{Asst_{t-1}} \right) + \varepsilon_t \quad (4)$$

where $CFO_{i,t}$ represents the cash flow from operating activities, $Sale_{i,t}$ represents the annual sales, $\Delta Sale_{i,t}$ stands for the change in the sales from $t - 1$ to t , and $Asst_{i,t-1}$ are the lagged total assets.

The calculation of ($|CF|$) involves multiplying the absolute value of the residual by -1 . A higher value of ($|CF|$) represents a normal level of cash flow and represents LREM. In contrast, a lower value indicates a higher level of REM, which may suggest a deviation from the normal cash flow pattern and the possibility of price manipulation.

5.3.2. Overinvestment (OF)

To measure overinvestment (OF), we employ two partitioning variables. First, the firm's cash balances are used to determine the degree of financial restrictions and constraints. Firms with limited cash reserves may face financial constraints that curtail their investment opportunities, whereas companies with ample cash reserves may succumb to agency problems that lead to excessive investment (Biddle et al., 2009; Opler et al., 1999). Second, we consider the firm's leverage as an additional measure of liquidity. Myers (1977) argues that firms with high leverage may face a debt overhang issue, which can impede their investment capacity and lead to underinvestment.

Initially, a ranking applies to firms according to their cash balance and leverage. Then, we average the resulting ranks to compute the two partitioning variables and rescale the resulting values to range between 0 and 1. The results obtained from this procedure are referred to as OF. This rescaling aims to aggregate the two measures and reduce the error that may be generated from using a single variable. The new variable obtained from the above-presented procedure increases with an increase in cash balance and a decrease in leverage, and vice versa (Biddle et al., 2009).

5.3.3. Governance (GOV)

To quantify the impact of corporate governance on firm behavior, we consider two critical factors in equation (1): institutional ownership and the number of financial analysts. Institutional ownership provides numerous advantages, enhancing corporate governance, mitigating information asymmetry, and improving stock liquidity and borrowing costs Yang et al. (2022). Institutional ownership is defined as the proportion of shares held by institutional investors who invest in the firm. At the same time, financial analysts represent the number of analysts who track and report on a firm's financial performance, according to the Institutional Brokers Estimate System (IBES) database. These two measures are employed in the literature as proxies for governance (Biddle et al., 2009; Chang et al., 2009). They serve to capture the monitoring and oversight roles of institutional investors and analysts, respectively. By incorporating these governance variables, we aim to shed light on the potential influence of external stakeholders on firm decision-making and behavior and ultimately provide insights into the efficacy of governance mechanisms in promoting firm performance and accountability.

5.4. Control variables (Cntrl)

Our methodology consider a set of control variables that are unique to each firm in our analysis as follows: (1) MTB represents the ratio of the market value of total assets to the book value of total assets; (2) DIV is a binary variable that takes a value of one if the company distributes dividends, and zero otherwise; (3) AGE the time gap between the initial year of the firm's appearance in Eikon and the present year, (4) K_S stands for K-structure, or, the proportion of long-term debt to the

total of long term debt to market value of equity, (5) IND_K_S is the industrial K-Structure, representing the average K-Structure for companies belonging to the identical SIC code of each industry, (6) BNKRUP is a proxy for bankruptcy by deploying Taffler's (1983) z-score, (7) CFOTSALE is the cash flow ratio from operation to revenue sales, (8) S_SALE is the standard deviation of sales, based on five years, divided by average total assets, (9) S_I is the standard deviation of cash flow from investing, based on five years, divided by average total assets, (10) S_CFO is the standard deviation of cash from operation divided by average total assets, and (11) OPCYCLE refers to the operating cycle, which is the logarithm of accounts receivable to sales plus inventory to cost of goods sold multiplied by 360.

6. Empirical results and discussion

6.1. Descriptive statistics and correlation matrix

The descriptive statistics for the entire sample of 11,172 firm-year observations are present in Table 3, which include the standard measures for all variables used in this study. Table 4 presents the correlation coefficient between numerical variables of interest. Notably, the investment variable displays significant variability, spanning from negative 39% to positive 175%, with a mean of 6%. By contrast, the REMs metrics show a lesser degree of variability, with minimum values of negative 2.67, negative 1.76, and negative 1.08 for |PR|, |CF|, and |DI| measures, respectively.

Table 3. Descriptive statistics

#	Variables	Obs.	Mean	Min	Median	Max	STD
1	INV	11,172	0.05	-0.39	0.01	1.75	0.21
2	PR	11,172	-0.17	-2.67	-0.12	0.00	0.19
3	CF	11,172	-0.10	-1.76	-0.08	0.00	0.10
4	DI	11,172	-0.15	-1.08	-0.12	0.00	0.14
5	OF	11,172	0.50	0.00	0.50	1.00	0.29
6	GOV	11,172	4.80	0.00	3.19	17.95	4.75
7	MTB	11,172	1.99	0.46	1.55	24.65	1.63
8	S_CFO	11,172	0.05	0.01	0.04	0.73	0.06
9	S_SALE	11,172	0.20	0.01	0.14	1.61	0.21
10	S_I	11,172	0.08	0.00	0.06	0.57	0.08
11	BNKRUP	11,172	9.39	-105.38	8.09	64.73	14.44
12	K_S	11,172	0.15	0.00	0.09	0.83	0.18
13	IND_K_S	11,172	0.14	0.05	0.11	0.40	0.07
14	CFOTSALE	11,172	0.07	-14.20	0.09	0.55	0.41
15	DIV	11,172	0.36	0.00	0.00	1.00	0.48
16	AGE	11,172	20.46	0.00	20.00	38.00	9.16
17	OPCYCLE	11,172	0.00	0.00	0.00	0.01	0.00

INV total investment. PR Proxy for measuring the normal level of production. CF Proxy for measuring the normal level of cash flow. DI Proxy for measuring the normal level of discretionary expenses. OF Over Firm proxy consist of two partitioning variable. GOV Governance. MTB The ratio of the market value of total assets divided by the book value of total assets. S_CFO The standard deviation of cash from operation divided by average total assets. S_SALE The standard deviation of sales that is based on five years divided by average total assets. S_I The standard deviation of cash flow from investing is based on five years divided by average total assets. BNKRUP Bankruptcy was measured by deploying Taffler's (1983) z-score as a proxy. K_S K-Structure expresses the proportion of long-term debt to the total of long-term debt to the market value of equity. IND_KS Industrial K-Structure represents the average K-Structure for companies belonging to the identical SIC code of each industry. CFOTSALE The ratio of cash flow from operation to revenue sales. DIV A binary variable that equals one when the firms distribute dividends and zero otherwise. AGE The time gap between the initial year of the firm's appearance in Eikon and the calculated year. OPCYCLE The operating cycle.

Table 4. Correlations during 2000–2020

#	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		
1	INV	1																		
2	PR	-0.03	1																	
3	CF	-0.08	0.2	1																
4	DI	-0.03	0.67	0.28	1															
5	OF	-0.08	-0.04	-0.18	-0.07	1														
6	GOV	0.04	0.07	-0.02	0.08	-0.2	1													
7	MTB	0.16	-0.1	-0.35	-0.14	0.19	0.15	1												
8	S_CFO	0	-0.11	-0.4	-0.18	0.26	-0.23	0.15	1											
9	S_SALE	0.02	-0.33	-0.15	-0.23	0.1	-0.16	0	0.32	1										
10	S_I	0.02	0.04	-0.11	0.02	0.12	-0.11	0.04	0.31	0.11	1									
11	BNKRUP	0.1	0.05	-0.02	0.13	0.25	0	0.09	-0.16	-0.11	-0.08	1								
12	K_S	-0.11	0.02	0.19	0.05	-0.64	0.08	-0.3	-0.18	-0.07	-0.01	-0.27	1							
13	IND_K_S	-0.04	-0.08	0.11	-0.1	-0.3	0.01	-0.17	-0.12	0.05	-0.09	-0.11	0.38	1						
14	CFOTSALE	0.01	0.07	0.21	0.17	-0.08	0.19	-0.15	-0.24	-0.07	-0.13	0.35	0.04	0.02	1					
15	DIV	0	0.04	0.06	0.04	-0.25	0.48	0.01	-0.25	-0.14	-0.16	0.04	0.09	0.13	0.13	1				
16	AGE	-0.02	0.14	0.08	0.12	-0.12	0.18	-0.03	-0.13	-0.17	-0.14	0.03	0.05	0.01	0.1	0.26	1			
17	OPCYCLE	-0.03	0.13	-0.02	0.12	0.16	-0.15	0.03	0.09	-0.17	0.07	0.08	-0.14	-0.25	-0.18	-0.14	-0.02	1		

INV total investment is defined as the net increase in both tangible and nontangible assets and scaled by lagged total assets. PR Proxy for measuring the normal level of production. CF Proxy for measuring the normal level of cash flow. DI Proxy for measuring the normal level of discretionary expenses. OF Over Firm proxy consist of two partitioning variable, liquidity, and leverage; increases at a high level of cash and low leverage and decreases at a low level of cash and high level of leverage. GOV Governance measure represents the average of two variables: the percentage of institutional investors who invest in the firm and the number of financial analysts who track and follow the firm, according to IBES. MTB The ratio of the market value of total assets divided by the book value of total assets. S_CFO The standard deviation of cash flow from operation divided by average total assets. S_SALE The standard deviation of sales that is based on five years divided by average total assets. S_I The standard deviation of cash flow from investing is based on five years divided by average total assets. BNKRUP Bankruptcy was measured by deploying Tafler's (1983) z-score as a proxy. K_S K-Structure expresses the proportion of long-term debt to the total of long-term debt to the market value of equity. IND_KS Industrial K-Structure represents the average K-Structure for companies belonging to the identical SIC code of each industry. CFOTSALE The ratio of cash flow from operation to revenue sales. DIV A binary variable that equals one when the company distributed dividend and zero otherwise. AGE The time gap between the initial year of the firm's appearance in Eikon and the calculated year. OPCYCLE The operating cycle that is expressed by the logarithm of accounts receivable to sales plus inventory to cost of goods sold multiplied by 360.

The predictor variables in our study display a degree of moderate correlation, as evident from the small correlation coefficients in Table 4. Importantly, none of the correlation coefficients surpass the acceptable common threshold of 0.7, which effectively mitigates any collinearity-driven effects, as indicated by prior literature (Brun et al., 2020).

6.2. Diagnostic test

To address the issue of outliers, we apply winsorization at the firm-year level by setting the winsorization limits at the 1% and 99% percentiles. This allows us to mitigate any potential distortion or bias in our empirical analysis and findings due to the presence of outliers.

To mitigate potential endogeneity issues, i.e., feedback loops between the predictors and response variables and unobserved heterogeneity, we use the generalized method of moments (GMM) for analyzing linear dynamic panel data. This technique relies on the specific moment conditions designed to produce reliable estimates, even in the presence of heteroscedasticity. In contrast to alternative approaches, GMM can estimate optimal weights to account for heteroscedasticity, facilitating a more comprehensive understanding of the underlying phenomena Lin and Lee (2010). Drawing on expression (1) and the variables discussed in Sections 5.3 and 5.4, and by employing GMM for linear dynamic panel data, GMM can fulfill tests of linearity, specification, and overidentification (Baltagi, 2021; Phillips & Han, 2019):

$$\begin{aligned}
 INV_{i,t+1} = & \alpha \overline{INV}_{i,t} + \beta_1 \overline{LREM}_{i,t} + \beta_2 \overline{LREM}_{i,t} * \overline{OF}_{i,t+1} + \beta_3 \overline{OF}_{i,t+1} + \beta_4 \overline{GOV}_{i,t} + \beta_5 \overline{GOV}_{i,t} * \overline{OF}_{i,t+1} \\
 & + \sum_{j=1}^{11} \gamma_j \overline{Cntrl}_{j,i,t} + \sum_{p=t+1}^T \delta_p d_p + \varepsilon_{i,t+1}
 \end{aligned} \tag{5}$$

Where p is the order of the autoregressive (AR) model $j= 1, \dots, 11; t = 1, 2, \dots$. Expression (5) satisfies the specification (Arellano and Bond test), overidentification (Hansen J-test), and linear hypotheses (Wald test) tests.

6.3. Regression results

According to Table 5, the GMM estimates reveal significant values for all measures. Based on the coefficient (β_1), we can confirm a positive relationship between LREM and investment efficiency among firms that are most likely to underinvest (H1). Specifically, we observe the following results for β_1 for the three measures: |CF| 0.313, |PR| 0.216, and |DI| 0.316. These findings support our hypothesis that LREM is positively associated with investment efficiency, as all measures are positive. In other words, LREM will increase investment in firms more prone to underinvestment.

To evaluate the impact of LREM on overinvestment, we begin by analyzing the estimated coefficient for the interaction term between REMs and overinvestment (β_2). We obtain negative coefficients for each measure respectively: (|CF|) -0.372, (|PR|) -0.231, and (|DI|) -0.394. We then assess the effect of LREM on overinvestment, which represents the sum of the estimated coefficients for LREM represented by (β_1) and the interaction term (β_2). The resulting coefficients are as follows: (|CF|) -0.059, (|PR|) -0.0143, and (|DI|) -0.780. These findings suggest that LREM has a negative impact on overinvestment. Specifically, firms with LREM are less likely to engage in overinvestment.

The resulting outcome confirms that LREM is inversely related to overinvestment, thereby confirming hypothesis H2 ($\beta_1 + \beta_2 < 0$). This finding suggests that firms with LREM are less likely to engage in overinvestment, highlighting the importance of controlling REM in promoting efficient investment decisions. The negative association between LREM and overinvestment also implies that firms with high levels of REM are more prone to overinvestment, which may negatively impact firms' financial performance in the long run. Therefore, firms should control the levels of REM to ensure optimal investment decisions.

Table 5. GMM estimate

Variables	CF	PR	DS
INV	0.0250	0.0170	0.0217
LREM	0.3127**	0.2163**	0.3156**
LREM*OF	-0.3721*	-0.2306*	-0.3936**
OF	-0.0931***	-0.0784***	-0.0914***
GOV	-0.0108**	-0.0113**	-0.0102**
GOVOF	0.0032*	0.0175**	0.0160**
MTB	0.0221***	0.0218***	0.0221***
S_CFO	0.3846*	0.3246*	0.3217*
S_SALE	-0.0017	0.0004	0.0014
S_I	-0.5275***	-0.5284***	-0.5583***
BNKRUPT	-0.0001	-0.0003	-0.0005*
K_S	-0.1592*	-0.1663*	-0.1668*
IND_K_S	0.0417	0.1630*	0.1777*
CFOTSALE	-0.0063	-0.0071	-0.0062
DIV	0.0025	0.0003	0.0004
AGE	-0.0065	-0.0066	-0.0072
OPCYCLE	0.0003	-0.0002	-0.0005**
Years Dummies	Yes	Yes	Yes
Observations	11,172	11,172	11,172
Arellano and Bond	-0.085	-.099	0.040
p-value	0.932	.921	0.968
Hansen J-test	202.33	203.26	201.03
p-value	0.2100	.1972	0.2290
Wald test	591.91	601.86	615.48
p-value	<10 ⁻⁴	<10 ⁻⁴	<10 ⁻⁴

INV total investment is defined as the net increase in both tangible and nontangible assets and scaled by lagged total assets. LREM variable is used to express the degree of antithetical activity of REM; when REM is at its highest, LREM will be at its lowest, and vice versa. OF Over Firm proxy consist of two partitioning variable: liquidity and leverage; increases at a high level of cash and low leverage and decreases at a low level of cash and high level of leverage. GOV Governance measure represents the average of two variables: the percentage of institutional investors who invest in the firm and the number of financial analysts who track and follow the firm, according to IBES. MTB The ratio of the market value of total assets divided by the book value of total assets. S_CFO The standard deviation of cash from operation divided by average total assets. S_SALE The standard deviation of sales that is based on five years divided by average total assets. S_I The standard deviation of cash flow from investing is based on five years divided by average total assets. BNKRUPT Bankruptcy is measured by deploying Taffler's (1983) z-score as a proxy. K_S K-Structure expresses the proportion of long-term debt to the total of long-term debt to the market value of equity. IND_KS Industrial K-Structure represents the average K-Structure for companies belonging to the identical SIC code of each industry. CFOTSALE The ratio of cash flow from operation to revenue sales. DIV A binary variable that equals one when the company distributed dividend and zero otherwise. AGE The time gap between the initial year of the firm's appearance in Eikon and the calculated year. OPCYCLE The operating cycle that is expressed by the logarithm of accounts receivable to sales plus inventory to cost of goods sold multiplied by 360. *** Coefficient is significant at the 0.0001 level; **Coefficient is significant at the 0.01 level; *Coefficient is significant at the 0.05 level.

The empirical findings are consistent with both agency theory and signalling theory. The negative association between real earnings management and investment efficiency support the notion that the practices of real earnings management will lead to suboptimal decisions or practice that will result in an inefficient investment. This confirms that the absence of monitoring of the agents' behavior by the principal creates a moral hazard, where managers can exploit information asymmetry scenarios to induce achieving earnings benchmarks for

personal gains in private contractual agreements instead of maximizing the firm's value (D. A. Cohen & Zarowin, 2010; Kothari et al., 2016; Roychowdhury, 2006). The theoretical assumptions are validated by our finding as we find an adverse effect between REM on investment efficiency; when there is an increase in real earnings management, this result in an increase in information asymmetry which eventually cause either an intentional misreporting in real earnings will result in a reduction in information asymmetry.

The result highlights three major practices of real earnings management (REM) result when managers deviate from the normative level of production |PR|, cash low |CF| and discretionary accrual |DI| Roychowdhury (2006). The result of these practices is aligned with the agency theory, which suggests that managers may engage in these practices with the intention of safeguarding their personal interests (Jensen & Meckling, 1976), and the result showed a negative relation between these practices and investment efficiency.

7. Conclusion

Our research enhances the existing literature by thoroughly analyzing the relationship between REM and investment efficiency. We investigate whether REM is negatively associated with investment efficiency by testing how controlled or low degree of earnings management LREM is negatively associated with both overinvestment and underinvestment. The current research supports our hypothesis, which has been confirmed by applying different testing methods. Initially, we examine the conditional association between LREM and investment, considering the firm's propensity toward overinvestment or underinvestment, as well as their access to liquidity. For this analysis, we evaluate the firm's cash and leverage levels and employ three distinct REM measures (i.e., |CF|, |DI|, and |PR|). Our results are consistent with our hypothesis, demonstrating that REM is negatively associated with investment efficiency as LREM mitigates the risk of underinvestment and overinvestment.

As a further step, we conduct sensitivity analysis by anticipating the investment opportunities of the firms and considering the firm's performance measured by sales growth and optimal level of capital investment. We classify the firms into three groups based on their deviation from the optimal level of investment (i.e., overinvestment, underinvestment, and a bench group). Regarding H1, we found a positive relationship between LREM and investment levels during underinvestment. The logistic regression findings indicate that all coefficients measuring LREM (i.e., |CF|, |DI|, |PR|) are positive, demonstrating that as LREM increases, the probability of investment level increases, thereby reducing underinvestment and enhancing investment efficiency. These findings support that LREM is negatively associated with underinvestment and positively associated with investment efficiency, particularly for firms prone to underinvestment. Similarly, to examine the relationship between LREM and investment levels during overinvestment, the logistic regression findings show negative coefficients for all LREM variables (i.e., |CF|, |DI|, |PR|), indicating that as LREM increases, the probability of investment level decreases, which may lead to a reduction in overinvestment. These results support the conclusion that LREM is negatively associated with overinvestment and positively associated with investment efficiency, particularly for firms prone to overinvestment. By drawing upon the aforementioned outcome, it is ascertained that there is an inverse relation between REM and investment efficiency. Thus, mitigating or constraining the harmful effects of REM serves to augment investment efficiency.

This study offers a number of potential implications: First, enhancing the investment decision can result in reducing the practice of real earnings management, which leads to suboptimal practices and choosing inefficient projects; this can result in a better allocation of the firm's resources and improve its performance. Second, we highlight the negative effect of real earnings management on investment, as firms engaging in REM tend to either overinvest in unprofitable projects or underinvest and avoid profitable projects. Third, the study sheds light on the importance of transparency in financial reporting in enhancing investment efficiency, and firms are encouraged to improve their financial reporting practices to make their performance more visible and reliable. Fourth, this study also contributes to

protecting the interests of investors by providing guidance toward making more informed decisions and choosing the right investment, as lower levels of real earnings management can enhance transparency, reduce adverse selection, and mitigate inefficient investments.

Considering the limitations of this study which warrant future research, it does not consider managers' personal attributes, such as overconfidence and optimism, which have been linked to overinvestment and investment distortions that reduce the firm value (Ben Mohamed et al., 2020; He et al., 2019). Additionally, risk-averse managers may cause underinvestment by avoiding high-risk projects with positive net present values (Roychowdhury, 2010). Furthermore, managerial myopia can lead to investment inefficiency, as managers prioritize short-term objectives over long-term negative impacts, especially when the compensation is tied to short-term performance (Lambert, 2001; Roychowdhury et al., 2019). Finally, gender diversity is not considered in this study as female directors may outperform male counterparts but may not be effective without having financial background in order to limit earnings management (Alves, 2023; Le & Nguyen, 2023; Zalata et al., 2022), or by examining the female directors to play advisory or monitoring role in order to influence corporate governance to have more control on earnings management (A. M. Zalata, C. G. Ntim, et al., 2019), or by exploring whether female CEO exhibit higher ethics or risk aversion in comparison with male (A. M. Zalata, Ntim, et al., 2019).

8. Robustness analysis

The purpose of this sensitivity test is to explore the relationship between REM and firms' investment efficiency while considering firms' investment behavior and how it may differ from their optimal level of investment. The test employs a direct modeling approach to evaluate the anticipated level of capital investment for a given firm, taking into account its investment opportunities. It focuses on the nature of firms' investment behavior, shedding light on deviations from the expected level of investment (Biddle et al., 2009), which is based on sales growth as a driver for investment. This approach offers a more comprehensive understanding of investment inefficiency, allowing for a deeper exploration of the factors that influence investment behavior and how firms would deviate from their optimal level of investment by applying the following:

$$INV_{i,t+1} = \alpha_0 + \alpha_1 SGrowth_{i,t} + \gamma_t \quad (6)$$

where $INV_{i,t+1}$ represents the total change in tangible and intangible assets for firms i during the period $t + 1$ deflated by the lagged total for period t . $SGrowth_{i,t}$ represents the percentage of sales growth for firms i in the year t .

We classify the firms based on the magnitude of the residuals, which represents the deviation from the predicted level of investment. By using quartiles as a framework, firms are sorted based on the magnitude of their residuals, which represents the gap between their actual and expected investment levels. For instance, the bottom quartile, with the highest negative residuals, is classified as under-investing, while the top quartile, with the highest positive residuals, is classified as over-investing. Finally, we regard the two middle quartiles as a benchmark group. Then, we investigate the relationship between LREM and investment efficiency by utilizing a multinomial logit model to estimate the likelihood of a firm belonging to either one of the two upper or lower quartiles. In other words, to estimate the likelihood for a firm to overinvest (upper quartile) or underinvest (lower quartile). We incorporate the same set of control variables used earlier (e.g., expressions (1) and (5)) for consistency purposes. Following Houcine's (2017) approach, we estimate the investment efficiency as follows:

$$LOGITINV_INEFF_{i,t+1} = \alpha_0 + \alpha_1 LREM_{i,t} + \sum_{j=1}^{11} \gamma_j Cntrl_{j,i,t} + \varepsilon_{i,t+1} \quad (7)$$

where $INV_INEFF_{i,t+1}$ represents investment inefficiency for firm i in year $t + 1$, which is a binary variable. Specifically in Table 6, for testing LREM with underinvestment: a value of 1 is set to the

binary variable if the residuals fall within the lower quartile of underinvestment and 0 otherwise. In the case of Table 7, for testing LREM with overinvestment: a value of 1 is set to the binary variable if the residuals fall within the upper quartile of overinvestment and 0 otherwise. Moreover, $LREM_{i,t}$ refers to a set of different measures for REM, which increase by maintaining LREM and decrease when there is a high REM. $Ctrl_{j,i,t}$ represent the same control variables used earlier.

To mitigate the problems of heteroskedasticity, serial correlation, and cross-sectional correlation in our estimation and adjust the standard error using ordinary least squares (OLS), we utilize the two-dimensional cluster method at the firm and year levels. This technique has been suggested by Petersen (2009) as the preferred approach for estimating standard errors in financial applications using panel data. This approach allows for accounting for the unobserved firm and time effects while addressing the issues above. This ensures that our results are reliable and robust and reduces the likelihood of spurious findings.

Table 6 presents the findings for H1, which examines the relationship between LREM and investment levels in the case of underinvestment. The logistic regression results reveal positive coefficients for the |CF| (i.e., 0.055), |DI| (i.e., 0.421), and |PR| (i.e., 0.535). Notably, all of the coefficients associated with LREM are positive, indicating that as LREM increases, the probability of investment level increases, too, while we are considering underinvestment. In other words, such increases will reduce underinvestment. These findings support H1 that LREM is negatively associated with underinvestment and eventually positively associated with investment efficiency for firms prone to underinvestment.

Table 6. Sensitivity analysis of logit test for REM proxies with underinvestment

Variables	(CF)	(DI)	(PR)
LREM	0.055	.421*	0.535***
MTB	-0.200***	-.196***	-0.195***
S_CFO	1.764***	1.850***	1.755***
S_SALE	-0.492***	-.456***	-0.357**
S_I	1.759***	1.696***	1.645***
BNKRUP	-0.022***	-.022***	-0.022***
K_S	1.270***	1.253***	1.278***
IND_K_S	-0.677	-.589	-0.593
CFOTSALE	0.039	.024	0.029
DIV	-0.104	-.104	-0.105
AGE	-0.002	-.002	-0.003
OPCYCLE	196.1***	187.9***	186.5***
(Intercept)	-0.386**	-.328*	-0.311*
Observations	11,172	11,172	11,172
Clustered by Firm	Yes	Yes	Yes
Clustered by Year	Yes	Yes	Yes

LREM variable is used to express the degree of antithetical activity of REM; when REM is at its highest, LREM will be at its lowest, and vice versa. MTB The ratio of the market value of total assets divided by the book value of total assets. S_CFO The standard deviation of cash from operation divided by average total assets. S_SALE The standard deviation of sales that is based on five years divided by average total assets. S_I The standard deviation of cash flow from investing is based on five years divided by average total assets. BNKRUP Bankruptcy is measured by deploying Taffler's (1983) z-score as a proxy. K_S K-Structure expresses the proportion of long-term debt to the total of long-term debt to the market value of equity. IND_KS Industrial K-Structure represents the average K-Structure for companies belonging to the identical SIC code of each industry. CFOTSALE The ratio of cash flow from operation to revenue sales. DIV A binary variable that equals one when the company distributed dividend and zero otherwise. AGE The time gap between the initial year of the firm's appearance in Eikon and the calculated year. OPCYCLE The operating cycle that is expressed by the logarithm of accounts receivable to sales plus inventory to cost of goods sold multiplied by 360. *** Coefficient is significant at the 0.0001 level; **Coefficient is significant at the 0.01 level; *Coefficient is significant at the 0.05 level.

A positive coefficient assigned to LREM indicates that firms exhibiting LREM are more likely to engage in more investment activities when facing conditions that may lead to underinvestment. This result confirms the increase of investment under conditions of underinvestment, which in turn enhances investment efficiency.

Table 7 presents the findings for H2, which examines the relationship between LREM and investment levels when firms are more likely to overinvest. The logistic regression results reveal negative coefficients for the LREM as follows: |CF| (i.e., -1.640), |DI| (i.e., -0.226), and |PR| (i.e., -0.114). Notably, all the coefficients measuring LREM are negative. This finding indicates that as LREM increases, the probability of investment level decreases when considering overinvestment. Consequently, this inverse relationship may reduce overinvestment. These findings support our second hypothesis (H2) that LREM is negatively associated with overinvestment and positively associated with investment efficiency for firms that are prone to overinvestment.

The negative coefficients of the LREM variables suggest that firms with LREM are less likely to engage in overinvestment, resulting in greater investment efficiency. This finding suggests that when firms engage in REM, they may inflate their earnings reporting by the use of excessive production, price manipulation, or an abnormal level of discretionary expenses to justify excessive investments. As a result, we can view LREM as a positive indicator of a firm's investment quality and efficiency, reflecting a more accurate representation of the firm's actual financial performance. Overall, H2 suggests that maintaining LREM is a crucial factor in determining investment behavior and efficiency, particularly in firms that are prone to overinvestment.

Table 7. Sensitivity analysis of logit test for REM proxies with overinvestment

Variable	(CF)	(DI)	(PR)
LREM	-1.640***	-.226	-0.114
MTB	0.153***	.175***	0.176***
S_CFO	-4.071***	-2.890***	-2.850***
S_SALE	0.085	.078	0.067
S_I	1.628***	1.632***	1.629***
BNKRUP	0.010***	.012***	0.012***
K_S	-0.846***	-.828***	-0.838***
IND_K_S	-0.895	-.985	-0.951
CFOTSALE	0.491	.444	0.421
DIV	-0.120	-.101	-0.101
AGE	-0.009	-.009	-0.009
OPCYCLE	-191.2***	-2.2***	-203.4***
(Intercept)	-1.761***	-1.739***	-1.720***
Observations	11,172	11,172	11,172
Clustered by Firm	Yes	Yes	Yes
Clustered by Year	Yes	Yes	Yes

LREM variable is used to express the degree of antithetical activity of REM; when REM is at its highest, LREM will be at its lowest, and vice versa. MTB The ratio of the market value of total assets divided by the book value of total assets. S_CFO The standard deviation of cash from operation divided by average total assets. S_SALE The standard deviation of sales that is based on five years divided by average total assets. S_I The standard deviation of cash flow from investing is based on five years divided by average total assets. BNKRUP Bankruptcy is measured by deploying Taffler's (1983) z-score as a proxy. K_S K-Structure expresses the proportion of long-term debt to the total of long-term debt to the market value of equity. IND_KS Industrial K-Structure represents the average K-Structure for companies belonging to the identical SIC code of each industry. CFOTSALE The ratio of cash flow from operation to revenue sales. DIV A binary variable that equals one when the company distributed dividend and zero otherwise. AGE The time gap between the initial year of the firm's appearance in Eikon and the calculated year. OPCYCLE The operating cycle. *** Coefficient is significant at the 0.0001 level; ** Coefficient is significant at the 0.01 level; * Coefficient is significant at the 0.05 level.

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Note

1. LREM variable used to express the degree of antithetical activity of REM, when REM is at its highest LREM would be at its lowest, and vice versa.

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