

*Managing a Financial Turnaround*

*The GTI Case*

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# Corporate Credit Scoring Models and the Bond Rating Equivalence

# Forecasting Distress With Discriminant Analysis

## Linear Form

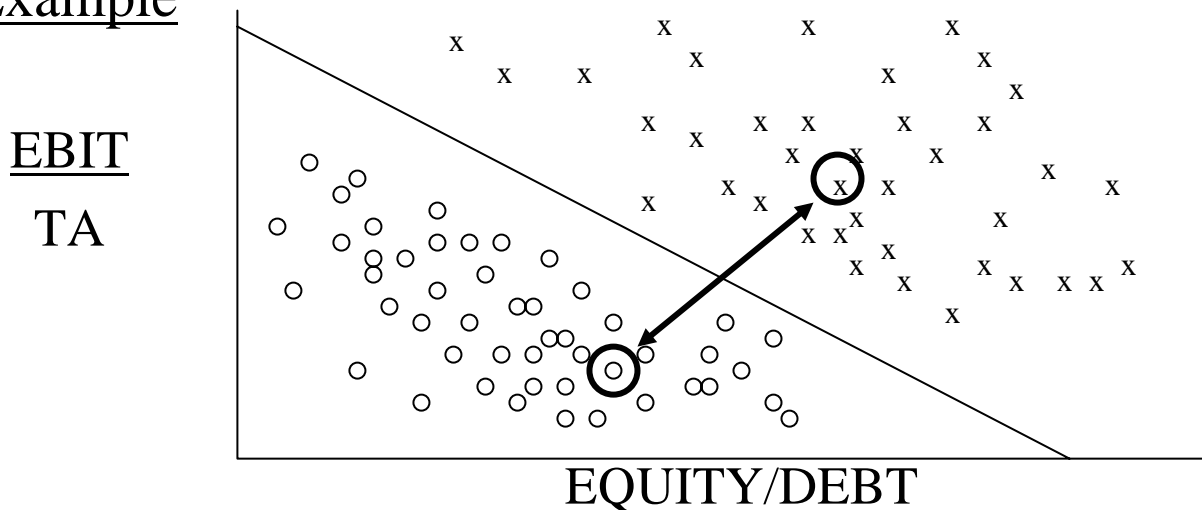
$$Z = a_1x_1 + a_2x_2 + a_3x_3 + \dots + a_nx_n$$

Z = Discriminant Score (Z Score)

$a_1 \rightarrow a_n$  = Discriminant Coefficients (Weights)

$x_1 \rightarrow x_n$  = Discriminant Variables (e.g. Ratios)

## Example



## “Z” Score Component Definitions

<u>Variable</u>	<u>Definition</u>	<u>Weighting Factor</u>
$X_1$ - - - - -	$\frac{\text{Working Capital}}{\text{Total Assets}}$	1.2
$X_2$ - - - - -	$\frac{\text{Retained Earnings}}{\text{Total Assets}}$	1.4
$X_3$ - - - - -	$\frac{\text{EBIT}}{\text{Total Assets}}$	3.3
$X_4$ - - - - -	$\frac{\text{Market Value of Equity}}{\text{Book Value of Total Liabilities}}$	0.6
$X_5$ - - - - -	$\frac{\text{Sales}}{\text{Total Assets}}$	1.0

## Z Score Bankruptcy Model

$$Z = .012X_1 + .014X_2 + .033X_3 + .006X_4 + .999X_5$$

e.g. 20.0%

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + .6X_4 + .999X_5$$

e.g. 0.20

$$X_1 = \frac{\text{Current Assets} - \text{Current Liabilities}}{\text{Total Assets}}$$

$$X_4 = \frac{\text{Market Value of Equity}}{\text{Total Liabilities}}$$

$$X_2 = \frac{\text{Retained Earnings}}{\text{Total Assets}}$$

$$X_5 = \frac{\text{Sales}}{\text{Total Assets}} \quad (= \# \text{ of Times e.g. } 2.0x)$$

$$X_3 = \frac{\text{Earnings Before Interest and Taxes}}{\text{Total Assets}}$$

*Zones of Discrimination:*  
*Original Z - Score Model*

$Z > 2.99$  - “Safe” Zone

$1.8 < Z < 2.99$  - “Grey” Zone

$Z < 1.80$  - “Distress” Zone

# Average Z-Score by S&P Bond Rating S&P 500: 1992 - 2001

Rating	1996-2001			1995		1994		1993		1992	
	# Firms	Average Z Score	SD	Average Z Score	SD	Average Z Score	SD	Average Z Score	SD	Average Z Score	SD
AAA	66	6.20	3.06	5.02	1.60	4.38	1.38	4.51	1.50	5.26	2.19
AA	194	4.73	2.36	4.30	1.91	4.05	1.83	4.03	1.89	4.23	2.09
A	519	3.74	2.29	3.61	2.26	3.47	2.01	3.61	2.18	3.92	3.26
BBB	530	2.81	1.48	2.78	1.49	2.70	1.58	2.84	1.74	2.60	1.54
BB	538	2.38	1.85	2.45	1.62	2.28	1.69	2.19	1.63	2.10	1.54
B	390	1.80	1.91	1.67	1.23	1.88	1.52	1.96	1.72	1.96	2.33
CCC+CC	9	0.33	1.16								

## *Estimating Probability of Default and Probability of Loss Given Defaults*

- Credit scores on new issues to estimate
- Bond ratings equivalents on new issues and then,
- Utilize mortality rates to estimate annual and cumulative defaults



# Marginal and Cumulative Mortality Rate Equation

$$\mathbf{MMR}_{(t)} = \frac{\text{Total value of defaulting debt in year } (t)}{\text{total value of the population at the start of the year } (t)}$$

MMR = Marginal Mortality Rate

One can measure the cumulative mortality rate (CMR) over a specific time period (1,2,..., T years) by subtracting the product of the surviving populations of each of the previous years from one (1.0), that is,

$$CMR_{(t)} = 1 - \prod_{t=1} SR_{(t)},$$

here  $CMR_{(t)}$  = Cumulative Mortality Rate in  $(t)$ ,  
 $SR_{(t)}$  = Survival Rate in  $(t)$  ,  $1 - MMR_{(t)}$

# Mortality Rate Concept (Illustrative Calculation)

## For BB Rated Issues

Security No.	Issued Amount	Year 1 Default	Call	SF	Year 2 Default	Call	SF
1	50	--	--	5	--	--	5
2	50	50	--	--	NE	NE	NE
3	100	--	100	--	NE	NE	NE
4	100	--	--	--	100	--	--
5	150	--	--	--	--	--	15
6	150	--	--	--	--	--	--
7	200	--	--	20	--	--	20
8	200	--	--	--	--	200	--
9	250	--	--	--	--	--	--
10	250	--	--	--	--	--	--
<b>Total</b>	<b>1,500</b>	<b>50</b>	<b>100</b>	<b>25</b>	<b>100</b>	<b>200</b>	<b>40</b>
Amount Start of Period	1,500	-	175	-	1,325	- 340	= 985
<b>Marginal Mortality Rate</b>		<b>Year 1</b>			<b>Year 2</b>		
		50/1,500 = 3.3%			100/1,325 = 7.5%		
<b>Cumulative Rate</b>		3.3%			1 - (SR1 x SR2 ) = CMR2 1 - (96.7% x 92.5%) = 10.55%		

NE = No longer in existence  
SF = Sinking fund

# Mortality Rates by Original Rating

## All Rated Corporate Bonds<sup>a</sup> 1971-2003

		Years after Issuance									
		1	2	3	4	5	6	7	8	9	10
AAA	Marginal	0.00%	0.00%	0.00%	0.00%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%
	Cumulative	0.00%	0.00%	0.00%	0.00%	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%
AA	Marginal	0.00%	0.00%	0.33%	0.17%	0.00%	0.00%	0.00%	0.00%	0.03%	0.02%
	Cumulative	0.00%	0.00%	0.33%	0.50%	0.50%	0.50%	0.50%	0.50%	0.53%	0.55%
A	Marginal	0.01%	0.11%	0.02%	0.09%	0.05%	0.10%	0.06%	0.21%	0.11%	0.06%
	Cumulative	0.01%	0.12%	0.14%	0.23%	0.28%	0.38%	0.44%	0.65%	0.75%	0.82%
BBB	Marginal	0.40%	3.45%	1.58%	1.45%	0.98%	0.56%	0.28%	0.25%	0.16%	0.42%
	Cumulative	0.40%	3.84%	5.38%	6.73%	7.64%	8.16%	8.98%	9.11%	9.25%	9.63%
BB	Marginal	1.22%	2.52%	4.44%	2.05%	2.55%	1.10%	1.65%	0.88%	1.72%	3.70%
	Cumulative	1.22%	3.77%	7.98%	9.87%	12.17%	13.14%	14.57%	15.15%	16.61%	19.69%
B	Marginal	3.06%	6.92%	7.48%	8.58%	6.08%	4.18%	3.74%	2.31%	2.00%	0.88%
	Cumulative	3.06%	9.77%	16.52%	23.69%	28.32%	31.32%	33.89%	35.41%	36.70%	37.26%
CCC	Marginal	8.18%	15.57%	19.15%	12.18%	4.26%	10.25%	5.65%	3.15%	0.00%	4.28%
	Cumulative	8.18%	22.48%	37.32%	44.96%	47.30%	52.70%	55.37%	56.78%	56.78%	58.63%

(a) Rated by S&P at Issuance

Based on 1,719 issues

Source: Standard & Poor's (New York) and Author's Compilation

# Mortality Losses by Original Rating

## All Rated Corporate Bonds<sup>a</sup> 1971-2003

		Years after Issuance									
		1	2	3	4	5	6	7	8	9	10
AAA	Marginal	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Cumulative	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
AA	Marginal	0.00%	0.00%	0.06%	0.06%	0.00%	0.00%	0.00%	0.00%	0.03%	0.02%
	Cumulative	0.00%	0.00%	0.06%	0.12%	0.12%	0.12%	0.12%	0.12%	0.15%	0.17%
A	Marginal	0.00%	0.04%	0.01%	0.04%	0.02%	0.06%	0.02%	0.04%	0.08%	0.00%
	Cumulative	0.00%	0.04%	0.05%	0.09%	0.11%	0.17%	0.19%	0.23%	0.31%	0.31%
BBB	Marginal	0.28%	2.54%	1.15%	0.94%	0.65%	0.37%	0.47%	0.15%	0.10%	0.29%
	Cumulative	0.28%	2.81%	3.93%	4.83%	5.45%	5.80%	6.24%	6.38%	6.48%	6.75%
BB	Marginal	0.73%	1.51%	3.24%	1.46%	1.40%	0.75%	0.99%	0.28%	0.94%	1.18%
	Cumulative	0.73%	2.23%	5.40%	6.78%	8.08%	8.78%	9.68%	9.93%	10.78%	11.83%
B	Marginal	2.13%	5.05%	5.60%	6.00%	4.56%	2.51%	2.74%	1.64%	1.10%	0.67%
	Cumulative	2.13%	7.07%	12.38%	17.54%	21.30%	23.38%	25.00%	26.23%	27.04%	27.53%
CCC	Marginal	5.48%	11.68%	15.37%	9.72%	3.20%	8.21%	4.80%	2.52%	0.00%	3.22%
	Cumulative	5.48%	16.52%	29.35%	36.22%	38.26%	43.37%	46.05%	47.41%	47.41%	49.10%

(a) Rated by S&P at Issuance

Based on 1,535 issues

Source: Standard & Poor's (New York) and Author's Compilation

## *Financial Distress Prediction Users*

- Lenders
- Investors
- Security Analysts
- Regulators
- Auditors
- Managers
- Bond Raters
- Advisors
- Government Officials
- Researchers
- M&A
- Purchasers, Suppliers

## Objectives

- To demonstrate that specific management tools which work are available in crisis situations
- To illustrate that predictive models can be turned “inside out” and used as internal management tools to, in effect, reverse their predictions
- To illustrate an interactive, as opposed to a passive, approach to financial decision making

## *Physical & Financial Facilities*

- 7 Manufacturing facilities (California to New York)
- 3 Offices locations (California to Germany)
- American Stock Exchange Listed Company
- Incorporated in late 1960's
- Successful IPO through early 1970's

## *Financial Changes at GTI during 1st half of 75*

- Working Capital decreased by \$6 million
- Retained Earnings decreased by \$2 million
- A \$2 million loss incurred
- Net Worth decreased from \$6,207 to \$4,370
- Market Value of Equity decreased by 50%
- Sales decreased by 50%



## *Ethical Consideration*

- Pressure led to “Corner Cutting”
- Returns not reported
- Bad inventory (and too much of it)
- Questionable Deferrals and Reserves levels

## *Employee Moral & Attitude*

- Internally Competitive
- Angry
- Insecure

## *Management's Responsibility*

- “PROTECT and ENHANCE  
the Stockholders Investment in GTI”  
*(Words of the new CEO)*

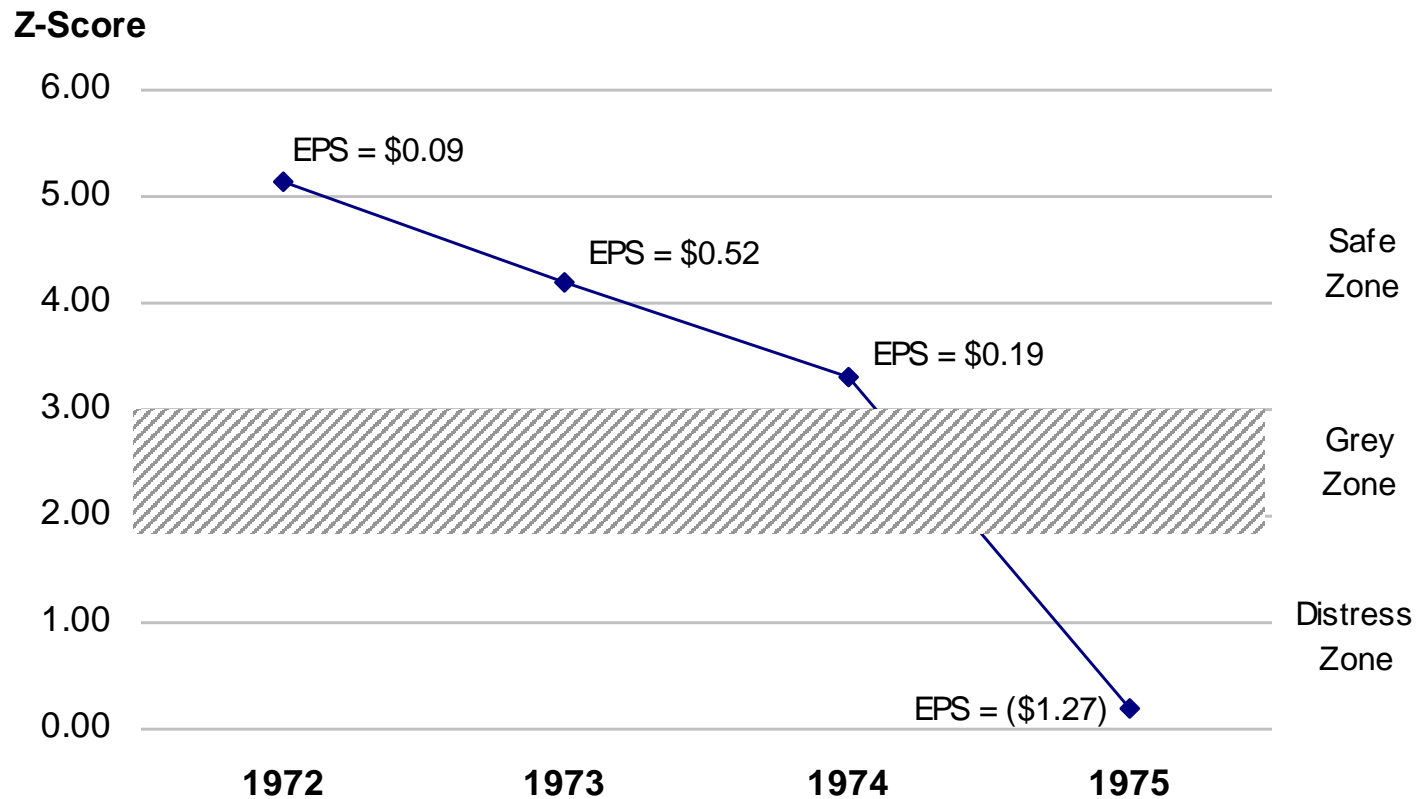
## *Material to be Covered*

- Condition of GTI in June of 1975
- Management & Control changes
- Definition of Management's Responsibility
- Description of Management tools used
- Caveats for a successful Turnaround

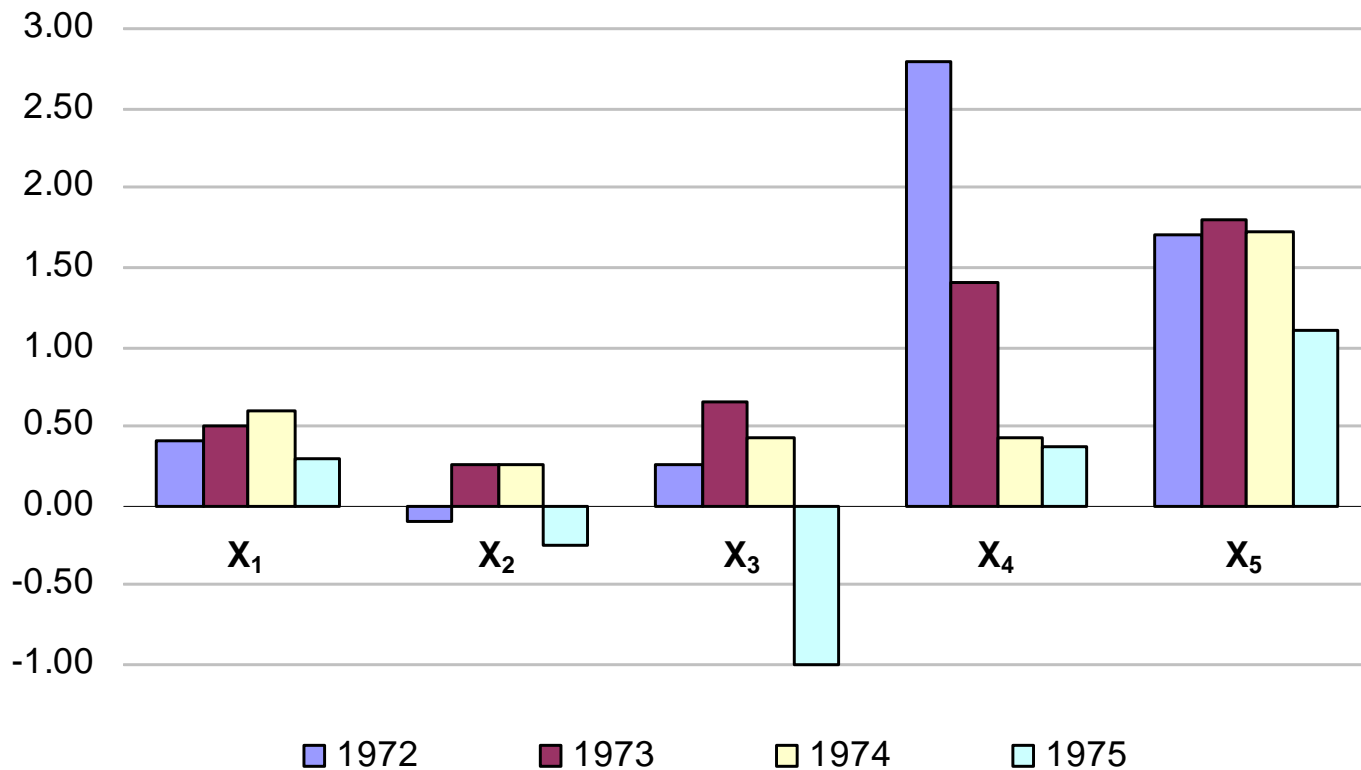
## Z-Score Component Definitions

<u>Variable</u>	<u>Definition</u>	<u>Weighting Factor</u>
$X_1$	$\frac{\text{Working Capital}}{\text{Total Assets}}$	1.2
$X_2$	$\frac{\text{Retained Earnings}}{\text{Total Assets}}$	1.4
$X_3$	$\frac{\text{EBIT}}{\text{Total Assets}}$	3.3
$X_4$	$\frac{\text{Market Value of Equity}}{\text{Book Value of Total Liabilities}}$	0.6
$X_5$	$\frac{\text{Sales}}{\text{Total Assets}}$	.999

# Z-Score Distressed Firm Predictor: Application to GTI Corporation (1972 – 1975)



# Components of Z-Score Distressed Firm: *Predictor as Applied to GTI Corporation*



## *Management Tools Used*

- Altman's Distressed Firm Predictor (Z-Score)
- Function / Location Matrix
- Financial Statements
- Planning Systems
- Trend Charts



## Strategy

- **Strategy #1:** Reduce Personnel & Eliminate Capital Spending
- **Reason:** Reverse Cash drain
- **Tool:** Source and Application of Funds
- **Timing:** Immediate

## Strategy

- **Strategy #2:** Consolidate Locations
- **Reason:** Reduce Management Costs
- **Tool:** Function Location Matrix
- **Timing:** Short and Long Term Planning

# Function / Location Matrix

	Pennsylvania	Indiana	New York	California	West Germany	
Operations	\$1	\$1	\$1	\$1	\$1	\$5
Marketing	\$1	\$1	\$1	\$1	\$1	\$5
Engineering	\$1	\$1	\$1	\$1	\$1	\$5
Finance	\$1	\$1	\$1	\$1	\$1	\$5
	\$4	\$4	\$4	\$4	\$4	\$20

## *Key Actions - 1975*

- Immediate Reduction of Personnel
- Stop Capital Spending
- Consolidate Profitable Product Lines

## Z-Score Component Definitions

<u>Variable</u>	<u>Definition</u>	<u>Weighting Factor</u>
$X_1$	$\frac{\text{Working Capital}}{\text{Total Assets}}$	1.2
$X_2$	$\frac{\text{Retained Earnings}}{\text{Total Assets}}$	1.4
$X_3$	$\frac{\text{EBIT}}{\text{Total Assets}}$	3.3
$X_4$	$\frac{\text{Market Value of Equity}}{\text{Book Value of Total Liabilities}}$	0.6
$X_5$	$\frac{\text{Sales}}{\text{Total Assets}}$	.999

StrategyReasonImpact

Consolidated Locations

Eliminate Underutilized  
Assets

Z-Score

Drop Losing  
Product Lines

Eliminate Unprofitable  
Underutilized Assets

Z-Score

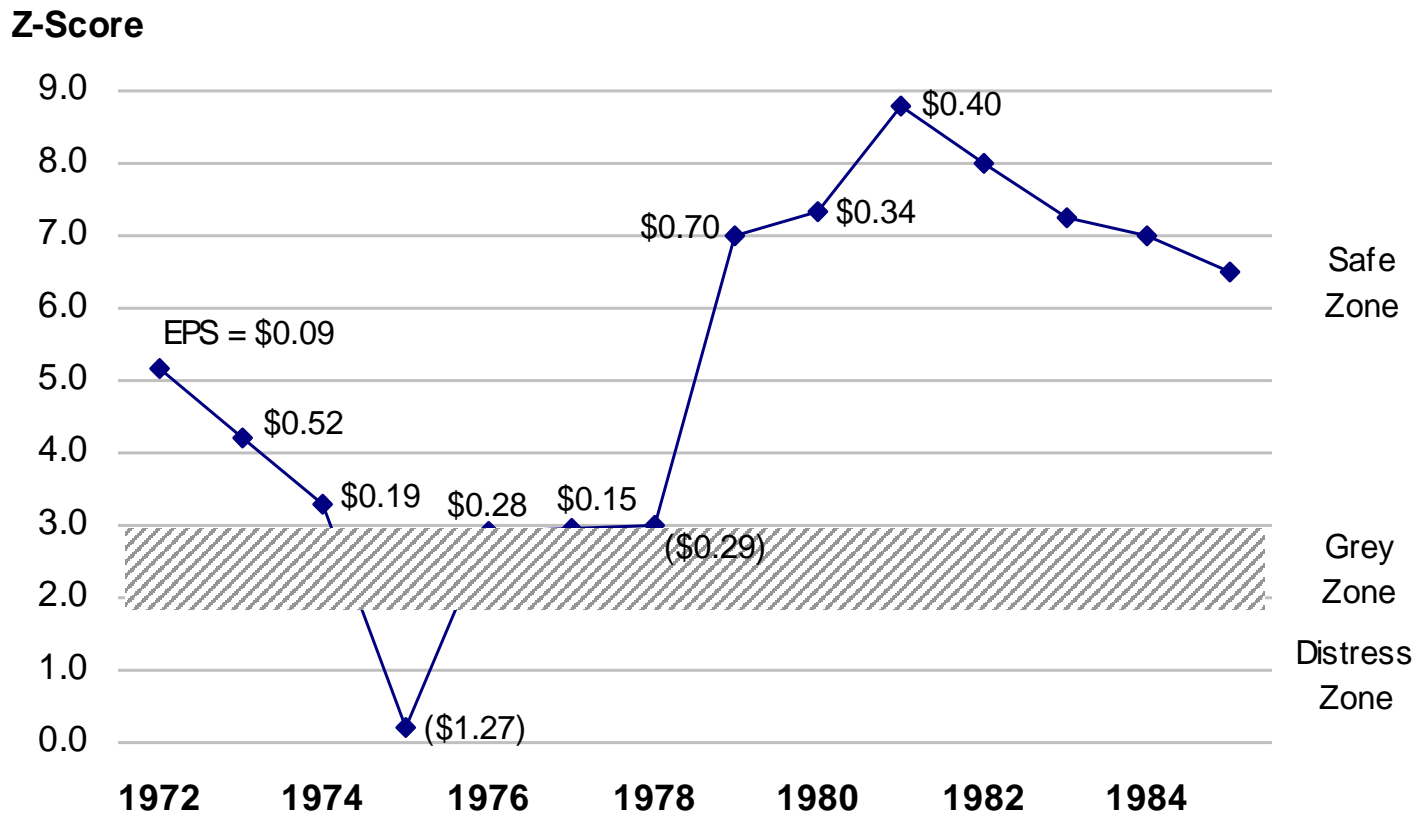
Reduce Debt Using  
Funds Received from  
Sale of Assets

Reduce Liabilities  
and Total Assets

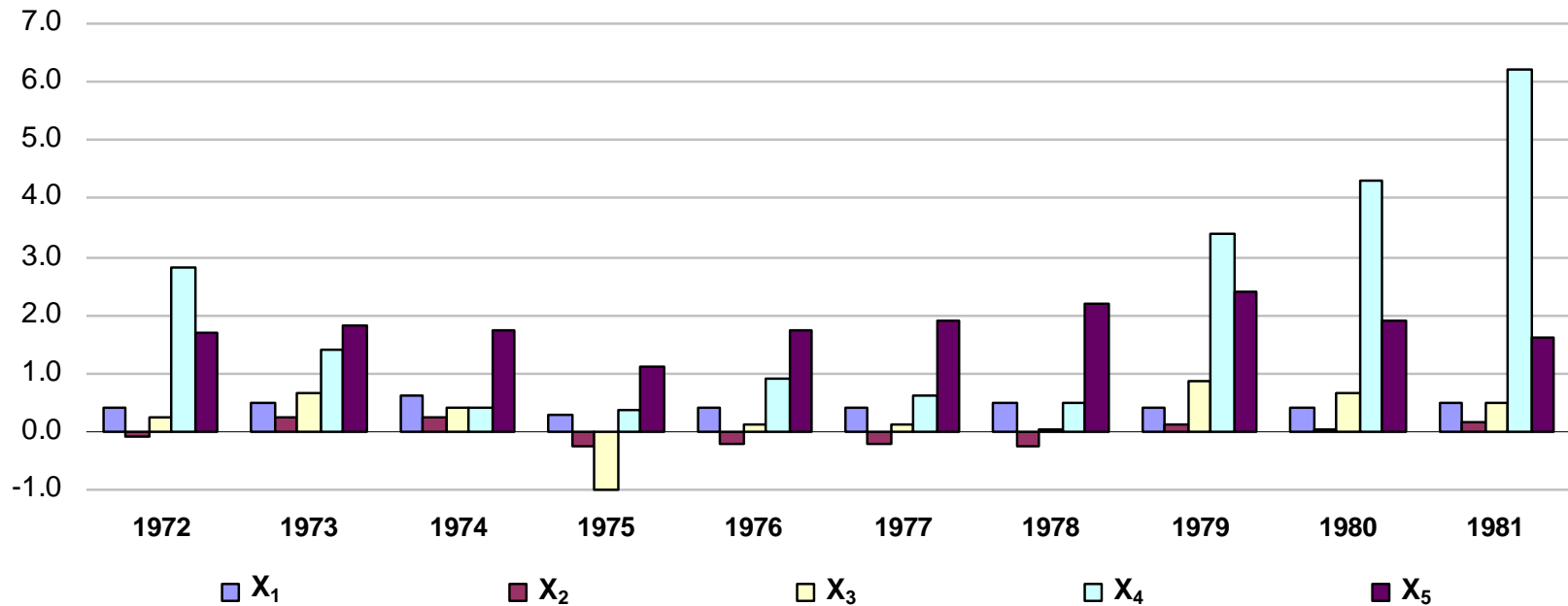
Z-Score

# Z-Score Distressed Firm Predictor

## *Application to GTI Corporation (1972 – 1984)*

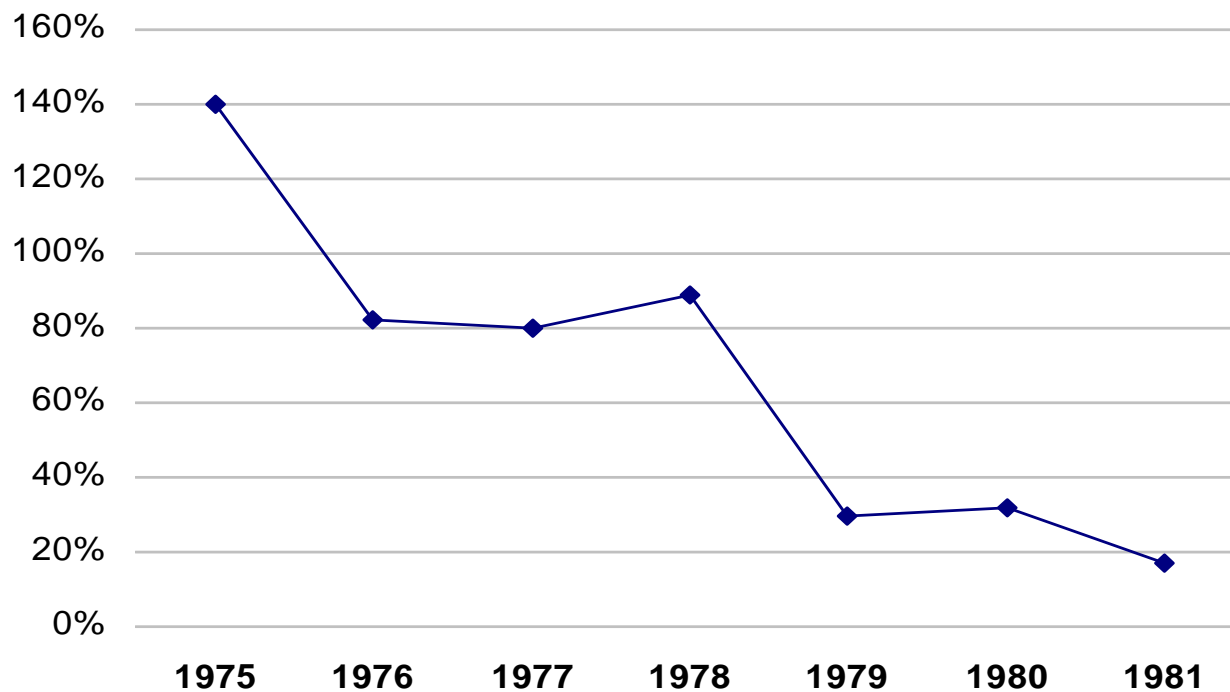


# Components of Z-Score Distressed Firm: *Predictor as Applied to GTI Corporation*





## Debt / Equity Ratio



## *Sales Dollars / Employee*

