BANKRUTCY PREDICTION MODELS

- William H. Beaver`s model
- Altman`s Z score Model
- Wilcox Model
- Blum Marc`s Model
- L.C. Gupta Model

William H. Beaver`s Model

" **Failure** as the inability of a firm to pay it's Financial obligations as they mature. "

- **Failed Firms**

Bankruptcies, bond defaults, overdrawn bank accounts, and firms that omitted payment of preferred stock dividends

- The seventy-nine failed firms were identified from Moody's Industrial Manual during the time period of 1954 to 1964.

- The majority of the seventy-nine failed firms operated in the manufacturing type of business.

- Their asset size range from $0.6 million to $45 million with a mean of approximately $6 million.

TABLE 1

List of Ratios Tested[a]

GROUP I (CASH-FLOW RATIOS)

1. Cash flow to sales
2. Cash flow to total assets
3. Cash flow to net worth
4. Cash flow to total debt

GROUP II (NET-INCOME RATIOS)

1. Net income to sales
2. Net income to total assets
3. Net income to net worth
4. Net income to total debt

GROUP III (DEBT TO TOTAL-ASSET RATIOS)

1. Current liabilities to total assets
2. Long-term liabilities to total assets
3. Current plus long-term liabilities to total assets
4. Current plus long-term plus preferred stock to total assets

GROUP IV (LIQUID-ASSET TO TOTAL-ASSET RATIOS)

1. Cash to total assets
2. Quick assets to total assets
3. Current assets to total assets
4. Working capital to total assets

GROUP V (LIQUID-ASSET TO CURRENT DEBT RATIOS)

1. Cash to current liabilities
2. Quick assets to current liabilities
3. Current ratio (current assets to current liabilities)

GROUP VI (TURNOVER RATIOS)

1. Cash to sales
2. Accounts receivable to sales
3. Inventory to sales
4. Quick assets to sales
5. Current assets to sales
6. Working capital to sales
7. Net worth to sales
8. Total assets to sales
9. Cash interval (cash to fund expenditures for operations)
10. Defensive interval (defensive assets to fund expenditures for operations)
11. No-credit interval (defensive assets minus current liabilities to fund expenditures for operations)

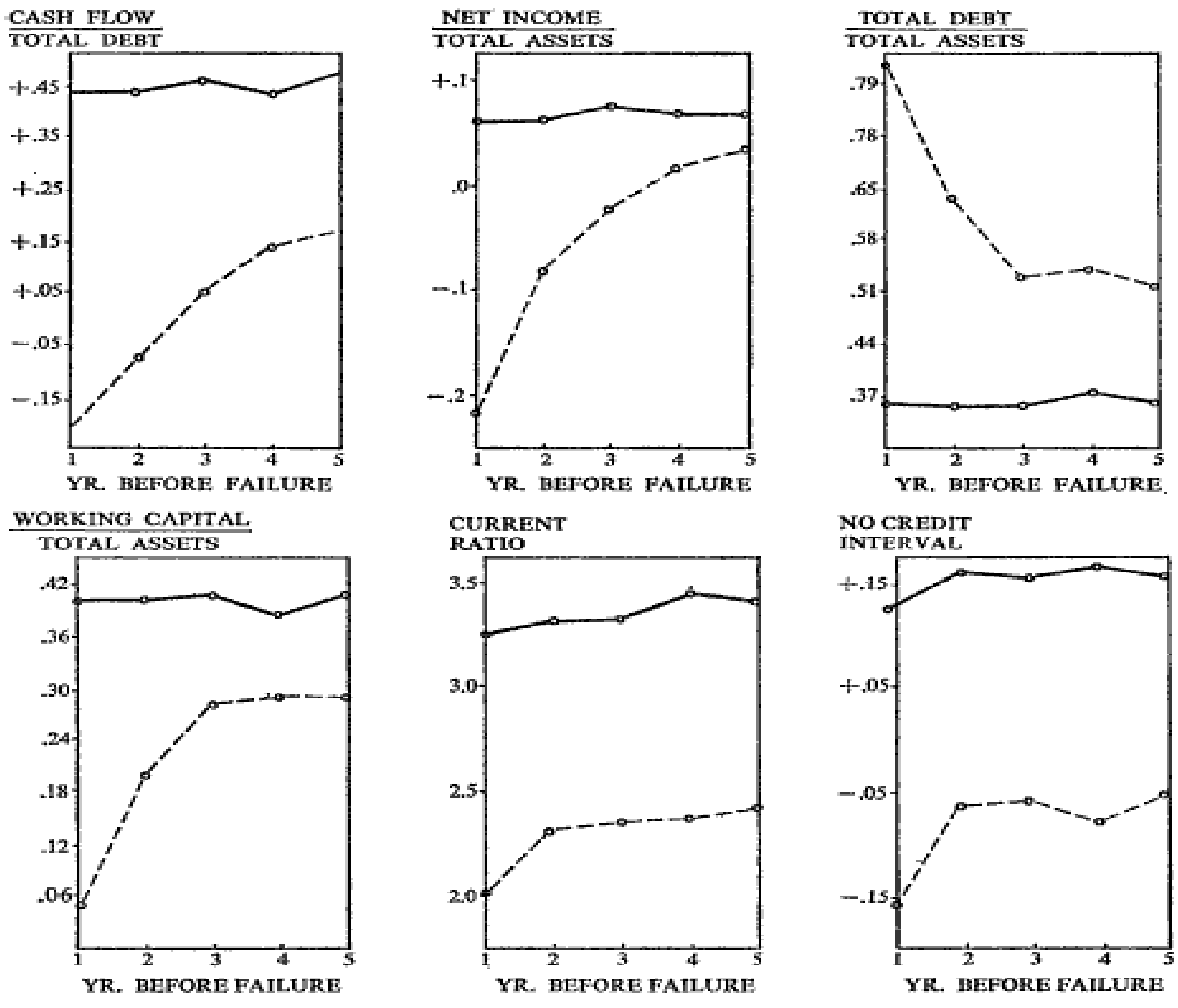
Prediction of the Mean Values of Failed and Nonfailed Firms

Ratio	Prediction[a]
Cash flow to total debt[b]	Nonfailed > failed
Net income to total assets	Nonfailed > failed
Total debt to total assets[b]	Failed > nonfailed
Working capital to total assets	Nonfailed > failed
Current ratio	Nonfailed > failed

Analysis of Financial Ratios

- Profile Analysis
- Dichotomous Classification Test

Profile Analysis



Dichotomous Classification Test

Percentage of Firms Misclassified[a]: Dichotomous Classification Test

Ratio	Year before Failure				
	1	2	3	4	5
Cash flow / Total debt	.13 (.10)	.21 (.18)	.23 (.21)	.24 (.24)	.22 (.22)
Net income / Total assets	.13 (.12)	.20 (.15)	.23 (.22)	.29 (.28)	.28 (.25)
Total debt / Total assets	.19 (.19)	.25 (.24)	.34 (.28)	.27 (.24)	.28 (.27)
Working capital / Total assets	.24 (.20)	.34 (.30)	.33 (.33)	.45 (.35)	.41 (.35)
Current ratio	.20 (.20)	.32 (.27)	.36 (.31)	.38 (.32)	.45 (.31)
No-credit interval	.23 (.23)	.38 (.31)	.43 (.30)	.38 (.35)	.37 (.30)
Total Assets	.38 (.38)	.42 (.42)	.45 (.42)	.49 (.41)	.47 (.38)

[a] The top row represents the results of the second test. The bottom row refers to the first test.

Edward I. Altman`s Model

- ❖ Improvement over Beaver`s univariate study

Z-Score

$$Z = 3.3 \times \frac{\text{EBIT}}{\text{Total assets}} + 1.2 \times \frac{\text{Net working capital}}{\text{Total assets}}$$
$$+ 1.0 \times \frac{\text{Sales}}{\text{Total assets}} + 0.6 \times \frac{\text{Market value of equity}}{\text{Book value of debt}}$$
$$+ 1.4 \times \frac{\text{Accumulated retained earnings}}{\text{Total assets}}$$

A score of Z less than 2.675 indicates that a firm has a 95 per cent chance of becoming bankrupt within one year. However, Altman's results show that in practice scores between 1.81 and 2.99 should be thought of as a grey area. In actual use, bankruptcy would be predicted if $Z \leq 1.81$ and non-bankruptc if

$Z \geq 2.99$

$$Z = 6.56 \times \frac{\text{Net working capital}}{\text{Total assets}} + 3.26 \times \frac{\text{Accumulated retained earnings}}{\text{Total assets}}$$

$$+ 1.05 \times \frac{\text{EBIT}}{\text{Total assets}} + 6.72 \times \frac{\text{Book value of equity}}{\text{Total liabilities}}$$

where $Z < 1.23$ indicates a bankruptcy prediction,

$1.23 \geq Z \leq 2.90$ indicates a grey area,

And

$Z > 2.90$ indicates no bankruptcy.

Financial statements of Sanofi-Aventis SA

Consolidated statement of financial position				
(€ million)	Note	31 December 2007	31 December 2006	31 December 2005
ASSETS				
Property, plant and equipment	D.3	6,538	6,219	6,184
Goodwill	D.4	27,199	28,472	30,234
Intangible assets	D.4	19,182	23,738	30,229
Investments in associates	D.6	2,493	2,637	2,477
Financial assets – non-current	D.7 – D.20	1,037	1,045	1,318
Deferred tax assets	D.14	2,912	3,492	3,382
Non-current assets		**59,361**	**65,603**	**73,824**
Assets held for sale	D.8	–	–	676
Inventories	D.9	3,729	3,659	3,430
Accounts receivable	D.10	4,904	5,032	5,021
Other current assets	D.11	2,126	2,208	2,434
Financial assets – current	D.12 – D.20	83	108	311
Cash and cash equivalents	D.13 – D.17	1,711	1,153	1,249
Current assets		12,553	12,160	13,121
TOTAL ASSETS		71,914	77,763	86,945

(€ million)	Note	31 December 2007	31 December 2006	31 December 2005
LIABILITIES AND EQUITY				
Equity attributable to equity holders of the company	D.15.2	44,542	45,600	46,128
Minority interests	D.16	177	220	189
Total equity		**44,719**	**45,820**	**46,317**
Long-term debt	D.17	3,734	4,499	4,750
Provisions and other non-current liabilities	D.18	6,857	7,920	8,250
Deferred tax liabilities	D.14	6,935	9,246	12,208
Non-current liabilities		17,526	21,665	25,208
Liabilities related to assets held for sale	D.8	–	–	259
Accounts payable		2,749	3,008	3,193
Other current liabilities	D.19	4,713	4,825	5,543
Short-term debt and current portion of long-term debt	D.17	2,207	2,445	6,425
Current liabilities		9,669	10,278	15,420
TOTAL LIABILITIES AND EQUITY		71,914	77,763	86,945

Consolidated income statement

Consolidated income statement			
(€ million)	Year ended 31 December 2007	Year ended 31 December 2006	Year ended 31 December 2005
Net sales	**28,052**	**28,373**	**27,311**
Other revenues	1,155	1,116	1,202
Cost of sales	(7,571)	(7,587)	(7,566)
Gross profit	**21,636**	**21,902**	**20,947**
Research and development expenses	(4,537)	(4,430)	(4,044)
Selling and general expenses	(7,554)	(8,020)	(8,250)
Other operating income	522	391	261
Other operating expenses	(307)	(116)	(124)
Amortization of intangibles	(3,654)	(3,998)	(4,037)
Operating income before restructuring, impairment of property, plant and equipment and intangibles, gains and losses on disposals, and litigation	**6,106**	**5,729**	**4,753**
Restructuring costs	(137)	(274)	(927)
Impairment of property, plant and equipment and intangibles	(58)	(1,163)	(972)
Gains and losses on disposals, and litigation	–	536	79
Operating income	**5,911**	**4,828**	**2,888**
Financial expenses	(329)	(455)	(532)
Financial income	190	375	287
Income before tax and associates	**5,772**	**4,748**	**2,643**
Income tax expense	(687)	(800)	(477)
Share of profit/loss of associates	597	451	427
Net income	5,682	4,399	2,593
Net income attributable to minority interests	419	393	335
Net income attributable to equity holders of the Company	5,263	4,006	2,258
Average number of shares outstanding (million)	1,346.9	1,346.8	1,336.5
Average number of shares outstanding after dilution (million)	1,353.9	1,358.8	1,346.5
– Basic earnings per share (in euros)	3.91	2.97	1.69
– Diluted earnings per share (in euros)	3.89	2.95	1.68

Calculation of Z- Score

$$\frac{\text{Net working capital}}{\text{Total assets}} = \frac{\text{Current assets} - \text{Current liabilities}}{\text{Total assets}}$$
$$= \frac{12{,}553 - 9{,}669}{71{,}994} = 0.040$$

$$\frac{\text{Accumulated retained earnings}}{\text{Total assets}} = \frac{47{,}275}{71{,}994} = 0.657$$

$$\frac{\text{EBIT}}{\text{Total assets}} = \frac{5{,}911}{71{,}994} = 0.082$$

$$\frac{\text{Book value of equity}}{\text{Total liabilities}} = \frac{44{,}719}{27{,}195} = 1.644$$

The next step is to calculate the revised *Z*-score:

$$Z = 6.56 \times 0.040 + 3.26 \times 0.657 + 1.05 \times 0.082 + 6.72 \times 1.644$$
$$= 11.05$$

Finally we determine that the *Z*-score is above 2.9, and we conclude that Sanofi-Aventis is a good credit risk.

THANK

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