FINANCIAL DISTRESS PREDICTION COMPETENCE OF THE ALTMAN Z SCORE AND ZMIJEWSKI MODEL: EVIDENCE FROM SELECTED ZIMBABWE STOCK EXCHANGE FIRMS

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ABSTRACT

Purpose- The study aimed to assess the predictive competence of Zmijewski X score and Altman Z score in detecting financial distress in two manufacturing companies that are listed on the Zimbabwe Stock Exchange. The purpose of the study was to ascertain which of the two models is better at foretelling financial distress. The study's conclusions may aid in improving practitioners' and academics' comprehension of the relative benefits of each model and their ability to forecast financial trouble and bankruptcy.

Methodology- The Altman Z score model was employed in the study as a yardstick measure to differentiate between the safe (Z >2.99), grey (1.81<Z<2.99), and distress (Z<1.81) zones for manufacturing organisations. An entity would be classified as bankrupt (X>0) or non-bankrupt (X<0) based on the Zmijewski X score, which was also employed in the research. Two manufacturing businesses registered on the Zimbabwe Stock Exchange made up the sample size for this study, which was carried out between 2010 and 2017. The research was dependent on secondary data gleaned from the two companies' financial statements.

Findings- Manufacturing firm 1's Z-score placed the firm in the distress zone in 2010 and the grey zone in the years 2011 to 2012. From 2010 until 2017, Manufacturing Company 2 experienced financial difficulties. The two manufacturing enterprises under investigation did not exhibit bankruptcy, according to the X-score statistics. According to the study's findings, the Z-score is a better indicator of financial difficulty in emerging nations than the X-score. The Altman Z score and Zmijewski X score models are both useful in predicting financial distress in firms. However, a limitation of these models is that they constitute different financial ratios (Z-score with 5 ratios and X-score 3 ratios) and interpretation. Despite this limitation, these models are still key in unearthing financial distress in firms.

Conclusion- The study concludes that the Altman Z score is superior to the Zmijewski X score in predicting financial distress in developing countries. The Altman Z score model uses 5 financial ratios to predict whether a company has a high probability of becoming insolvent. The Zmijewski X score model uses 3 financial ratios to predict bankruptcy. The study's findings are important for investors in protecting their investments as the model can help with informed decision making in terms of future prospects of the firm in terms of bankruptcy. There have been cases where an auditor provides an unqualified opinion of the financial statements of an entity only for the entity to be declared bankrupt after the release of the financial statements. Therefore, models such as the Altman Z score can aid in protecting investor loss as the tool can be used to determine bankruptcy, a key signal to divest from the company.

Keywords: Bankruptcy, signalling theory, Altman Z Score, Zmijewski X Score, manufacturing companies.
JEL Codes: M40, M41

1. INTRODUCTION

The Zimbabwe economic environment hasn't been favourable for firms. The local currency has lost considerable value with citizens preferring to hedge against inflation by storing value by acquiring United States of America dollars and investment in real estate. Hyperinflation has hampered borrowing as the Reserve Bank of Zimbabwe increased interest rates to 200% hence challenging to meet working capital needs. According to CZI (2011:8), Low output demand, equipment failure, inadequate operating capital, plus a shortage of primary commodities were the manufacturing industries' top capacity bottlenecks. major capacity constraints faced by the manufacturing sectors were low production demand, machine breakdown, lack of working capital and lack of primary commodities. CZI (2012:3) posits availability and cost of funding, power shortages, economic instability and high costs of labour and rigid labour laws as factors that negatively impacted capacity utilization. According to CZI (2014):15, the PMI is 43.5%, which indicates that the economy is weakening. Inconsistency in legislation, a decline in domestic product demand, competition from exports, easy access to capital, and corruption are the main factors influencing business in 2016. The shortage of foreign currency in 2019 as a result of the inadequate auction rate had a detrimental impact on the industrial sector. Because of the price indexing in USD, manufacturers therefore faced high raw material costs. Employees that participated in load shedding worked one shift. Low de The frequent power outages and lack of foreign cash for purchasing replacement components made the

situation with outdated equipment and frequent equipment breakdowns worse. The lack of access to foreign cash by Local Authorities to buy water treatment chemicals caused the water shortages to worsen and reduced demand for goods as a result of declining disposable incomes brought on by rising inflation rates.

According to Confederation of Zimbabwe Industries (CZI, 2021), policy inconsistencies affect prediction of the operating environment. Zimstats (2022) postulates Purchasing Managers Index (PMI) stood at 30.3 points down from 35 points thus signalling manufacturing sector contraction. Therefore, capacity utilisation from 2009 to 2021 is as per table 1 below:

Table 1: Weighted Capacity Utilisation

Year	Weighted Capacity Utilisation %
2009	32.3
2010	43.7
2011	52.7
2012	44.9
2013	36.1
2014	36.5
2015	34.3
2016	47.4
2017	45.1
2018	48.2
2019	36.4
2020	47.0
2021	56.3

Ndlovu (2019) states 96 companies closed due to the harsh economic environment. Massive power outages, punitive interest rates for short term loans were some of the factors attributed for company failure as they impacted on manufacturing activities. Zimstats (2022) articulates raw material shortages, and cash flow challenges as some of the major constraining factors to production. The study pursued bankruptcy prediction comparative competence of Altman Z Score and Zmijewski model to identify the key financial distress model that can users of financial statements can adopt to analyse a firms's financial complication in terms of financial astuteness. In comparing the two models, the study answers the following research questions:

    i.   What is the level of financial distress of the selected manufacturing firms?

    ii.   Which model is the most accurate in determining financial distress of firms between the Altman Z Score and Zmijewski models?

    iii.   Which ratio within the Altman Z Score and Zmijewski models impact financial distress of the selected manufacturing firms?

2. LITERATURE REVIEW

2.1. Signalling Theory

According to Watts (2003), the theory underscores the significance of financial information furnished to users of financial statements concerning current and future prospects of the company in order for investors to inform on the financial information released in relation to the company. Therefore, in the context of bankruptcy, the theory advances companies will send signals, portraying bankruptcy or likelihood of bankruptcy. Togno (2010) studied the effect of financial distress signals in relation to bankruptcy prediction models and concluded that profitability, leverage and liquidity are crucial financial distress signals as the various users of financial statements are able to determine a company's financial vigour. Hutton and Marcus (2015) suggest activities like the issuance of equity, can signal company's financial distress thus leading to bankruptcy. Greco and Manca (2019) articulate the combination of financial ratio and signalling theory significantly impact accuracy of bankruptcy prediction models. The signals (good or bad) are important to users of financial statements in order to mitigate risk that is linked with bankruptcy.

2.2. ALTMAN Z SCORE

The Z score bankruptcy model was developed by Edward I Altman in 1968. Based on five financial parameters, the Altman Z-score is a formula that assesses a company's risk of insolvency. Leverage, liquidity, solvency, profitability, and activity ratios are all taken into consideration by the algorithm. A linear combination of four business ratios for private sector companies or five business ratios for manufacturing enterprises, weighted by coefficients, creates the Z-score. The model was stated as follows for manufacturing firms:

$$Z = 1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 + 0.999X5$$

Where:
X1: Working Capital / Total Assets
X2: Retained Earnings / Total Assets
X3: Earnings Before Interest and Taxes / Total Assets
X4: Market Value of Equity / Book Value of Total Liabilities X5: Sales / Total Assets.
Z: Overall index

Firms that operate in the private sector utilize the following Z score model:

$$Z\text{-Score} = 6.56\ X1 + 3.26\ X2 + 6.72\ X3 + 1.05\ X4$$

Where:
X1: Working Capital / Total Asset
X2: Retained Earnings / Total Assets
X3: Earnings Before Interest & Taxes / Total Assets
X4: Market Value of Equity / Book Value of Total Liabilities

The variables of the model as explained below.

X1: Working Capital / Total Asset. Firms that regularly experience operating losses are likely to have dwindling current assets in comparison to total assets (Altman, 1968). To this effect, the ratio is a stringent measure of liquidity when compared to the current ratio or acid test/quick ratio.

X2: Retained Earnings/ Total Assets. Businesses that have more retained earnings relative to their overall assets often funded their assets through profit accumulation. (Altman, 1968).   **X3: Earnings Before Interest and Taxes / Total Assets.** The ratio gauges' efficiency of an entity's assets, hence crucial in corporate failure research (Altman, 1968).

X4: Market Value of Equity / Book Value of Total Liabilities. The ratio signifies the extent to which the firm's property can fall in value before liabilities surpass assets leading to firm bankruptcy (Altman, 1968).

X5: Sales / Total Assets. The ratio measures the ability of the firm's assets to generate revenue (Altman, 1968).

2.3. Zmijewski

The Zmijewski X model was published in 1984 and utilises ratios to analyze financial performance, leverage and liquidity of entities. One indicator of a company's risk of insolvency is the Zmijewski score. Zmijewski created it and used it on 800 steady businesses and 40 failed enterprises. Metrics including financial liquidity, leverage, and performance are used to compute the score. The chance of the corporation filing for bankruptcy increases with the score. The model is as stated below.

$$X\ Score = -4,3 - 4,5X1 + 5,7X2 - 0,004X3$$

Where:
X1: Net Income / Total Assets
X2: Total liabilities /Total Assets
X3: Current Assets / Current Liabilities

The variables of the model are as explained below:

X1: Net Income/ Total Assets. A superior ratio indicates a better financial state for the organisation.

X2: Total liabilities / Total Assets. The ratio's magnitude indicates how financially healthy the firm is as it reveals an entity's aptitude in settling its debts with assets held.

X3: Current Assets /Current liabilities. A higher ratio indicates that the firm can pay its current commitments revealing superior company financial health.

2.4. EMPIRICAL LITERATURE REVIEW

Huyghebaert and Van de Gucht (2007) posit the Z-score outperformed the X-score in financial distress prediction of Belgian firms. Fatmawati (2012) suggests Zmijewski model (X-score) as unearthing greater precision than Altman model (Z-score) and Springate models. Avenhuis (2013) proposes X-score model as having greater precision than Z-score, and Ohlson O score based on 14 bankrupt and 326 non bankrupt companies from 2011 to 2012. In their comparative analysis of the Altman, Grover, Springate, and Zmijewski models, Fauzi, Sudjono, and Saluy (2021) find that the Altman Z Score is the most effective in forecasting financial difficulty. The Grover and Zmijewski model had erratic results.   According to Supitriyani, Astuti, and Azwar (2022), when equated to the Springate, Grover, and Zmijewski model, the Altman Z score is the most precise. According to Viciwati (2020), the Zmijewski X Score model has a 90% accuracy rate for predicting insolvency. The Zmijewski model, according to Lutfiyyah and Bhilawa (2021), is 72% accurate in predicting financial problems in English league football clubs. When the Altman Z score, Zmijewski, and Springate models were examined by Yendrawati and Adiwafi

(2021) in the real estate industry, the Altman Z score's accuracy was greater than that of the Zmijewski and Springate models'. Different bankruptcy prediction models are investigated by Noor Salim and Ismudjoko in 2021. According to their investigation, the Altman Z Score and Ohlson models are more accurate at predicting financial hardship, with an accuracy rate of 90%. The precision level of the Zmijewski model was 86.36%, whereas that of the Grover model was 81.82%. The Springate model's prediction rate is the lowest, with 63.64%. According to Melina and Kalinggo (2023), the Altman Z score, Grover, and Zmijewski models did not significantly affect the ability to predict financial hardship for listed coal businesses listed on the Indonesian stock exchange between 2017 and 2021.In the automobile industry, Winarso and Edison (2020) examined bankruptcy prediction models based on the Altman Z score, the X-Score Zmijewski, the G-Score Grover, and the S-Score Springate. According to their research, the Springate S score outperformed the Altman Z score and Grover and Zmijewski models in terms of accuracy in predicting bankruptcy.

Sinarti and Sembiring (2015) suggest there exists significant differences between the Z-score and X-score in their study of 11 manufacturing firms. Chadha (2016) advances the Z-score unearthed 25.94% of 196 Kuwait Stock Exchange firms as being in financial distress from 2009 to 2014 with the X-score results being inconclusive. In Spain, the Z-score outperformed the X-score in financial distress prediction (Rovira and Blasco,2016). Fauzan (2017) postulates the Z-score accuracy as 46.67% and X-score error level of 100%. Edi and May (2018) unearths Z-score as superior to the X-score based on their research in Indonesia. According to Heusein and Pambekti (2014), the X-score is unsurpassed compared to the Z-score and Grover models. Salim and Sudiono (2017) postulate the X model as dependable than the Z score and Springate S score models in their study of 19 coal mines in Indonesia. Wang and Huang (2017) advance X-score and more effective in determining financial distress in the short term with Z-score in the long term. According to Huda, Paramita, and Amboningtyas (2018), the X-score has the greater precision with the least error rate when compared with Z score and Springate models in the retail sector on IDX 2013-2017. Anggraeni (2008) and Abadi (2017) reveal the Zmijewski model as incapable of detecting bankruptcy. Wanaya, Muliartha, Budiasih and Waratmaja (2020) posit the X-score as revealing greater accuracy with 80% when compared with the Z-score. The accuracy of the Z-Score, Springate, and Zmijewski models in forecasting financial distress circumstances of businesses in the real estate, property, and building construction sectors was compared by Yendrawati and Adiwafi (2020). All real estate firms that were registered with the Indonesian Stock Exchange between 2014 and 2018 were included in the study sample. The Altman Z-Score model, followed by the Zmijewski and Springate models, was shown to have the highest accuracy in predicting financial trouble in the property, real estate, and building construction sectors.

3.. METHODOLOGY

The study is descriptive in nature, estimating the degree of distress of the chosen enterprises across the study period using financial indicators and ratios. The analysis of the report focuses on two manufacturing companies that are listed on the Zimbabwe Stock Exchange. To investigate the financial distress of the involved enterprises, the Zmijewiski X score and Altman score are computed to identify any early warning indicators of financial distress that may be remedied over time. This study makes use of secondary data that was retrieved from the websites of the two manufacturing businesses that were chosen, as well as financial statement data for the years 2010 through 2017.

3.1. Models for Analysis

The study compares two corporate failure models and adopts the following models for financial distress analysis.

3.1.1. Altman Z Score

$$Z = 1.2_{X1} + 1.4_{X2} + 3.3_{X3} + 0.6_{X4} + 0.999_{X5} \tag{1}$$

X1: Working Capital / Total Assets
X2: Retained Earnings / Total Assets
X3: Earnings Before Interest and Taxes / Total Assets
X4: Market Value of Equity / Book Value of Total Liabilities X5: Sales / Total ssets.
Z: Overall index

Model interpretation; Z < 1.81 Distress zone, 1.81< Z < 2.99 Grey zone, Z > 2.99 Safe zone

3.1.2. Zmijewski Model

$$\text{X-Score} = -4{,}3 - 4{,}5_{X1} + 5{,}7_{X2} - 0{,}004_{X3} \tag{2}$$

X1 = Net income / Total Assets
X2 = Total Debt / Total Assets
X3 = Current Assets / Current Liabilities

Model interpretation; X > 0 Bankrupt, X < 0, Not Bankrupt

3.2. Accuracy of the Model

In order to determine the accuracy of the models, the following was utilised.

Accuracy of the model = (Total number of correct predictions / total sample) (100)   (3)

4. RESULTS AND DISCUSSION

The ability to forecast a company's risk of financial hardship or bankruptcy makes bankruptcy models valuable. These models can provide information about a company's financial health and spot possible warning indicators of financial problems by examining a variety of financial ratios and other pertinent data. Decisions regarding the company's future can be made using this information by legislators, investors, and other stakeholders. To hedge against possible losses, investors may decide to sell their firm shares if a bankruptcy model indicates that the business is very vulnerable to financial trouble. In a similar vein, authorities may employ bankruptcy models to pinpoint businesses that face insolvency and implement measures to stop or lessen the effects of such occurrences on the whole economy. In general, bankruptcy models can lessen the likelihood of financial crises and serve to foster financial stability.

The study compared Altman Z Score and Zmijewski models in seeking to determine financial incapacitation of companies in a developing country. The results of the comparative analysis are as per table 2 and 3 below. are as tabulated below.

Table 2: Manufacturing 1 Altman Z Score

MNF 1	2010	2011	2012	2013	2014	2015	2016	2017
1.2X1	0.06	(0.024)	0.119	0.148	0.469	0.216	0.346	0.455
1.4X2	(0.186)	(0.290)	(0.160)	(0.052)	0.112	0.265	0.307	0.370
3.3X3	(0.690)	0.0630	0.330	0.393	0.508	0.571	0.399	0.505
0.6X4	1.175	0.920	0.952	2.363	3.113	4.747	5.146	5.168
0.999X5	1.041	1.259	1.676	1.439	1.227	1.126	1.012	0.938
Z SCORE	**1.400**	**1.928**	**2.917**	**4.291**	**5.429**	**6.925**	**7.210**	**7.436**

Table 3: Manufacturing 2 Altman Z Score

MNF 2	2010	2011	2012	2013	2014	2015	2016	2017
1.2_{X1}	(0.005)	(0.005)	(0.053)	(0.025)	(0.054)	(0.076)	(0.329)	(0.319)
1.4_{X2}	0.069	0.112	0.123	0.126	0.050	0.014	(0.260)	(0.298)
3.3_{X3}	0.050	0.175	0.099	0.109	(0.185)	(0.070)	(0.828)	(0.129)
0.6_{X4}	0.269	0.220	0.059	0.092	0.09	0.09	0.098	0.103
0.999_{X5}	0.102	0.150	0.180	0.147	0.116	0.118	0.167	0.128
Z SCORE	**0.485**	**0.652**	**0.408**	**0.449**	**0.017**	**0.076**	**(1.152)**	**(0.515)**

The Altman Z Score results for manufacturing company 1 (table 2) uncovers distress in 2010. In the years 2011 to 2012, grey zone and safe zone from 2013 to 2017. The Altman Z Score for manufacturing company 2 (table 3) reveals distress from 2010 to 2017. The distress zone is when Z < 1.81, 1.81< Z < 2.99 grey zone and Z > 2.99 Safe zone. A low Altman Z score indicates that a company may be more vulnerable to financial distress or bankruptcy, which could result in massive losses for its shareholders. Based on this, the results show that manufacturing company 1 is more liquid than manufacturing company 2. Manufacturing company 2 investors holding onto its shares could experience losses on their investment as a result of the liquidity challenges the firm has been facing. Investing in an illiquid company carries some risk because it may be difficult to sell your shares if you need to liquidate your investment quickly, but it can also present opportunities for higher returns if the company performs well over the long run. Prior to making an investment in an illiquid company, it's critical to assess the firm's development potential, management group, and financial standing.

Table 4: Manufacturing 1 Zmijewski Model

MNF 1	2010	2011	2012	2013	2014	2015	2016	2017
Constant	(4.3)	(4.3)	(4.3)	(4.3)	(4.3)	(4.3)	(4.3)	(4.3)
4.5X1	(0.599)	(0.351)	0.441	0.261	0.482	0.630	0.230	0.468
5.7X2	0.371	0.433	0.701	1.180	0	0.479	0	0
0.004X3	0.004	0.004	0.005	0.004	0.008	0.007	0.009	0.010
X SCORE	**(3.326)**	**(3.512)**	**(4.035)**	**(3.377)**	**(4.774)**	**(4.444)**	**(4.521)**	**(4.758)**

Table 5: Manufacturing 2 Zimjewski Model

MNF 2	2010	2011	2012	2013	2014	2015	2016	2017
Constant	(4.3)	(4.3)	(4.3)	(4.3)	(4.3)	(4.3)	(4.3)	(4.3)
$4,5_{X1}$	0.0686	0.153	0.054	0.032	(0.464)	(0.126)	(0.894)	(0.145)

5,7 $_{X2}$	0.1995	0.285	0.023	0.593	0.730	0.713	1.000	1.081
0,004 $_{X3}$	0.004	0.004	0.002	0.003	0.002	0.002	0.007	0.006
X SCORE	(4.165)	(4.164)	(4.329)	(3.736)	(3.104)	(3.459)	(2.399)	(3.068)

The Zmijewski X Score for manufacturing company 1 and 2 (table 4 and 5) does not expose bankruptcy for the years 2010 to 2017 as the outcome is less than zero. According to X score, X < 0, the 2 manufacturing firms are not in financial distress or near bankruptcy.

4.1. Accuracy of the Model

According to table 6 and 7 below, the Z-score is a superior financial distress model as X-score failed to detect bankruptcy from 2010 to 2017 compared to the Z-score that detected financial distress in manufacturing company 2 from 2010 to 2017 and manufacturing company 1 in 2010 with 2011 to 2012 in the grey zone and 2013 to 2017 in the safe zone. Manufacturing company 2 was placed under judicial management in 2015 with final judicial management in 2016 in accordance with notices to shareholder obtained from the company's website. This further validates the accuracy of the Altman Z Score based on research findings and model accuracy statistics below in table 6. The findings are in agreement with Huyghebaert and Van de Gucht (2007), Fauzi, Sudjono, and Saluy (2021), Supitriyani, Astuti, and Azwar (2022), Yendrawati and Adiwafi (2021), and Noor Salim and Ismudjoko (2021) who advance the Z-score as a superior financial distress predictor than the X score.

Table 6: Altman Z Score

Years	Number of Correct predictions (Distress Zone)	Grey Zone	Safe zone	Sample	Level of accuracy
2010	2			2	100%
2011	1	1		2	50%
2012	1	1		2	50%
2013	1		1	2	50%
2014	1		1	2	50%
2015	1		1	2	50%
2016	1		1	2	50%
2017	1		1	2	50%

Table 7: Zmijewski X Score

Years	Number of Correct predictions (Bankrupt)	Not Bankrupt	Sample	Level of accuracy
2010		2	2	0%
2011		2	2	0%
2012		2	2	0%
2013		2	2	0%
2014		2	2	0%
2015		2	2	0%
2016		2	2	0%
2017		2	2	0%

4.2. Theory Implications

The study confirms the signalling theory through signals (good or bad) contained the published financial statements. These signals assist users of financial statements in risk management to protect their current and future investments as the signals can be that the company is bankrupt or is not bankrupt. The Z-score for manufacturing company 1 exposes entity as in the distress zone in 2010 and grey zone in 2011 to 2012. Manufacturing company 2 was in financial distress from 2010 to 2017. The signals would ideally protect the investments of stakeholders in terms of further investment, withdrawing further funding to the company, and attracting new capital.

5. CONCLUSION

The study used two manufacturing companies registered on the Zimbabwe Stock Exchange between 2010 and 2017 to evaluate the Z-score and X-score models for identifying insolvency. Z-score results for manufacturing company one uncovers distress in 2010. In the years 2011 to 2012, grey zone and safe zone from 2013 to 2017. The Z-score for manufacturing company 2 revealed distress from 2010 to 2017. The X-score results did not unearth bankruptcy in the two manufacturing companies. The study advances the Z-score as superior to the X-score as predictors of financial distress in developing countries. The two models can be significant to users of financial statements in order to limit bankruptcy risk to a minimum in terms of their possible investments. A limitation that is inherent in the models is that they constitute different financial ratios (Z-score with 5 ratios and X-score 3 ratios) and interpretation though they are key in unearthing

financial distress in firms.

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