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Investor Sentiment and the Likelihood of Fraudulent Financial Reporting in Petroleum and Petrochemical Industries: the Moderating Role of Risk Disclosure

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Highlights

- The likelihood of fraud is lower when investor sentiment is high;
- The market reaction to fraud announcements differs depending on the level of investor sentiment during the announcement;
- The market's response to fraud announcements is not negative during periods of high investor sentiment;
- Risk disclosure moderates the relationship between investor sentiment and the likelihood of fraudulent financial reporting.

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Abstract

In the behavioral finance paradigm, investor sentiment can affect managers' behavior in financial reporting. Therefore, this study examines the relationship between investor sentiment and the likelihood of fraudulent financial reporting. Additionally, as risk disclosure may influence the relationship between investor sentiment and the possibility of fraud, this paper investigates its moderating role. For this purpose, the data on 41 companies operating in the petroleum and petrochemical industries in the Tehran Stock Exchange from 2013 to 2021 were used. The research models have been examined by the logistic regression method. The results show that the likelihood of fraud is lower when investor sentiment is high. Furthermore, the study of the market's reaction to fraud shows that the market's response to fraud announcements is not negative during periods of high investor sentiment. In addition, the results demonstrate that risk disclosure moderates the relationship between investor sentiment and the likelihood of fraudulent financial reporting. It may be because risk disclosure reduces the impact of investor sentiment on auditors' optimism by reducing information asymmetry between managers and investors. This leads to increased audit report clauses confirming the likelihood of fraudulent financial reporting.

Keywords: Fraud, Investor Sentiment, Risk Disclosure, Market Reaction

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1. Introduction

Behavioral finance seeks to explain market anomalies by applying psychological theories to financial models. The main characteristic of behavioral finance is that it contradicts efficient markets theory. Efficient markets theory states that investors act rationally, whereas behavioral finance considers that investors are not always rational and explains investors' behavior from a psychological and sociological perspective (Lopes-Cabarcos et al., 2020). Among the many concepts studied in behavioral finance, investor sentiment and its relationship with the real economy and capital market field has attracted the most attention in recent years. Barberis et al. (1998) believe that investor sentiment can be defined as the optimism/pessimism of an investor about future stock market activity. Baker and Wurgler (2006) define investor sentiment as how investors form beliefs. Baker and Wurgler (2007) define investor sentiment as the demand for securities whose prices are not adjusted to existing realities. Higher investor sentiment indicates that investors are more bullish about the future performance of the stock market (Liu, 2015), or it indicates overconfidence (Odean, 1998), which can lead to disruptive trading (De Long et al., 1990; Renault, 2017). Piccoli and Chaudhury (2018) believe that investor sentiment is related to overreaction in such a way that overreaction increases high investor sentiment.

Many researchers have studied investor sentiment and its impact on financial markets. Evidence suggests that managers exploit high investor sentiment through their opportunistic behavior. For example, during periods of high investor sentiment, managers are more likely to disclose and accent pro forma earnings metrics that exceed those based on generally accepted accounting principles (GAAP) (Brown et al., 2012). Managers also remain strategically silent to maintain optimistic valuations (Bergman and Roychowdhury, 2008). In these periods, investors pay less care to understand the accrual and cash components of earnings, so managers report optimistic accruals to estimate and manage earnings (Ali and Gurun, 2009; Simpson, 2013; Du, 2019; Santana et al., 2020; Bashirimanesh and Oradi, 2018). According to previous research, investor sentiment is expected to have a positive relationship with the likelihood of fraudulent financial reporting.

After financial scandals and economic crises during the past decades, risk disclosure has been one of the concerns of accounting and professional institutions worldwide. While acknowledging the importance of risk disclosure, financial institutions developed accounting standards and provided a framework for exposure and organization of risk disclosure. The German Accounting Standards Board (GASB) published the first comprehensive risk disclosure reporting standard, Risk Reporting, in 2001. Risk disclosure is one of the most essential types of disclosure for several reasons. First, it conveys the existing and potential risks and uncertainties that companies face during their commercial business: threats to the continuity of their activity. In addition, risk disclosure by reducing agency problems and information asymmetry will have significant investment, financing, and liquidity implications. Risk disclosure will improve stewardship accountability, investor protection, and better risk management (Abraham and Cox, 2007; Ntim et al., 2013). Habbash and Hussainey (2019) state that risk disclosure is among the most essential value-relevance disclosures. Recently, there have been many discussions about firms' inadequacy of risk disclosure and the companies' lack of transparency in this area. There is a growing demand for more disclosure to reduce the scarcity of access to company information and ensure that shareholders can fully evaluate company performance. Shareholders are interested in risk profiling to better understand the company's risks, how managers manage risk, and how to measure and disclose risk-related issues (Oliveira, 2013; Al-Shammari, 2014). Therefore, agency and signaling theories are among the most critical drivers of management for risk disclosure (Linsmeier et al., 2002). Thus, risk disclosure is expected to have a negative effect on the relationship between sentiment and the likelihood of fraudulent financial reporting.

Considering the potential impact of investor sentiment on financial reporting motives and the lack of study of this critical issue in previous research, the current paper studies this relationship in three parts. The first part studies the relationship between investor sentiment and the likelihood of fraudulent financial reporting. The second analysis examines whether the market reaction to fraud differs based on the level of investor sentiment during the announcement. For this purpose, two time periods have been used: from one day before to one day after the released date of the audit report and from one day before to four days after the released date of the audit report. Then, the moderating role of risk disclosure on the relationship between investor sentiment and the likelihood of fraudulent financial reporting was investigated. To this end, risk disclosure was measured based on two metrics. The current research is conducted for petroleum and petrochemical companies.

2. Literature review

The early studies on investor sentiment aimed to solve puzzles in financial markets that could not be explained by investors acting purely on firm fundamentals. Investors' demand for risky assets is affected by their beliefs, which are not justified by fundamental information (Shleifer and Summers, 1990). High sentiment means investors believe in bullish markets or are overconfident, which will lead to disruptive trading (Liu, 2015; Renault, 2017). The findings of the studies show that investor sentiment affects managers' behavior, and managers react to investor sentiment through disclosure procedures. Bergman and Roychowdhury (2008) show managers' efforts to prolong optimistic earnings valuations through their long-horizon disclosure choices by remaining silent regarding earnings forecasts in periods with high sentiment. During these periods, managers prefer to voluntarily disclose pro forma earnings metrics that overstep those based on the GAAP (Brown et al., 2012). During high sentiment periods, investors pay less care to understand the accrual and cash components of earnings, and managers report optimistic accruals to estimate and manage earnings (Ali and Gurun, 2009; Simpson, 2013; Du, 2019; Santana et al., 2020; Bashirimanesh and Oradi, 2019). The findings of some other studies indicate an increase in management's optimistic forecasts in periods of high investor sentiment (Hurwitz, 2018). These findings reflect managers' opportunistic motives and misreporting incentives during high sentiment periods. These findings show that investor sentiment can affect the amount of risk assessment by auditors and, as a result, their behavior. Auditors' reporting decisions are one of the client risk management strategies that auditors use to keep their risk exposure at a desirable level (Amin et al., 2021). This brings the paper to the first hypothesis.

Hypothesis 1: A positive association exists between investor sentiment and the likelihood of fraudulent financial reporting.

A substantial decline in the company's market value is an essential determinant of lawsuit auditor risk (Palmrose and Scholz, 2004). Therefore, if high investor sentiment reduces the risk of lawsuits against auditors, it is expected that the market reaction to the likelihood of misstatement will be limited during such periods (Amin et al., 2021). Researchers' findings suggest that the intensity of the market reaction to negative information is influenced by investor sentiment. For example, Amin et al. (2021) believe that the market reaction to the likelihood of misstatement in financial statements is less adverse when sentiment is high. According to Bouteska (2019), during periods of high sentiment, the market reaction toward earning restatements bad news is not negative. Therefore, this paper states the second hypothesis.

Hypothesis 2: The market reaction to fraud announcements is less adverse during high investor sentiment.

Risk disclosure is any opportunity or prospect, or of any hazard, danger, harm, threat, or exposure, that has already impacted the company or may impact the company in the future or risk management (Linsley and Shrives, 2006). Elbannan and Elbannan (2015) defined risk disclosure as publishing any quantitative or qualitative information about the company's uncertainties or risks. Examples of these disclosures include financial risks such as interest rates, exchange rates, and liquidity risks; operational risks such as customer dissatisfaction or product or service failure; integrity risks such as illegal acts and profit management; and strategy risks such as competitors and industry risks (Habbash and Hussainey, 2019). Risk disclosure is essential compared to other types of disclosure. Companies transfer information to users about hazards that threaten their going concern through risk disclosure. Campbell et al. (2014) find that higher levels of risk disclosures are negatively associated with information asymmetry. By reducing agency problems and information asymmetry, risk disclosure conveys important concepts regarding investment, financing, and liquidity. Risk disclosure can improve accountability for stewardship, investor protection, and better risk management (Abraham and Cox, 2007; Ntim et al., 2013). There is an increasing demand for even greater disclosure to reduce asymmetries of access to corporate information and ensure shareholders can fully assess a company's performance. Shareholders become more interested in risk profiles to better understand the company's risks and how the managers manage risks and to improve the measurement and disclosure of risk-related matters (Oliveira, 2013; Al-Shammari, 2014). Therefore, agency and signaling theories are the most critical drivers of management for risk disclosure (Linsmeier et al., 2002). Signaling theory explains managers' incentives to disclose more information in accounting reports. Based on this theory, managers disclose adequate information in the financial reports to convey specific signals to current and potential users. This kind of communication is credible to investors because managers who send unrealistic signals to the market will be punished (Al-Shammari, 2014). In companies with favorable performance, managers use optional risk disclosure to signal risk management procedures and attract more investors. Thus, risk disclosure will convey helpful information to users and improve stakeholders' understanding of risk exposure, which is vital in showing companies' performance (Linsmeier et al., 2002). According to agency theory, managers must present relevant information to prove their actions to benefit the shareholders and creditors to reduce agency costs. Providing reliable news about risk by the management will reduce the information asymmetry problem (Al-Shammari, 2014; Heydari et al., 2015). This brings the paper to the third hypothesis.

Hypothesis 3: Risk disclosure moderates the relationship between investor sentiment and the likelihood of fraudulent financial reporting such that increased risk disclosure weakens the positive effect of investor sentiment on the possibility of fraudulent financial reporting.

Abdelfattah et al. (2022) studied the relationship between the level of risk information disclosed by auditors and the level of corporate narrative risk disclosure. They found a significant positive association between the risk information disclosed by auditors and the risk information disclosed by firm managers.

Weber and Mubig (2022) surveyed the effect of business strategy on risk disclosure. They showed that business strategy influenced the coverage of the principal risk topics and risk disclosure complexity. Also, the influence of business strategy on risk disclosure was more substantial for small, young, and low-technology firms.

Ostovarnejad et al. (2022) studied the effect of investor sentiment on audit quality in companies listed on the Tehran Stock Exchange. Their results showed that investor sentiment positively impacted the auditor's tenure and discretionary accruals by lowering criteria for audit quality. In addition, the results showed that investor sentiment significantly negatively impacted the qualified audit reports as audit quality criteria increased.

Shailar and Zhang (2021) studied whether auditors' year-to-year modification to risks of material misstatements in extended auditors' reports was associated with changes in underlying audit effort as a proxy by changes in audit fees. They showed that, on average, audit fees increased more from the previous year's fees when more risks of material misstatements were added to the current year's extended auditors' report. Generally, results suggested that changes in the choice of risks of material misstatements included in extended auditors' reports reflected changes in underlying audit effort.

Khoshkholg and Talebnia (2021) examined the effect of financial reporting concepts on companies' risk disclosure levels. They found that among the concepts of financial reporting, financial reporting quality index, corporate governance, audit quality, increasing the level of supervision, transparency, and proper disclosure had a significant positive effect on risk disclosure in annual financial reporting and increased the level.

Bolo and Mohammadinasaf (2021) investigated the relationship between the two strategies of risk disclosure and profit smoothing in relation to the company's risk levels. They concluded a positive and significant relationship between risk disclosure and company risk and between the level of profit smoothing and company risk. As the company's risk increases, the level of risk disclosure and profit smoothing policy increases significantly in the investigated companies.

Hong and Young (2020) reviewed the association between corporate social responsibility performance and the probability of serious misstatements being detected. They discovered that corporate social responsibility significantly decreased the likelihood of engagement in a serious misstatement in general. In contrast, it increased the detection probability only when there were salient indicators of misstatement engagement.

Amin et al. (2021) investigated the relationship between investor sentiment and the likelihood of misstatements and auditor behavior. They concluded that increased sentiment increased the possibility of misstatements, and auditors charged lower fees. In addition, high sentiments led to a decrease in going concern opinion.

Soleimani and Shokrian (2021) studied the effect of auditing fee reduction on the possibility of misstatement of business managers and disclosure of significant distortions by auditors. Also, they researched the moderating impact of contracting with quality audit firms on these relationships. They found that reducing auditing fees had a negative effect on auditors' disclosure of material misstatements but a positive impact on the likelihood of misstatement by business managers; they also investigated the significance by auditors, the likelihood of misstatement by the directors, and confirmation of the adjustment effect of this variable on the link between the audit fee reduction and the disclosure of material misstatements by the auditors and the likelihood of misstatement by the directors.

Santana et al. (2020) studied the association between investor sentiment and earnings management in Brazil. They found discretionary accruals positively relate to investor sentiment in the Brazilian capital market. Further, analyzing low and high sentiment periods, their findings suggested that managers increased accruals after high sentiment and reduced them after low sentiment.

Seok et al. (2019) investigated the relationship between accounting-based anomalies and investors' behavioral biases. They found that stock price reaction to positive earnings surprises was significantly greater for companies with high sentiment, suggesting that investors were more optimistic about the expected cash flows included in good earnings news for companies with high sentiment.

Hurwitz (2018) examined whether investor sentiment was effective on behavioral bias in managers' annual earnings forecasts. This paper found that management forecasts were significantly more optimistic during high sentiment periods.

Simpson (2013) studied the effect of investor sentiment on earnings management. He concluded that managers inflated earnings in periods of higher sentiment but reported more conservatively in periods of low sentiment. Furthermore, the probability of income-increasing earnings management to avoid negative earnings surprises was also positively associated with investor sentiment.

Brown et al. (2012) reviewed the influence of investor sentiment on managers' discretionary disclosure of pro forma earnings metrics in earnings press releases. They found that managers' propensity to disclose an adjusted earnings metric increased with investor sentiment. Moreover, their analyses suggested that, as investor sentiment increased, managers excluded higher levels of recurring and nonrecurring expenses in pro forma earnings number and accented the pro forma figure by placing it more prominently within the earnings press release.

3. Methodology

The sample of this paper includes the firms in the petroleum and petrochemical industry accepted in the Tehran Stock Exchange from 2014 to 2021. Considering the unique position of this industry in the country's economy, research hypotheses have been tested for this industry. The companies whose fiscal year-end does not end in March were left out to compare companies. Moreover, firm-years with missing data necessary to estimate the model are deleted. Thus, by applying these criteria, the final sample includes 41 companies.

The first model examines the relationship between investor sentiment and the likelihood of fraudulent financial reporting.

$$\begin{aligned}\Pr(\mathrm{Fraud}_{it} = 1) = {} & \alpha_0 + \alpha_1 \mathrm{SENTIMENT}_t + \alpha_2 \mathrm{SIZE}_{it} + \alpha_3 \mathrm{CR}_{it} + \alpha_4 \mathrm{RECINV}_{it} \\ & + \alpha_5 \mathrm{REPLAG}_{it} + \alpha_6 \mathrm{LEV}_{it} + \alpha_7 \mathrm{MWO}_{it} + \alpha_8 \mathrm{GROWTH}_{it} + \alpha_9 \mathrm{GCO}_{it} \\ & + \alpha_{10} \mathrm{ROA}_{it} + \alpha_{11} \mathrm{BIG4}_{it} + \varepsilon it\end{aligned} \tag{1}$$

where BIG4 is the controlling variable of the auditor's firm size; if the rating of the audit institution is *A*, the value is one; otherwise, it is zero; the current ratio (CR) is the current assets divided by current liabilities; the sales growth (GROWTH) indicates the percent change in sales; the going concern opinion (GCO) is a dummy variable. In such a way that if the auditor's statement contains an ambiguity clause in the going concern opinion, it will be given a value of one; otherwise, it will be given a value of zero; the financial leverage (LEV) divides total liabilities by total assets; the internal control weakness (MWO) is above one if the company receives a comment about it; otherwise, it is zero; RECINV denotes the ratio of receivables plus inventory to the total assets; REPLAG indicates the logarithm of the number of days between the client's fiscal year-end and the auditor signature date; return on assets (ROA) is the net income divided by the total assets; firm size (SIZE) is equal to the logarithm of assets.

The dependent variable of the research is the likelihood of fraudulent financial reporting, measured by auditing standard No. 240, entitled "Auditor's Responsibility in Financial Statements Fraud and Error". According to this standard, signs indicating the likelihood of fraudulent financial reporting are as follows:

1. Overstatement of inventory;
2. Overstatement of accounts and notes receivable;
3. Overstatement of fixed assets;
4. Overstatement of investments;
5. Deductions of allowance for doubtful accounts;
6. Deductions of depreciation;
7. Overstatement of revenues;

8. Overstatement of earnings;
9. Overstatement of retained earnings;
10. Understatement of accounts and payable notes;
11. Deductions of taxes payable;
12. Contingent liability;
13. Deductions of provision for staff termination benefits;
14. Understatement of costs;
15. Accounts and receivables that are long overdue.

If any of these signs are present in the adjustment clauses of the companies' annual audit reports, their value will equal one; otherwise, it will be zero.

Investor sentiment was calculated at the level of each year, and, similar to the work of Trichilli et al. (2020), two indexes of market difference and psychological lines were used to measure it.

The market incremental index (HLI) was calculated from the difference between the market index's highest and lowest prices, divided by the lowest price during one year. Equation (2) calculates the psychological line index (PLI):

$$PLI_t = \frac{T_u}{T} \tag{2}$$

where T_u represents the number of days when the closing price of the market index at time t is higher than its closing price at time $t - 1$, and T is the number of trading periods. After calculating the above two indexes, they are combined using the primary component analysis method, and Equation (3) is obtained to measure investor sentiment at the level of each year.

$$\text{Sentiment} = 0.7071 \times HLI + 0.7071 \times PLI \tag{3}$$

The second part investigates whether there is a significant difference in the market's reaction to the likelihood of fraud in periods with different investor sentiment. For this purpose, a sample of companies with a high probability of fraud was considered. The research periods were also classified into high and low sentiment periods by comparing the investor sentiment of the period corresponding to the middle of the investor sentiment during the research periods to calculate the market reaction from the daily cumulative abnormal return in the period from one day before to one day after the released date of the audit report (Kothari and Warner, 2007) and from one day before to four days after the released date of the audit report (Ghaemi and Masoumi, 2011). The daily cumulative abnormal return is calculated by Equation (4).

$$CAR_i = \sum_{t=-1}^{1} AR_{i.t} \tag{4}$$

A stock's daily abnormal return (AR) is obtained from the difference between the actual stock and market return.

The fifth research model examines the impact of risk disclosure on the relationship between investor sentiment and the likelihood of fraudulent financial reporting.

$$\begin{aligned}\Pr(\mathrm{Fraud}_{it}=1) = \alpha_0 + \alpha_1\mathrm{SENTIMENT}_t + \alpha_2\mathrm{SIZE}_{it} + \alpha_3\mathrm{CR}_{it} + \alpha_4\mathrm{RECINV}_{it} \\ + \alpha_5\mathrm{REPLAG}_{it} + \alpha_6\mathrm{LEV}_{it} + \alpha_7\mathrm{MWO}_{it} + \alpha_8\mathrm{GROWTH}_{it} + \alpha_9\,\mathrm{GCO}_{it} \\ + \alpha_{10}\mathrm{ROA}_{it} + \alpha_{11}\mathrm{BIG4}_{it} + \alpha_{12}\mathrm{RD}_{it} + \alpha_{13}\mathrm{SENT}_t * \mathrm{RD}_{it} + \varepsilon it\end{aligned} \tag{5}$$

To measure the level of risk disclosure (*Riskdisc*), the number of relevant sentences and words in the board activity reports, management interpretive reports, and the notes to the financial statements have been used. Thus, the natural log of the number of relevant sentences and the number of appropriate words in these reports will represent the level of risk disclosure. This method has already been used by researchers such as Linsley and Shrives (2006), Elbannan and Elbannan (2015), and Mihkinen (2013).

4. Results

Table 1 lists the descriptive statistics of the research variables. The mean variable of investor sentiment is 1.189, and its range is between 0.512 and 2.575. Logistic regression has been used to test the hypotheses to control industry effects. Hosmer–Lemeshow tests and prediction accuracy percentages were used to check the models' goodness of fit. The variance inflation factor was used to detect collinearity, and the findings in all models showed that independent variables did not have collinearity problems.

Table 1

Descriptive statistics

Variable	Mean	Median	Standard Deviation	Max	Min
Fraud	0.4875	0	0.500	1	0
SENTIMENT	1.189	0.943	0.710	2.575	0.512
SIZE	6.361	6.297	0.693	7.784	5.191
LEV	0.575	0.567	0.240	1.051	0.14307
ROA	0.123	0.099	0.159	0.476	–0.177
BIG4	0.737	1	0.440	1	0
MWO	0.248	0	0.432	1	0
GCO	0.068	0	0.252	1	0
RECINV	0.502	0.501	0.222	0.860	0.091
CR	1.548	1.311	0.980	4.313	0.314
GROWTH	0.288	0.222	0.396	1.175	–0.341
REPLAG	1.871	1.922	0.165	2.075	1.544
RD-SEN	2.353	2.833	1.685	4.575	0
RD-WOR	1.858	2.197	1.154	3.367	0

Table 2 reports the results of the investigation of the relationship between investor sentiment and the likelihood of fraudulent financial reporting, according to the first hypothesis. The model is significant at the 95% confidence level. The coefficient of investor sentiment is negative and significant, which means that the likelihood of fraud decreases in high investor sentiment periods. Companies with high GCO, RECINV, and REPLAG have more incentives for fraud. On the contrary, in companies with high CR, the likelihood of fraud is low. The Hosmer–Lemeshow test results show that the model fits well. The accuracy percentage of model prediction is also 69.56%. The sign (**) indicates significance at the 95% confidence level.

Table 3 presents the results of the second hypothesis test. The second hypothesis investigates the market reaction to fraud announcements in periods with different investor sentiments. As mentioned, to

calculate the market reaction, daily cumulative abnormal returns are used from one day before to one day after the audit report is released and from one day before to four days after the report is released. The findings show that in both periods, the market's adverse reaction after releasing an audit report containing fraudulent financial reporting is significantly smaller in periods with high investor sentiment than in periods with low sentiment.

Table 2

Investor sentiment and the likelihood of fraudulent financial reporting

Variable	Coefficient	*z*	***P*** **>|*z*|**
SENTIMENT	–0.077	–3.89	0.000
SIZE	0.038	1.68	0.093
LEV	0.029	0.32	0.746
ROA	–0.154	–1.46	0.145
BIG4	0.010	0.37	0.714
MWO	0.021	0.74	0.462
GCO	0.315	5.08	0.000
RECINV	0.250	3.48	0.000
CR	–0.066	–3.27	0.001
GROWTH	0.042	1.29	0.196
REPLAG	0.904	11.87	0.000
	IND		Controlled
	Wald Chi^2		331.56**
	Pseudo R^2		0.2397
	Hosmer–Lemeshow		0.1150
	Correctly classified		69.56%

Table 3

Market reaction to fraudulent financial reporting

	Average cumulative abnormal return	
	$CAR_{-1,1}$	$CAR_{-1,4}$
SENTIMENT$_{Low}$	–0.0114	–0.0313
SENTIMENT$_{High}$	0.0092	0.0242
***Pr*(diff)**	0.0018	0.0001

Table 4 tabulates the results of investigating the moderating role of risk disclosure in the relationship between investor sentiment and the likelihood of fraudulent financial reporting based on the third hypothesis. Model 5 has been examined based on two measures for risk disclosure: the logarithm of relevant sentences and the logarithm of appropriate words. The model is significant in both parts at the 95% confidence level. In the first part, risk disclosure negatively affects the relationship between investor sentiment and the likelihood of fraudulent financial reporting. The possibility of fraud is high in companies with high SIZE, GCO, RECINV, and REPLAG. On the contrary, fraud is less likely in companies with more CR. The accuracy percentage of model prediction is also 70.22%. In the second part, risk disclosure based on the natural logarithm of the relevant word has a negative and significant effect on the relationship between investor sentiment and the likelihood of fraud. The possibility of fraud is high in companies with high SIZE, GCO, RECINV, and REPLAG. On the contrary, in

companies with high CR, the likelihood of fraud is lower. The accuracy percentage of model prediction is also 69.56%. The Hosmer–Lemeshow test results in both parts show that the model fits well.

Table 4

The moderating role of risk disclosure in the relationship between investor sentiment and the likelihood of fraudulent financial reporting

1. Risk disclosure: the logarithm of the number of relevant sentences				
Variable	**Coefficient**	***z***	***P* >|*z*|**	
SENTIMENT	0.039	0.80	0.424	
SIZE	0.057	2.45	0.014	
LEV	0.008	0.09	0.931	
ROA	–0.163	–1.54	0.124	
BIG4	0.013	0.49	0.624	
MWO	0.022	0.77	0.440	
GCO	0.310	5.13	0.000	
RECINV	0.287	4.02	0.000	
CR	–0.065	–3.16	0.002	
GROWTH	0.045	1.38	0.167	
REPLAG	0.903	11.90	0.000	
RD-SEN	0.003	0.22	0.830	
RD-SE*SENT	–0.028	–2.06	0.039	
IND	Controlled	Correctly classified	70.22%	
Wald Chi^2	333.16**	Hosmer–Lemeshow	0.2070	
Pseudo R^2	0.2466			
2. Risk disclosure: The logarithm of the number of relevant words				
Variable	Coefficient	*z*	*P* >|*z*|	
SENTIMENT	0.025	0.50	0.615	
SIZE	0.052	2.27	0.023	
LEV	0.005	0.05	0.959	
ROA	–0.161	–1.53	0.126	
BIG4	0.012	0.44	0.660	
MWO	0.021	0.74	0.458	
GCO	0.311	5.10	0.000	
RECINV	0.281	3.89	0.000	
CR	–0.067	–3.29	0.001	
GROWTH	0.044	1.35	0.175	
REPLAG	0.902	11.91	0.000	
RD-WOR	0.020	0.88	0.381	
RD-WO*SENT	–0.038	–2.02	0.044	
IND	Controlled	Hosmer–Lemeshow	0.1044	
Wald Chi^2	329.18**	Correctly classified	69.56%	
Pseudo R^2	0.2430			

5. Conclusions

Despite the prevalence of research on investor sentiment, the relationship between investor sentiment and the likelihood of fraudulent financial reporting in the petroleum and petrochemical industries has not been investigated. Therefore, the current research examines this relationship in three parts described below.

The first part examines the relationship between investor sentiment and the likelihood of fraudulent financial reporting in petroleum and petrochemical companies. The findings show that the possibility of fraudulent financial reporting decreases when investor sentiment is high. This result contradicts the

findings of Amin et al. (2021), stating that the likelihood of misstatement in financial statements decreases with an increase in investor sentiment. In the present research, the possibility of fraud is measured based on the adjustment clauses of the audit report. This can be one of the reasons for reducing the likelihood of fraud in periods of high investor sentiment. However, with high investor sentiment, auditors will demand lower fees and issue audit reports less conservatively. This view is built on research findings, demonstrating that investors pay limited attention to firms' financial information during high sentiment periods (Povel et al., 2007; Ali and Gurun, 2009). Investor inattention results in less efficient processing of financial reports (Hirshleifer and Teoh, 2003) and could result in a lower risk of lawsuits against auditors. Thus, auditor litigation risk is lower during high sentiment periods, and reporting conservatism is reduced (Kaplan and Williams, 2013; Amin et al., 2021). This prediction is based on auditors' business incentives to retain owners and their willingness to detect the likelihood of fraud during periods with less exposure to litigation risk.

In the second part, the market reaction to the likelihood of fraud in high sentiment periods and low sentiment periods is compared. The findings show that the market's response to the possibility of fraud is lower in periods with high investor sentiment than in periods with low investor sentiment. To measure the market reaction, the daily cumulative abnormal return is used during two periods: from one day before to one day after the released date of the audit report and from one day before to four days after the released date of the audit report. These results are similar to the findings of Amin et al. (2021), Bouteska (2019), Seok et al. (2019), and Li et al. (2021). Amin et al. (2021) showed that market reaction to misstatement decreased with high sentiments. Bouteska (2019) also believed that the market's response to bad news about the renewal of profits was more limited in periods with high sentiments. Li et al. (2021) stated that in periods of high (low) sentiment, market reaction to good (bad) earnings news increased (decreased) as investor sentiment increased.

The final part examines the moderating role of risk disclosure in the relationship between investor sentiment and the likelihood of fraudulent financial reporting. To measure the risk disclosure, the logarithm of the number of relevant sentences and the logarithm of the number of relevant words are used in the board activity reports, management interpretive reports, and the notes to the financial statements. The results show that risk disclosure reduces the relationship between investor sentiment and the likelihood of fraud by using both indicators. According to agency theory, managers provide relevant information to reduce agency costs and prove performance for the benefit of shareholders and creditors. Providing reliable information about risk by management minimizes the problem of information asymmetry (Al-Shammari, 2014; Campbell et al., 2014; Heydari et al., 2015). Thus, by reducing information asymmetry, risk disclosure minimizes the impact of investor sentiment on auditors' optimism and reduces the likelihood of fraudulent financial reporting.

The research findings on reducing the probability of fraud (based on the auditor's opinion) in periods with high investor sentiment indicate the need for legislators and investors to pay attention to periods with different investor sentiments. In addition, considering the moderating role of risk disclosure in the relationship between investor sentiment and the likelihood of fraudulent financial reporting, investors are advised to pay attention to the content of published information about risk in companies' financial reports. Legislators are suggested to establish an approved guideline for risk reporting to improve user decision-making.

Nomenclature

GAAP	Generally accepted accounting principles

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