Identification of Financial Distressed Firms at Pakistan Stock Exchange Through Infusion of Corporate Social Responsibility Information into Altman Z-Score

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Abstract

Financial distress is one of the leading reasons for corporate default, foreclosure, and subsequent bankruptcy. Traditionally accounting information-based models have been used to identify the financially distressed firms. Inaccurate identification results in type-I and type-II errors. These errors are attributable to the elements of conservatism and prudence within the accounting information. Enclosure of market information into these models may reduce the quantum of errors and improve the existing ability of these models to accurately identify the financially distressed firms. This study has infused the Corporate Social Responsibility information into the Altman Z-Score. The enclosure has been made using additive index methodology, resulting in formation of a Composite Default Index. 161 non- financial firms listed on the Pakistan Stock Exchange have been taken as the sample over the study period of 2010-2016. The accuracy of Composite default Index has been found significantly better as compared to the Z-Score Default Index as the type-I and type-II errors are reduced by 41% and 132% respectively. This study has implication for the corporate regulators, practitioners, stakeholders and researchers in form of providing a better mechanism to identify the financially distressed firms, future studies may consider other forms of market information and the accounting information-based models to improve upon the same, further.

Introduction

Financial distress within the publicly listed firms is one of the symptoms of corporate default leading to bankruptcy and subsequent liquidation (Khan & Ullah, 2021). At firms' level, the early identification of financial distress within a firm helps its stakeholders to take pre-emptive measures for safeguarding their respective stake(s) n the firm (Opp, C. C., 2019).Such pre-emptive measures supplement the efforts to keep the firm as going-concern, keep the firm

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afloat, and avoids unnecessary reactive efforts and costs (Gutierrez, et.al., 2020). While at markets' level, the timely identification of financially distressed firms helps the corporate regulators in taking all the necessary steps to safe guard the interest of stakeholders within the firms, and in the financial markets (Jamaluddin, M., 2018).

Timely response through appropriate steps assistsin keeping the market stable, and free of the speculative elements looking for the opportunitiesof windfall profiteering from trading the under or overpriced / valued stocks of the publicly listed firms (Jonker, P., 2019). It is therefore deemed important that the financial distress withina firm, and financially distressed firms within a stock market, be identified well in time to avoidany harm to the stakeholders' interests, and to the market stability as well.

Healthy firms, and sound financial markets, are key to economic growth and stability of any country (Sugiharto, Sulistiowati, & Nofiyanti, 2019), to which Pakistan is no exception. Pakistan Stock Exchange (PSX) is one of the leading stock exchanges of the region, with innate potential to offer table market returns alongside suffing for the risk appetite of investors. Given the turbulent political and economic conditions, coupled with deteriorating PKR to US$ parity, the PSX has had its fair share of speculative movements in the PSX-100 index. Such movements get aggravated with unexpected corporate defaults and bankruptcies, causing market unrest and erosion in the stakeholders' confidence in the financial markets.

This study argues that the timely identification of financial distress within a firm, and the financially distressed firms within a market, is key to firm stability and soundness of financialmarkets. The bankruptcy theory also stresses upon the timely identification of the financially distressed firms. This raises an important question as to how the financial distress within a firm, and the financially distressed firms within a market, may be timely identified. Altman Z-Score 1968, along with its lateral variants for different sectors, has extensively been used to identifythe level of financial distress within the firm.

Z-Score is based on five key accounting ratios, organized in form of an algorithm, with an absolute numeric outcome, broadly categorized in three slabs, i.e., 1.8 or below, 1.8 to 2.7, and 2.7 or above. These three slabs represent a firm is the state of financial distress, average financial health, and good financial health, respectively.

Though the results present an easy depiction to a firm's financial health, nevertheless, the limitation of accounting ratios for their ability to present a firm's future outlook has the due criticism in place. These ratios are based on the accounting information contained within the published financial statements of the firms. Accounting information, by its very construct is historic in nature, and based on the conventions of prudence and conservatism (Malo-Alain, Aldoseri, & Melegy, 2021). Furthermore, the financial statements present past financial performance, for which the accounting convention are fairly. But when it comes to anticipation, foresight, and prediction, the same accounting information needs to be infused with the futuristic and foresighted information, i.e., the market information.

This study has used the Corporate Social Responsibility (CSR), as one relevant aspect of the market information, to beinfused into the Z-Score for timely identification of the financially distressed firms listed at thePSX. The infusion of CSR in to the Altman Z-Score has improved upon the Z-Score's standaloneability to identify the financially distressed firms, listed at PSX. The study contributes towards corporate regulators' ability to safeguard the stakeholders' interests within the PSX through forewarning about the anticipated firm defaults.

Literature Review

Theory of firm proposed by Ronald Coase in 1937, defines the firm in relation to the market for its existence, structure, and behavior. It states that the creation and existence of firm, and the associated decisions in the same context, are made to maximize the profits. Given the fact that firms have perpetual succession, they should exist indefinitely, unless faced by bankruptcy or default. The bankruptcy theory, on the contrast, argues that the bankruptcy should be restricted to solving the coordination issues caused by firms' creditors, rather that calling for the firm closure. Pertinent to mention that bankruptcy is consequence of default, which stars with the financial distress.

Financial distress is one of the leading reasons for the corporate default, and for the firms submit to voluntary or compulsory foreclosure (McConnell, et.al.,2021). Unanticipated corporate defaults and the subsequent bankruptcies have staggering implications on the financial markets and the stakeholders within these markets. A timely and accurate identification of the financially distressed firms is highly likely to reduce the number of defaults, foreclosures, and bankruptcies to a significant extent (Farooq, et.al., 2018).

Corporate regulators across the globe use an array of models and algorithms to identify thefinancially distressed firms, timely and accurately (Svabova, Kramarova, & Durica, 2018). Although these models may be classified into different stream and types, but for the purpose of this study these are broadly classified into the Accounting Based Models (ABM) and Market Based Models (MBM). Though Artificial Intelligence Based Models (AIBM) are also in use by certain markets in addition of the modelsbased on the financial and statistical information, but these do not fall within the scope of thisstudy.

ABMs are the oldest generation of modes being used to gauge financial health and future outlook of the firms in commercial terms. Accounting itself, as a discipline, has a long history (Li & Faff, 2019). It has been practiced since the commercial elements become part of human history. It has formal principles, laid down laws, recognized conventions, and established practices. The discipline is primarily historic in nature, conservative by practice, and prudent by outlook. It is primarily meant for reporting the financial position of the business based of a past time period (Ninh, Thanh, & Hong, 2018). Though future projections may be drawn on the basis of past performance, but this is only one of the many options for doing so. In case of the Public Limited Companies (PLC), also known as the Limited Liability Companies (LLC), the condition of mandatory external audit grants more credibility to the accounting information (Madhoun, 2021). But this credibility pertains to the truthiness and fairness of the accounting information presented for the latest past, rather than its suitability for any other use then just reporting (Zhou & Xu, 2021). This is where the users of accounting information usually may get caried away.

Any use of the accounting information, other than reporting, needs the information to be tailored for the specific purpose, for it to be useful in true sense (Stuebs, et.al., 2022). The use of accounting information for identifying the financially distressed firms, is no exception. This study has argued and presented that foresight must be added to the accounting information before deploying the same for identifying the financially distressed firms. For this purpose, this study has suggested the use of Corporate Social Responsibility (CSR) information.

Many studies support the use of CSR as an indicator of a firm's financial health (Zafar, Sulaiman, & Nawaz, 2022). Financially healthy firms are more likely to get engaged into the CSR activities (Kuzey, et.al., 2021). These activities represent the social responsiveness of a

firm towards society, which includes catering for the stakeholders' non-financial interests within a firm (Carroll, 2021). Socially responsive organizations are more likely to stay as a going-concern, mainly attributable to their understanding of society, economy, and financial markets (Firmansyah & Venusita, 2021).

Although these studies support use of CSR for ascertaining firms' likelihood for default / bankruptcy, nevertheless, environmental and governance factors also need to be taken into account for their coupling with CSR for enclosure into the accounting-based models. To evaluate the impact of CSR enclosure into the Altman -Score, this study has kept its focus limited to the CSR only.

Timely and accurate identification of financial distress requires a holistic understanding ofthe phenomenon (Handriani, Ghozali, & Hersugodo, 2021). This understanding may not be factored to an either-or scenario for ascertaining the reason for the financial distress, rather an inclusive strategy is deemed better for a holistic understanding. Based on the same argument, this study has proposed and tested the inclusion of CSR into the Altman Z-Score for identifying the financially distressed firms in a relative more timely and accurate manner. The Altman Z-Score algorithm is stated below.

$$Z\text{-}Score = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 0.999X_5 \quad \text{.................} (Eq\text{-}2.1)$$

Where;

Z = overall index or score.

X_1 = Ratio of working capital to total assets, i.e., Working Capital / Total Assets.

X_2 = Ratio of retained earnings to total assets, i.e., Retained Earnings / Total Assets.

X_3 = Ratio of earnings before interest and taxes to total assets, i.e., EBIT / Total Assets.

X_4 = Ratio of market value of equity to book value of total liabilities.

X_5 = Ratio of sales to total assets, i.e., Sales / Total Assets.

Methodology

This study has adopted a positivist approach where the current algorithmic outcome of the Z-Score has been kept intact. The CSR has been infused into the existing algorithm, as CSR Expense Ratio (CSR), i.e., CSR Expense / Nat Profit, through forming an additive index using Goompers et. al., 2009 methodology. The study period has been chosen, based on its representativeness of the major economic trends with minimal effects of abnormal events such as financial crises, economic emergency, natural calamity, political turbulence, and internal security of the country.

Since the Z-Score uses financial ratios based on accounting information from the publishedannual reports of the listed firms, secondary data from the published reports from 161 non- financial sector firms, listed at PSX during the period of 2010-2016 has been used. The sampleof 161 firms out of the total population of 484 listed firms at the PSX has been extracted usingthree conditionalities. First, the firms belong to non-financial-sector. Firms from the financial sector have not been included due to the distinct nature of their business. Second, the firms have not gotten delisted from PSX during the study period, i.e., 2010-2016. And third, the dataelements required for Z-Score and CSR expense made by the firms are available in form of theaudited and published information.

It is important to ascertain whether Altman Z-Score, in its standalone capacity, is able to correctly identify the financially distressed firms listed at PSX, or, the infusion of CSR into the Z-Score bring any improvement in its ability to identify the financially distressed firms. The comparison for this purpose needs to be made on even grounds, for which two separate indices have been constructed. First the Z-Score Distress Index (ZDI), and second, the Composite Default Index (CDI). Both indices have been constructed using the additive index methodology, so that the comparison between both the indices may be drawn. To assess the impact of CSR's infusion into the Z-Score for improving its ability to identify the financially distressed firms, corporate distress score prediction of the firm proxied by the Z-Score, the following dynamic panel data model would be estimated under the GMM environment

Z-Score $_{i,t}$ = αi+ β1(Z-Score) $_{i,}$ t-1 +β2(CSRER) $_{i,}$ t +Year Effect + Industry Effect + $\acute{\varepsilon}_{i,}$ t ...... (Eq-3.1)

This study has developed a default index comprising of the Altman Z-Score, and the CSRER. The index is named as the Composite Default Index (CDI), and has been constructed in four steps. First, the Z-Score obtained for the firms in sample has been converted into two quintiles, i.e., quintile 1, and quintile 5. The firms having a Z-Score of 1.8 or less have been assigned to the quintile 1, while the ones with a Z-Score of more than 1.8 are assigned to the quintile 5. The firms in quintile 1 are the ones having high degree of financial distress, and are likely to default, while the firms in quintile 5 are the ones with moderate or minimum level of financial distress, and are likely to survive. Second, the Corporate Social Responsibility (CSR) is converted into 5 quintiles. The 4th and 5th quintiles indicate higher CSR scores and consequently lower level of financial distress, while the 1st and 2nd quintiles indicate lower CSR scores and high financial distress levels. Whereas the 3rd quintile refers to observations of CSR that has median score, and is less likely to default. Third, once both the stated variables, i.e., Z-Score, and CSR have been converted into quintiles, the yearly minimum and maximum values have been estimated to determine the Range of the CDI as; Range = Maximum value – Minimum Value. Fourth, all quintiles are added every year for every firm. After obtaining the aggregate sum, the default index proposed in this study is computed as; Composite Default Index-1 = [Sum – Minimum] / Range

The index ranges from 0 to 1. Firms falling within the higher quintiles, i.e., 3rd 4th and 5th have lesser degree of financial distress and are less likely to default in the foreseeable future. While the firms falling within lower quintiles, i.e., 1st and 2nd have higher degree of financial distress and are more likely to default in the foreseeable future.

Data Analysis, Results and Findings

Data Analysis

The data for the 161 firms in sample has been analyzed using STATA. The main data components include the Altman Z-Score, the financial ratios within its algorithm, and the CSRER. While the analysis comprises of two types, i.e., the statistical analysis and arithmetic analysis. Both types of analysis aim at ascertaining the supremacy of either of the ZDI or CDI over each other to determine which of the indices is a better in identifying the financially distressed firms, which are likely to default. The statistical analysis includes the descriptive statistics, correlation, regression, paired independent sample t-test, and the estat abond arellenao bond test. While the arithmetic analysis includes the computation of simple arithmetic percentage of the type-1 and type-2 errors yielded by either of the ZDI and CDI.

Results

The results presented below have been drawn on the basis of methodology stated in the previous section. Table 4.1 to table 4.7 present the statistical tests, while table 4.8 presents the simple arithmetic percentage comparison. The results obtained from the data analysis have been presented below.

Table 4.1 Summary statistics for the Z-Score, and CSRER

	Count	Mean	Stand Dev	Min	Max
Z-Score	966	1.298	.771	-.011	4.932
CSRER	966	.015	.235	-.9325	7.086
N	966				

Table 4.1 presents the summary statistics for the Z-Score and the CSR ExpensesRatio (CSRER). The 966 firm-year observations represent the 161 firms in sample observed over a period of six years, i.e., 20210-2016. The values presented in table present no anomaly except the two negative values mentioned in the minimum value column, which is attributable to the negative values within the ratio components of theZ-Score and CSRER data elements. Having a negative working capital and a net loss isquite likely for a few firms in the sample.

Table 4.2 Altman Z-Score's components' summary statistics

	Count	Mean	Stand Dev	Min	Max
WC	966	.298	.337	-1.141	.999
RE	966	.0124	.127	-2.836	.558
EBIT	966	.065	.139	-1.240	.998
MV/TL	966	2.732	9.586	.0032	200.248
Sales	966	1.189	.8106	3.836	6.488
N	966				

Table 4.2 presents the component summary statistics for the elements within thealgorithm of the Altman Z-Score. The 966 firm year observations have been analyzed for the mean, standard deviation, minimum value, and the maximum value. Thenegative minimum values for the Working Capital (WC), Retained Earnings (RE), andEarnings Before Interest and Tax (EBIT) and attributable to excess of current liabilitiesover the current assets, and reported annual losses respectively.

Table 4.3 Correlation matrix for Altman Z-Score and CSRER

	Z-Score	CSRER
Z-Score	1.00	
CSRER	0.81[**]	1.00

Table 4.3 presents the correlation between the Altman Z-Score and the CSRER.The result exhibits a strong positive correlation between the CSRER to that of the amount of financial distress within the firms.

Table 4.4 Regression analysis for the Altman Z-Score and CSRER

	Z-Score
Z-Score	0.610***
	(0.157)
CSRER	0.048***
	(0.017)
Intercept	-0.381
	(0.341)
N	644

Table 4.4 presents the regression analysis for the Altman Z-Score and the CSRER. The results exhibit a strong association between the two, hence making it casefor the enclosure and infusion to improve the ability of the Z-Score for timely identification of the financially distressed firms at PSX.

Table 4.5 estat abond Arellano Bond test results for Z-Score

ORDER	Z	Prob > z
1	-3.429	0.0006
2	-1.434	0.152

The results above report the extent of serial correlation in the first-differenced errors. It is based on the residuals of the estimation. The test, by default, is carried out with the standard covariance matrix of the coefficients. The results shown that autocorrelation does not exist within the first order and second order testing foridentifying any serial correlation. This makes the enclosure of the CSRER viable, intothe Altman Z-Score.

Table 4.6 CDI Summary Stats

Quint	Count	Mean	Stand dev	Min	Max
1	299	.055	.0622	0	.125
2	173	.236	.0392	.125	.25
3	187	.403	.052	.375	.5
4	140	.5	0	.5	.5
5	167	.778	.142	.625	1
N	966				

Table 4.6 exhibits the summary statistics for the Composite Default Index (CDI). The first two quintiles, i.e., 1st and the 2nd quintile, represent firms with a high level of financial distress under which the firms are likely to default. The total count ofsuch firm-year observations is 472 out of the total of 966. firms-year observations. Thedifferential between the results of CDI's classification of the firm-year observation compared with that of the one presented by the ZDI may be observed from the results in table 4.7, where comparative supremacy of the means has been presented.

Table 4.7: CDI: Paired sample t-test

t-test CDI mean = ZDI mean

Variable	Observ.	Mean	Std. Err.	Std. Dev.	[95% Conf.Interval]	
CDI-1A mean	161	.511	.030	.386	.451	.571
ZDI mean	161	.226	.0280	.355	.170	.281
diff	161	.286	.028	.351	.231	.340

mean(diff)   = Mean (CDI mean - ZDI mean) **t = 10.334**

Ho: mean(diff)   = 0   degree of freedom = 160

Ha: mean(diff) < 0   Ha: mean(diff) = 0   Ha: mean(diff) > 0
Pr (T < t) = 1.0000   Pr (|T| > |t|) = 0.0000   Pr (T > t) = 0.0000

Table 4.7 presents the paired sample t-test between the means of the ZDI and the CDI. The t-value of 10.334 representing the mean difference the CDI and ZDI, exhibits the supremacy in accuracy of the CDI over the ZDI in rightly identifying the financially distressed firms listed at the PSX, which are likely to default. To warrant the same, an alternate in form of success ratio has been presented in the following table.

Table 4.8 Comparative success ratio of CDI and ZDI

Success Mean		CDI		ZDI		Differential		Error
Mean	D / S	Firms	Count	Firms	Count	Diff	% Diff	Type
0	D	39	**73**	24	**123**	50	41%	I
1	D	34		99				
2	S	11	**88**	6	**38**	50	132%	II
3	S	77		32				
N		161	**161**	161	**161**			

Table 4.8 presents the comparative success ratio of the CDI with the ZDI. The results exhibit that a total of 50 firms have been reclassified as the ones not likely to default, representing an overall reduction of 41% in the type-I and 132% in type-II errors respectively, which amounts to a significant improvement in the right identification of the financially distressed firms.

Findings

Based on results presented in the section 4.1, it is found that the enclosure of CSR into the existing algorithm of Altman Z-Score brings a significant improvement the Z-Score's ability to rightly identify the financially distressed firms, listed at the PSX which are likely to default, if left undetected. This improvement is evident from table4.7 where the mean accuracy of the CDI is significantly higher than that of the ZDI. The t-value of 10.3342 presents the CDI as a significantly better predictor of the financial distress leading to the corporate default as compared to the ZDI.

Furthermore, table 4.8 exhibits the finding based on a simple arithmetic percentage. Referring back the conditionalities applied for taking a sample of 161 firms out from the total population where the firms stayed listed for the study period. It means that none of the firms

were actually defaulted lead by the financial distress. The ZDI predicted 123 out of the 161 firms to default because of financial distress, while the CDI predicted only 73 out of the total of 161, meaning there by that moving 50 firms out from a wrongly classified bracket of to-be-defaulted firms. This correction reducesthe quantum of type-I errors by 41% and the type-II errors 132%, respectively. This reduction in errors leads to a significant improvement in the Altman Z-Score's ability to identify the financially distressed firms.

Limitation, and recommendation

This study has kept the sample limited to the non-financial firms listed at the PSX, while the future studies may include or have a separate analysis carried out for the financial sector firms at PSX. Other stock exchanges in the region may also be takenas the unit of analysis for the future studies. Further this study has been kept limited tothe use of Altman Z-Score as the accounting-based model, while other model of the same category may also be taken into account by the future studies. Similarly, only CSR has been taken as the market information, while other forms of market informationmay also be considered for its infusion into the accounting-based models.

Conclusion and implication

It may be concluded that the conservative and prudent nature of accounting information restricts its ability to identify the financially distressed firms. It is evident from the quantum of type-I and type-II errors yielded by Altman Z-Score, while identifying the financially distressed firms at the PSX. This quantum has been significantly reduced through the infusion of the market-based foresighted information, in form of CSR, into the Altman Z-Score, which is evident from the reduction in type-I and type-II error once the composite default index is formed.

These findings have theoretical and practical implications, contributing towards theory and practice, respectively. Theoretical criticism on use of accounting-based models for identifying financially distressed firms has been fractionally addressed. In addition, the portfolio managers have a better tool in hand to identify the financially distressed firms at PSX, in an accurate and timely manner, by using the composite default index.

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