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Research Paper

The Empirical Test of the Relationship Between Information Asymmetry, Overvalued Equities and Stock Price Crash Risk

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Abstract

This study empirically examines the effect of equity overvaluation on future stock price crash risk in companies with greater information asymmetry. The study investigates whether overvalued firms are more susceptible to future crash risk by utilizing information asymmetry and crash risk indicators. The primary objective of this study is to explore the relationship between overvaluation and future stock price crash risk. As information asymmetry between a firm and the market increases, managers gain greater abilities and opportunities to withhold negative news while expediting the release of positive news. Consequently, it is anticipated that the information asymmetry between managers and investors heightens future stock price crash risk. To achieve this, one main hypothesis and three subsidiary hypotheses are identified, and data from 111 listed companies on the Tehran Stock Exchange from 2009 to 2017 are analyzed. A panel data approach is employed to test the research hypotheses. The findings reveal a positive and significant relationship between overvaluation and future stock price crash risk in companies operating in monopolistic markets, and this relationship is further intensified by information asymmetry.

1 Introduction

This paper examines the firm-level determinants of future stock price crash risk, specifically focusing on information asymmetry and overvaluation. The existing literature on the determinants of crash risk at the firm level is surveyed, and research suggestions are provided for both determinants and consequences of crash risk. The underlying theory behind the stock price crash literature is the bad news hoarding theory, which emerged from extreme stock price declines observed during events like the 2008 financial crisis and accounting scandals such as World.Com. Previous studies, starting from Jin and Myers [1] and Bleck and Liu [2], have raised concerns about the potential relationship between agency costs arising from managers' inside information and stock price crash risk. Stock price crash risk refers to a firm's susceptibility to experiencing a sudden drop in its stock price and is of significant importance to investors due to its undiversifiable nature. Following the 2008 financial crisis, investors' perception of crash risk has heightened, accompanied

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by increased uncertainty and fear of further crash risk, factors that contribute to dramatic price drops. Unlike risks associated with systematic fluctuations, crash risk cannot be eliminated through diversification, making it a crucial element affecting investors' stock returns [3]. The existing literature on the underlying causes of crash risk points to agency theory, which suggests that managerial incentives aligned with personal interests, such as compensation contracts, career concerns, litigation risks, and earnings targets, lead to the withholding of bad news and its accumulation within the company. Managers continue to conceal bad news until a certain threshold is reached, at which point all the previously undisclosed negative firm-specific shocks become public, resulting in a sudden decline in stock prices.

Agency costs arise within a company when managers, involved in the firm's affairs, have interests that conflict with those of other shareholders. Given that managers stand to gain more benefits during periods of overvaluation, overvaluation is likely to incur significant agency costs. It is important to note that managers of overvalued companies not only fail to correct market mistakes but actively prolong the overvaluation, taking steps to foster optimistic market expectations. They may withhold information from shareholders and even the board of directors, driven by their desire to accumulate benefits through overvaluation and the continuous growth of the company, which translates into higher rewards and valuations of their personal shares. These managerial actions lead market participants to raise their performance expectations for overvalued stocks. Consequently, the agency theory directly links these actions to lower future stock performance. Bentley et al. argue that as information asymmetry between a firm and the market increases, managers gain more abilities and opportunities to withhold bad news while accelerating the release of good news. Companies that hoard bad news are associated with greater crash risk. Additionally, the failure to disclose negative information has a positive and significant impact on stock price crash risk, particularly pronounced in companies with high information asymmetry [4]. Based on the materials discussed in this research, the aim is to identify a comprehensive set of independent variables that are compatible with Iran's economic conditions and readily available. The study also examines additional factors that investigate the relationship between equity overvaluation and stock price crash risk in companies with greater information asymmetry. Moreover, crash risk is calculated based on weekly returns, which offers greater accuracy compared to seasonal and monthly calculations [5].

The remaining sections of this paper are structured as follows: Section 2 provides a literature review and hypothesis development. Section 3 describes the data and research framework. Section 4 presents the empirical results and analysis. Finally, Section 5 presents the conclusions, limitations, and directions for future research.

2 Literature Review and Hypothesis Development

Since the financial crisis in 2008 and due to the emergence of stock-price crash, it received arousing attention. The decline in market-wide price results in lots of research aiming at better handling of stock-price crash risk in order to lessen its adversity. One of the most important indicators of financial performance are stock market [1,2], therefore, there can be a severe negative impact of stock price crash on a firm’s financial stability [3]. The tendency to hide bad news from outside investors by managers produces crash risk [4]. Hence, the stock price crash literature is based on the bad news hoarding theory. [5]. First, managers’ concerns regarding the effect of bad news on their career incentivize them to withhold bad news hoping future events bring the opportunity to “bury” the bad news. Second, compensation motivators, including gaining performance-based bonuses and avoiding a decline in the value of stocks, stock appreciation rights, and options, can also prompt managers to disguise negative news in the company. Third, litigation risks, such as avoiding debt covenant violations that could lead to restrictions on new investment, can also be dominant reasons for

managers to withhold bad news. Different from the argument of withholding bad news to meet financial expectations, Ball [6] argues that managers' nonfinancial motives are also powerful incentives for managers to withhold bad news. He points out that nonfinancial motivators, such as maintaining the esteem of one's peers or empire building, are more powerful than commonly believed, and sometimes are the main reason to conceal negative information. Collectively, prior literature has found that both financial and nonfinancial motives play important roles for managers to opportunistically withhold bad news in the firm.

"Stock-price crash risk" is an entity, meaning experiencing frequent negative skewness in stock returns that is asymmetrically distributed and is described simply by abrupt large movements in the stock returns that are usually decreasing, rather than increasing. The literature defines crash risk as related to negative skewness in the distribution of returns for individual stocks. Andrew Van Buskirk showed that firms with greater volatility skew are more likely to experience large earnings period stock price drops declaring that having information about future earnings is not the same as knowing them when they are revealed due to non-timely disclosure of information [7]. A number of approaches have been used to measure skewness in the crash risk literature and bulk of the literature relates these estimates to a variety of explanatory variables in order to identify potential determinants of stock price crash risk. Crash risk captures higher moments of the stock return distribution i.e., extreme negative returns [8] and hence has important implications for portfolio theories, and for asset and option-pricing models [9].

Jin and Myers extended the work of Myers and investigated the relationship between the lack of informational transparency and stock price crash. Depending on studies, they assumed that all outside investors are imperfectly informed and all private information is held by inside managers. They found that when the accumulated hidden bad news comes out, extreme negative outcomes in stock returns took place (i.e., stock price crash) and that less transparent markets exhibit more frequent crashes. Equity is overvalued when a firm's stock price is higher than its underlying value. By definition, this means the company will not be able to deliver—except by pure luck—the performance to justify its value [10]. Companies that have optimistic expectations will tend to overvalued equities, these firms have more incentive to conceal bad news from investors to sustain such overvaluation. Further to the discussion that equity overvaluation motivates managers to commit financial misreporting, it follows that crash risk will be higher for firms during periods of equity overvaluation. There are various reasons that a company is improperly assessed. However, reasons of overvaluation are difficult to accurately describe and define empirically. Mousavi Shiri et al. [11], investigated the role of information asymmetry on equity overvaluation. They stated that, when information asymmetry increases, actual value of stock a firm is different from value that investors got for that. The results of their research showed that information asymmetry has a positive and significant relationship with equity overvaluation and when managers have information advantages and manipulate earning, tend to intensify overvaluation and destroy shareholder wealth. Information asymmetry is one of the main drivers behind negative skewness in stock price returns that broadly implicated two aspects: (1) hidden information shown in adverse selection problem and (2) hidden action (agency problem) shown in moral hazard problem [12]. The information asymmetry between managers and shareholders motivates self-interested managers to maximize their self-interests and sacrifice the long-term interests of shareholders [13]. Beginning from Jin and Myers, researchers find evidence consistent with the nature of agency problems motivating managers to strategically control the disclosure of bad news about the firm to the public. If managers keep withholding and accumulating bad news for an extended period, negative information is likely to be stockpiled and becomes too costly to continue withholding it, leading to a large, negative, and an abrupt decline in stock price [16]. Hutton et al, studied the empirical link between information opacity, information risk, and stock-price crash risk. They demonstrated that information asymmetry has the explanatory power of stock price crash risk and positively associated future stock price crash risk to the opaqueness of financial reporting consistent

with Jin and Myers. Financial economists have always viewed stock price changes as tied to firm-specific information. Managers' asymmetric disclosure incentives imply that there is more privately received bad news than good news remaining to be disclosed at the end of the period - which is behind the investors' timely quest for more information in both quantity and quality aspects (i.e., market transparency)- hoping that poor current performance will be concealed by strong future performance and that the firm's situation improves before the required information is released.

According to prior research, investigating the relationship between stock price crash risk, overvaluation and information asymmetry is an essential factor for considering and making investors and creditors better familiar with the capital market, so, it is necessary to study in this field, In this regard, we identify one main hypothesis and three subsidiary ones. Thus, based on the mentioned arguments above, we develop the hypothesis of the research as follows:

H_1. Ceteris paribus, the effect of overvaluation on stock price crash risk is greater in companies with higher information asymmetry:

$H_1 - 1$. The effect of overvaluation on stock price crash risk is greater in companies which are operating in monopolistic market than competitive market.*

$H_1 - 2$. The effect of overvaluation on stock price crash risk is greater in companies that the proportion of outside directors on their boards is less than 50 percent.

$H_1 - 3$. The effect of overvaluation on stock price crash risk is greater in companies that institutional investors are not included in as a main shareholder.

The Herfindahl-Hirschman Index is used to determine the market status of a company's products and to separate the monopolistic market from the competitive market in the statistical sample which is defined on the part of "Variables of Research".

3 Methodology

To obtain research results via referred variables in last section, multi variate regression and panel data model has been used. The statistical population of the research includes all accepted companies in Tehran Stock Exchange during the period of 2009-2017. Since the applied data for calculating variables of this research include the information of the previous year, the period from 2008 to 2017 was considered as the domain of time for testing the hypothesis. The sampling method in this research was established according to the systematic elimination, therefore all of the companies in this sample are ought to have the following characteristics:

1- Research is conducted for non-financial companies, so banks and all investment companies, leasing companies and financial institutions are excluded from the sample.
2- In order to compare the information, the fiscal year of these companies will be March 29th each year.
3- The financial statements of the fiscal year 2008 to 2017 are available.
4- According to Hutton and Tehranian, only companies can be selected as models for implementing the stock price model of a negative skewing model that has at least six months of monthly yield.
5- To have a high frequency of data (at least 28 data of year-company) for the studied industry, since the modified Rhodes et al. [14] model are applied in the research to fit each industry.

According to the above-mentioned limitations, 8 industries were selected (the industries with at least 7 companies in the stock market). Applying aforementioned criteria, 111 companies (999 data year- company), which had all conditions, were selected as the statistical sample.

3.1 Variables of Research

In this research, the Crash risk is considered as a dependent variable. First, we follow previous literature and use two measures of firm-specific crash risk [15]. Both measures are based on the firm-specific weekly returns estimated as the residuals from the market model. Similar to Li and Myers and Hutton, Marcus and Tehranian we use expanded market model to estimate idiosyncratic risk. We calculate weekly returns (following the Wednesday to Wednesday daily return in Tehran Stock Exchange) for all stocks in the sample, according to Hutton et al. each firm-year is required to have at least 26 weekly stock returns. To calculate the firm-specific abnormal weekly returns for each firm and year, denoted as W, we run the following expanded index regression model:

$$r_{j,\theta} = \beta_0 + \beta_{1j} r_{m,\theta-2} + \beta_{2j} r_{m,\theta-1} + \beta_{3j} r_{m,\theta} + \beta_{4j} r_{m,\theta+1} + \beta_{5j} r_{m,\theta+2} + \varepsilon_{j,\theta} \quad (1)$$

Where $r_{j.\theta}$ is the return of firm j in week θ and $r_{m.\theta}$ is market return in week θ. The firm-specific weekly return for firm j in week θ ($w_{j.\theta}$) is calculated as the natural logarithm of one plus the residual return from Eq. (1) above.

$$w_{j.\theta} = \mathrm{Ln}(1 + \varepsilon_{j.\theta}) \quad (2)$$

$w_{j.t}$: Weekly returns of the company j in the week θ,

$\varepsilon_{j.\theta}$: The residual return of the company j in the week θ is the residual of the model in relation (1),

Our first measure of crash risk is the negative conditional skewness of firm-specific weekly returns over the fiscal year (NCSKEW). NCSKEW is calculated by taking the negative of the third moment of firm-specific weekly returns for each year and normalizing it by the standard deviation of firm-specific weekly returns raised to the third power. Specifically, for each firm j in year θ, NCSKEW is calculated as:

$$Ncskew_{j.\theta} = -[n(n-1)^{\frac{3}{2}} \sum_1^n W_{j.\theta}^3]/[(n-1)(n-2)(\sum_1^n W_{j.\theta}^2)^{3/2}] \quad (3)$$

The down-to-up volatility (DUVOL) is used as the other measure of stock price crashes, consistent with Chen et al. In order to calculate DUVOL, we first separate all the weeks into "down" weeks if firm-specific abnormal weekly returns are lower than the annual average return and "up" weeks if the firm-specific abnormal weekly returns are higher than the annual average return. DUVOL is the logarithm of the standard deviation on the down weeks minus the logarithm of the standard deviation on the up weeks [24].

$$Duvol_{j.t} = \log\{(n_u-1)\sum_{DOWN} w_{j.t}^2 / (n_d - 1)\sum_{UP} w_{j.t}^2\} \quad (4)$$

Where n_u is the number of up weeks and n_d is the number of down weeks. Again, the higher value of this measure corresponds to a more left skewed distribution, which indicates the higher incidence of stock price crashes.

Equity Overvaluation: A common valuation measure is the ratio of market value of assets to book value of assets (*M/B*). The literature has used *M/B* as proxies for both misvaluation and growth opportunities. As Rhodes et al. (2005) if there exists a perfect measure of the firm's true value, *V*, we can first think of *M/B* as:

$$M/B = M/V \times V/B, \quad (5)$$

where *M/V* captures misevaluation and *V/B* captures growth opportunities. The logarithmic form of the above equation could be written as follows:

$$m - b = (m - v) + (v - b), \quad (6)$$

where the lowercase letters denote logarithm values. *(m – v)*, the deviation of the firm's market value from its true value, can arise from industry-wide misvaluation or firm-specific misvaluation. Therefore, for any firm *i* at year *t*, we can further decompose *(m – v)* into two components and rewrite *(m – b)* as following:

$$m_{it} - b_{it} = m_{it} - v(\theta_{it}; \alpha_{jt}) + v(\theta_{it}; \alpha_{jt}) - v(\theta_{it}\,; \alpha_j) + v(\theta_{it}\,;\, \alpha_j) - b_{it} \quad (7)$$

where we use *j* to denote industry. We express *v* as a linear function that multiplies some firm-specific accounting information *it* and a vector of estimated accounting valuation multiples α. $v(\theta_{it}; \alpha_{jt})$ is the estimated firm value based on contemporaneous industry-level valuation multiples α_{jt}.Thus, the first component in Eq. (7) captures the valuation error caused by firm specific deviation from contemporaneous industry-level valuation.

$v(\theta_{it}; \alpha_j)$ is the estimated firm value based on long-run industry-level valuation multiples α_j. Thus, the second component in Eq. (7) captures the valuation error caused by the deviation of current industry valuation from the long-run industry valuation. The third component in Eq. (7) is the difference between long run value and book value, i.e., the logarithm of the true value-to-book ratio, capturing growth opportunities. Note that each of the three components varies across firms and years because each component utilizes θ_{it}, which is firm *i*'s accounting information at year *t*.

To operationalize, we need to estimate the valuation models $v(\theta_{it}; \alpha_{jt})$ and $v(\theta_{it}\,;\, \alpha_j)$.

The first term on the right-hand side of Eq. (7), $m_{it} - v(\theta_{it}; \alpha_{jt})$, referred to as the firm-specific error (FSE), measures the difference between market value and fundamental value, and is estimated using firm-specific accounting data, θ_{it} , and the contemporaneous sector accounting multiples, α_{jt} , and is intended to capture the extent to which the firm is misvalued relative to its contemporaneous industry peers. The second term, $v(\theta_{it}; \alpha_{jt}) - v(\theta_{it}\,; \alpha_j)$, referred to as time-series sector error (TSSE), measures the difference in estimated fundamental value when contemporaneous sector accounting multiples at time *t*, α_{jt}, differ from long-run sector multiples, α_j, and is intended to capture the extent to which the industry (or, possibly, the entire market) may be mis-valued at time *t*. Total valuation error (TVE) is the sum of FSE and TSSE. The third term, referred to as LRVTB, measures the differ measure is interpreted as the investment opportunity component of the MTB ratio.

Rhodes et al. use three different models to estimate $v(\theta_{it}; \alpha_{jt})$ and $v(\theta_{it}\,;\, \alpha_j)$. The models differ only with respect to the accounting items that are included in the accounting information vector, θ_{it}. The 3rd model is the most comprehensive model that includes the book value (b), net income (NI), and market leverage (LEV) ratio in the accounting information vector. Expressing market value as a simple linear model of these variables yields.

$$m_{it} = \alpha_{0jt} + \alpha_{1jt}\, b_{it} + \alpha_{2jt} \ln(NI)^+_{it} + \alpha_{3jt} I(<0) NI_{it} + \alpha_{4jt} LEV_{it} + \varepsilon_{it} \quad (8)$$

where, because NI can sometimes be negative, it is expressed as an absolute value $(NI)^+$ along with a dummy variable, I (<0), to indicate when NI is negative.

To calculate the contemporaneous accounting multiples, α_{jt}, each year we group all CRSP/Compust at firms according to the 12 Fama and French industry classifications; run annual, cross-sectional regressions (of Eq.

(7)) for each industry; and generate estimated industry accounting multiples for each year $\hat{t}, \alpha_{jt}$. The estimated value of $v(\theta_{it}; \alpha_{jt})$ is the fitted value from regression Eq. (8).

$$v(b_{it}, NI_{it}, LEV_{it}, \hat{\alpha}_{0jt}, \hat{\alpha}_{1jt}, \hat{\alpha}_{2jt}, \hat{\alpha}_{3jt}, \hat{\alpha}_{4jt}) = \hat{\alpha}_{0jt}+\hat{\alpha}_{1jt}b_{it}+\hat{\alpha}_{2jt}\ln(NI)^{+}_{it}+\hat{\alpha}_{3jt}\, I(<0)(NI)^{+}_{it}+\hat{\alpha}_{4jt}LEV_{it} \quad (9)$$

According to overvaluation criteria, the independent variable in the main research of model will be total valuation errors (Firm-specific valuation error + time series sector error).

Control variables: With regard to prior studies, we controlled common factors, which would be deterministic and effective factors on stock price crash risk.

Information Asymmetry: To describe the conditions indicating information asymmetry in this study, it is assumed that in case of the company's operation in monopolistic market, the absence of institutional shareholders in shareholders' composition and the presence of less than 50 percent of non-executive directors in the composition of its board members, there would be information asymmetry in that company. According to the abovementioned information, there are three variables defined for information asymmetry measurement:

The Company's Product Market Status:

Following Hou and Robinson, we measure the extent of product market competition using the Herfindahl-Hirschman [16] Index, which is defined as follows:

$$\mathrm{HHI} = \sum_{j=1}^{n} S_j^2 \quad (10)$$

in this equation:

HHI: Herfindahl-Hirschman Index for an industry in a fiscal year,

S_j^2: The market share of j Company available in an industry.

Therefore, the index rate exceeding 0.5 in a company implies the activity of that company in monopolistic markets and the rate index below 0.5 in a company implies the activity of that company in competitive markets. In this case, the index value for the active companies in monopolistic markets is equal to 'One' and 0 otherwise. The following steps are taken in order to calculate the Herfindahl-Hirschman index:

1- Calculating the total net sale for all active companies in each industry of the sample, every year;
2- Calculating the market share of each company, dividing each company of the industry's net sales by the total sales of that industry;
3- Calculating the index market in each year for that industry by squaring the share of the companies in each industry. In brief, the Herfindahl-Hirschman Index is computed for each industry by means of equation (9).

The Composition of board members (OutDir):
The value of this variable is defined in a way that the companies with board members comprising of more than 50% non-executive directors will have '1' value index rate and "0" otherwise.

The composition of company shareholders (INST):

In this study, the institutionalization of institutional investors is determined on the basis of Iran's Accounting Standard No. 20 and Accounting Standards Board's Declaration No. 18. According to the aforementioned statement, direct or indirect investment in at least 20% of the stocks using the unitary voting right leads to the effective leverage in that company, unless otherwise noted. According to the definition, the presence of institutional investors in companies leads to the '1' index rate and 0 otherwise.

Other control variables are as follows:

DTURN: is the difference of the average monthly share turnover over the current fiscal year and the previous fiscal year, where monthly share turnover is defined as the monthly trading volume divided by the total number of shares outstanding during the month. Chen et al. indicate that this variable is used to measure differences of opinion among shareholders and is positively related to crash risk proxies.

RET: Chen et al. show that negative skewness is larger in stocks that have had positive stock returns over the prior 36 months. To control for this possibility, we include past one-year weekly returns (RET).

SDRET: SDRT is the standard deviation of firm-specific weekly returns over the fiscal year denoting stock volatility as more volatile stocks are likely to be more crash prone.

SIZE: To control for the size effect, we add SIZE measured as the natural log of total assets.

MTB: The variable MTB is the market value of equity divided by the book value of equity.

LEVERAGE: LEVERAGE is the total long-term debt divided by total assets, which is shown to be negatively associated with future crash risk [17,18].

ROA: Return on assets which is calculated through dividing annual operational earning by total company asset.

3.2 Hypotheses Test Models

Based on the mentioned arguments above, we identify one main hypothesis and three subsidiary ones as follows:

$$\mathrm{CRASH}_{i.t} = \gamma_0 + \gamma_1 \mathrm{TVE}_{t-1} * \mathrm{HHI}_{j.t-1} + \gamma_2 \mathrm{HHI}_{j.t-1} + \gamma_3 \mathrm{TURN}_{t-1} + \gamma_4 \mathrm{RET}_{t-1} + \gamma_5 \mathrm{SDRET}_{t-1} + \gamma_6 \mathrm{SIZE}_{t-1} + \gamma_7 \mathrm{MTB}_{t-1} + \gamma_8 \mathrm{LEVERAG}_{t-1} + \gamma_9 \mathrm{RET}_{t-1} + \varepsilon_{i.t} \quad (11)$$

$$\mathrm{CRASH}_{i.t} = \gamma_0 + \gamma_1 \mathrm{TVE}_{t-1} * \mathrm{INST}_{j.t-1} + \gamma_2 \mathrm{INST}_{j.t-1} + \gamma_3 \mathrm{TURN}_{t-1} + \gamma_4 \mathrm{RET}_{t-1} + \gamma_5 \mathrm{SDRET}_{t-1} + \gamma_6 \mathrm{SIZE}_{t-1} + \gamma_7 \mathrm{MTB}_{t-1} + \gamma_8 \mathrm{LEVERAG}_{t-1} + \gamma_9 \mathrm{RET}_{t-1} + \varepsilon_{i.t} \quad (12)$$

$$\mathrm{CRASH}_{i.t} = \gamma_0 + \gamma_1 \mathrm{TVE}_{t-1} * \mathrm{OUTDIR}_{j.t-1} + \gamma_2 \mathrm{OUTDIR}_{j.t-1} + \gamma_3 \mathrm{TURN}_{t-1} + \gamma_4 \mathrm{RET}_{t-1} + \gamma_5 \mathrm{SDRET}_{t-1} + \gamma_6 \mathrm{SIZE}_{t-1} + \gamma_7 \mathrm{MTB}_{t-1} + \gamma_8 \mathrm{LEVERAG}_{t-1} + \gamma_9 \mathrm{RET}_{t-1} + \varepsilon_{i.t} \quad (13)$$

4 Results

4.1 Descriptive Statistics

Table 1, presents descriptive statistics for our key variables of interest. This table mainly includes information about measures of central tendency such as average, median, minimum and maximum as well as information on measures of dispersion such as standard deviation. The number of observations for each variable is 999. The most important central indicator is the mean, which represents the equilibrium point and distribution center, and is a good indicator of the centrality of the data.

The mean values of the crash risk measures, NCSKEW and DUVOL, are 0.009 and −0.006 respectively,

which indicate that most data related to this variable are centered around this point.
The amount of average for TVE is −1.541 with a somewhat high standard deviation (3.013). The average change in monthly trading volume (as a percentage of shares outstanding) is 35.7%. The average firm in our sample has a firm-specific weekly return of 3.1%, market-to-book ratio of 12.43, a weekly return volatility of 0.12, a leverage of 0.12. The average of ROA is 0.49.
The value of standard deviation for the market-to-book ratio variable is 44.12 and for the RET equal to 0.04, which shows that among the variables of research, MTB and RET have the largest and most the least amount of dispersion. Due to the variables of Business strategy, Product Market Status, shareholders composition and board of directors are Dummy and only take on the value 0 or 1, their Descriptive statistics are not presented.

Table1: Descriptive Statistic of Research Variables

	Variables	**Mean**	**Median**	**Min**	**Max**	**SD**
Crash risk measures	SKEW	0.009	0.28	-6.91	6.40	1.93
	DUVOL	-0.0006	-0.04	-0.77	1.42	0.27
Equity Overvaluation Measures	TVE	-1.54	-1.19	-10.3	63.31	3.01
Control Variables	DTURN	0.35	0.14	0.000	4.93	0.55
	RET	0.03	0.02	-0.07	0.29	0.04
	STDRET	0.12	0.10	0.00	0.69	0.08
	SIZE	14.22	14.05	10.03	19.73	1.60
	LEVER	0.66	0.58	0.13	1.91	0.38
	MTB	12.43	2.57	-4.43	154.32	44.12
	ROA	0.49	0.41	-6.61	26. 43	1.75

In this study, Im – Pesaran – Shin (IPS test) statistics was used for testing variables' stationary. In this test null hypothesis which was non-stationary or unit-root was rejected so all variables are stationary. Based on the results, IPS values and also level of significance shows that all variables are 95% stationary so that level of significance is lower than 0.05 in all of them. So, integration test is not needed and there is no problem with fake regression. In order to test the heteroscedasticity, we use Breusch-Pagan (BP) test. The results of Breusch-Pagan test indicate that the model is heteroskedastic. The Prob (F-Statistic) is less than 5% therefore the Null Hypothesis should be rejected. To remove heteroscedasticity, we use generalized least squares (GLS). When heteroscedasticity is present, the variance of the estimated values resulting from generalized least squares (GLS) is less than ordinary least squares (OLS). The lower variance suggests that the (GLS) procedure provides more reliable estimates when heteroscedasticity is present.
Another assumption of regression is the independence of the residuals from each another. To investigate this assumption, the Breusch -Godfrey test has been used in this research. The results indicate that null hypothesis of no serial autocorrelation is accepted.

4.2 Inferential Statistics

The results of the Limer test for the companies surveyed are summarized in Table 2 by the research hypothesis, As the table shows, the results of Chow test is indicating that "Panel regression model", is preferred to " Pooled regression model". The p-value of the test is less than the error level of 5 and 10%, and the null hypothesis rejected.

Table 2: F Limer Test

Model	Variable	Statistic	prob
Hypothesis 1-1	SKEW	1.28	0.03**
	DUVOL	1.20	0.08*
Hypothesis 1-1	SKEW	1.28	0.03**
	DUVOL	1.19	0.09*
Hypothesis 1-3	SKEW	1.29	0.02**
	DUVOL	1.19	0.09*

Note: statistically significant ***p < 0.01, **p < 0.05, *p < 0.10

Using the Hausman's test we compared the random effects model to the fixed effects models, the results are shown in the table 3, according to the obtained statistics for Hausman test for the section with the probability of less than 10%, the null hypothesis of random effects is rejected, the table shows that the fixed effects model was consistent when compared to the panel regression model for the companies surveyed in all models examined.

Table3: Hausman's Test

Model	Variable	Statistic	prob
Hypothesis 1-1	SKEW	16.36	0.05*
	DUVOL	23.57	0.00***
Hypothesis 1-2	SKEW	15.07	0.08*
	DUVOL	22.81	0.00
Hypothesis 1-3	SKEW	15.48	0.07*
	DUVOL	20.81	0.01***

Note: *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 4, presents the GLS regression results of estimating to test our first subsidiary hypothesis on the association between overvaluation and stock price crash risk in companies which are operating in monopolistic markets ($H_1 - 1$). The dependent variable is crash risk measures, Ncskew and Duvol and the independent variable, overvaluation, is proxied by total valuation error (TVE). T-statistics shown in the table are adjusted for firm-level clustered standard errors. The positive and significant coefficients on TVE*HHI for the two crash risk measures (i.e., NCSKEW and DUVOL) support ($H_1 - 1$) at the 0.05 and 0.1 level. The coefficients on TVE*HHI are 0.111 and 0.022 for the NCSKEW and DUVOL respectively. In terms of economic significance regression results suggests that there is a direct and significant relationship between overvaluation and the increasing stock price crash risk in companies which are operating in the monopolistic market.

Table 4: Overvaluation and Stock Price Crash Risk: The Impact of HHI

Variables	NSKEW			DUVOL		
	Coefficient	t-statistic	Prob	Coefficient	t-statistic	Prob
TVE (-1) *HHI (-1)	0.111	2.617	0.009***	0.022	1.766	0.077*
HHI (-1)	-0.095	-0.441	0.659	0.017	0.426	0.67
DTURN (-1)	0.059	1.331	0.183	-0.013	-0.77	0.441
RET (-1)	-0.676	-0.625	0.532	0.272	1.319	0.187
SDRET (-1)	-1.254	-2.111	0.035**	0.226	0.956	0.338
SIZE (-1)	0.086	1.306	0.191	-0.042	-1.129	0.258

LEVER (-1)	-0.337	-1.578	0.114	0.124	2.611	0.009***
MTB (-1)	-0.008	-4.876	0.00***	0.0008	0.799	0.424
ROA (-1)	-0.874	-1.601	0.109	0.387	6.298	0.00***
C	-0.442	-0.386	0.699	0.4599	0.875	0.381
Adjusted R2	0.09			0.04		
Observations	999			999		

Table 5: Overvaluation and Stock Price Crash Risk: The Impact of BOD

Variables	NSKEW			DUVOL		
	Coefficient	t-statistic	Prob	Coefficient	t-statistic	Prob
TVE (-1) *BOD (-1)	0.062	1.828	0.067*	-0.003	-0.454	0.649
HHI (-1)	0.166	1.884	0.059	0.001	0.058	0.953
DTURN (-1)	0.061	1.051	0.293	-0.014	-0.982	0.326
RET (-1)	-1.121	-1.377	0.168	0.295	1.209	0.227
SDRET (-1)	-1.136	-1.949	0.051*	0.207	1.141	0.254
SIZE (-1)	0.083	1.102	0.27	-0.041	-1.894	0.058*
LEVER (-1)	-0.373	-1.808	0.07*	0.134	2.635	0.008***
MTB (-1)	-0.008	-6.196	0.00***	0.000	0.976	0.329
ROA (-1)	-0.869	-2.14	0.032**	0.401	3.952	0.000***
C	-0.57	-0.521	0.602	0.438	1.377	0.168
Adjusted R2	0.08			0.04		
Observations	999			999		

Table 6: Overvaluation and Stock Price Crash Risk: The Impact of INST

Variables	NSKEW			DUVOL		
	Coefficient	t-statistic	Prob	Coefficient	t-statistic	Prob
TVE (-1) *INST (-1)	-0.029	-0.776	0.437	0.013	1.496	0.134
INST (-1)	0.027	0.216	0.828	0.014	0.821	0.411
DTURN (-1)	0.054	0.906	0.365	0.008	0.823	0.410
RET (-1)	-0.942	-1.3	0.192	0.168	1.322	0.186
SDRET (-1)	-1.252	-2.066	0.039**	-0.068	-0.589	0.555
SIZE (-1)	0.084	0.932	0.351	-0.022	-1.41	0.158
LEVER (-1)	-0.357	-1.569	0.117	0.115	4.685	0.00***
MTB (-1)	-0.008	-7.216	0.00***	0.001	2.169	0.03**
ROA (-1)	-0.87	-2.142	0.032**	0.394	6.172	0.00***
C	-0.551	-0.424	0.671	0.194	0.917	0.359
Adjusted R2	0.08			0.08		
Observations	999			999		

The results of testing the second subsidiary hypothesis have been shown in Table 5. According to results in Table 5, the positive and significant coefficient on TVE (-1) *BOD (-1) for NCSKEW crash measure supports $H_1 - 2$ but for DUVOL measure is insignificant. The coefficient on TVE (-1) *BOD (-1) is 0.111 for the NCSKEW crash measure, with associated t-statistics of 2.617. Thus, firms which the proportion of outside directors on their boards is less than 50 percent accompanied by overvaluation are more likely to experience stock price crashes. Next, we test the third subsidiary hypothesis to find the relationship between overvaluation and stock price crash risk in companies that institutional investors are not included in as a main shareholder. The results from GLS regression are shown in table 6. According to results in Table 6, the negative coefficient on TVE (-1) *INST (-1) for NCSKEW and positive coefficient for DUVOL are insignificant. So, third subsidiary hypothesis is rejected.

5 Conclusion

This study investigated the impact of equity overvaluation on stock price crash risk of companies with greater information asymmetry on the Tehran stock exchange during a 9-year period. For achieving this aim, the Company's Product Market Status, composition of company shareholders and board members as criterias for information asymmetry and valuation errors as criteria for overvaluation determined by using the model of Rohdes-Kropf et al. [19], were calculated. Generally, results from the previous studies support that equity overvaluation will lead to increasing stock price crash risk [20], our study provides direct evidence on the link between the increased impact of overvaluation on stock price crash risk in monopolistic markets. The extreme overvaluation with high information asymmetry is positively related to future stock price crash risk because it facilitates managerial bad news hoarding. Results from the hypothesis of research are consistent with Mousavi Shiri et al. Furthermore, the results of the study show that there is not a significant relation between the increasing stock price crash risk and overvaluation in firms which institutional investors are not included in as a main shareholder and also a more independent and qualified board of directors can help depress the occurrence of overvalued equity.

The most important limitation of the research is as follows: The lack of adjustment of financial statements items due to inflation, which may affect the results of the research. The present study has been approved by using the data of 111 companies from 8 industries admitted to Tehran Stock Exchange and investment, leasing and insurance companies have been excluded from the statistical society due to their specific nature of activity, so these results are in the hands of ready cannot be generalized to all companies.

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