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The Interactive Effect of Ownership Structure on the Relationship between Annual Board Report Readability and Stock Price Crash Risk

Mohsen Tavakoli Shandiz [1], Farzaneh Nassir Zadeh [1,*] and Davood Askarany [2]

[1] Faculty of Economics and Administrative Sciences, Ferdowsi University of Mashhad, Mashhad 917794895, Iran; mtshandizi@gmail.com
[2] Business School, Accounting and Finance, The University of Auckland, Private Bag, Auckland 92019, New Zealand; d.askarany@auckland.ac.nz
*   Correspondence: nasirzadeh@um.ac.ir

Abstract: This study investigates the interactive effect of ownership structure on the relationship between annual board report readability and stock price crash risk in companies listed on the Tehran Stock Exchange (TSE). The negative skewness model was used to measure the crash risk of stock prices and the Fog index was used for determining the readability of the board of directors' report. The ownership structure is examined in institutional ownership, significant managerial ownership, and family ownership. The data of companies listed on the TSE from 2013 to 2019 have been used. The statistical method of this research is multiple regressions and, to test the research hypotheses, the data panel model and the ordinary least squares method have been employed. Overall, this study provides new evidence to explain the reporting quality and the crash risk of stock prices from the lenses of the agency theory. It further investigates the interactive effect of ownership structure on the relationship between annual board report readability and stock price crash risk. The results show a significant correlation between the readability of the board of directors' report and the crash risk of stock prices. Furthermore, the relationship between the readability of the board report and stock price crash risk is not affected by the ownership structure, including institutional ownership, significant managerial ownership, and family ownership. It can be inferred that an ownership structure, which includes institutional shareholders, significant shareholders, and family ownership, increases the supervision of managers and their reports, so they cannot keep adverse information from being released. This will ultimately improve the readability of their reports and reduce the risk of stock price crashes.

Keywords: annual board report readability; Fog index; ownership structure; stock price crash risk

1. Introduction

The stock price is one of the most talked-about issues in the financial market (Aman and Nguyen 2008; French and Poterba 1990; Khan et al. 2019; Tong and Bremer 2016; Liu 2021). Some experts seek and interpret the reasons for a stock price crash within the framework of agency theory. In this context, it is argued that managers, in line with their incentives and interests, such as reward contracts and job positions, tend to avoid publishing adverse information and accumulate it within the company. Keeping negative information from disclosure by managers continues to a certain extent. It is impossible and costly to continue not to disclose it, and the manager will be forced to release it. Thus, the market will be given much adverse information all at once, leading to stock price crashes (Jin and Myers 2006; Hutton et al. 2009; Benmelech et al. 2010; Azadi et al. 2021; Andreou et al. 2021; Zaman et al. 2021).

Identifying the determinants of stock price crash risk is one of the essential issues in investment. We have witnessed global stock market crashes several times in recent

years. Recently, the readability of companies' annual reports (as one of the potentially influential factors) has drawn many people's attention, including capital market activists and academics. Theoretically speaking, the literature suggests that by improving the readability of the board of directors' reports, the crash risk of stock prices decreases. It also argued that the ownership structure has a positive and significant effect on the relationship between the readability of the board report and the crash risk of stock prices. However, so far, little research has been reported to examine the relationship between the readability of annual reports and the stock price crash risk.

The annual reports published by companies provide essential information for economic decisions for the users of financial statements, including potential investors. For users to make the right decisions, these reports must be prepared and published in a way that they are easily understood by users (Rezaei Pitenoei and Gerayli 2019).

However, the impact of readability of annual reports on some financial issues, such as the crash risk of falling stock prices, has been ignored. Obviously, to read and understand a text, using shorter sentences and more familiar words make it much easier than using longer sentences and unfamiliar words. Readability is one of the subsets of information transparency and examines the text from the viewpoint of linguistics. Despite the importance of readability and quality of financial reporting, only a few studies have examined the implications of readability on a few aspects of companies (Loughran and McDonald 2014; Kim et al. 2019). Recent studies have indicated that investors are considering the factors related to the transparency of companies' annual reports in examining future stock price crashes. At the same time, it can be argued that sophisticated annual reports increase information ambiguity and thus enable managers to hide adverse information for long periods. When such an accumulation of data exceeds a certain extent, the negative information will be suddenly released and lead to a stock price crash. Therefore, it can be argued that there is a positive relationship between the complexity of financial reports and the crash risk of stock prices (Kim et al. 2019). Furthermore, the literature suggests that the ownership structure can also affect stock price risk (Gao et al. 2017).

Given the above, this study investigates the effect of ownership structure on the relationship between annual board report readability and stock price crash risk. This study aims to provide new evidence to explain the reporting quality and the crash risk of stock prices from the lenses of the agency theory. It further investigates the interactive effect of ownership structure on the relationship between annual board report readability and stock price crash risk.

This study can contribute to the literature in three areas: first, it provides evidence to support the notion that the readability of the board of directors' report is a decisive, influential, and effective factor affecting the crash risk of stock prices. Second, the results of this study provide investors with a greater understanding of the stock price crash risk. Third, the present study explains how to measure the structure of mixed ownership using the components of institutional ownership, significant managerial ownership, and family ownership, which helps to enrich the literature in the field of ownership structure.

The research structure is organized as follows: first, the theoretical bases and development of research hypotheses are explained; then the research method and data analysis are presented; and finally, based on the research findings, conclusions and recommendations are presented.

2. Theoretical Bases and Development of Hypotheses

Transparency of information plays an essential role in conveying concepts, and this is done through the readability and comprehensibility of annual reports. A readable text is a text that the reader can read fluently and understand its meaning easily. The less complex the text is, the more readable and understandable it becomes. Readability can be examined from both physical and content dimensions. The physical dimension often discusses design, visual processes, fonts, etc. In contrast, the content dimension focuses on some topics such

as text length, basic vocabulary, sentence structure, syntactic and semantic ambiguities, and writing style (Tajvidi 2006). In this research, the content dimension has been focused on.

Several studies have investigated the risk of a stock price crash in various fields (Acharya and Pedersen 2019; Atanasov and Black 2016; Amihud 2018; Zaman et al. 2021; Hossain et al. 2022; Hasan et al. 2021). In the area of political issues, Ebrati and Bahri Sales (2019) examined the effect of political relations on the stock price crash risk, emphasizing product market competitiveness. The results showed that political relations positively affect the risk of stock price crashes. This means managers misrepresent the company's conditions and show it more favorable by not releasing undesirable information. This behavior of managers leads to a fall in stock prices in the long run. In the field of accounting, Kim and Zhang (2016) show that conservative accounting policy reduces the concealment of undesirable information and the risk of stock price crashes. The research results by Hutton et al. (2009) indicate that accrual earnings management is associated with the crash risk of stock prices. Hutton et al. (2009) and Kim et al. (2015) found that improving information transparency reduces the stock price crash risk. The results of the study by Kim et al. (2019), entitled "Readability of K-10 reports and stock price crash risk", indicate that reducing the readability of financial reports increases the stock price crash risk, and there is a negative correlation between the readability of financial reports and the risk of stock price crash. They argue that managers can successfully conceal unwanted information by preparing complex reports. When the undesirable hidden information reaches its peak, it can lead to a fall in stock prices.

Jin and Myers (2006) believe that no matter how much managers try to conceal undesirable events to keep their jobs, receive more rewards, and maintain their credibility and positions, these adverse events and information will be accumulated and disseminated one day. The publication of such news in the long term to shareholders and investors and their unwillingness to pay higher prices for stocks will lead to a crash in stock prices. So, improving information transparency is supposed to limit managers' accumulation of undesirable information and ultimately reduce the risk of stock price crashes. Azadi et al. (2021) examined the relationship between the readability of financial statements and their effect on the crash risk of stock prices and shareholders' behavior. The results showed that the readability of financial statements affects the behavior of shareholders and reduces the stock price crash risk. However, we found no research regarding the interactive effect of ownership structure on the relationship between the readability of annual reports and stock price crash risk (Aguilera and Crespi-Cladera 2016; Fuentelsaz et al. 2020; Karaevli and Yurtoglu 2021; Liu et al. 2011). So, to expand empirical knowledge in this area, this study aims to examine the effect of the ownership structure as a moderating variable on the relationship between the readability of board reports and stock price crash risk. This research can show the importance of the understandability of the board of directors' reports in improving users' decisions and reducing the risk of stock price crashes.

The Relationship between the Readability of Annual Reports and the Stock Price Crash Risk

Considering the agency theory and the probability of the existence of conflicts of interest between managers and owners, it can be argued that some managers are likely to pursue their personal incentives and interests (such as reward contract theory and job position) and prevent the dissemination of unfavorable information and accumulate it within the company. The keeping of the adverse information by managers can be continued only to a certain extent. Still, it could become impossible or costly to do so forever, and the manager could be forced to disclose it. Then a considerable amount of undesirable information is given to the market at once, leading to a fall in stock prices. Since the stock price crash is expected to be due to the presentation of nontransparent and complex information, the more readable the data, the more understandable it becomes, thus reducing the risk of a stock price crash. Kim and Zhang (2016) examined the effect of comparability of financial statements on the crash risk of stock prices. Using the criteria suggested by De Franco et al. (2015) to measure comparability, they found that the risk

of stock price crashes decreases with increasing financial comparability. This negative correlation is more significant in environments where managers are more likely to hide undesirable information. Badavar Nahandi and Taghizadeh Khanqh (2017) examined the relationship between the comparability of financial reports and the crash risk of stock prices, emphasizing the role of information asymmetry. He found a negative and significant correlation between the comparability of financial statements and the stock price crash risk—the level of such a negative correlation increases in the case of information asymmetry.

Hwang and Kim (2017) and Kim et al. (2017) conclude that readability can affect company value. When the readability of financial statements is poor, investors become distrustful of the information disclosed by the company and, as a result, the value of the company decreases. Kim et al. (2019) report that companies whose financial statements are unreadable are at greater risk of a stock price crash in the future. Given the above, the first hypothesis is proposed as follows.

Hypothesis 1 (H1). *There is a positive relationship between the readability of the annual board report and stock price crash risk.*

Ownership structure is one of the most talked-about contextual factors in organizations (Axarloglou and Kouvelis 2007; Bao and Lewellyn 2017; Calabrò et al. 2013; Munisi et al. 2014; Oesterle et al. 2013). According to the active supervision theory, institutional owners are long-term investors who have a great incentive and ability to actively monitor the performance of the manager/s (Brous and Kini 1994). Brous and Kini (1994) suggest monitoring the managers' activities and preventing them from doing things that serve their interests. According to this theory, institutional shareholders encourage managers to make long-term decisions to increase the company's value. According to this theory, the existence of institutional shareholders is valuable for the whole company (Petra 2007).

Callen and Fang (2013) report that the supervision of institutional investors reduces the risk of stock price crashes. To investigate the effect of institutional ownership on the crash risk of stock prices, Vadeei Noghabi and Rostami (2014) first divided institutional ownership into active and inactive groups. The results showed that active institutional owners had a negative effect on the crash risk of stock prices. In contrast, inactive institutional ownership positively affected the crash risk of stock prices. In other words, active institutional ownership has a negative effect, and passive institutional ownership positively affects the risk of future stock price fall. Considering the active supervision theory, it can be argued that the ownership structure, including institutional shareholders, significant shareholders, and family ownership, can increase the supervision of managers and their reports so that they cannot hide undesirable information. This, in turn, ultimately improves the readability of their reports and reduces the stock price crash risk.

In line with the above discussions, the next question is what factor/s may affect the relationship between the readability of the board report and the stock price crash risk. Theoretically, institutional investors may have specific incentives to actively monitor management practices (Pound 1988; Shleifer and Vishny 1997). The high amount of investment can probably be an incentive for investors to manage their capital actively. Maug (1998) states that there is a direct relationship between the amount of investment of institutional investors and the supervision of management practices. In other words, the level of use of institutional investors from their capabilities to monitor management practices depends on the amount of their investment.

Rao and Zhou (2019) examined the relationship between the stock price crash risk, institutional shareholders, and stock returns. They studied the companies listed on the Shanghai Stock Exchange between 2005 and 2015 and found that the risk of stock price crashes was higher with higher institutional ownership. Given the above discussion, the second hypothesis can be proposed as follows:

Hypothesis 2 (H2). *The existence of institutional shareholders positively affects the relationship between the readability of the board report and the stock price crash risk.*

Theoretically, institutional ownership and significant managerial ownership are very similar. Considerable shareholders are usually more motivated to oversee management. According to the cost–benefit principle, if the costs associated with supervising management are less than the expected benefits of large shareholders in a given company, significant investors are expected to monitor management practices as much as possible. In centrally owned companies, the board and major shareholders act as supervisors who can increase the quality of management and the level of efficiency of the company. A similar argument to institutional ownership can be proposed regarding the structure of significant managerial ownership and the stock price crash risk. This question begins with the statement that if there is substantial managerial ownership in a company, supervision of the preparation and submission of reports by the management intensifies. This leads to high-quality and transparent reporting and ultimately reduces the crash risk of the stock price in that company. Accordingly, it can be concluded that significant managerial ownership, like institutional ownership, affects the relationship between the readability of the board of directors' report and the risk of a stock price crash. Therefore, the third hypothesis can be proposed as follows:

Hypothesis 3 (H3). *The existence of significant managerial ownership positively affects the relationship between the readability of the board report and the stock price crash risk.*

This study defines family companies as subsidiaries of a group of holding members. Cascino et al. (2010) examined the effect of family ownership on the quality of accounting information. They concluded that family firms have a higher profit quality than non-family firms and that the determinants of accounting quality are usually different in family and non-family firms. In family companies, the quality of accounting is directly associated with leverage, board independence, and auditing quality, while institutional ownership is negatively correlated with it. Ali et al. (2007) studied family and non-family companies regarding the quality of information disclosure. The results of their study indicate that financial reports provided by family companies are of higher quality than those of non-family companies—especially when there is unfavorable information; meanwhile, they offer less disclosure on corporate governance. Therefore, it can be argued from their research that since the annual reports are provided with higher quality in family companies, this can reduce the risk of stock price crashes.

Hypothesis 4 (H4). *The existence of family ownership is positively affecting the relationship between the readability of the board report and the stock price crash risk.*

3. Methodology

3.1. Statistical Population and Data Collection

The statistical population of this study includes all 331 companies listed on the Tehran Stock Exchange (TSE) that have been active in the TSE during the years 2013 to 2019. To eliminate the effect of uncontrollable phenomena and increase the comparability of companies, those companies that meet one of the following criteria are excluded from the statistical population: (a) companies that have entered or left the TSE during the research period; (b) companies that have changed their fiscal year-end during the research period; (c) companies that have not disclosed all the data necessary to calculate the variables; (d) investment companies, holdings, and banks; and (e) companies with interruption of transactions.

Based on the above criteria, 67 companies in 13 industries were identified as suitable statistical populations. The targeted sample provided 469 firms' year observations (67×7 years = 469) for the study period (2013 to 2019). The required data were collected

manually from the annual reports of the board of directors, financial statements, and explanatory notes, along with those statements available in the Securities and Exchange Organization's Information System (CODAL) and the website of the Statistical Center of Iran (SCI).

3.2. Measuring the Variables

3.2.1. The Dependent Variable

In this study, the crash risk of stock prices ("crash risk") is the dependent variable. Previous research has used the "maximum sigma" index (Bradshaw et al. 2010) and the "down-to-up volatility" index (Chen et al. 2001) to calculate the risk of falling stock prices. The negative skewness index has been mainly used to calculate such a risk in this research. This index is suitable for measuring the crash risk of stock prices for two reasons. First, it is an accurate measurement tool and, second, it is possible to study a wide range of companies using this index (Dianati Dilami et al. 2012; Khodarahmi et al. 2016; Heidar Poor et al. 2017).

Since a sharp drop in stock prices may be due to a decline in the general level of prices in the market, to measure the risk of a stock price crash it is also necessary to pay attention to the general market conditions and interpret a sharp drop in stock returns relative to market returns. Therefore, the following equation can be used to calculate the specific return of the given company:

$$R_{i,t} = \beta 0 + \beta 1 \, R_{m,t-2} + \beta 2 \, R_{m,t-1} + \beta 3 \, R_{m,t} + \beta 4 \, R_{m,t+1} + \beta 5 \, R_{m,t+2} + \varepsilon_{i,t}$$

where R_i represents the monthly return of the company, R_m represents the monthly return of the market, and t represents the months of the year. The remainder of the above equation represents the specific return of the company relative to the market and for making their distribution closer to the normal distribution, the following equation can be used:

$$W_{i,t} = Ln\,(\,1 + \varepsilon_{i,t}\,)$$

where $W_{i,t}$ represents the specific return of the company. According to this definition and assuming that the distribution of particular returns is normal, the "crash period" is the period during which the specific return of the company will be lower than the average of its specific return by 3.09 standard deviation. According to Kim et al. (2011), if a company experiences a crash period once a year, its value will be one (1), and otherwise, it will be zero (0) (Darabi and Zareie 2017).

3.2.2. Independent Variable

The independent variable in this study is "readability". The practical definition of readability assumes that readability is a quality that makes the text easier to read and is affected by the length of sentences and the number of syllables of a word (Lehavy et al. 2011). The readability can be measured by several indices, the most important and widely used is the Fog index (Loughran and McDonald 2014; Kim et al. 2016). In particular, the Fog index has been extensively used in accounting and finance literature (Li 2008; Rennekamp 2012; Lim et al. 2018). In this study, the Fog index was used to measure readability. This index is a function of two variables, the average number of words in each sentence and the percentage of complex words (i.e., words that have three syllables or more than three syllables in a text). The sum of these values is multiplied by 0.4 to become proportional. Therefore, the Fog index is calculated as follows:

$$Fog = 0.4 \times (Words\ per\ sentences + complex\ words\ percent)$$

The number of words per sentence is calculated by dividing the total number of words by the number of sentences in the board of directors' report. At the same time, complex words percent are words that have three syllables or more. Long sentences and a higher number of complex words increase this index and thus reduce readability.

3.2.3. Moderating Variable

As discussed in the literature review section, it can be argued that the ownership structure affects the relationship between readability and the crash risk of stock prices. Therefore, the effect of ownership structure will be examined as a moderating variable and includes institutional owners, significant owners, and family owners. Institutional ownership includes legal persons as shareholders, influential owners include both real and legal persons as shareholders with ownership over 5%, and family ownership comprises companies that are members of a group or a subsidiary of a holding company.

3.2.4. Control Variables

The control variables in this study include firm size (size), financial leverage (LEV), market-to-book value of a company (MTB), return on assets (ROA), return on equity (ROE), accruals (OPAQUET), and the Hirschman–Herfindahl index (HHI), as well as year and industry as dummy variables. Table 1 summarizes the research variables and how to measure them.

Table 1. Research variables.

Variable	Type	Symbol	Practical Definition
Readability	Independent	Readability	It is a quality that makes the text easier to read and is affected by the length of sentences and the number of syllables in a word
Stock price crash risk	dependent	Crash Risk	Interpretation of a sharp decline in share returns compared to market returns
Institutional ownership	Moderating	INS	Legal persons as shareholders
Significant ownership		IOS	Real and legal persons ad shareholders with ownership over 5%
Family ownership		Family	Companies that are members of a group or subsidiary of a holding
Firm size	Control	Size	The logarithm of total assets
Financial leverage		LEV	The result of dividing the sum of debts by assets
Return on assets		ROA	Net profit to average total assets
Return on equity		ROE	Net profit divided by the sum of equity at the end of the period
Market competitiveness *		HHI	$HHI = \sum_{i=1}^{n} \left(\frac{Si}{S} \right)$
Company value		MTB	The sum of the company's market value to the book value of equity
Accruals		OPAQUET	The difference between operating profit and operating cash flows
Industry	Dummy	IndustryDum	One for the industry under review and zero for the other industries
Year		YearDum	One for the year under review and zero for the other years

* HHI: Market competitiveness is measured by Herfindahl–Hirschman index, which is defined as follows: $HHI = \sum_{i=1}^{n} \left(\frac{Si}{S} \right)$, where Si is the sales revenue of the company, S is the sales revenue of the companies in the industry in which i company operates, and n is the number of existing companies. The smaller the index, the more competition there is in that industry. Companies face higher risk in a competitive market; thus, the probability of stock price crash increases.

3.3. Research Model

This section focuses on developing a model to examine the risk factors for the stock price crash. This study uses regression Model 1 to empirically investigate the effect of the

readability of the board report on the stock price crash risk (the first hypothesis). Moreover, regression Models 2–4 are used to investigate the moderating role of ownership structure on the relationship between the readability of the board report and the risk of stock price crash (Hypotheses 2–4).

Model (1)

$$Crash\ Risk_{i,t} = \beta_0 + \beta_1 MODFOG_t + \beta_2\ OPAQUET_t + \beta_3\ SIZE_t + \beta_4\ MBT_t + \beta_5\ LEV_t + \beta_6\ ROA_t \\ + \beta_7\ ROE_t + \beta_8\ HHI_t + \sum YEAR + \sum Industry\ Dum_j + \varepsilon_{i,t}$$

Model (2)

$$Crash\ Risk_{i,t} = \beta_0 + \beta_1 MODFOG_t + \beta_2\ INS_t + \beta_2\ INS_t * MODFOG_t + \beta_2\ OPAQUET_t + \beta_3\ SIZE_t \\ + \beta_4\ MBT_t + \beta_5\ LEV_t + \beta_6\ ROA_t + \beta_7\ ROE_t + \beta_8\ HHI_t + \sum YEAR \\ + \sum Industry\ Dum_j + \varepsilon_{i,t}$$

Model (3)

$$Crash\ Risk_{i,t} = \beta_0 + \beta_1 MODFOG_t + \beta_2\ IOS_t + \beta_2\ IOS_t * MODFOG_t + \beta_2\ OPAQUET_t \\ + \beta_3\ SIZE_t + \beta_4\ MBT_t + \beta_5\ LEV_t + \beta_6\ ROA_t + \beta_7\ ROE_t + \beta_8\ HHI_t + \sum YEAR \\ + \sum Industry\ Dum_j + \varepsilon_{i,t}$$

Model (4)

$$Crash\ Risk_{i,t} = \beta_0 + \beta_1 MODFOG_t + \beta_2\ FAMILY_t + \beta_2\ FAMILY_t * MODFOG_t + \beta_2\ OPAQUET_t \\ + \beta_3\ SIZE_t + \beta_4\ MBT_t + \beta_5\ LEV_t + \beta_6\ ROA_t + \beta_7\ ROE_t + \beta_8\ HHI_t + \sum YEAR \\ + \sum Industry\ Dum_j + \varepsilon_{i,t}$$

In these models, $(Crash\ Risk)_{i,t}$ represents the risk of stock price crash i in year t, $(FOG)_{i,t}$ indicates the readability index of the board report i in year t, $(INS\ \&\ IOS\ \&\ FAMILY)_{i,t}$ represents the ownership structure of i in year t, and the control variables include firm size, financial leverage (LEV), return on assets (ROA), return on equity (ROE), market competitiveness (HHI), company value (MTB), and accruals (OPAQUET).

To control time and sector, the dummy (two-dimensional) variables of "year" and "industry" are used, respectively. In Model 2, the Fog readability index and institutional ownership are explanatory variables. It is also necessary that these two variables be multiplied and added to the model as an interactive variable. In Model 3, the Fog readability index and significant ownership are included as explanatory variables.

In Model 4, the Fog readability index and family ownership are included as explanatory variables. It is also necessary that these two variables be multiplied and added to the model as an interactive variable.

The first hypothesis is supported if, in Model 1, the β_1 coefficient is negative and the t-statistic is significant at 5%. In this case, there is a negative and significant correlation between readability and the stock price crash risk.

Moreover, if coefficient β_3 is negative and the *t*-statistic is significant at the level of 5% in Models 2–4, the second, third, and fourth hypotheses are also supported. The ownership structure strengthens the relationship between the readability of the board of directors' report and the crash risk of stock prices.

4. Research Findings

4.1. Descriptive Statistics

Table 2 shows the descriptive statistics related to the variables used in the empirical analysis. Following previous research, this study has modified outliers (extreme data by 1%) (Winsorized). It is observed that the mean of stock price crashes is 0.27, its median is 0.12, the minimum risk level is −3.56, and the maximum is 3.96, with a standard deviation

of 1.54. The mean readability of the board report is −19.17, and its median is −17.25, with a minimum value of −34.16, a maximum of −13.24, and a standard deviation of 4.72. The mean for institutional shareholders is 69.27, and 69.39 for significant shareholders. The mean of financial leverage is 0.58, which indicates that the debt-to-asset ratio of the firm is 58%. The mean size of the companies is 13.8, with a minimum value of 9.01 and the maximum value of 19.27.

Table 2. Descriptive statistics of variables.

Variable	Symbol	Mean	Median	Maximum	Minimum	Standard Deviation
Stock price crash risk	Risk	0.27	0.12	3.96	−3.56	1.54
Readability	MODFOG	−19.17	−17.25	−13.24	−34.16	4.72
Significant shareholders	IOS	69.38	74.12	98.70	7.56	20.20
Institutional shareholders	INS	69.27	78.76	98.7	0	27
Company value	MTB	2.72	2.07	17.74	−1.44	2.71
Financial leverage	LEV	0.58	0.57	2.08	0.013	0.225
Return on assets	ROA	0.13	0.11	0.64	−0.30	0.14
Accruals	OPAQUET	0.045	0.03	4.661	−3.541	0.381
Size	SIZE	13.80	13.86	19.27	9.01	1.51
Return on equity	ROE	0.246	0.272	−1.314	0.897	0.339
Market competitiveness	HHI	0.043	0.016	0.349	0.005	0.070
Number of observations				469		

4.2. Descriptive Statistics for Ownership Structure

Table 3 shows the descriptive statistics related to ownership structure. Using the median for measuring the ownership structure, the findings show that 234 companies have *significant shareholders*. However, considering the mean instead of the medium, this number increases to 271 companies. Similarly, for *institutional shareholders,* the median number of companies is 234, while the mean number rises to 303. The number of companies with *family ownership* was 260, constituting 55%.

Table 3. Descriptive statistics ownership structure.

Variable	Frequency (%)	Count
Dummy variable of significant shareholders using mean	0.578	271
Dummy variable of significant shareholders using median	0.499	234
Dummy variable of institutional shareholders using mean	0.646	303
Dummy variable of institutional shareholders using median	0.499	234
Family ownership	0.554	260

4.3. Hypotheses Testing Results

4.3.1. Examining the First Hypothesis

According to Table 4, the value of the *F* statistic of the model and its probability are equal 4.333 and 0.000, respectively, which indicates the proper fit of the model and the significance of the whole model. On the other hand, the adjusted coefficient of determination of the model is equal to 0.124, which indicates that the explanatory variables explain 12.4% of the changes in the model's dependent variable (both control and independent variables). Since the *p*-value of the board report readability variable is 0.0255, it can be said that this variable is significant in the model. Accordingly, there is a significant negative correlation between the readability of the board report and stock price crash risk, and the first hypothesis of this study is supported. There is a significant correlation between firm size, market-to-book value, and financial leverage with stock price crash risk among the control variables.

Table 4. Results of the first hypothesis.

Variable	Symbol	First Hypothesis			
		Estimated Coefficient	Standard Error	*t* Statistic	*p*-Value
Intercept	C	−3.285	2.153	−1.526	0.128
Readability	Readability	−0.019	0.017	−1.140	0.0255
Accruals	OPAQUET	0.178	0.193	0.924	0.356
Firm size	Size	0.161	0.058	2.764	0.006
Market-to-book value	MTB	0.122	0.028	4.384	0.000
Financial leverage	LEV	2.046	0.773	2.648	0.008
Return on assets	ROA	−0.128	0.451	−0.283	0.777
Return on equity	ROE	−0.291	0.251	−1.159	0.247
Hirschman–Herfindahl index	HHI	3.832	9.308	0.412	0.681
Constant effects of "year" and "industry."		Controlled			
F statistic		3.94			
Significance of *F* statistic		0.000			
The adjusted coefficient of determination		0.124			

4.3.2. Examining the Second Hypothesis

According to Table 5, the value of the *F* statistic of the model and its probability are 3.76 and 0.000, respectively, which indicates the proper fit of the model and the significance of the whole model. Meanwhile, the adjusted coefficient of determination of the model is 0.127, which suggests that 12.7% of the changes in the model's dependent variable are explainable by the explanatory variables (i.e., control and independent variables) in the model. Due to the fact the *p*-value of the interactive effect of the board report readability variable and institutional shareholders is 0.524, it can be concluded that this variable is not significant in the model. Thus, institutional shareholders have no significant effect on the correlation between the readability of the board report and stock price crash risk. The second hypothesis of this study is also not supported. There is a significant correlation between firm size, market-to-book value, return on assets, and stock price crash risk among the control variables.

Table 5. Results of the second hypothesis.

Variable	Symbol	Second Hypothesis			
		Estimated Coefficient	Standard Error	*t* Statistic	*p*-Value
Intercept	C	−3.219	2.171	−1.483	0.139
Readability	Readability	0.009	0.026	0.348	0.728
Institutional shareholders	INS	0.672	0.640	1.050	0.294
Readability × institutional shareholders	INS × Readability	0.021	0.032	0.638	0.524
Accruals	OPAQUET	0.187	0.193	0.968	0.334
Firm size	Size	0.137	0.060	2.293	0.022
Market-to-book value	MTB	0.124	0.028	4.407	0.000
Financial leverage	LEV	−0.262	0.460	−0.569	0.569
Return on assets	ROA	1.991	0.773	2.576	0.010
Return on equity	ROE	−0.323	0.251	−1.286	0.199
Hirschman–Herfindahl index	HHI	4.250	9.303	0.457	0.648
Constant effects of "year" and "industry."		Controlled			
F statistic		3.76			
Significance of *F* statistic		0.000			
The adjusted coefficient of determination		0.127			

4.3.3. Examining the Third Hypothesis

According to Table 6, the value of the *F* statistic of the model and its probability are 3.62 and 0.000, respectively, which indicates the proper fit of the model and the significance of the whole model. However, the adjusted coefficient of determination of the model is 0.12, which suggests that 12% of the changes in the model's dependent variable are explainable by the explanatory variables in the model (i.e., control and independent variables). The *p*-value of the interactive effect of the board report readability variable and significant shareholders is

0.675, which means this variable is insignificant in the model. Thus, significant shareholders have no meaningful effect on the correlation between the readability of the board report and stock price crash risk; therefore, the third hypothesis is not supported. Finally, there is a significant correlation between firm size, market-to-book value, and return on assets with stock price crash risk among the control variables.

Table 6. Results of the third hypothesis test.

Variable	Symbol	Third Hypothesis			
		Estimated Coefficient	Standard Error	*t* Statistic	*p*-Value
Intercept	C	−3.350	2.182	−1.535	0.125
Readability	Readability	0.011	0.026	0.415	0.678
Significant shareholders	IOS	0.328	0.620	0.528	0.597
Readability × significant shareholders	IOS × Readability	0.013	0.032	0.419	0.675
Accruals	OPAQUET	0.188	0.194	0.968	0.333
Firm size	Size	0.156	0.059	2.632	0.009
Market-to-book value	MTB	0.122	0.028	4.309	0.000
Financial leverage	LEV	−0.164	0.455	−0.361	0.719
Return on assets	ROA	2.016	0.776	2.599	0.010
Return on equity	ROE	−0.303	0.252	−1.199	0.231
Hirschman–Herfindahl index	HHI	3.828	9.331	0.410	0.682
Constant effects of "year" and "industry."		Controlled			
F statistic		3.62			
Significance of *F* statistic		0.000			
The adjusted coefficient of determination		0.12			

4.3.4. Examining the Fourth Hypothesis

According to Table 7, the value of the *F* statistic of the model and its probability are 3.62 and 0.000, respectively, which shows the proper fit of the model and the significance of the whole model. The adjusted coefficient of determination of the model is 0.12, which shows that 12% of the changes in the model's dependent variable can be explained by the explanatory variables (i.e., control and independent variables) in the model. Since the p-value of the interactive effect of the board report readability variable and family shareholders is 0.446, it can be concluded that this variable is not significant at the 5% level. Accordingly, family shareholders have no meaningful effect on the correlation between the readability of the board report and stock price crash risk, and the fourth hypothesis is not supported. Ultimately, there is a significant correlation between firm size, market-to-book value and return on assets with stock price crash risk among the control variables.

Table 7. The results of the fourth hypothesis test.

Variable	Symbol	Fourth Hypothesis			
		Estimated Coefficient	Standard Error	*t* Statistic	*p*-Value
Intercept	C	−2.953	2.206	−1.339	0.181
Readability	Readability	0.036	0.028	1.292	0.197
Family shareholders	Family	−0.469	0.636	0.738	0.461
Readability × Family shareholders	Family × Readability	−0.026	0.034	−0.763	0.446
Accruals	OPAQUET	0.180	0.193	0.929	0.353
Firm size	Size	0.153	0.061	2.512	0.012
Market-to-book value	MTB	0.122	0.028	4.313	0.000
Financial leverage	LEV	−0.105	0.453	−0.231	0.817
Return on assets	ROA	2.046	0.780	2.622	0.009
Return on equity	ROE	−0.308	0.252	−1.220	0.223
Hirschman–Herfindahl index	HHI	4.128	9.347	0.442	0.659
Constant effects of "year" and "industry."		Controlled			
F statistic		3.62			
Significance of F statistic		0.000			
The adjusted coefficient of determination		0.12			

4.4. Additional Tests

According to Tables 8 and 9, the second and the third models provide the same results for all four hypotheses. Therefore, by changing the criterion for the significant and institutional shareholders, there will be no significant difference in the findings.

Table 8. The result of the second model by changing the index related to the institutional shareholders.

Variable	Symbol	Mean			Index		
		Coefficient	*t* Statistic	*p*-Value	Coefficient	*t* Statistic	*p*-Value
Intercept	C	−2.970	−1.343	0.180	−3.254	−1.435	0.152
Readability	Readability	0.012-	0.389	0.697	−0.019	0.401	0.048
Institutional shareholders	INS	0.295	0.437	0.662	0.004	0.352	0.725
Readability × Institutional shareholders	INS × Readability	0.007	0.189	0.850	0.000	−0.037	0.970
Accruals	OPAQUET	0.173	0.889	0.375	0.173	0.894	0.372
Firm size	Size	0.121	2.030	0.043	0.132	2.166	0.031
Market-to-book value	MTB	0.077	3.814	0.000	0.123	4.383	0.000
Financial leverage	LEV	0.052	0.116	0.907	−0.168	−0.369	0.712
Return on assets	ROA	2.224	2.870	0.004	2.048	2.645	0.008
Return on equity	ROE	−0.300	−1.182	0.238	−0.312	−1.242	0.215
Hirschman–Herfindahl index	HHI	3.892	0.415	0.678	4.189	0.450	0.653

Table 9. The result of the third model by changing the index related to the significant shareholders.

Variable	Symbol	Mean			Index		
		Coefficient	*t* Statistic	*p*-Value	Coefficient	*t* Statistic	*p*-Value
Intercept	C	−3.588	−1.619	0.106	−4.266	−1.737	0.083
Readability	Readability	0.005	0.173	0.862	−0.029	−0.464	0.043
Significant shareholders	IOS	0.533	0.822	0.411	0.014	0.917	0.360
Readability × Significant shareholders	IOS × Readability	0.021	0.620	0.536	0.001	0.793	0.428
Accruals	OPAQUET	0.191	0.989	0.323	0.183	0.949	0.343
Firm size	Size	0.150	2.507	0.013	0.161	2.709	0.007
Market-to-book value	MTB	0.123	4.339	0.000	0.122	4.299	0.000
Financial leverage	LEV	−0.169	−0.372	0.710	−0.180	−0.396	0.692
Return on assets	ROA	2.309	2.635	0.009	2.022	2.612	0.009
Return on equity	ROE	−0.320	−1.266	0.206	−0.315	−1.247	0.213
Hirschman–Herfindahl index	HHI	4.423	0.474	0.636	3.797	0.407	0.684

In both indices, the error level of the readability * institutional shareholders variable is higher than the error level of 5%. It is therefore insignificant, which is consistent with the results of the original model.

In both indices, the error level of the readability * significant shareholders variable is higher than the error level of 5% and is resultantly insignificant. This also conforms to the results of the original model.

4.5. Sensitivity Analyses

Tables 10–13 examine the sensitivity analyses for Hypotheses 1 to 4. The readability variable was converted to a qualitative variable using quintile, i.e., two higher quintiles for high-level readability and two lower quintiles for low-level readability. For this purpose, 1 was attributed to desirable readability (easy) and zero to undesirable readability (complex). The results are presented below.

Table 10. Sensitivity analysis of the first hypothesis.

Variable	Symbol	Estimated Coefficient	Standard Error	*t* Statistic	*p*-Value
Intercept	C	−3.823	2.236	−1.170	0.088
Readability	MODFOG	0.209	0.176	1.186	0.023
Accruals	OPAQUET	0.038	0.210	0.183	0.855
Firm size	SIZE	0.126	0.068	1.845	0.066
Market-to-book value	MTB	0.142	0.031	4.526	0.000
Financial leverage	LEV	1.995	0.993	2.137	0.033
Return on assets	ROA	−0.272	0.490	−0.555	0.579
Return on equity	ROE	0.063	0.301	0.209	0.835
Market competitiveness	HHI	6.084	9.633	0.632	0.528

As it can be seen, despite the applied changes in the readability variable, its effect on the crash risk of stock prices is still insignificant.

Table 11. Sensitivity analysis of the second hypothesis.

Variable	Symbol	Estimated Coefficient	Standard Error	*t* Statistic	*p*-Value
Intercept	C	−3.698	2.24	−651.1	0.1
Readability	MODFOG	0.149	0.23	647.0	0.518
Institutional shareholders	INS	0.13	0.25	519.0	0.604
Readability × Institutional shareholders	INS × MODFOG	0.163	0.337	484.0	0.629
Accruals	OPAQUET	0.046	0.21	221.0	0.826
Firm size	SIZE	0.113	0.07	617.1	0.107
Market-to-book value	MTB	0.145	0.032	581.4	<0.001
Financial leverage	LEV	−0.371	0.5	−741.0	0.459
Return on assets	ROA	1.975	0.934	114.2	0.035
Return on equity	ROE	0.042	0.302	139.0	0.89
Market competitiveness	HHI	6.511	9.649	675.0	0.5

It is observed that the institutional shareholders show no significant effect on the correlation between the desired level of readability and stock price crash risk. This result is consistent with the initial findings, and there is no difference in terms of support or rejection of the hypothesis.

Table 12. Sensitivity analysis of the third hypothesis.

Variable	Symbol	Estimated Coefficient	Standard Error	*t* Statistic	*p*-Value
Intercept	C	−3.805	2.247	−1.694	0.091
Readability	MODFOG	0.199	0.235	0.846	0.398
Significant shareholders	IOS	0.009	0.242	0.037	0.971
Readability × Significant shareholders	IOS × MODFOG	0.021	0.321	0.064	0.949
Accruals	OPAQUET	0.041	0.212	0.195	0.846
Firm size	SIZE	0.125	0.069	1.806	0.072
Market-to-book value	MTB	0.142	0.032	4.447	<0.001
Financial leverage	LEV	−0.28	0.496	−0.565	0.573
Return on assets	ROA	1.987	0.939	2.116	0.035
Return on equity	ROE	0.06	0.303	0.198	0.843
Market competitiveness	HHI	6.081	9.667	0.629	0.53

Significant shareholders show no significant effect on the correlation between the desired level of readability and stock price crash risk. This result is also consistent with the initial findings, with no difference in terms of support or rejection of the hypothesis.

Table 13. Sensitivity analysis of the fourth hypothesis.

Variable	Symbol	Estimated Coefficient	Standard Error	*t* Statistic	*p*-Value
Intercept	C	−3.899	2.251	−1.732	0.084
Readability	MODFOG	0.399	0.274	1.453	0.147
Family shareholders	FAMILY	0.168	0.282	0.596	0.551
Readability× Family shareholders	FAMILY × MODFOG	−0.32	0.356	−0.899	0.369
Accruals	OPAQUET	0.046	0.211	0.218	0.828
Firm size	SIZE	0.113	0.073	1.554	0.121
Market-to-book value	MTB	0.14	0.032	4.423	<0.001
Financial leverage	LEV	−0.247	0.493	−0.501	0.617
Return on assets	ROA	1.937	0.938	2.066	0.04
Return on equity	ROE	0.035	0.303	0.116	0.908
Market competitiveness	HHI	6.615	9.681	0.683	0.495

The existence of family ownership has no adverse effect on the correlation between the desired level of readability of the board's report and the stock price crash risk. Again, this finding conforms to the initial result with no significant difference regarding the change in readability.

5. Conclusions and Suggestions

This study investigates the relationship between annual board report readability and stock price crash risk and the interactive effect of ownership structure on the relationship between yearly board report readability and stock price crash risk in companies listed on the Tehran Stock Exchange (TSE). For this purpose, the negative skewness model was used to calculate the crash risk of stock prices and the Fog index was used to determine the readability of the board of directors' report.

We proposed and tested four hypotheses. The first hypothesis test results showed a significant correlation between the readability of the board report and stock price crash risk. Our results illustrate a significant positive correlation between the readability of the board report and stock price crash risk, and the first hypothesis of this study will be supported. This result was inconsistent with Mokhtari Nnejad (2019) study, which also concluded that there is no significant correlation between the readability of financial statements and the crash risk of stock prices. However, the result of this test is consistent with the studies by Kim et al. (2019) and Azadi et al. (2021), since there was a significant correlation between the readability of financial reports and the crash risk of stock prices in their studies.

The results of testing the second, third, and fourth hypotheses suggest that all three components of the ownership structure (institutional shareholders, significant shareholders, and family shareholders) have no significant effect on the relationship between the readability of the board report and the stock price crash risk, is inconsistent with active supervision theory.

We re-examined our four proposed hypotheses using our second and third suggested models and found no differences. These results were consistent with our initial findings using the first proposed model.

It can be inferred that an ownership structure, which includes institutional shareholders, significant shareholders, and family ownership, increases the supervision of managers and their reports, so they cannot keep adverse information from being released. This will ultimately improve the readability of their reports and reduce the risk of stock price crashes. These results are consistent with the findings of Luo and Zhang (2020), who suggest that policy uncertainty is significantly and positively related to a stock price crash.

Further studies are suggested to examine the impact of other contextual factors such as internal audit quality and external factors (e.g., industry, economic, and political conditions, etc.) on the crash risk of stock prices.

The present study is subject to some limitations. The most important limitation is that most targeted populations have been under strict economic and financial restrictions

because of the monetary sanction. The second limitation is the country's very high inflation rate (two digits for more than 40 years). Furthermore, 469 observations could be considered too few to draw a general conclusion in this study. Therefore, generalizing the findings to other markets may not be very applicable. However, we believe this limitation had no significant impact on the validity and reliability of the models and the obtained results.

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