

Probability of Stock Price Crashes: A Closer Look towards Pakistan Stock Market

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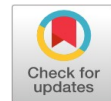
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Abstract: The concept of stock price crash probability has become popular in recent years. In Pakistan, being an emerging economy, this area needs to be explored yet. This research investigates the impact of internal and external predictors effecting stock price crash probability for the period of 2006-2021. Pooled OLS is utilized as a baseline regression with clustering at firm level to test the hypothesis. For robustness analysis, in order to capture issues of serial correlation and cross sectional dependency, FGLS and GMM regression techniques are employed. Furthermore, in this study theoretical arguments are built on the basis of bad news hoarding theory, agency theory and information asymmetry. The findings suggest that corporate tax avoidance has an insignificant relation with stock price crash probability. While, other predictors have an inverse relation with stock crash probability. The results are consistent while using FGLS technique however, GMM estimates exhibit corporate tax avoidance as a significant predictor. Overall, the outcomes support H2 and H3, while H1 is rejected particularly for market of Pakistan. This study attempts to assist investors, regulators and policymakers to timely predict the chances of a stock price and thus make corrective decisions to mitigate its chances.

Keywords: Pakistan, Stock price crash probability, Corporate tax avoidance, Foreign investors, Renewable energy consumption.

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INTRODUCTION

Stock price crash probability has gained attention of various academicians, professionals and investor communities. Stock price crash probability, also known as, crash risk, generally focuses on downside risk and is crucial for investment and risk management (Habib et al., 2018). Callen & Fang (2015), Kim et al. (2014) define stock price crash risk as negative skewness in the distribution of returns of individual stocks. This topic seeks high interest due to certain past renowned corporate scandals like Volkswagen emissions scandal (2015), Global financial crisis GFC (2007-2009), U.S Mortgage crisis (2007) (Guenster et al., 2011; Molina-Azorin et al., 2009; Yeung et al., 2018). These incidents provided a great insight to the researchers to explore the predictors of stock price crash (Zaman et al., 2021).

Businesses during their life can face an unfavorable event of stock price crash, adversely affecting the market stakeholders. Single stock or whole market both can undergo this situation where negative fluctuations are a result. Effects of stock price crash are wide in a sense that stability and development of capital markets is at stake (Yin & Tian, 2017). Together with this, it influences the reputational capital, when an investor who owns these stocks faces a significant crash. Sudden decline in stock prices causes the wastage of wealth of large number of investors. Moreover, this whole scenario acts as a demotivation factor for the shareholders (Murata & Hamori, 2021).

This study holds the significance as it desires to study whether several factors have impact on probability of stock price crash or not in economy like Pakistan. Although, many studies have viewed the determinants related to stock price crash risk but focus is on developed countries. Dang & Nguyen (2021), Andreou et al. (2016), Francis et al. (2016), Garg et al. (2022) describe the impact of internal factors like CEO age, ownership structure, board structure, financial reporting transparency, corporate tax avoidance. External monitoring factors like foreign investors (Kim et

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al., 2020), laws related to environment (Zhang et al., 2021) and external board social capital (Jebran et al., 2022) attempt to explain their impact on future stock crash risk. Seeing in the perspective of Pakistan, it lacks good institutional quality, proper management, and checks on ethical responsibilities of managers. Acquisition of correct information is quite costly and available public information is not up to date. These drawbacks provide managers with an excuse to withhold bad news from investors resulting in more conspicuous crash probabilities in such economies in contrast to developed ones. Moreover, this phenomenon of stock price crash does not diminish solely through portfolio diversification, which is quite different from asymmetric volatilities. However, attempts can result in minimizing this process of decline in stock prices through proper screening (Kim et al., 2014).

From the investor point of view, it becomes complicated to find out which firm is holding bad news, due to information asymmetry issue, so investors become prone to unfavorable event of stock price crashes (Murata & Hamori, 2021). Analysis of determinants of stock price crash probability allows investors to make improvements in the future. This also assists corporate firms to remain vigilant in order to attract the investors. Investors shall also keep in view firm's reputation while investing because investor's wealth is significant. Investors tend not to trust the firms with a history of declining stock prices because of more risk associated. Regulators can also enhance market stability by in depth analysis of stock price crash probability (Murata & Hamori, 2021; Kim et al., 2011). Crash risk constitutes asymmetry risk that is important for investment decisions and risk management. Higher management authorities also overview stock price crash probability because it has an impact on their individual remuneration. With the purpose of minimizing probability of stock price crash, many researchers attempted to explain method in order to predict and control this risk. This study attempts to assist policymakers who are eager to design new methods in an attempt to reduce the issues related to information asymmetry. Therefore, determining the factors of probability of stock price crash is of utmost importance.

In this perspective, the current study contributes the literature in many ways. First, it aims to expand the argument on predictors related to internal and external monitoring mechanism attributes and how they are related to the dependent variable. In past literature, variables like corporate tax avoidance (Garg et al., 2022; Kim et al., 2011), foreign investors (Vo et al., 2020; Kim et al., 2020, Huang et al., 2020), corporate social responsibility (Kim et al., 2014; Feng et al., 2022) were studied separately. This research, however, focuses on corporate tax avoidance and foreign investors as predictors of stock price crash probability in Pakistan. Also, it includes variable related to green energy transition as an external monitoring mechanism for the corporate firms. Green energy transition represents the conversion from old sources to renewable sources of energy that will create sustainable industry and cut pollution. Yildiz & Karan (2020) study impact of environmental performance on stock price crash risk. While other studies focus on green bonds (Bagnoli & Watts, 2020), green investments (D'Orazio & Popoyan, 2019) and government green funds (Carfora & Scandurra, 2019). Lastly, most researches have been done in developed countries where strong corporate, ethical and transparent standards are capable of minimizing future stock crashes. Pakistan, on the other hand, is still on the verge of strengthening all these areas which make it an interesting market to focus. Therefore, this study empirically examines how these predictors have an impact on stock price crash probability. The remaining paper follows the following sequence. Section 2 outlines a theoretical and empirical overview of predictors of stock price crash probability. Section 3 refers to the methodology and data. Section 4 explains the empirical findings. Section 5 concludes and presents future directions.

LITERATURE REVIEW

Theoretical Framework

Most of the theories related to stock price crash probability tend to explain these questions: Why stock prices exhibit a negative trend? Why all businesses, stocks or markets have a fear of sudden decline in stock prices at any stage of their lifecycle? What are the factors that determine stock price crash probability? Jin & Myers (2006) tried to explain this phenomenon with the help of "bad news hoarding theory", "information asymmetry theory" and "agency theory". Issue of information asymmetry arises when one party possesses more information as compared to the other. This ultimately creates imbalance in the market thereby exploiting the party that possess less information. Due to difference in information, managers deliberately conceal any negative information that is in accordance with the theory of bad news hoarding. On reaching a maximum limit, this information is released in the market. That ultimately creates a disturbance among market participants.

Likewise, talking about agency theory, an issue that arises in any principal agent relationship, agents prioritize their personal interests. They attempt to hide any information that collides with their motives. Apart from it, they voluntarily do not work according to the shareholders' expectations. In the long-run, these aspects enhance the probability of stock prices to crash.

Empirical Evidence

Corporate tax avoidance :As per the definition by Dyreng et al. (2008), tax avoidance refers as minimizing the tax expenses. Avi-Yonah (2006) describe that with assistance of tax avoidance activities, shareholders' wealth is maximized. Corporate firms exhibit more profits to investors in order to compete in the market. This phenomenon is hazardous for the society because it is quite expensive to social welfare. It is observed that firms save taxes by earning management activity as calculating taxes is an accounting method (Monem, 2003). Firms adopt this practice of tax avoidance because a proportion of profit is paid in the form of income tax. This causes a decrease in book income that causes a conflict between government authorities and capital market. It is the need of capital market to exhibit higher book income as it does not favor firms to pay more taxes. In this regard, firms utilize extensive and confidential methods to avoid tax payments (Chen & Chu, 2005). Managers have access to private legal information and are able to decrease effective tax rate (ETR) (Crocker & Slemrod, 2005).

There are two aspects in context of tax avoidance (Garg et al., 2022). First suggests tax avoidance process as a key factor of enhancing cash flow for the shareholders. As, it reduces the tax liability of the firm thereby maximizing wealth of the shareholders. Moreover, some past studies regard tax avoidance as an extension of shareholders' preferred tax-favored activities like utilization of debt (Graham & Tucker, 2006; Kim, 2010). If corporate tax avoidance is used instead of debt usage than it results in increase in financial slack, credit quality and enhances firm's profitability (Lim, 2011; Graham & Tucker, 2006). This positive association between tax avoidance and stock price crash risk is based on two assumptions. One is that tax avoidance enables managers to adopt opportunistic behaviors. This ultimately cause deliberate hiding of any bad news from outside investors (Garg et al., 2022). Other is, presence of efficient managers reduce any chance of information asymmetry. The level of transparency and access to every information by the outside investors reduce the likelihood of stock crashes (Kim et al., 2014).

The other aspect refers to agency conflicts (Hanlon & Heitzman, 2010; Desai & Dharmapala, 2006; Slemrod, 2005; Chen & Chu, 2005). Desai et al. (2007) explain that tax authorities and outside managers are more concerned about self-interested behavior of the managers. To overcome this, an effective tax enforcement authority keep an eye on managers' complicated tax planning strategies. This ultimately reduces chances of stock crashes despite of enhanced tax avoidance by the managers. Furthermore, shareholders like reduced tax expenses and allow managers to engage in tax avoidance as long as the marginal benefits of tax planning activities are more than the marginal costs. Desai & Dharmapala (2009a) propose that a suitable and good corporate governance mechanism of a firm can reduce tax avoidance. A firm with weak internal corporate governance practices cannot bring an efficient tax management system.

A number of proxies are used in literature in order to determine corporate tax avoidance (Hanlon & Heitzman, 2010). Following Chen et al. (2001), this research uses cash effective tax rate (ETR) as a proxy of tax avoidance. Garg et al. (2022) suggests that there is an inverse relation between ETR and tax avoidance. With high effective tax rate, tax avoidance is less ultimately probability of stock price crash is also less. Firms who pay less cash taxes over an extended time reflect more tax avoidance and vice versa (Halioui et al., 2016; Kim et al., 2011; Neifer & Utz; 2019). So, the hypothesis suggests:

H₁: Cash effective tax rate has an inverse relation with probability of stock price crash.

Foreign investors :One view on foreign ownership in past studies exhibit a direct link between foreign ownership and stock price crash probability. The reason of this relation involves information asymmetry and agency issues due to foreign investment in developing markets. Generally, self-interested managers tend to control activities according to their own benefits (Chen et al., 2017; Jensen & Meckling 1976). Following the same perspective, Huang et al. (2020) suggest that foreign ownership could lead to a greater stock price crash risk. It is because of the fact that local investors are more aware of the private information as compared to foreign investors. Hence, managers tend to hide bad news voluntarily in order to save their careers and reputation of the firm. When the accumulated news reaches a limit, concealing the information becomes costly for the managers. Hence, this information spreads in the

market causing stock prices to crash (Jin & Myers, 2006).

According to another view on foreign ownership, Al Amosh & Mansor (2020) propose that foreign ownership assists in attaining trust and confidence between firms and shareholders. Skills and expertise of foreign shareholders are utilized in achieving targeted goals of a firm. Presence of foreign shareholders in a firm pressurize managers not to conceal any information and make the environment favorable for investment. In developing economies, foreign shareholders are institutional investors who occupy a major portion of assets (Ozel et al., 2021). They have expertise in processing the information of a firm thereby improving the corporate governance mechanism (Kim & Yi, 2015). This argument is in line with the studies that propose existence of foreign shareholders cause the stock price crash risk to decline (Kim et al., 2020; DeFond et al., 2014). Foreign ownership also acts as an external monitoring system for the firms thereby improving governance mechanism. Standard of financials and annual reporting are also improved. Due to strong governance mechanism, managers are unable to hide unfavorable news thereby decreasing probability of stock prices to crash. Kim et al. (2011a, 2011b, 2014), Kim & Zhang (2014), Callen & Fang (2015) also support this evidence that a good corporate governance ultimately reduces the probability of stock price crash. In case of developing economies, foreign shareholders play a significant part in reducing the probability of stock price crash, because of effective strategies, more compatible skills and expertise. So, the hypothesis suggests:

H₂: Foreign investors have an inverse relation with probability of stock price crash.

Green energy transition: The optimistic approach refers that environmental initiatives play a positive role in creating a favorable scenario for the firms to operate (Zhu et al., 2019; Singhania & Saini, 2021). This ultimately assists the organizations to expand and establish resilient business operations. In the absence of such government's green concerns, industries will work in their own interest to maximize their profits (Stavropoulos et al., 2019). Several past studies discuss how environmental regulations effect the economic performance of developed markets. Results suggest that government implementing environmental strategies have a positive impact on financial performance of the firms (Ramiah et al., 2013; Kong et al., 2014; Quan et al., 2018). However, any violation to the government's green regulations causes serious damages for a firm. Reputation of a firm is at stake together with the future of manager's careers (Zhang et al., 2021).

Anwar et al. (2021) attempt to study the role of renewable energy consumption and non-renewable energy consumption on CO₂ emission of ASEAN economies. Another study, explain a positive relation among green energy transitions (both consumption and production perspectives) and economic growth (Khan et al., 2021). This result highlights the importance of renewable energy in attaining an improved environmental quality. Furthermore, it explains that conversion from non-renewable to renewable energy sources reduces energy shortages and enhances energy efficiency. Farooq et al. (2021) find a positive relation between government's green environmental concerns and investment decisions of the firm. These environmental concerns include electricity production from renewable resources, renewable energy consumption and green growth productivity. Green energy initiatives depict efforts regarding cleaner environment as they utilize natural resources. Together with this, it is less costly for the firms to adopt green energy transitions.

Zhang et al. (2021) explain the relation between government's commitment towards environment and stock price crash risk. When companies religiously follow government's strategies towards clean environment, prices of stock stabilize. Resultantly, chances of stock price to crash also decline. Moreover, environmental regulations act as monitoring system on the governance mechanism of a firm. Any deviations from these can portray an adverse image of the firm. Corporate managers respond to these strategies in two ways following "bad news hoarding theory". First, managers tend to remain honest and disclose bad news remaining committed to environmental regulations. This causes stock price to decline which accounts for "Deterrent hypothesis". Second, executives voluntarily pile up bad news and conceal it for personal interests refers as "Cover-up hypothesis". As a conclusion, probability of stock price crash rises.

Another recent study propose that green finance policies aim at reducing the risk of stock price crashes of major polluting industries (Ge & Zhu, 2022). Such green credit policies assist the firms to engage in more green energy developments and transitions. Zheng et al. (2022) proposes a positive relation between low-carbon energy transitions and stock price crash risk. This relation intensifies when firms do not disclose information related to environment. Following Khan et al. (2021), this research uses renewable energy consumption as proxy for green energy transition. So, the hypothesis suggests:

H₃: Renewable energy consumption has an inverse relation with probability of stock price crash.

Control variables: This study utilizes two firm level variables i.e. leverage and return on assets while one country level variable i.e. real GDP growth as controls. Talking about Leverage and return on assets, past studies have shown that they have an effect on probability of stock price crash (Kim et al., 2011a, b; Chen et al., 2001; Hutton et al., 2009; Callen & Fang, 2013; Murata & Hamori, 2021). Firms having greater debt to asset ratio is expected to experience greater crashes. Likewise, firm's profitability is assumed to have a direct relation with probability of stock price crash. Real GDP (Moradi et al., 2021, Zaman et al., 2020, Hu et al., 2020) exhibits value of goods and services for a concerned period adjusted for inflation. GDP represents economic condition of a country. Corporate firms usually hide adverse economic condition in order to maintain corporate financial image for the investors. When this information of declining GDP reaches the market, stock price crashes ultimately rise (Moradi et al., 2021).

METHODOLOGY

Hunjra et al. (2020) argue that it is need of the hour to study concept of stock price crash probability in developing economies. It is because of the fact that firms in emerging countries lack suitable governance strategies. Apart from this, certain other issues like payment of taxes, adoption of environmental initiatives and protection of workers' health and rights are ignored. There are total 513 companies listed on Pakistan stock exchange while 401 are non-financial firms (PSX as on Jan 20, 2023). This study uses only non-financial firms for analysis because of different operations, laws and accounting standards. The period for study is 2006 to 2021. The reason for selection of this time is to cover Global Financial Crisis period that begun from mid-2007.

Selection Criteria

Data of weekly closing prices of stocks, fulfilling the following criteria is obtained.

- Active trading of the stock
- Representative of the sector
- Existence of the stock for the entire period of analysis.

Moreover, if any firm has trading weeks less than 30 in a year, then that firm is excluded because of less trading activity and in order to capture greater crashes (Dang & Nguyen, 2021, Xu et al., 2013). Hence, 100 companies are analyzed for this study. Closing prices are then adjusted, according to the following empirical formula, for any right share issued, stock dividend and cash dividend.

$$p_{t,a} = \frac{S_t}{S_{t-1}} \left[P_t \left(1 - \frac{RI_t SP_t}{S_{t-1} PR_t SP_t} \right) + D_t \right]$$

Where, $p_{t,a}$ = adjusted prices pa for time 't' and $S_t = S_{t-1} + RI_t + SS_t$. P_t = Actual closing price at time 't', S_t = Share outstanding at time 't', RI_t = Shares issued through rights at time 't', SS_t = Shares issued through stock dividends at time 't', SP_t = Subscription price for the rights at time 't', PR_t = Stock prices at time of rights (ex-date), D_t = Cash dividend at time 't'.

For variable of corporate tax avoidance, this study uses positive ETR values, as negative ones are difficult to interpret. Either the numerator is negative or denominator's value is zero or less than zero, in both cases this study does not include them. Moreover, if ETR value is so high even greater than 1 or so low like below zero, the same treatment of non-inclusion is done (Garg et al., 2022). On the other hand, data for renewable energy consumption for Pakistan is available from 2006 to 2019 on world development indicator so this study analyzes unbalanced data.

Variables Measurement

Crash Probability: Past studies utilize three proxies (Chen et al., 2001; Jin & Myers, 2006) for measuring Probability of stock price crash. This research utilizes one proxy of stock price crash probability deduced from the below mentioned expanded market model (Chen et al., 2001).

$$r_{k,t} = \alpha_k + \gamma_{1,k} r_{m,t} - 2 + \gamma_{2,k} r_{m,t-1} + \gamma_{3,k} r_{m,t} + \gamma_{4,k} r_{m,t+1} + \gamma_{5,k} r_{m,t} + 2 + \epsilon_{k,t} \dots \text{Eq.(1)}$$

Where, $r_{k,t}$ is the return of a firm k for the concerned week t. $r_{m,t}$ is the return of KSE-100 index for the week t. The above equation contains lead and lag terms in order to overcome the issue of non-synchronous trading. The trading frequencies are different for every stock and depend on the situation. The intensity of trading differs even from hour to hour. $\epsilon_{k,t}$ represents residual that will exhibit portion of a firm's stock return that is unexplained by the market factor. Furthermore, the firm-specific weekly returns for firm 'k' in week 't' is denoted as $W_{k,t}$. It is

measured as natural log of one plus residual return.

$$W_{kt} = \ln(1 + \epsilon_{kt}) \dots \dots \text{Eq.(2)}$$

Negative coefficient of skewness (NCSKEW) estimates probability of stock price crash. It refers to the negative coefficient of firm-specific weekly returns over the year. This proxy explains the asymmetry of distributing returns (Zaman et al., 2020). Equation to measure NCSKEW is (Chen et al., 2001):

$$NCSKEW_{k,t} = - \left[n(n-1)^{3/2} \sum W_{k,t}^3 \right] / \left[(n-1)(n-2) \left(\sum W_{k,t}^2 \right)^{3/2} \right] \dots \dots \text{Eq(3)}$$

Where n is total observations for year t of a firm k. First, the negative of the third moment of firm-specific weekly returns for each year is to be calculated. After that, it is normalized by the standard deviation of firm-specific weekly returns raised to the third power. Negative sign in eq.2 exhibits that concerned variable will rise as return distribution moves towards negative skewness. In other words, higher value of NCSKEW indicates more negative skewness (left side distribution) and greater probability of stock price crash. Furthermore, weekly estimations are annualized by following Chen et al. (2001).

Corporate tax avoidance: This study uses cash effective tax rate (ETR) as a proxy for corporate tax avoidance (Chen et al., 2010, Lennox et al., 2013), obtained from annual reports. ETR and tax avoidance has a negative relation. High ETR value exhibits less tax avoidance and low stock price crash probability (Garg et al., 2022). Formula for ETR is as follows:

$$ETR_{k,t} = \text{Total income tax expense}_{k,t} / \text{Pretax book income}_{k,t}$$

Foreign investors: Foreign investor is the percentage of foreign holdings in a firm (Vo, 2020). Presence of foreign investors in the firm enhance mechanism of external monitoring. Also, managers' opportunistic behavior and hoarding of bad news reduces. Together with this, quality of financial reporting and efficiency of firms enhances. As a result, probability of stock price crash declines (Kim et al., 2020).

Green energy transition: This variable uses renewable energy consumption as its proxy, obtained from WDI in percentage (Farooq et al., 2021; Khan et al., 2021). Adoption of green energy transitions, create an efficient environment for the investors. The notion behind it explains that firms conceal less information when subjected to environmental monitoring. Ultimately, stock price crash probability decreases (Zhang et al., 2021).

Control variables: Ratio of long-term debts and total assets estimate leverage. The firms with high ratio of debts to assets are considered to have a direct impact on stock price crash probability. While, return on assets is calculated as net income divided by total assets. Glamorous stocks are more prone to stock crashes (Chen et al., 2001, Hutton et al., 2009). Data to estimate leverage and return on assets is obtained from companies' respective annual reports. However, GDP values are taken from WDI (Hu et al., 2020). When economy is in crisis, then firms tend to hide this information from the investors. The purpose behind this is to protect the image of the corporations. At a particular time, managers are no longer able to conceal this news and float it in the market. Hence, probability of stock price to crash increases (Moradi et al., 2021).

Estimation technique: This study utilizes three techniques; Pooled OLS (Ordinary Least Square), FGLS (Feasible Generalized Least Square) and GMM (Generalized Method of Moments) to investigate hypothesis H₁, H₂ and H₃.

Econometric Model: Following is the Panel data equation to find the relation between Stock Price crash probability and its predictors.

$$SCP_{k,t} = \alpha_0 + \alpha_1 CTA_{k,t-1} + \alpha_2 FI_{k,t-1} + \alpha_3 GET_{j,t-1} + \alpha_4 \sum_{kj}^3 Cont_{t-1} + \epsilon_{k,t} \dots \dots \text{Eq(4)}$$

Where SCP represents stock price crash probability. In this research, it is measured by negative coefficient of skewness (NCSKEW) of firm 'k' at time 't'. CTA exhibits corporate tax avoidance. It is measured by effective tax rate (ETR). FI shows foreign investors. GET represents green energy transitions. It is measured by renewable energy consumption 'j' at time 't-1'. Cont. is an indicator of three control variables. Three controls include two firm level variables "leverage" and "return on assets". While other is country level variable "GDP growth". $\epsilon_{k,t}$ represents error term. One year lag of independent variables is utilized to analyze its impact on dependent variable in period "t".

With the proxies of variables, equation 4 is written as:

$$NCSKEW_{k,t} = \alpha_0 + \alpha_1 ETR_{k,t-1} + \alpha_2 F_{k,t-1} + \alpha_3 RE_{j,t-1} + \alpha_4 \sum_{kj}^3 Controls_{t-1} + \epsilon_{k,t} \dots \dots \text{Eq(5)}$$

EMPIRICAL RESULTS AND DISCUSSION

Descriptive Statistics

Table 1 reports the descriptive statistics of dependent, independent and control variables. The mean value of crash probability measure, that is negative coefficient of skewness (NCSKEW), is 0.1936. However, the mean values of effective tax rate, foreign investors and renewable energy consumption are 0.2804, 0.1490 and 0.4564 respectively. This value of effective tax rate exhibits payment of cash taxes by the firms. Mean value of foreign investors exhibit a suitable presence of external shareholders in the firm. While mean value of renewable energy consumption depicts an appropriate amount of government's effort towards cleaner environment.

Panel ADF test suggests that all variables are stationary at the level and have no unit root. Table 2 exhibits Pearson's correlation matrix and all variables have value less than 0.5, which means there is no multicollinearity in the data (Al-Shaer & Zaman, 2016). In addition, the variance inflation factor of 1.05 as described in Table 3, confirms that correlation among the regressors, will not affect the coefficient estimates of a regression analysis.

Table 1: : Descriptive Statistics

Variables	Mean	Standard deviation
NCSKEW _t	0.1936	1.1459
ETR _{t-1}	0.2804	0.1526
FI _{t-1}	0.149	0.2467
RE _{t-1}	0.4564	0.0183
LEV _{t-1}	0.1488	0.1546
ROA _{t-1}	0.0972	0.1923
GDP _{t-1}	0.0373	0.0187

Note: NCSKEW_t=negative coefficient of skewness, ETR_{t-1}=effective tax rate, FI_{t-1}=foreign investors, RE_{t-1}=renewable energy consumption, LEV_{t-1}=leverage, ROA_{t-1}=return on assets, GDP_{t-1}=gross domestic product.

Table 2: : Correlation Analysis

	1	2	3	4	5	6	7
NCSKEW _t	1						
ETR _{t-1}	-0.0073	1					
FI _{t-1}	-0.037	0.0379	1				
RE _{t-1}	-0.1805	0.081	-0.0462	1			
LEV _{t-1}	0.0087	0.0383	-0.1966	0.0941	1		
ROA _{t-1}	-0.0182	-0.0397	0.0958	0.0264	-0.1311	1	
GDP _{t-1}	-0.0316	-0.0637	0.013	-0.1797	0.0252	0.0649	1

Note: NCSKEW_t=negative coefficient of skewness at "t", ETR_{t-1}=effective tax rate at "t-1", FI_{t-1}=foreign investors at "t-1", RE_{t-1}=renewable energy consumption at "t-1", , LEV_{t-1}=leverage at "t-1", ROA_{t-1}=return on assets at "t-1", GDP_{t-1}=GDP growth at "t-1".

Table 3: : Test for multi-collinearity

Variables	VIF
NCSKEW _t	1.05
ETR _{t-1}	1.01
FI _{t-1}	1.05
RE _{t-1}	1.1
LEV _{t-1}	1.06
ROA _{t-1}	1.02
GDPT _{t-1}	1.05

Note: VIF=variance inflation factor

Diagnostic Tests

Diagnostic tests are shown in Table 4. According to it, p-value for Breusch-Pagan test is 0.94 which is greater than 0.05. This result accepts null hypothesis H_0 =constant variance and suggests there no issue of heteroscedasticity in the data. However, serial autocorrelation was observed in panel data. P-value for Wooldridge test is 0.03 that is less than 0.05. Results exhibit existence of autocorrelation in the data that rejects null hypothesis H_0 =no first order autocorrelation.

Table 4: : Test for multi-collinearity

Breusch-Pagan Test For Heteroscedasticity	Chi2=0.00	Prob>chi2=0.94
Wooldridge Test For Autocorrelation	F-statistics =4.83	Prob>F=0.03

Regression Analysis

Equation 5 is estimated using Pooled OLS technique (Jory et al., 2020; Kim et al., 2015; Garg et al., 2022) to determine hypothesis H_1 , H_2 and H_3 . LM test reported in Table 5 indicates the choice of Pooled OLS model. The p-value is 1.00 which is greater than 0.05. Hence, null hypothesis i.e. H_0 = select common effect, is accepted here. Also, to overcome serial correlation issue, standard errors are clustered at firm level (Cameron et al., 2011; Petersen, 2009). Column 1 of Table 5 indicates results of our baseline regression model. First independent variable i.e. corporate tax avoidance exhibits an insignificant relation with stock price crash probability in Pakistan. Hence, hypothesis H_1 is not accepted here. This finding is consistent with the results of Neifer & Utz (2019) that suggest that tax avoidance has no link with shareholder's wealth. Managers are not concerned with gaining personal profits by reducing taxable income. Moreover, tax avoidance enhances stock crashes only if it is involved in managerial rent extraction and bad news hoarding activities (Kim et al., 2011b). The result acquired by this study is quite different from the past studies (Kim et al. 2011, Garg et al. 2022) suggesting a significant negative relation between effective tax rate and stock price crash risk.

Findings for variable "foreign investor (FI)" reveal that it has a significant and inverse relation with stock price crash probability. Hypothesis H_2 is accepted here. However, this finding is consistent with the findings of Kim et al. (2020) that suggests that FI acts as an external monitoring system for the firms to duly regulate and monitor the news. It helps in reducing the probability of stock price crash. Another point of view is that presence of foreign investors help in improving the reporting quality of firms thereby reducing the chances of bad news hoarding by the inside managers (Kim et al., 2020). In an economy like Pakistan, presence of foreign investors help the internal managers to learn with new skills and ways of coping any unfavorable circumstance. This reduces the likelihood of any future crash.

Result of renewable energy transition (RE) reveal a negative and significant relation. This result is in accordance with the findings of Zhang et al. (2021) that propose that environmental regulations act as an external monitoring mechanism for the firms. In other words, managers remain honest while following green practices and observe transparency in their practices. Hence, increased environmental enforcement follows a "deterrent hypothesis" thereby reducing stock price crashes. Therefore, hypothesis H_3 is accepted in case of Pakistan. Following these government's green regulations assist to create a favorable investment environment. To attract the investors, managers are keen to display every information regarding environmental policies thereby reducing the probability of stock crashes.

For control variables, leverage and return on assets exhibit an insignificant relation with stock price crash probability. This result is consistent with the findings of Xu et al. (2014). However, this result differs from what it was expected. On the other hand, GDP growth exhibits a negative significant relation with stock price crash probability. Findings suggest that due to uncertain economic conditions, like in case of declining GDP, managers tend to hide bad news in order to save the image of the firms. When this information is spread among the market, probability of stock price to crash increases (Luo & Zhang, 2020).

Table 5: : Regression Results for Dependent variable NCSKEW

Independent Variables	Model 1 (POOLED OLS)	Model 2 (FGLS)	Model 3 (GMM)
ETR _{t-1}	0.03 (0.10)	0.03(0.12)	-0.17(-2.19)***
FI _{t-1}	-0.28 (-1.78)*	-0.28(-2.04)**	-0.60(-4.50)***
RE _{t-1}	-13.05(-10.02)***	-12.98(-7.05)***	-24.48(-38.59)***
Control Variables			
LEV _{t-1}	0.17(0.66)	0.17(0.74)	-0.70(-5.44)***
ROA _{t-1}	-0.03(-0.20)	-0.03(-0.21)	0.35(19.75)***
GDP _{t-1}	-6.74(-3.18)***	-6.76(-2.88)***	-3.03(-6.82)***
Firm Fixed Effect	Included	Included	Not Included
No. of observations	1199	1199	913
No. of Instruments			97
Adjusted R2	0.05		
F-statistics(p>F)	17.52***		
Prob>chi2		0	0
Pesaran test		65.54***	
LM test	1		
AR1 p-value			0
AR2 p-value			0.06
Hansen J p-value			0.42

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ indicate statistical significance at 1, 5 and 10% level respectively. t and z statistics are presented in parenthesis. In case of Pooled OLS, standard errors are clustered at firm level. Also, firm fixed effects are added in order to overcome the omitted variable bias issue.

Robustness Check

This study conducted analysis by using other alternative estimation techniques in order to find the relation of ETR, FI, RE with SCP. The choice of technique is based on several diagnostic tests. Like LM test is used to choose the Pooled OLS model.

For robustness analysis, equation 5 is analyzed using other two techniques. For that purpose, FGLS (Haiyue et al., 2021; Jory et al., 2020) and two-step dynamic GMM technique (Zaman et al., 2020; Murata & Hamori, 2021) are used to estimate hypothesis H₁, H₂ and H₃. The results of Wooldridge Test in Table 4 indicates the presence of autocorrelation in the data. Therefore, in order to capture it, these additional techniques are utilized as a robustness check. Column 2 of Table 5 reports the FGLS estimation and results are consistent with Pooled OLS analysis. Overall, results support hypothesis H₂ and H₃. Column 3 of Table 5 exhibits estimation of GMM technique. Here, results are quite different from other two techniques. All three hypothesis gets accepted here. The result of Hansen test reported in Table 5 confirms the validity of the instrument. Further, AR2 shows there is no second order autocorrelation. In addition, this study conducted Pesaran Test reported in Table 5 to examine the cross-sectional dependence. Results suggest the presence of cross-sectional dependency thereby making the estimates of FGLS model more convincing.

CONCLUSION AND FUTURE DIRECTIONS

This research analyzes the impact of several internal and external determinants effecting the probability of stock crash. The period of 2006-2021 for the stocks listed on Pakistan stock exchange is selected. Using panel data estimation techniques, results suggest that in economy of Pakistan, corporate tax avoidance has no relation

with stock price crash probability. This result is quite different from what was initially supposed. It depicts that shareholder's wealth is independent of opportunistic behavior adopted by the managers. Possibility of future crashes arise only when managers focus on bad news hoarding activities while managing taxable income for the firms. Managers can maximize their profits by indulging in other activities despite getting involved in tax avoiding techniques. Likewise, result of other predictor i.e. presence of foreign investors exhibits a negative significant relation with probability of stock crashes. This is because of the fact that foreign investors are equipped with skills and expertise. Foreign investors act as an external monitoring mechanism thereby improving the standards of financial reporting and corporate governance. The study further suggests that renewable energy consumption leads to a lower probability of stock crash. For that purpose, managers tend to disclose corporate information in order to maintain the sustainable standard of a country. Moreover, investors evaluate the environmental situation of an economy before making investment decisions. The environmental sustainability has an impact as an external factor on the managerial decisions and firm's financial outcomes.

Our findings have certain implications. It attempts to point out the factors and their impact on probability of stock crashes. It will surely assist investors to make good investment choices. As protection of investor's wealth is ultimate priority. Furthermore, policymakers can look for the ways helpful in reducing this probability. Hence, this ultimately needs focus on factors effecting stock crashes. This study also suffers from some limitations that can be addressed by future researchers. Other internal factors like audit quality; board meetings; number of women directors on board; number of young directors can be studied. Some country level variables, like economic policy uncertainty, inflation etc. can also be included in the model. This study analyzes only one economy; therefore, other emerging countries can be analyzed to study the probability of crash in emerging economies. A detailed comparative analysis of developed and developing countries can also be studied to get a difference in trend of Stock crash in both type of economies.

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