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Repercussion of financial distress and corporate disclosure on the valuation of non-financial firms in India

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Abstract

Distressed companies create panic among the investors, and the overall effect comes on the economy and leads to a degraded image and value of the companies. Transparency and disclosure involve disclosing the operational as well as the financial performance and corporate governance practices employed by the firms. A corporation or person is said to be in a financial distress (FD) if they are unable to keep their pledge to make payments on time. The current study seeks to shed light on the effects of Financial Distress (FD) and Transparency and Disclosure (T&D) on the value of non-financial firms operating in India. The study makes use of panel data analysis (PDA). The authors of the study used secondary data of non-financial companies included in the S&P BSE 100 index for five fiscal years, from 2015–2016 to 2019–2020. Altman Zscore for FD measure and Tobin's Q, MCAP, and MTB for the firm's valuation is considered. Our study established that Financial Distress (FD) negatively impacts a firm's valuation because a positive association between Zscore (financial soundness) and a firm's value is found. However, Transparency and Disclosure (T&D) have no significant impact on the firm's valuation. We also find evidence that financial distress significantly impacts the value of firms under the influence of T&D. With the help of information about financial distress provided in our study, companies can analyze and take required steps to minimize the probability of being in a state of insolvency or being bankrupt. Investors can also gain knowledge of the business factors and their effect on a company's valuation so that they can cautiously choose and include healthy companies in their targeted list of companies to invest in. No such study has been conducted till now in any of the developing countries that include finding the impact that (FD) as well as (T&D) have on the value of the firms in the non-financial sector.

Keywords Financial distress, Bankruptcy, Transparency, Disclosure, Non-financial firms, Valuation

Introduction

Firms are crucial to an economy's effective operation. The firm's value is a widely accepted parameter to signal the sustainability of a firm's business activity. Hence, it is an essential determinant for all the concerned stakeholders for making their economic and financial judgements. In general, the ups and downs, we observe in economies during different periods are directly related to the impact of these firms of varying nature and sizes. The firm's value keeps on changing over time. Many factors (internal or external to firms) are present in the business environment that directly and significantly impact the firm's value, such as Corporate Governance (CG), Market Size, Financial Distress (FD), and Bankruptcy. The firm's external factors are not in the firm's control. However, internal factors can be controlled by taking proper and timely actions. The firm's FD situation is a critical factor for the firm's smooth business process [52]. Additionally, information disclosure with transparency is also an essential

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element for the stakeholders [53]. Hence, Financial Distress, Transparency, and Disclosure are variables which we will include in our study.

Financial distress, often known as FD, is a word used to describe an unfavorable financial situation in which a company faces challenges with its cash flow and has difficulty paying its debts in full, leading to the firm's closure [52]. When a company struggles to preserve liquidity and subsequently betrays the creditors' faith, it is considered distressed [25]. According to Aksu and Kosedag [3], a good Transparency and Disclosure (T&D) mechanism should protect the rights of minority shareholders and creditors, reduce informational asymmetry within the company and the likelihood of fraud, increase the likelihood that fraud will be more easily detected, lower the cost of capital, and ultimately increase the value of the firm [3]. Cases like IL&FS, DHFL, Jet Airways defaults, and many more have proved that there is still a lot to be known about the financial health of the companies in India. All these distressed companies, at one time, were one of the major giants in their respective areas. But something went wrong within them, ultimately causing either the company's insolvency or a large loss to creditors and investors in the form of a decline in the value of the firms' shares and assets. All these incidents of distressed companies created doubt in investors' minds. Investors start to avoid investing in companies which ultimately leads to decreased investment in the economy. All these defaults and other problems make FD a perfect factor to be explored to determine the extent of its effect on a firm's value. The research on FD mostly revolves in developed countries. Emerging countries like India have very few studies in this regard. However, India is one of the fast-growing country in the world and recent business failures draw a concern to explore the consequences of such business collapses.

If we talk about the Corporate Governance laws and rules, before the compulsion by the regulators to follow these rules as well as laws, the stakeholder's rights were never protected, and management of the company in which stakeholders used to hold interest was never concerned about their opinions. There was no transparency in the working of the company, the management used to invest only in those projects which were only profitable to them. So, to eliminate all these factors, corporate governance was introduced in India in the early '90 s when the nation's economy was also adopting globalization. Due to several regulatory reforms in disclosure policies, it is essential to investigate the impact of T&D on valuation because the regulatory reforms in T&D have affected the information disclosure practice for good corporate governance. Considering that transparency and disclosure are fundamental components of corporate governance [53] but have not received as much research as the notion of corporate governance as a whole, as many descriptive, as well as practical researches have been done on CG, we found that T&D individually is not much explored especially for evaluating its effect on firm's value, making it our significant factor to be studied through this study.

The goal of this study is to look into the impact that "Financial Distress" and "Transparency and Disclosure" as variables have on the valuation of the non-financial firms included in the BSE 100 index in India so that a logical and novel result can be derived. Our study has included FD as an independent variable and T&D as a moderating variable. The goal of the study is to determine how FD affects the value of businesses that are affected by T&D. The study can contribute significantly to this area of research. Due to the fact that non-financial businesses are one of the primary forces driving an economy's improvement, only this subset of businesses has been included. This section comprises firms from different areas such as Manufacturers, Agriculture, Construction, Real Estate, and other non-financial areas. The final data include 78 companies out of 100 companies. The study was carried out over five years, from 2015–2016 to 2019–2020.

There have been a few studies done to date to determine the effects of variables on the valuation of enterprises in developed countries, but if we take a look at the number of studies conducted in developing countries, there is no such record of any significant research done to detect reasons for such fluctuations in the value of the firm, as it is difficult in obtaining firm-level disclosure information for companies trading in emerging markets [64]. India is one of the fastest growing economies which has faced several business failures in recent times. There have been several regulatory reforms taken place including reforms in disclosure policies. That is why we felt the need to explore this unexplored area, particularly in the Indian context, and fill this important gap in the existing literature. The objectives of conducting this study are: (i) To investigate the impact of a firm's FD on the firm's value, (ii) To investigate the impact of Transparency and Disclosure (T&D) on a firm's value, (iii) To examine the impact of FD on the firm's value under the influence of T&D.

Several factors inspired this investigation. First off, given that India's economy is among the fastest growing in the world, there is a constant need to identify all the variables and the effects they may have on the healthy growth of the economy. The business environment varies from country to country due to certain specific conditions like geographic, regulatory, economic, and others. Therefore, fresh evidence needs to be searched for a country (India in the current study). Secondly, the two variables (FD and T&D) have been studied to analyze

their effect on a firm's performance. Still, we wanted to explore the possibilities of using these two factors (FD and T&D) in other areas where they might be having some involvement but have yet not explored. The role of the CG mechanism cannot be avoided for the healthy performance of a firm. T&D is a very important element to identify a firm's CG practices. Hence, it would be interesting to find the FD's impact on a firm's value under the moderating effect of T&D.

This work makes a number of contributions. This is the first significant study that expressly includes the companies that are part of the BSE 100 index to determine the effect that Financial Distress (FD) and Transparency and Disclosure (T&D) have when combined on the value of businesses operating in India's non-financial sector. It delivers a novel evidence on FD and firm's value association under the moderating effect of T&D. As per our belief, such investigation is rarely found in existing literature. Second, interested academics might utilize this study as a starting point for future investigations on firms in other industries, indexes, or nations. Third, these kinds of research will contribute to the accurate depiction of the financial standing of the organizations and other significant challenges that businesses may be experiencing, which may ultimately result in bankruptcy or insolvency.

The remainder of the paper is organized as follows. A brief analysis of the literature is included in the next section. The study results are presented after an explanation of the data, tables, methods, and models employed. The work will be concluded in the section on conclusions and limits.

Literature review and hypotheses formulation

This section will cover several topics of FD and T&D in various economies worldwide in the previous research in the distress and disclosure area.

As per Baldwin and Mason [12], Financial Distress (FD) is:

> *"When a firm's business deteriorates to the point where it cannot meet its financial obligations, the firm is said to have entered a state of financial distress. The first Distress signals are usually violations of debt covenants coupled with the omission or reduction in dividends" (p. 505).*

It is clear from the literature that few studies have been done to ascertain how financial crisis affects valuation. In his research on manufacturing firms listed on the Indonesian stock exchange, Witjaksono [68] discovered that, of all the independent factors he included in the study, only financial distress has an impact on the firm valuation. Dewi et al. [23] explained with the help of their paper that only financial distress has a direct impact, whereas profitability and liquidity are directly not impacted by the firm value. Sumaryati [61] found that after keeping FD as a mediator and a firm's value as an independent variable, the conclusion came out to be that financial distress does not affect a firm's value.

Firms worldwide face many ups and downs during crises in the economy by being financially distressed or bankrupt. Researchers worldwide study these problems by considering companies of different sizes, nature, or countries. On exploring these two major factors (crisis and the resultant financial distress in companies), it is observed that they are interconnected at some level. Lemonakis [42] concluded that particularly during times of crisis, businesses with lower levels of short-term debt are healthier than those with larger levels.

After being unable to detect symptoms and protect the firms from such crisis-like situations for years, The Hazard Model by Charalambakis [17] started providing early warning signals of the impending crisis. Charalambakis [17] proposed and implemented a model that predicted FD and the failure of Malaysian firms after the Asian financial crisis of 1997. The model successfully predicted distress at the rate of 88 percent. According to Aasen [1], the Oslo stock exchange manufacturers were generally more financially distressed than non-manufacturers during the global financial crisis (2008–2009). All these studies conclude that now we have enough models either established or newly found out to find the symptoms of the impending crisis to minimize its effect on firms working in the economy.

According to the Trade-off theory, firms take debt financing for tax benefits and value addition to the firm. However, such debt financing benefits the firms to some extent after that it starts increasing financial distress. This financial distress leads to poor firm performance and hence, reduces the firm's valuation [49]. Some other studies related to the Financial Distress factor apart from the firm value involve finding out its impact on a firm's performance. As per [7], non-financial firms in Pakistan are affected negatively by financial distress, and the relationship existing between FD and the firm's performance is significant. Financial Distress results in poor firm performance [36]. Mahmood et al. [45] also tried to explore and found that financially flexible firms are less likely to face the situation of being financially distressed. A study conducted by Tan [63] during the Asian financial crisis of 1997–1998, the results affirmed that firms with low financial leverage tend to perform better than those with high financial leverage. These studies were conducted in different economies but still gave the same results.

According to empirical work done by Ufo [66], Leverage has a negative and considerable impact on the financial distress of Ethiopian manufacturing enterprises.

Idrees and Qayyum [34] demonstrated that the market's inefficiency makes it statistically negligible for the financial distress risk and the book-to-market equity effect to account for the stock returns of distressed companies. But the size impact plays a key role in understanding the stock returns of struggling businesses. The study also shows that to prevent uncertainty on the Pakistan Stock Exchange, it is critical to forecast financial distress risk with a better predictor.

In a study on Indian banks, Rawal et al. [55] discovered evidence that corporate disclosures had a considerable impact on the value of businesses experiencing financial trouble. Banks often have a liberal dividend policy, contrary to the finding by Sidhu et al. [59] that financial distress is nonlinearly associated with bank dividend policies in an inverted U shape in the early stages of a stressful scenario. However, once the banks are under pressure, they start to restrict dividend payments to shareholders. Furthermore, the correlation between financial difficulty and the dividend distribution policy of banks has been demonstrated to be a substantial effect of shareholder activism.

According to research done by Gautam et al. [27] on Indian health sector companies, corporate disclosures have a detrimental impact on financial distress when inventory is present. Using financial distress indicators such as the financial distress ratio, Altman's Zscore model, and Ohlson's bankruptcy technique, Gupta and Mahakud [28] discovered that FD increases investment-cash flow sensitivity and has a detrimental impact on corporate investment. Additionally, it describes how financial hardship puts more constraints on outside funding, which raises the importance of cash flow for corporate investment among Indian enterprises.

Studies on the impact of valuation mentioned above have not yielded conclusive findings, demonstrating the need for much more research in various nations and industries before drawing any conclusions that can be generalized. It is important to hunt for this element because of this gap. As a result, we have assumed the following hypothesis for empirical research in this field.

H1 Firm's financial distress significantly impacts the firm's value.

Chi [22] has explained the term Transparency and Disclosure in the following manner-

> *"T&D forms the core of corporate governance mechanism. It helps solve problems such as conflicts of interest arising from the agency problem and asymmetry of information between managers and stakeholders."*

If we discuss the second factor that we cover in our paper, T&D, comparatively more research has been conducted in this area—starting with the study conducted on three sub-indices of corporate governance (T&D, board composition, ownership, and holding). Out of these three, T&D particularly has no critical effect on the value. The same conclusion was found in a study done by Sumatriani et al. [62]. As per Charumathi and Ramesh [20] and Li et al. [44], Voluntary disclosures and a firm's value as determined by Tobin's Q model are positively correlated. According to Cheung et al. [21], there is a large and favorable correlation between the market valuation of enterprises and transparency. The study conducted in Egypt's emerging market found a highly substantial but unfavorable correlation between mandated disclosure and a firm's worth [30]. More research was done to delve deeper into this topic [41, 43, 58].

One of the most important aspects of reducing information asymmetry is good corporate transparency [32]. According to Akerlof's [4] formulation of the Lemons problem, information asymmetry between businesses and investors can lead to a phenomenon known as adverse selection. According to Verreecchia (1983), managers that hide information risk having their firms' worth negatively evaluated by the market. Positive press about a corporation typically raises security prices and provides managers with incentives [48].

As far as the impact of T&D on a firm's performance is concerned, as a firm's value and performance are generally evaluated together, T&D has a positive relationship with the firm's performance, as explained in the studies conducted by Jiamsagul [35], Kim et al. [37], Oino [50], Stiglbauer [60], and Zaman et al. [70]. Al- ahdal et al. [9] claimed that T&D has an insignificant negative impact on a firm's performance. Hassouna et al. [31] and Temiz [64] explored that disclosure score does not have a significant effect on firms' performance, whereas an opposite finding by Chi [22] stated that T&D has a substantial role in the firm's performance. More studies such as Ahmed et al. [8], and Drobetz et al. [24] have also been conducted to provide a stronger base for the results.

Many studies, including T&D as a variable, have been established involving varying sectors to find different outcomes which are relevant to their respective areas [13, 16, 47, 51], but none of them combined it with financial distress aspect for exploring its effect on firms. This gap is enough to justify its involvement in our study. The following hypothesis has been framed for empirically testing the impact T&D has on valuation.

H2 The firm's transparency and disclosure significantly impact the firm's value.

Although there are many justifications for more transparency in the literature, organizations do not always make all of their information accessible to the public [2]. However, the majority of organizations avoid doing so since it is impossible to quantify the costs and benefits with complete objectivity are going to full disclosure [2]. It was noticed that organizations that engage in frequent strategic interactions with one another lose their competitive advantage as a result of information exposure, which lowers their profitability [2]. The lower profitability may cause financial distress and influence the firm's valuation.

Managers or even company directors may follow to do creative accounting for their benefit. They hide the company's distress situation and reveal only the firm's healthy conditions to attract investors. This may lead to enhanced firm value [2, 8, 24]. The government has now made certain regulations to be followed for information disclosure to have an appropriate level of transparency among all stakeholders. The enhanced transparency of information leads to lower conflicts between the stakeholders [2, 8, 24]. This further increases the firm's performance and wins the belief of investors and other stakeholders. This further leads to an improved firm's value. Sometimes, a higher level of information disclosure may leak the company's sensitive information which may give a competitive advantage to the rival companies. This results in low profitability of firms [2, 8, 24]. This may reduce the firm's value. Therefore, the role of T&D in the association of FD and the firm's value cannot be ignored. Hence, the investigation of the moderating effect of T&D for the connection between FD and valuation is an interesting research idea.

Our study's fundamental structure entails determining the effect that FD has on the firm's worth. Transparency and Disclosure are moderating variables in our study. To our knowledge, no research has yet been conducted that employed FD as an independent variable and T&D as a moderating variable to analyze the overall effect that FD and T&D have on a firm's value. This notion demonstrates our study's uniqueness on its own. We have therefore developed a hypothesis for experimentally assessing the combined influence of FD and T&D as independent and moderating variables, respectively, on the value of enterprises in India's non-financial sector to address this substantial vacuum in the literature.

H3 Financial difficulty of the company has a substantial impact on the company's value when T&D is present.

Data and methodology

Data

The current paper has utilized the data of 78 non-financial firms listed in BSE100 in India between 2015–2016 and 2019–202020. These 78 firms (please see Table A1 in Appendix 1.3 for a list of sample firms). The sample includes only non-financial firms for the study. Financial firms are excluded due to their differentiated reporting strategies and operations. Hence, both types of firms cannot be analyzed together [46]. These firms and the time period are chosen as they have sufficient data required for the study to get a reliable outcome. The possible recent time period (includes the most recent year 2019–2020 because proper data are not available after this year) not available after this year) is included to reflect these firms' current status. The authors believe that the time-frame is also important due to the recent regulatory reforms particularly the introduction of the Insolvency and Bankruptcy Code (IBC) 2016 in India. The secondary data of these firms have been collected from the CMIE Prowess database and the online data provided by the Bombay Stock Exchange. The description of variables for which the data are collected is given in Table 1.

Methodology

Panel data analysis is the technique used to test presumptions (PDA). The advantages of using the PDA over pure time-series or cross-sectional study are the availability of more variability and information as it exhibits both the behaviors of time-series and cross section [14, 29]. A total of nine models are developed, i.e., three models each for one dependent variable (three dependent variables for the firm's valuation are taken; hence, there are 3×3 models). Among the three models, the first model examines the linear association [14, 15], the second model examines the nonlinear association [10, 14], and the third model investigates the interaction effect [14, 19] of the explanatory variables on each dependent variable representing the firm's value. The following models are specified for the investigation of the framed hypotheses:

$$Y_{it} = \alpha + \beta_1 Zscore1_{it} + \beta_2 TD_{it} + \delta_1 l\_sales_{it} + \delta_2 DDE_{it} + u_{it} \quad (1)$$

$$Y_{it} = \alpha + \beta_1 Zscore1_{it} + \beta_2 TD_{it} + \beta_3 Zscore12_{it} + \delta_1 l\_sales_{it} + \delta_2 DDE_{it} + u_{it} \quad (2)$$

$$Y_{it} = \alpha + \beta_1 Zscore1_{it} + \beta_2 TD_{it} + \beta_3 Zscore12_{it} + \beta_4 ZS1TD_{it} + \delta_1 l\_sales_{it} + \delta_2 DDE_{it} u_{it} \quad (3)$$

where Eq. 1, Eq. 2, and Eq. 3 presents the PDA models for linear, nonlinear, and interaction effects, respectively. Y_{it} is the dependent variable representing valuation (i.e., TQ, MTB, or l_mcap) of firm i at time t. Zscore1 (the firm's FD) is used as the primary explanatory variable. TD is also taken as the explanatory variable. Two variables (i.e., l_sales and DDE) are also included in the model.

Table 1 Variables description

Variables type	Variable name	Symbol	Definitions	References
Dependent variables	Tobin's Q	TQ	The ratio of a firm's market value to the replacement cost of the firm's assets	[26, 56]
	Market-to-book ratio	MTB	The ratio of the firm's capital to its book value of the shares	[57]
	Market Capitalization	l_mcap	Multiplying the current market price of the firm's share to the total no. of outstanding shares. The natural log value is taken hence, symbolizes as l_mcap	[39]
Explanatory variables	Altman Z- score	Zscore1	Signals the firm's FD. Higher the score better the financial soundness. (Please refer to Appendix 1.1)	[6]
	Transparency & disclosure	TD	represents corporate governance. A higher value indicates good CG. (Please refer to Appendix 1.2)	[53]
Control variables	Sales	l_sales	Represents the amount of money a firm receives in exchange for goods sold. The natural log value is taken hence, symbolized as l_sales	[18]
	Debt to equity (leverage ratio)	DDE	measured as the amount of debt divided by the sum of debt and equity of the firm	[5, 38]

Definitions of the variables used for the are explained in Table 1. Three variables (TQ, MTB, and l_mcap) are used for the dependent variable as the firm's value. Two explanatory variables (Zscore1 and TD) are taken. Control variables (l_sales and DDE) are used for good model fit

Zscore12 is the square of Zscore1 (i.e., quadratic term) to test nonlinear association. ZS1TD is the multiplication of Zscore1 and T&D (Zscore1*TD), representing interaction terms in the model to test the interaction effect. α is the constant term, and u_{it} is the error term in the models. A detailed description of the variables used in the models is given in the following subsection.

Variables

This paper has used three dependent variables: TQ (Tobin's Q), MTB (Market to book ratio), and market capitalization (MCAP) as the proxy of a firm's valuation. Tobin's Q is computed as the proportion of a company's market value to its assets' replacement cost [26, 56]. The MTB is calculated as the ratio of a firm's market capitalization to its book value of the shares [57]. The market capitalization of the company is calculated by dividing the share's current market price by the total number of outstanding shares [39, 57].

Altman's Zscore and T&D are used as explanatory variables. The Altman Zscore signals the firm's FD. A higher score indicates the better financial health of the firm and vice-versa [6]. Corporate governance is exemplified by transparency and disclosure (CG). A higher value of T&D indicates a good CG comparatively [53]. A detailed discussion on the measurement of these two factors (FD as Altman Zscore and T&D as T&D index) is given in Appendix 1.1 and 1.2. Sales and DDE are two control variables included in the models for a good fit. The firm's sales represent the amount of money the firm receives in exchange for goods and services sold [18]. DDE is the debt ratio measured as the amount of debt divided by the firm's sum of debt and equity [5, 38].

Results

Descriptive statistics and correlation

This portion of the current publication summarizes the findings of all nine models used in the investigation, together with descriptive statistics and correlations of the

Table 2 Descriptive statistics and correlation

	TQ	MTB	l_mcap	Zscore1	TD	l_sales	DDE	Mean	SD
TQ	1							6.3529	19.1370
MTB	0.1357*	1						7.0473	8.8903
l_mcap	0.0579*	0.0614*	1					11.4142	11.6953
Zscore1	0.9793*	0.0804*	0.0600*	1				14.0980	41.3022
T&D	0.0987*	− 0.061*	0.1702*	0.1091*	1			0.4619	0.0606
l_sales	0.0180*	− 0.226*	0.5481*	0.0212*	0.0950*	1		9.5988	1.3366
DDE	− 1.575*	− 0.480*	0.0773*	− 0.1780*	0.1699*	− 0.2930*	1	0.1600	0.1809

*Represents a significant correlation coefficient at 0.05. The l_mcap and l_sales are the log of market capitalization and sales, respectively

variables used in the study. Table 2 demonstrates the correlation between the variables and their descriptive statistics. The TQ (firm value) has a mean value of 6.3529, showing on average a fair firm value in India. MTB (another proxy of firm value) has a mean value of 7.047. It also signals on average a good firm value in India. The average value of l_mcap (logarithm of mcap (market capitalization) as firm value) is 11.4142 indicating a large amount of market capitalization (firm value). The average ZScore1 (proxy of FD) of 14.0980 shows that the firms in India are not at risk of bankruptcy. The mean value of TD shows a moderate level of transparency and disclosure of information from the firms listed in India. l_sales (logarithm of sales) has an average value of 9.988, which shows good sales in Indian listed firms. DDE (leverage ratio) has a mean value of 0.1600. All the pairs of variables have a significant correlation between them. DDE—TQ, DDE-Zscore1, and DDE-MTB exhibit a negative correlation. MTB-l_sales and MTB-TD also have a negative correlation. The other pairs all have a good correlation. The data set is free of multicollinearity problems because the significant correlation coefficients do not exceed the cutoff of 0.80 except for TQ and Zscore1. However, the high correlation between TQ and Zscore1 does not cause multicollinearity because it exists between independent variables in a model [14]. A high correlation between independent variables causes multicollinearity leading to unreliable results. Hence, it is necessary to check this issue [14].

To investigate the linear relationship between the FD and T&D and TQ (firm's value), Model 1 has been created. Table 3 offers the outcome of this model. Both the F-test for FE (fixed effect) and the B-P (Breusch-Pagan) test for RE (random effect) are significant at 0.05 when compared to the model diagnostics. Hausman test is therefore used to determine if the FE or RE [14, 69]. Given that the Hausman test is significant at 0.05. It affirms that FE is appropriate for Model 1. Furthermore, heteroscedasticity exists because the Wooldridge test rejects the null hypothesis of autocorrelation while the Wald test is significant at 0.05. Heteroscedasticity is present; hence, robust estimates are used [14, 69].

On considering the connection of FD and T&D to TQ, the coefficient of Zscore1(FD) is 0.2579 (with the *P*-value. 0000). The coefficient of Zscore1(FD) is both positive and significant; therefore, Zscore1 influences the firm's valuation positively. It implies that a low level of FD (a higher value of Zscore shows a lower level of FD) increases the firm's valuation. However, the coefficient of T&D is not significant, indicating no association of T&D with TQ (firm's value). It indicates that openness and disclosure have no impact on the company's valuation. Both the

Table 3 Result of regression analysis (model 1) (fixed effect model)

Variable Name	Standard errors (Normal)			Robust standard errors		
	Coefficient	SE	*P*-value	Coefficient	SE	*P*-value
Part A (Coefficient Analysis) Dependent Variable: TQ						
Constant	8.8094	5.3117	0.098	8.8094	7.361	0.236
Zscore1	0.2579*	0.0094	0.000	0.2579*	0.0196	0.000
T&D	− 3.2973	3.2208	0.307	− 3.2973	5.404	0.543
l_sales	− 0.4189	0.5942	0.481	− 0.4189	0.6585	0.527
DDE	− 0.6751	2.0097	0.737	− 0.6751	2.267	0.767
Part B (Model Estimates)						
F-test (Model)	191.71*(0..0000)					
R-Square	0..0713					
$\sigma_{\mu i}$	0..9413			. 9413		
F-test Fixed Effect	11.46* (0. 0000)					
Breush–Pagan Test	36.18*(0.0000)					
Hausman Test	183.73*(0.0000)					
No of observations (n)	390					
Degree of freedom	308					
Wald test for Heteroscedasticity[a]	4.0e+07* (0.0000)					
Wooldridge Autocorrelation Test[b] AR (1)	1.348* (0.249)					

[a] Wald test of heteroscedasticity has the null of no heteroscedasticity

[b] Wooldridge test of autocorrelation in the panel has the null of no autocorrelation (with 1 lag). $\sigma_{i\mu}$ is the variance of individual effect (states in this case). Robust estimates are estimated due to significant Heteroscedasticity and Autocorrelation. DV is tq (Valuation). The higher value represents the greater firm's value. The Zscore1 and td are the explanatory variables representing financial distress and transparency and disclosure of the firm. The l_sales is the log of sales and is the control variable. Another control variable is DDE. *Sig at 5%

control variables l_sales (sales) and DDE (leverage ratio) are also not significant. Similar outcomes are also found in the robust estimates.

Table 4 reports the outcome of Model 2. This model, which includes the quadratic term of the FD and other independent variables, is intended to study the nonlinear relationship between the FD and TQ (firm's value). The Hausman test is conducted because both the F-test for FE and the B-P test for RE are significant, and as a result, the model diagnostics favor the FE in the current model [14, 69]. Furthermore, the Wald test for heteroscedasticity rejects the null hypothesis of no heteroscedasticity by a large margin. However, because the Wooldridge test accepts the null hypothesis of no autocorrelation (i.e., an insignificant *P*-value > 0.05), it verifies the absence of autocorrelation. Given that the model contains heteroscedasticity, the robust Standard error estimates [14, 69].

The coefficient of Zscore1(FD) is both positive and significant (0.1517 with *P*-value 0.000). Hence, the FD has a negative linear connection to TQ (similar to the finding of Model1). T&D has no connection to TQ as its coefficient is not significant at 0.05. On considering the nonlinear association (quadratic) of FD to TQ, the coefficient of Zscore12(squared Zscore1) has a favorable and significant coefficient (0.3416 with *P*-value 0.000 < 0.05). Therefore, it indicates that the Zscore1 (FD) has a nonlinear (quadratic) positive relationship with TQ. It also means FD has a negative nonlinear connection with the firm's value (inverted U shape relationship). It implies that FD decreases the firm's valuation after a certain point. T&D and the control variables l_sales and DDE do not have significant coefficient. Similar results are also exhibited in the robust estimate.

In order to determine the linear, curvilinear, and interaction effects of FD on TQ, the current study created Model 3. Zscore1, Zscore12 (the square of Zscore1), and ZS1TD (Zscore1*TD) are included in Model 3 for their respective linear association, curvilinear association, and interactive effects. To examine T&D's impact on TQ (the firm's value), it is also incorporated into the model. Table 5 displays the Model 3 results. Since the F-test for the fixed effect is significant, Model 3 incorporates the FE. The FE effect is further supported by the Hausman test. With a significant *P*-value (0.0000.05), the Wald test rejects the null hypothesis of no heteroscedasticity. However, according to the Wooldridge test's non-significant *P*-value (0.575 > 0.05), the autocorrelation null hypothesis is not rejected. The robust standard errors are estimated due to the existence of heteroscedasticity [14, 69].

Table 4 Result of regression analysis (model 2) (fixed effect model)

Variable name	Standard errors (Normal)			Robust standard errors		
	Coefficient	SE	*P*-value	Coefficient	SE	*P*-value
Part A (Coefficient analysis) Dependent Variable: TQ						
Constant	4.1135	5.1791	0.428	4.1135	5.8335	.483
Zscore1	0.1517*	0.0223	0.000	0.1517*	0.0337	0.000
T&D	− 4.1969	3.0972	0.176	− 4.1969	5.2710	.428
l_sales	0.2122	.5833	0.716	0.2122	0.4049	0.602
DDE	− .2.5214	1.9619	0.200	− 2.5214	2.5537	0.327
Zscore12	0.3426*	0.0658	0.000	0.3426*	0.0855	0.000
Part B (Model estimates)						
F-test (Model)	171.79*(0.0000)					
R-Square	0.0736					
$\sigma_{\mu i}$	0.9465			0.9465		
F-test Fixed Effect	12.77* (0.0000)					
Breush–Pagan Test	34.24*(0.0000)					
Hausman Test	194.65*(0.0000)					
No of observations (n)	390					
Degree of freedom	308					
Wald test for Heteroscedasticity[a]	9.5e+06* (0.0000)					
Wooldridge Autocorrelation Test[b] AR (1)	1.464 (0.2300)					

[a] Wald test of heteroscedasticity has the null of no heteroscedasticity

[b] Wooldridge test of autocorrelation in the panel has the null of no autocorrelation (with 1 lag). $\sigma_{i\mu}$ is the variance of individual effect (states in this case). Robust estimates are estimated due to significant Heteroscedasticity and Autocorrelation. DV is TQ (Valuation). The higher value represents the greater firm's value. The Zscore1 and TD are the explanatory variables representing financial distress and transparency and disclosure of the firm. The l_sales is the log of sales and is the control variable. Another control variable is DDE. Zscore12 is the square of Zscore1 to check nonlinear association. *Sig at 5%

Table 5 Result of regression analysis (model 3) (fixed effect model)

Variable name	Standard errors (Normal)			Robust standard errors		
	Coefficient	SE	*P*-value	Coefficient	SE	*P*-value
Part A (Coefficient analysis) Dependent Variable: TQ						
Constant	− 7.5263	4.6342	0.105	− 7.5263*	3.7554	0.049
Zscore1	0.9864*	0.0846	0.000	0.9864*	0.2208	0.000
TD	8.3562*	2.9694	0.004	8.3562*	2.5118	0.000
l_sales	0.5738	0.5068	0.259	0.5738	0.3567	0.112
DDE	− 1.3920	1.7043	0.415	− 1.3920	0.0653	0.471
Zscore12	.2704*	0.0574	0.000	0.2704*	0.0855	0.000
ZS1TD	− 1.3325*	0.1315	0.000	− 1.3325*	0.4001	0.001
Part B (Model estimates)						
F-test (Model)	207.62*(0.0000)					
R-Square	0.8028					
$\sigma_{\mu i}$	0.9682			0.9682		
F-test Fixed Effect	17.86* (0.0000)					
Breush–Pagan Test	34.24*(0.0000)					
Hausman Test	228.94*(0.0000)					
No of observations (n)	390					
Degree of freedom	308					
Wald test for Heteroscedasticity[a]	6.2e+05* (0.0000)					
Wooldridge Autocorrelation Test[b] AR (1)	0.316 (0.575)					

[a] Wald test of heteroscedasticity has the null of no heteroscedasticity

[b] Wooldridge test of autocorrelation in the panel has the null of no autocorrelation (with 1 lag). $\sigma_{i\mu}$ is the variance of individual effect (states in this case). Robust estimates are estimated due to significant Heteroscedasticity and Autocorrelation. DV is TQ (Valuation). The higher value represents the greater firm's value. The Zscore1 and T&D are the explanatory variables representing financial distress (FD) and transparency and disclosure(T&D) of the firm. The l_sales is the log of sales and is the control variable. Another control variable is DDE. Zscore12 is the square of Zscore1 to check nonlinear association. ZS1TD is an interaction term that includes FD with TD. *Sig at 5%

Similar to the preceding models, the coefficient of Zscore1 (FD) is both positive and significant (0.9864 having a *P*-value of 0.000 < 0.005). Hence, there exists a positive linear link between Zscore1 and TQ. The coefficient of Zscore12(square of Zscore1) also has a favorable and significant coefficient (0.2704 with a *P*-value of 0.000 < 0.05). Therefore, it indicates that the Zscore1 (FD) has a nonlinear (quadratic) positive relationship with TQ (similar to Model2). Further, the coefficient of ZS1TD (interaction term Zscore1*T&D) is negative but significant (− 1.3325 with a *P*-value of 0.000 < 0.05). This indicates that Zscore1 affects the firm's valuation negatively under the influence of transparency and disclosure. This further implies that the firm's FD increases the firm's valuation under the impact of TD. It means that financial soundness (Zscore1) reduces the firm's value at higher T&D. TD is also linearly and positively connected to TQ as it has a positive and significant coefficient (8.3562 with a *P*-value of 0.004 < 0.0.05). No significant coefficient exists for the control variables. The robust estimations also point to comparable outcomes.

Model 4 has been designed to examine the linear association of the FD and T&D with MTB (as the firm's value). The result of this model is provided in Table 6 Both the F-test for FE (fixed effect) and the B-P (Breusch-Pagan) test for RE (random effect) are significant at 0.05 when compared to the model diagnostics. Thus, the Hausman test is additionally used to determine the FE or RE [14]. As the Hausman test is found significant at 0.05, it confirms the suitability of FE for Model 4. Further, there exists both heteroscedasticity and autocorrelation as the Wald test for heteroscedasticity and the Wooldridge test for autocorrelation; both are significant at 0.05, rejecting the null of heteroscedasticity and the null of autocorrelation. The robust estimates are taken due to the availability of heteroscedasticity and autocorrelation [14].

On considering the connection of FD and T&D to MTB (firm's value), the coefficient of Zscore1 (FD) is 0.0481 (with a *P*-value of 0.013). As the coefficient of Zscore1 is both positive and significant, therefore, Zscore1 influences the firm's valuation positively. It implies that a low level of FD (a higher value of Zscore1 shows a lower level of FD) increases the firm's valuation. However, the coefficient of T&D is not significant, indicating no association of T&D with MTB. It implies that transparency and

Table 6 Result of Regression Analysis (Model 4) (Fixed Effect Model)

Variable name	Standard errors (Normal)			Robust standard errors		
	Coefficient	SE	*P*-value	Coefficient	SE	*P*-value
Part A (Coefficient analysis) Dependent Variable: MTB						
Constant	− 17.8744	10.7919	0.099	− 17.8744	15.665	0.257
Zscore1	0.0481*	0.0191	0.013	0.0481	0.0308	0.123
T&D	0.6096	6.5436	0.926	0.6096	9.655	0.948
l_sales	2.7748*	1.2073	0.041	2.7748**	1.3814	0.077
DDE	0.5952	4.0832	0.884	0.5952	3.9399	0.880
Part B (Model estimates)						
F-test (Model)	2.80*(0.0260)					
R-Square	0.0351					
$\sigma_{\mu i}$	0.8192			0.8192		
F-test Fixed Effect	14.14* (0.0000)					
Breush–Pagan Test	390.11*(0.0000)					
Hausman Test	12.56*(0.0136)					
No of observations (n)	390					
Degree of freedom	308					
Wald test for Heteroscedasticity[a]	2.2e+06* (0.0000)					
Wooldridge Autocorrelation Test[b] AR (1)	35.581* (0.0000)					

[a] Wald test of heteroscedasticity has the null of no heteroscedasticity

[b] Wooldridge test of autocorrelation in the panel has the null of no autocorrelation (with 1 lag). $\sigma_{i\mu}$ is the variance of individual effect (states in this case). Robust estimates are estimated due to significant Heteroscedasticity and Autocorrelation. DV is MTB (valuation). The higher value represents the greater firm's value. The Zscore1 and T&D are the explanatory variables representing financial distress and transparency and disclosure of the firm. The l_sales is the log of sales and is the control variable. Another control variable is DDE. *Sig at 5% and ** at 10% significance

disclosure do not impact the firm's valuation. The control variable l_sales (sales) is significant at 0.05. However, DDE (leverage ratio) is not significant. Further, the robust estimates do not exhibit any significant connection of FD and T&D to MTB (firm's value) due to a *P*-value larger than 0.05 both for Zscore1 and T&D. Only l_sales is a positive and significant control variable.

Table 7 reports the outcome of Model 5. This model is designed to look into the nonlinear relationship between the FD and MTB (firm's value) as it incorporates the quadratic term of FD (Zscore12, i.e., the square of Zsquare1) and other independent variables. The model diagnostics favor the FE in the present model as the Hausman test is found significant at 0.05 (F-test for FE and B-P test for RE are both significant; hence, the Hausman test is run) [14, 69]. Further, the Wald test for heteroscedasticity is significant rejecting the null of no heteroscedasticity. However, the Wooldridge test confirms the absence of autocorrelation as it accepts null of no autocorrelation (i.e., insignificant *P*-value >0.05). As heteroscedasticity exists in the model, hence, the robust Standard error estimates [14, 69] are considered.

The coefficient of Zscore1 is both positive and significant (0.1235 with *P*-value $0.047<0.05$). Hence, the Zscore1 (FD) has a positive (negative) linear connection to MTB (similar to the finding of Model 4). T&D has no connection to MTB as its coefficient is not significant at 0.05. On considering the nonlinear association (quadratic) of FD to TQ, the coefficient of Zscore12(squared Zscore1) has a negative and significant coefficient (− 0.2431 with *P*-value $0.068<0.10$). Therefore, it indicates that the FD (reverse of Zscore 1) has a positive nonlinear (U shaped) relationship with MTB (firm's value). It shows that first FD decreases the firm's value to a threshold then it starts increasing the firm's value. T&D and the control variables l_sales (sales) and DDE (leverage) do not have significant coefficient. Similar results are also exhibited in the robust estimate.

In order to determine the linear, curved, and interacting effects of FD on MTB (firm's value), Model 6 has been created for the current study. Zscore1, Zscore12 (the square of Zscore1), and ZS1TD (Zscore1*T&D) are all included in Model 6 for the respective effects of linear association, curvilinear association, and interactive effect. The model also includes T&D to examine its effect on MTB (firm value). Table 8 displays the Model 6 results. The results of the F-test and B-P tests for FE and RE are noteworthy. A significant *P*-value of 5% is used in the Hausman test, which favors the FE in Model 6. [14, 69]. With a significant *P*-value (0.0000.05), the Wald test rejects the null hypothesis of no heteroscedasticity. The Wooldridge test also rejects the null of autocorrelation

Table 7 Result of regression analysis (model 5) (fixed effect model)

Variable name	Standard errors (Normal)			Robust standard errors		
	Coefficient	SE	*P*-value	Coefficient	SE	*P*-value
Part A (Coefficient analysis) Dependent Variable: MTB						
Constant	− 14.5423	10.9227	0.184	− 14.5423	15.1825	0.341
Zscore1	0.1235*	0.0470	0.009	0.1235*	0.0553	0.028
T&D	1.2480	6.5319	0.849	1.2480	9.2123	0.893
l_sales	2.2099	1.2301	0.100	2.2099	1.3163	0.127
DDE	1.9054	4.1377	0.645	1.9054	3.5933	0.597
Zscore12	− 0.2431**	0.1388	0.081	− 0.2431**	0.1313	0.068
Part B (Model estimates)						
F-test (Model)	2.87*(0.015)					
R-Square	0.0447					
$\sigma_{\mu i}$	0.8087			0.8087		
F-test Fixed Effect	13.54* (0.0000)					
Breush–Pagan Test	379.83*(0.0000)					
Hausman Test	12.03*(0.034)					
No of observations (n)	390					
Degree of freedom	307					
Wald test for Heteroscedasticity[a]	1.8e+06* (0.0000)					
Wooldridge Autocorrelation Test[b] AR (1)	35.005*(0.0000)					

[a] Wald test of heteroscedasticity has the null of no heteroscedasticity

[b] Wooldridge test of autocorrelation in the panel has the null of no autocorrelation (with 1 lag). $\sigma_{i\mu}$ is the variance of individual effect (states in this case). Robust estimates are estimated due to significant Heteroscedasticity and Autocorrelation. DV is TQ (Performance). The higher value represents the greater firm's value. The Zscore1 and td are the explanatory variables representing financial distress and transparency and disclosure of the firm. The l_sales is the log of sales and is the control variable. Another control variable is DDE. Zscore12 is the square of Zscore1 to check nonlinear association. *Sig at 5% and ** at 10%

as it has a significant *P*-value (0.000 < 0.05). Therefore, robust standard errors are estimated due to the existence of heteroscedasticity and autocorrelation [14, 69].

Unlike the preceding models, in this model, the independent variables Zscore1 and ZS1TD do not have significant coefficients. It indicates that FD does not have either linear connections to MTB (firm's value). Additionally, FD does not affect MTB (firm's value) under the influence of T&D. However, the quadratic term 'Zscore12' for nonlinear connection is found to be significant and negative (− 0.2263 with *P*-value = 0.042 < 0.05) as in Model 5. It means FD has a positive nonlinear association with the firm's value. It indicates, initially FD reduces the firm's value and after a limit, it adds value to the firm. Further, T&D and the control variables also do not have significant coefficients indicating T&D does not influence the firm's valuation, and the control variables are not significant for the model. The robust estimates also indicate similar results. However, it shows a positive nonlinear connection (U shape) between FD and MTB (firm's value) (with Zscore12 (inverse of FD) coefficient − 0.2263 and *P*-value 0.047). It shows first FD decreases the firm's value to a threshold then it starts increasing the firm's value.

Model 7 is designed to examine the linear association of the FD and T&D with l_mcap (as the firm's value). The result of this model is provided in Table 9. Both the F-test for FE (fixed effect) and the B-P (Breusch-Pagan) test for RE (random effect) are significant at 0.05 when compared to the model diagnostics. Thus, the Hausman test is additionally used to determine the FE or RE [14, 69]. As the Hausman test is found insignificant at 0.05, it confirms the suitability of RE for Model 7 as well. Further, there exists both heteroscedasticity and autocorrelation as the Wald test for heteroscedasticity and the Wooldridge test for autocorrelation; both are significant at 0.05, rejecting the null of heteroscedasticity and the null of autocorrelation. The robust estimates are also taken due to the availability of heteroscedasticity and autocorrelation [14, 69].

On considering the connection of FD and T&D to l_mcap (firm's value), the coefficient of Zscore1 is 0.0038 (with *P*-value 0.005). The coefficient of Zscore1(FD) is both positive and significant; therefore, Zscore1 influences the firm's valuation positively. It implies that a low level of FD (a higher value of Zscore shows a lower level of FD) increases the firm's valuation. However, the coefficient of T&D is not significant, indicating no association

Table 8 Result of regression analysis (model 6) (fixed effect model)

Variable name	Standard errors (Normal)			Robust standard errors		
	Coefficient	SE	*P*-value	Coefficient	SE	*P*-value
Part A (Coefficient analysis) Dependent Variable: MTB						
Constant	− 11.8325	11.2761	0.295	− 11.8325	13.8249	0.395
Zscore1	− 0.0707	0.2060	0.731	− .0707	0.2793	0.801
T&D	− 1.7434	7.2254	0.809	− 1.7434	6.4565	0.788
l_sales	1.9457	1.2333	0.116	1.9457	1.2957	0.137
DDE	1.6424	4.1470	0.692	1.6424	3.3863	0.629
Zscore12	− 0.2263	0.1398	0.107	− 0.2263*	0.1096	0.042
ZS1TD	0.3102	0.3201	0.333	0.3102	0.4653	0.507
Part B (Model estimates)						
F-test (Model)	2.55*(0.0201)					
R-Square	0.0476					
$\sigma_{\mu i}$	0.8090			0.8090		
F-test Fixed Effect	13.55* (0.0000)					
Breush–Pagan Test	379.68*(0.0000)					
Hausman Test	12.62*(0.0495)					
No of observations (n)	390					
Degree of freedom	306					
Wald test for Heteroscedasticity[a]	4.0e+06* (0.0000)					
Wooldridge Autocorrelation Test[b] AR (1)	35.911* (0.0000)					

[a] Wald test of heteroscedasticity has the null of no heteroscedasticity

[b] Wooldridge test of autocorrelation in the panel has the null of no autocorrelation (with 1 lag). $\sigma_{i\mu}$ is the variance of individual effect (states in this case). Robust estimates are estimated due to significant Heteroscedasticity and Autocorrelation. DV is TQ (valuation). The higher value represents the greater firm's value. The Zscore1 and T&D are the explanatory variables representing financial distress(FD) and transparency and disclosure (T&D) of the firm. The l_sales is the log of sales and is the control variable. Another control variable is DDE. Zscore12 is the square of Zscore1 to check nonlinear association. ZS1TD is an interaction term that includes FD with T&D. * sig at 5%

of T&D with l_mcap (firm's value). It implies that transparency and disclosure do not influence the firm's valuation. Both the control variables l_sales and DDE are significant at 0.05; however, l_sales (sales) has a positive coefficient, and DDE (leverage ratio) has a negative coefficient. Further, the robust estimates do not exhibit any significant connection of FD and T&D to MTB due to a *P*-value larger than 0.05 both for Zscore1 and T&D, but FD is significant at 10% significance.

Table 10 reports the outcomes of Model 8. This model is specified to investigate the nonlinear association of the FD with l_mcap (firm's value) as it incorporates the quadratic term of FD (Zscore12, i.e., the square of Zsquare1) and other independent variables. The model diagnostics favor the RE in the present model as the Hausman test is found insignificant at 0.05 (F-test for FE and B-P test for RE are both significant; hence, the Hausman test is run) [14, 69]. Further, the Wald test for heteroscedasticity is significant rejecting the null of no heteroscedasticity; hence, it confirms the availability of heteroscedasticity. The Wooldridge test confirms the presence of autocorrelation as it rejects the null of no autocorrelation (i.e., significant *P*-value < 0.05). As heteroscedasticity and autocorrelation exist in the model, robust Standard error estimates are also indicated [14, 69].

The coefficient of Zscore1 (FD) is both positive and significant (0.0110 with *P*-value $0.006 < 0.05$). Hence, the FD lowers the firm's value (l_mcap) (similar to the finding of Model 7). T&D has no connection to l_mcap as its coefficient is not significant at 0.05. On considering the nonlinear association (quadratic) of FD to l_mcap (firm's value), the coefficient of Zscore12 (squared Zscore1) has a negative and significant coefficient (− 0.0226 with *P*-value $0.054 < 0.10$ at 10% significance). Therefore, it indicates that the FD has a positive nonlinear relationship (U shape) with l_mcap (firm's value). It shows first FD decreases the firm's value to a threshold then it starts increasing the firm's value. The control variables l_sales (sales) and DDE have a significant coefficient, but l_sales has a positive coefficient (0.4352), and DDE (leverage) has a negative coefficient (− 0.6609). Similar results are also exhibited in the robust estimates.

To determine the linear, curvilinear, and interaction effects of FD on l mcap (firm's value), Model 9 has been

Table 9 Result of regression analysis (model 7) (random effect model)

Variable name	Standard errors (Normal)			Robust standard errors		
	Coefficient	SE	*P*-value	Coefficient	SE	*P*-value
Part A (Coefficient analysis) Dependent Variable: l_mcap						
Constant	6.7989*	0.5488	0.000	6.7989*	0.8954	0.000
Zscore1	0.0038*	0.0013	0.005	0.0038**	0.0019	0.051
T&D	− 0.4802	0.5013	0.338	− 0.4802	0.5363	0.371
l_sales	0.4480*	0.0556	0.000	0.4480*	0.0896	0.000
DDE	− 0.7432*	0.3157	0.019	− 0.7432*	0.3557	0.037
Part B (Model estimates)						
Wald Chi2 (Model)	75.98*(0.0000)					
R-Square	0.3914					
$\sigma_{\mu i}$	0.7679			0.7679		
F-test Fixed Effect	14.02* (0.0000)					
Breush–Pagan Test	360.79*(0.0000)					
Hausman Test	4.63 (0.3275)					
No of observations (n)	380					
Degree of freedom	298					
Wald test for Heteroscedasticity[a]	1.1e+05* (0.0000)					
Wooldridge Autocorrelation Test[b] AR (1)	77.330* (0.0000)					

[a] Wald test of heteroscedasticity has the null of no heteroscedasticity

[b] Wooldridge test of autocorrelation in the panel has the null of no autocorrelation (with 1 lag). $\sigma_{i\mu}$ is the variance of individual effect (states in this case). Robust estimates are estimated due to significant Heteroscedasticity and Autocorrelation. DV is l_mcap (log value of market capitalization representing the firm's valuation). The higher value represents the greater firm's value. The Zscore1 and TD are the explanatory variables representing financial distress and transparency and disclosure of the firm. The l_sales is the log of sales and is the control variable. Another control variable is DDE. *Sig at 5% and ** at 10%

designed for the current investigation. Zscore1, Zscore12 (the square of Zscore1), and ZS1TD (Zscore1*T&D) are all included in Model 9 for the respective effects of linear association, curvilinear association, and interactive effect. T&D is also included in the model to check its influence on l_mcap. Table 11 depicts the results of Model 9. There is a conflict between choosing FE or RE in this model as the F-test for FE and B-P test for RE are found significant. The Hausman test, however, also supports the RE effect for the model's applicability due to its non-significant *P*-value (0.359 > 0.05 of significance threshold). The Wald test excludes the null hypothesis of no heteroscedasticity since it has a significant *P*-value (0.0000.05) [14, 69]. Due to its significant *P*-value of.0000.05, the Wooldridge test also rejects the null hypothesis of autocorrelation. Since heteroscedasticity and autocorrelation exist, robust standard errors are also computed [14, 69].

Unlike the preceding models, the coefficient of Zscore1(FD) is negative but insignificant (− 0.0104 having p- a value of 0.548 > 0.005). Hence, there exists no linear association between Zscore1 (FD) and l_mcap (firm's value). However, the coefficient of Zscore12(square of Zscore1) has a negative and significant coefficient (− 0.0238 with a *P*-value of 0.043 < 0.05), unlike Model 8. Therefore, it indicates that the Zscore1 (FD) has a nonlinear (quadratic) negative relationship with l_mcap (firm's value). It means that the higher Zscore (or low level of FD) decreases the firm's valuation to some extent. Further, the coefficient of ZS1TD (interaction term Zscore1*T&D) is positive but insignificant (0.0353 with a *P*-value of 0.204 < 0.05). This indicates that Zscore1 does not affect the firm's value under the influence of transparency and disclosure. This further implies that the firm's FD does not influence the firm's valuation under the impact of T&D. T&D is also not connected to l_mcap (firm's value) as it has a negative but insignificant coefficient (-. 8694 with a *P*-value of 0.142 > 0.05). Both the control variables have significant coefficients. The robust estimates also indicate similar results.

Robustness and endogeneity

The issue of endogeneity (as per the Wu-Hausman test and Durbin-Chi square test) is not present in the model variables. Hence, the specified models are fit for the applied analysis. Triangulation is used to understand the research problem from different angles. In addition, it is used to enhance validity and to explore the in-depth picture of the research problem. This also helps to ensure the robustness of results. All the models exhibit similar outcomes, whether it is linear, nonlinear, or interaction

Table 10 Result of regression analysis (model 8) (random effect model)

Variable name	Standard errors (Normal)			Robust standard errors		
	Coefficient	SE	*P*-value	Coefficient	SE	*P*-value
Part A (Coefficient analysis) Dependent Variable: l_mcap						
Constant	6.8619	0.5510	0.000	6.8619*	0.9066	0.000
Zscore1	0.0110*	0.0039	0.006	0.0110*	0.0045	0.015
T&D	− 0.4659	0.5002	0.352	− 0.4659	0.5332	0.382
l_sales	0.4352*	0.0562	0.000	0.4352*	0.0911	0.000
DDE	− 0.6609*	0.3178	0.038	− 0.6609**	0.3527	0.061
Zscore12	− 0.0226**	0.0117	0.054	− 0.0226**	0.0119	0.058
Part B (Model estimates)						
Wald Chi2 (Model)	79.35*(0.0000)					
R-Square	0.3831					
$\sigma_{\mu i}$	0.7474			0.7474		
F-test Fixed Effect	14.25* (0.0000)					
Breush–Pagan Test	362.07*(0.0000)					
Hausman Test	5.77*(0.3287)					
No of observations (n)	380					
Degree of freedom	297					
Wald test for Heteroscedasticity[a]	1.4e+05* (0.0000)					
Wooldridge Autocorrelation Test[b] AR (1)	76.986*(0.0000)					

[a] Wald test of heteroscedasticity has the null of no heteroscedasticity

[b] Wooldridge test of autocorrelation in the panel has the null of no autocorrelation (with 1 lag). $\sigma_{i\mu}$ is the variance of individual effect (states in this case). Robust estimates are estimated due to significant Heteroscedasticity and Autocorrelation. DV is l_mcap (log value of market capitalization showing valuation). The higher value represents the greater firm's value. The Zscore1 and T&D are the explanatory variables representing financial distress and transparency and disclosure of the firm. The l_sales is the log of sales and is the control variable. Another control variable is DDE. Zscore12 is the square of Zscore1 to check nonlinear association. *Sig at 5% and ** at 10%

effect of a firm's FD on its valuation. Hence, the findings of the study are robust. Furthermore, similar outcomes are shown by normal error and robust error estimates. However, robust error estimates have been considered due to the presence of heteroscedasticity and/or autocorrelation (as discussed in the previous subsection). Hence, the robust error estimates have mainly counted for the findings and comparison of the results. The robust estimates have exhibited similar outcomes in almost all cases. As a result, the results' reliability is guaranteed.

To sum up the results with the help of the methodology used in our paper, hypothesis *H1* has enough evidence for its acceptance in the majority of the cases (both linear and nonlinear impacts). However, there does not exist enough evidence for the hypothesis *H2; hence, in most cases (except in Model 3), H2 gets rejected.* While considering interaction impact, only Model 3 (where TQ is the parameter for the firm value) exhibits enough evidence for acceptance of hypothesis *H3.*

Discussion

The result comprehensively implies that there is a significant impact of Financial Distress (FD) and Transparency and Disclosure (T&D) on the firm's value, and the firm's FD also significantly impacts the firm's value under the interaction of T&D. Most empirical evidence exhibits that Financial soundness (Zscore) of a firm adds value to the firm. It means that FD reduces the firm's value. The findings are in expected lines supporting the Trade-off theory that if the capital structure of a firm leads to the cost of FD then the firm's value reduces.

Not much literature is present which involves finding an association between FD and valuation considering linear, nonlinear, and under-interaction relations. FD is found impacting valuation in most cases. Hence, we have found similarities with some previously conducted research relevant to our study area. Witjaksono [68] found that FD influences a firm's value out of all the variables included in the study. Nicodano & Regis [49], Tan [63], and Ahmad et al. [7] also indicate a significant association of FD with valuation. The same results were established by Dewi et al. [23], whereas the result presented by Sumaryati [61] contradicts our result. Witjaksono [68] studied manufacturing firms and Dewi et al. [23] studied industrial companies, but our study is confined to non-financial firms working in India. The current findings means if the capital structure generates FD due to associated cost,hence, the firm's value gets reduced.

Table 11 Result of regression analysis (model 9) (random effect model)

Variable name	Standard errors (Normal)			Robust standard errors		
	Coefficient	SE	*P*-value	Coefficient	SE	*P*-value
Part A (Coefficient analysis) Dependent Variable: l_mcap						
Constant	7.1363*	0.5928	0.000	7.1363*	0.9639	0.000
Zscore1	− 0.0104	0.0173	0.548	− 0.0104	0.0146	0.476
T&D	− 0.8694	0.5913	0.142	− 0.8694	0.6389	0.174
l_sales	0.4324*	0.0564	0.000	0.4324*	0.0915	0.000
DDE	− .6620*	0.3179	0.037	− 0.6620**	0.3506	0.059
Zscore12	− .02387*	0.0118	0.043	− 0.02387*	0.0089	0.007
ZS1TD	0.0353	0.0278	0.204	0.0353	0.0235	0.133
Part B (Model estimates)						
Wald Chi2 (Model)	80.68*(0.0000)					
R-Square	0.3798					
$\sigma_{\mu i}$	0.7500			0.7500		
F-test Fixed Effect	14.33* (0.0000)					
Breush–Pagan Test	360.88(0.0000)					
Hausman Test	6.60*(0.3590)					
No of observations (n)	380					
Degree of freedom	396					
Wald test for Heteroscedasticity[a]	1.2e+05* (0.0000)					
Wooldridge Autocorrelation Test[b] AR (1)	79.208*(0.0000)					

[a] Wald test of heteroscedasticity has the null of no heteroscedasticity

[b] Wooldridge test of autocorrelation in the panel has the null of no autocorrelation (with 1 lag). $\sigma_{i\mu}$ is the variance of individual effect (states in this case). Robust estimates are estimated due to significant Heteroscedasticity and Autocorrelation. DV is l_mcap (valuation). The higher value represents the greater firm's value. The Zscore1 and T&D are the explanatory variables representing financial distress(FD) and transparency and disclosure(T&D) of the firm. The l_sales is the log of sales and is the control variable. Another control variable is DDE. Zscore12 is the square of Zscore1 to check nonlinear association. ZS1TD is an interaction term that includes FD with T&D. *Sig at 5% and ** at 10%

No study has been established so far, including T&D as a moderating variable and exploring its indirect impact on the valuation of firms. Furthermore, the firm' FD (one of the most important factors) has been looked at in several ways (linear, nonlinear, and under interaction) for its impact on the firm's value. We have contributed to the literature by mathematically explaining, with the help of panel data analysis (PDA), the significant and negative impact of FD on valuation. T&D has as a moderating variable indicating its negative impact on the association of financial stability and a firm's value. A multi-model approach using two proxies of the firm's value (TQ and MTB) is adopted to deliver robust results. In most cases, similar outcomes are found which shows the reliability of the empirical evidence.

The current study also finds an insignificant association between T&D and firms' value except in Model 3. However, our results are dissimilar and surprising to some previously conducted studies. Charumathi & Ramesh [20] and Li et al. [44] found a positive association between voluntary disclosures and the firm's value. According to Cheung et al. [21], there is a large and favorable correlation between the market valuation of enterprises and transparency. It means that the T&D level of the firm is not substantial and that it can contribute to the firm's value by influencing investors.

Despite all the similarities and dissimilarities, previous literature has with our study, and the current research has resulted in the origination of novel results. The current study has not only included FD with T&D together but has taken the discussion to the next level by giving mathematical evidence of their positive and significant impact on the value of non-financial firms in India. Moreover, it also gives evidence on the FD and valuation relationship under the influence of T&D as we believe not explored in earlier literature. The revealing contribution of this paper is in the context of non-financial firms. Studies like Witjaksono [68] and Hassan et al. [30] include different countries and sectors, and our study is for non-financial firms in the BSE 100 index in India. The novel evidence specific to a country is necessary to be found because a country may hold different features of the business environment due to its geographic, economic, regulatory measures, and so on.

Our findings have the following research implications. Firstly, the information related to FD provided in our

study can help companies analyze their financial health and take necessary steps to protect themselves from the adverse condition of being bankrupt or insolvent. Secondly, the investors also gain some basic knowledge about the actual effect that business environment factors can have on the value of companies so that investors can cautiously choose and include healthy companies in their portfolios.

Conclusion, limitation and future scope

Conclusion

This paper aims to explore the impact of FD and T&D on the valuation, using the data of firms from non-financial sectors. The contribution of this study is manifold. First, it resembles the status of listed non-financial firms in India through descriptive analysis. Second, we have analyzed that T&D has no significant impact on the firm's value, including direct and indirect association in most cases. In addition to this, the firm's FD is also investigated from different angles (linear, nonlinear, and under interaction with T&D); hence, the next aim explained that FD is significantly impacting the firm value linearly, nonlinearly, and under the influence of T&D. However, depending on the different situation, these impacts were found blended. In the majority, a firm's financial stability (reverse of FD) has a positive impact on the firm's value in both linear and nonlinear connection. The aims established in our study have covered the significant aspects that can directly or indirectly impact the value of companies in this competitive business environment.

Limitations and future scope

We have covered the two significant factors (FD and T&D) in this paper that can directly or indirectly affect the firm's value which reflects the companies' working and the economy. Still, it is impossible to cover every factor in a single study that can have a major or minor impact on the valuation. The major limitation observed in our paper is that the time period covered and the scope of the study are limited to India. However, to analyze the connectivity of FD and T&D to firm valuation, we believe that the chosen country and the time period are very important due to recent regulatory changes including the implementation of IBC 2016 in India. As this investigation is on the emerging economy of India, but we believe, this study will draw attention to other economies as well. Therefore, researchers are advised to include other business environment factors in their future studies, or they can also increase the number of years to be included in the study period. For firm valuation, other parameters can also be taken. The T&D index can be more robust by including more relevant determinants as per the contemporary need. Other measures of a firm's FD can also be considered in future studies. They can also broaden the scope by including firms working in the financial sector or by conducting a study on companies in other indices of different stock exchanges globally.

Appendix

Appendix 1.1: Altman's Zscore

For the investigation of the impact of FD on the firm (as assumed in hypothesis H1), the study uses Altman Zscore for the proxy of the firm's FD. Altman [6] has developed a model (known as Altman's Zscore model) using multi-variate discriminant analysis to predict the firm's FD condition (i.e., bankruptcy). The obtained outcome of the model is called Zscore(ZS). Altman (2000) claimed that it is the most reliable model to identify the firm's FD as the model has approximately 90% accuracy to predict bankruptcy. He has conducted his study on 66 firms which include 33 failed firms and the rest 33 non-distressed firms. He has recognized a total of 22 variables significant to predict bankruptcy. Further, he has chosen the five most significant factors out of those 22 factors to develop the Zscore model. The functional expression of the model is:

$$ZS = 1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 + 1.0X5 \quad (4)$$

where X1 = wc/ta: wc for working capital and ta for total assets. It indicates the liquid assets with respect to firm size. X2 = re/ta: re for retained earnings. It indicates the firm's profitability. X3 = EBIT/ta. It shows the firm's operating efficiency. X4 = market value of equity/book value of total liabilities. It signals the variations in security price. X5 = sales/ta. It indicates the total asset turnover of the firm. On the basis Zscore measure, the firms are categorized in the following manner:

ZS < 1.81: signals the firm in high risk of FD (Red Zone).
1.81 < ZS < 2.67: indicates a gray zone, the firm is in FD, but it can deal with it.
ZS > 2.67: indicates that the firm is in the green zone (having good financial health).

Appendix 1.2: Transparency and disclosure

For investigating the impact of TD on the firm's value (hypothesis H2), the TD index is proxied as TD.

The assessment of TD is based on the construction of the TD index. The TD index is constructed mainly in two ways: using the weighted or unweighted method. Following the methodology adopted by Hossain and Hammami [33], Turrent and Ariza [65], and Kumar and Kidwai [40], the unweighted method of constructing the TD index is used in the current study. The binary values (0 or 1) are assigned for the existence or non-existence of a particular attribute in the index. The numeral 1(0ne) is for the availability of the attribute in the index, and the numeral 0(zero) is for the non-availability of the attribute in the index.

In earlier studies like Arsov and Bucevska [11] and Patel and Dallas [54], only 98 attributes were taken into consideration, and Aksu and Kosedag [3] utilized 106 attributes in total. To have a constructive TD model, the current study has utilized the 102 most significant attributes. In this newly constructed TD index, we have also included the attributes from the following new categories:

- Ten (10) attributes from Ownership structure and investors' relation,
- Twenty-nine (29) attributes from the structure and processes of the Board & Management,
- Thirty (30) attributes from financial transparency & disclosure, and
- Thirty-three (33) attributes from strategy and technology.

As the newly included categories are not given due consideration in previous studies on TD, hence, much importance is given to these categories.

Appendix 1.3: Table A1 List of Firms

S.No	Company name	Type
1	ACC	Construction
2	Airtel	Communication
3	Ambuja	Construction
4	Apollo	Healthcare
5	Ashok Leland	Automobile
6	Asian Paints	Chemicals
7	Aurobindo	Healthcare
8	Avenue	Services
9	Bajaj Auto	Automobile
10	Berger	Chemicals
11	Bharat Forge	Automobile
12	Biocon	Healthcare
13	Bosch	Automobile
14	BPCL	Energy
15	Britannia	FMCG
16	CG	Cons Durable
17	Cipla	Healthcare
18	CoalIndia	Energy
19	Colgate	FMCG
20	ConCor	Services
21	Dabur	FMCG
22	Divilab	Healthcare
23	DLF	Construction
24	Dr Reddy	Healthcare
25	Eicher	Automobile
26	GAIL	Energy
27	Godrej	FMCG
28	Grasim	Construction
29	Havells	Engineering
30	HCL	Technology
31	HERO	Automobile
32	Hindalco	Metals
33	HPCL	Energy
34	HUL	FMCG
35	Indraprastha	Energy
36	Indus	Communication
37	InfoEdge	Services
38	Infosys	Technology
39	Interglobe	Services
40	IOCL	Energy
41	ITC	FMCG
42	JSW	Metals
43	Jubilant	Services
44	L&T	Construction
45	Lupin	Healthcare
46	M&M	Automobile
47	Marico	FMCG
48	Maruti	Automobile
49	Motherson	Automobile
50	MRF	Automobile
51	Nestle	FMCG
52	NTPC	Energy
53	ONGC	Energy
54	Page	Textiles
55	Petronet	Energy
56	PI	Chemicals
57	Pidilite	Chemicals
58	Piramal	Healthcare
59	PowerGrid	Energy
60	RIL	Energy
61	Shree	Construction
62	Siemens	Engineering
63	Sun pharma	Healthcare
64	Tata Motors	Automobile
65	Tata Steel	Metals
66	TataConsumer	FMCG

S.No	Company name	Type
67	TataPower	Energy
68	TCS	Technology
69	Tech Mah	Technology
70	Titan	Cons Durable
71	Torrentpharma	Healthcare
72	TVS Motors	Automobile
73	Ultratech	Construction
74	UPL	Chemicals
75	Vedanta	Metals
76	Voltas	Cons Durable
77	Wipro	Technology
78	ZEE	Services

Sample firms for study (BSE 100 listed non-financial firms from different sectors.

Abbreviations

B-P test	Breush Pagan test
CG	Corporate governance
CMIE	Centre for monitoring Indian economy
DDE	Debt to equity ratio
FD	Financial distress
FE	Fixed effect
IBC	Insolvency and bankruptcy code
MCAP	Market capitalization
MTB	Market to book ratio
PDA	Panel data analysis
RE	Random effect
T&D	Transparency and disclosure
TQ	Tobin's Q

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CMIE Prowess database (https://register.cmie.com//kommon/bin/sr.php?kall=wcontactus&tab=2060&rrurl=prowessiq.cmie.com) – data can be accesses through individual login creation or institutional access.

Declarations

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