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WANG LABORATORIES: A CASE STUDY OF BANKRUPTCY

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When Wang Laboratories filed for bankruptcy in August 1992, it was the conclusion of a story that had begun forty years before with the founding of a small company in Boston, Massachusetts that grew into a $2 billion giant in the business machine industry. Although it is devastating to employees and investors, the bankruptcy of a company provides a valuable opportunity to study and evaluate the effectiveness and timeliness of various analytical techniques in predicting the bankruptcy of an individual company.

In examining Wang Laboratories, this case (1) presents a brief history of the company, (2) reviews the bankruptcy of Wang, (3) analyzes the usefulness and timeliness of analytical techniques in predicting its bankruptcy, and (4) reviews the response of the stock market to Wang's changing financial condition. The study examines three commonly used predictors of financial distress: financial ratios, cash flows, and Z-scores. The case then examines a new procedure for evaluating the potential financial distress of a company, Economic Value Added (EVA).

In defining EVA, G. Bennett Stewart, senior partner at Stern Stewart (the New York consulting firm credited with creating EVA) states: "Simply put, EVA is a company's net operating profit after taxes and after deducting the cost of capital" (1995, p.117). Unlike earnings or cash flows determined under Generally Accepted Accounting Principles (GAAP), EVA earnings reflect both the cost of interest on debt and the cost of equity capital. Thus, John Rutledge writing in **Forbes** states: "GAAP accounting numbers, including earnings per share, give a misleading picture of the true ability of a business to generate cash flow for its owners" (1993, p.148). In contrast, EVA produces the economic profit necessary for the growth of a company and the information needed for a proper analysis of a company. Although EVA has been used as a measure of past corporate performance, the merit of EVA as a predictor of financial distress has not been examined.

George Foster (1986) states that among the primary indicators of the likelihood of financial distress are security returns. In regard to this measure, studies (e.g., Beaver, 1968; Aharony, Jones, and Swary, 1980; Clark and Weinstein, 1983) of bankrupt companies have reported that the capital market normally reacts to companies' deteriorating financial conditions well before the actual date of bankruptcy. Yet, case studies (Largay and Stickney, 1980; Kochanek and Norgaard, 1988) of the bankruptcies of W.T. Grant and Charter Company, respectively, showed that the stock market was slow in its reaction to these firms' financial deterioration. Therefore, as part of our examination, we examine the timeliness of the capital market's reaction to changes in Wang's financial state.

BACKGROUND

Wang Laboratories, Inc., was founded in 1951 by Dr. An Wang. Wang, born in Shanghai, China, received a PhD in applied physics from Harvard University in 1948. At Harvard, he developed and patented an early version of the magnetic core computer memory that he later sold to IBM. It was An Wang's development of a specialized calculator in 1964 that resulted in the first major growth of the company. However, in the early 1970s, as larger companies entered the calculator market and technology changed, Wang Laboratories dropped out of the market (**Forbes**, 1976).

In 1971, Wang Laboratories began producing word processors and small computers. The wide acceptance of these products initiated a period of growth for the company. Sales increased from $1 million in 1964 to $39 million in 1972 to $97 million in 1976 (Louis, 1986). Wang Laboratories was

known as a company that offered reliable products with a wide variety of specialized programs at a lower price than IBM's word processors or small computers. By 1982, Wang's sales had increased to nearly $1 billion.

However, in the early 1980s, stand-alone word processors were replaced by personal computers that could do both word and data processing. In 1983, Wang Labs announced fourteen new systems to compete in this changing market and stated that the systems would be available in early 1984. Based on the anticipated success of its new products, Wang Laboratories greatly increased hiring and expanded its production facilities (Louis, 1986).

Due to internal problems, the systems were delivered a year to four years later than forecast, and the market demand for them was much less than anticipated. Moreover, the systems triggered a series of complaints from customers about their reliability. In July 1985, John Cunningham, president of Wang Laboratories, quit primarily due to An Wang's decision to name his oldest son, Frederick Wang, president of the corporation. Also, in 1985, Wang Labs announced a quarterly loss of over $100 million. In November 1986, Fred Wang was named president of the company. A wage freeze was imposed, a cost reduction plan was instituted, and Wang laid off 1,000 workers (Cohen, 1990).

Additionally, Wang Labs' development of new systems faltered, and sales of its old systems continued to decline. For fiscal year 1987, Wang announced a loss of over $70 million. Then, for fiscal year 1989, Wang Labs reported an operating loss of over $300 million. In August 1989, Fred Wang resigned as president and was replaced by Richard Miller (Gold, 1992). Wang Labs' founder, An Wang, died in 1990, and Miller replaced him as CEO.

In order to raise cash and retire debt, major segments of Wang Laboratories were sold and massive layoffs began. The number of employees dropped from over 30,000 to less than 13,000. However, problems mounted. In the fourth quarter of 1991, Wang Labs reported a loss of over $300 million (Gold, 1992). In August 1992, Wang Laboratories filed for bankruptcy. In January 1993, Miller left Wang and Joseph M. Tucci was named CEO.

A smaller and much changed Wang Laboratories emerged from Chapter 11 in September 1992. Since then, it has again become profitable. For the fiscal year ending June 30, 1994, Wang reported a profit of $44 million on revenues of $885 million (Rifkin, 1994). Wang's reported revenue was a drastic drop from sales of nearly $2.5 billion in the 1980s; however, Wang had survived.

In April 1995, Microsoft Corporation and Wang Laboratories settled Wang's patent infringement lawsuit against Microsoft when Microsoft invested $90 million in cash in Wang and named Wang as its preferred vendor of work-flow software. In return, Microsoft received approximately ten percent of Wang's common stock and a license for Wang's software (Rifkin, 1995).

ANALYSIS OF THE DATA

The data for all variables used in computing the financial ratios, cash flow, Z-scores, and EVA were collected from Standard & Poors's COMPUSTAT for 1982 through 1992. As COMPUSTAT reclassifies firms' financial data in order to make intercompany comparisons possible, COMPUSTAT's definition for each component (e.g., net income) was used throughout the study. In the following sections, a brief description of each predictive technique is presented, followed by an examination of the technique's efficiency in predicting the bankruptcy of Wang Laboratories.

Financial Ratios

The use of financial ratios to predict bankruptcy was pioneered by William Beaver. Beaver (1966) found that four ratios were significant predictors of bankruptcy, and, in some cases, bankruptcy could be predicted up to five years before the failure. Since Beaver's study, various studies (e.g., Pinches,

Mingo, and Caruthers, 1973; Libby, 1975; Ohlson, 1980) have set forth ratios or classes of ratios useful in evaluating the financial distress of a firm. This study employs the ratios used by Largay and Stickney (1980) in their ratio analysis of the bankruptcy of W. T. Grant Company in which they examined the profitability, turnover, liquidity, and solvency of the company. In addition to these ratios, an additional ratio is examined, the ratio of cash flow to debt. Cash flow to debt was found by Beaver (1966) to be a consistent long-range predictor of bankruptcy, and today, the ratio of cash flow to debt continues to be widely used in ratio models of insolvency (e.g., Reilly, 1994; Gilbert, Menon, and Schwartz, 1990).

Exhibits 1, 2, and 3 present selected financial ratios from Wang Laboratories' financial statements for ten years preceding Wang's bankruptcy in August 1992. In addition to these ratios, Wang's profitability and turnover ratios were calculated. However, these ratios were found not to be significantly different from the selected ratios in the exhibits.

EXHIBIT 1
LIQUIDITY RATIOS

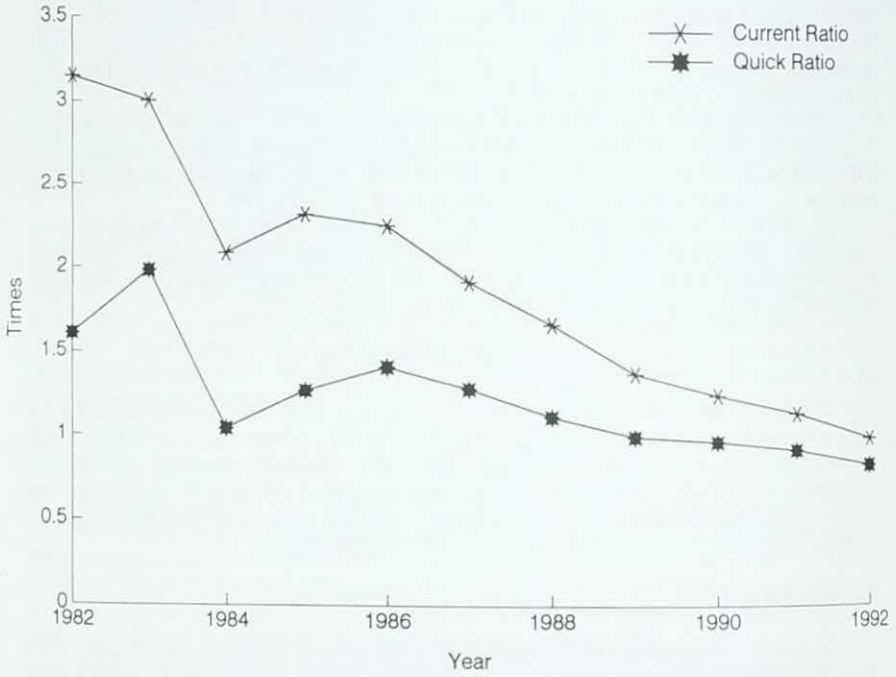


EXHIBIT 2
SOLVENCY RATIOS

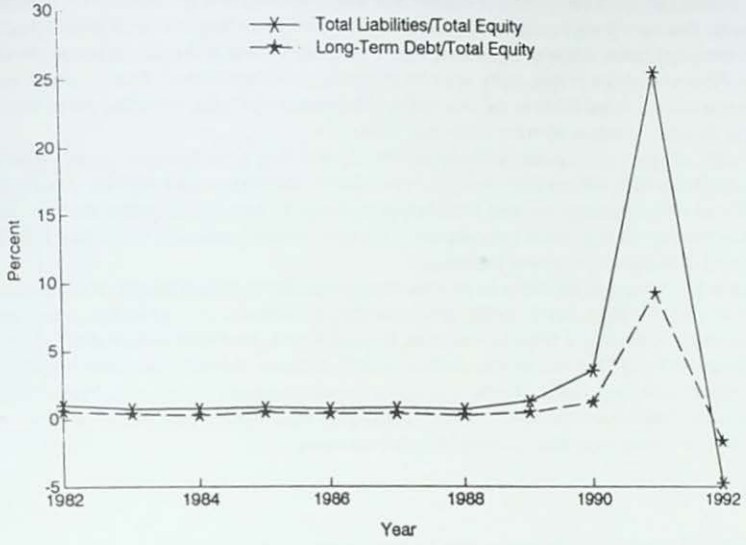
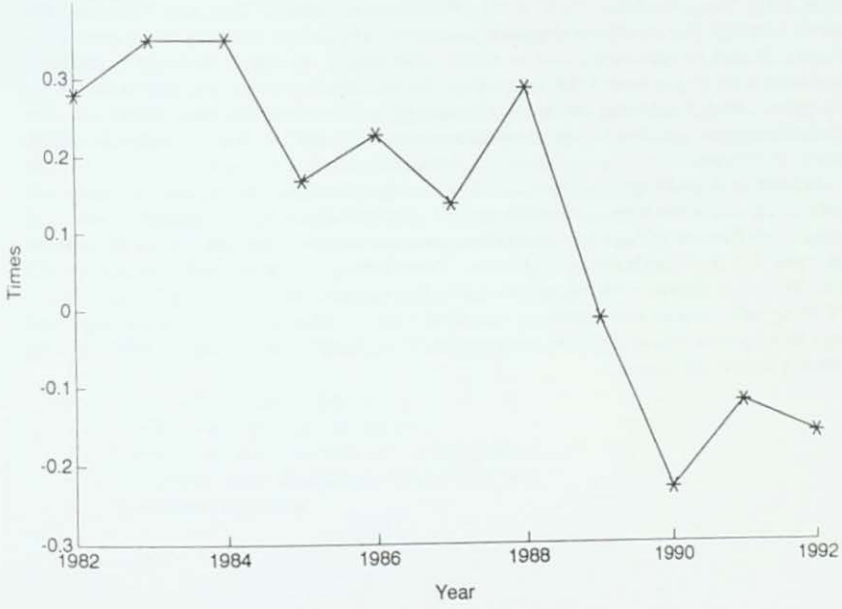


EXHIBIT 3
CASHFLOW/TOTAL DEBT



Even though Wang's liquidity ratios were strong in the early 1980s, both the current and quick ratios started to decline in fiscal year 1984. The ratios recovered slightly in 1985 and 1986, but in 1987, both the current and quick ratios began a decline that continued until Wang's bankruptcy. Fiscal year 1987 was the first year Wang's current ratio fell below 2.0 (five years before Wang's bankruptcy), and the ratio remained below 2.0 until its bankruptcy. This sharp decline is in contrast to that shown by bankrupt firms in Beaver's (1966) study of ratios as predictors of bankruptcy. Beaver found that the mean current ratio of failed firms in the year before bankruptcy was 2.02, which he stated hints that companies do some "window dressing" with their ratios.

Wang's solvency ratios (total liabilities/total equity and long term debt/total equity, Exhibit 2) showed little change from 1983 to 1989. In 1989, both solvency ratios increased slightly. Then in fiscal years 1990 and 1991, approximately two years before bankruptcy, the ratios increased sharply. By the time of its bankruptcy, Wang's ratios were negative. However, overall, solvency ratios gave little long-term warning of Wang's approaching bankruptcy.

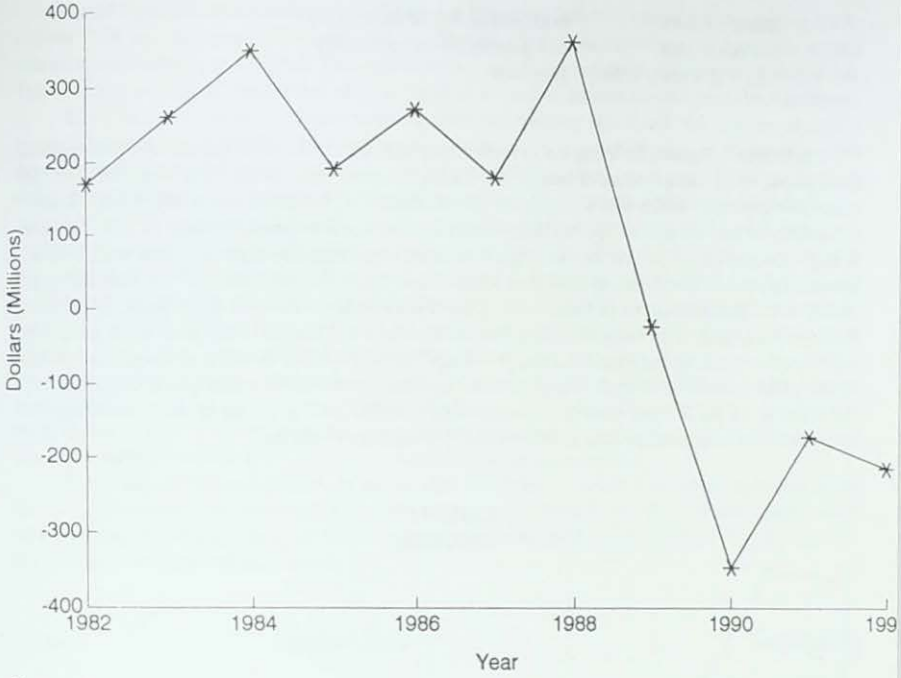
Beaver (1966) reported that the ratio with the strongest ability to predict corporate failure was the cash flow to total debt ratio, and the ratio's predictive ability could extend to up to five years before a firm's bankruptcy. In the case of Wang Laboratories, the cash flow to total debt ratio (Exhibit 3) showed its first decline in fiscal 1985 and another decline in 1987; however, the ratio increased in 1988. But, in 1989, Wang's cash flow to debt ratio became negative and remained negative until Wang's filing of bankruptcy. So, it appears that the cash flow to debt ratio gave clear signs of financial distress for Wang Laboratories for at least three years prior to Wang's bankruptcy.

Cash Flow

The role of cash flows in predicting future business events, such as stock prices, bankruptcies, and future cash flows, has been the basis of several studies. However, the effectiveness of cash flow as a long-range predictor of events, especially bankruptcy, is not clear. Several studies (e.g., Casey and Bartczak, 1984; Gentry, Newbold, and Whitford, 1985; Gombola, Haskins, Ketz, and Williams, 1987) have found that cash flow considered alone does not appear to be an important long-range predictor of bankruptcy and does not appear to improve upon ratio-based models. In order to investigate cash flow's effectiveness in predicting Wang Labs' bankruptcy, Wang's cash flow stream was examined over the study period. Both a traditional and a comprehensive (e.g., Casey and Bartczak, 1984) cash flow analysis of Wang Labs' cash flows were performed; however, the results from the two analyses were not significantly different.

In Exhibit 4, the traditionally defined cash flows for Wang Laboratories over the study period are presented. That is, depreciation and amortization are added to income before extraordinary items to determine cash flow. Note that Wang's cash flows were positive for the first seven years of the study. In fiscal year 1988 (four years before its bankruptcy), Wang Labs had a positive cash flow of over $350 million. The following year, 1989, Wang Labs had its first negative cash flow ($18 million). Then, in 1990, Wang had a massive cash outflow of over $340 million. These large outflows continued until Wang's bankruptcy in August 1992. In the section on EVA, the efficiency of cash flow in predicting bankruptcy is examined further.

EXHIBIT 4
CASH FLOW



Z-scores

In presenting their financial distress classification procedure, Recursive Partitioning Algorithm (RPA), Frydman, Altman, and Duen-Li Kao stated the obvious: "To tackle the bankruptcy issue, the standard for comparison is the DA (discriminant analysis) structure" (1985, p.271). Since Altman (1968) developed the first multivariate Z-score approach to bankruptcy classifications and predictions, the Z-score has been widely used as a standard for measuring the efficiency of other predictors. As in previous studies, the Z-score is used here as a standard for comparison.[1] The Z-score developed by Altman (1968) and applied by Foster (1986) is as follows:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + .6X_4 + 1.0X_5$$

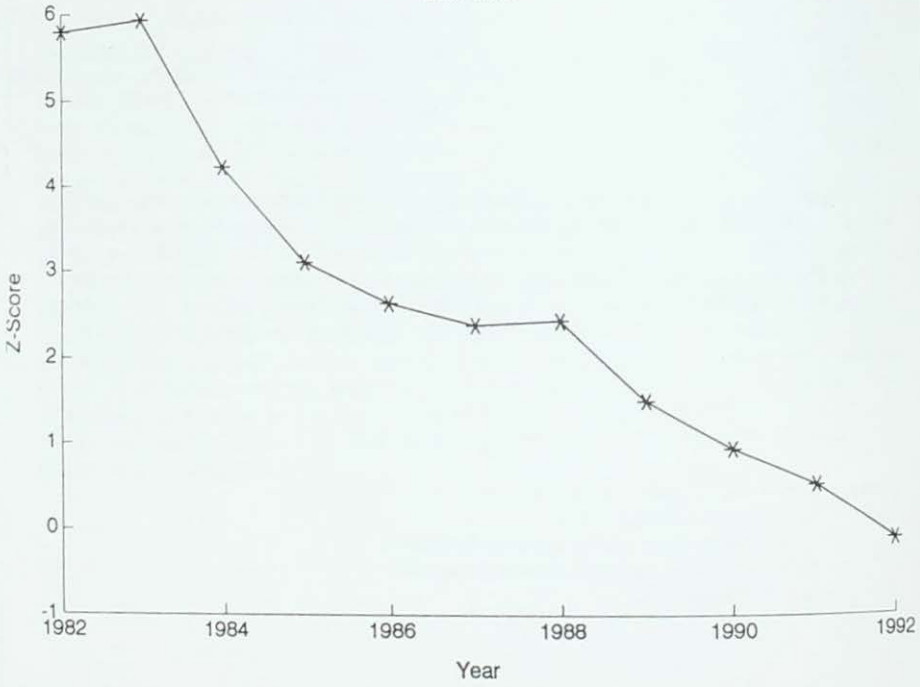
Where: X_1 = Working capital/Total assets
X_2 = Retained earnings/Total assets
X_3 = Earnings before interest and taxes/Total assets
X_4 = Market value equity/Book value of total debt
X_5 = Sales/Total assets

In applying this model, Altman (1968) found that the ranges of Z-scores indicate the following:

Z-score < 1.81	high probability of bankruptcy
Z-score > 2.99	low probability of bankruptcy
1.81 ≤ Z-score ≤ 2.99	gray area

In Exhibit 5, Z-scores for Wang Laboratories are presented for the study period. At the beginning of the period, Wang had a Z-score of nearly 6.0. Under Altman's scale, Wang Labs would be classified in the "non-bankrupt" sector with a Z-score of greater than 2.99. For fiscal year 1984, Wang's Z-score fell to 4.23, but was still above 2.99. In 1985, Wang's Z-score again dropped, this time to 3.10. In 1986, Wang's Z-score (2.63) moved into the "gray" area for predicting bankruptcy. Firms with Z-scores between 1.81 to 2.99 are difficult to classify on whether they belong in the "bankrupt" or "non-bankrupt" sector, and misclassifications of firms often arise (Foster, 1986). For two more years, Wang Labs remained in the "gray" area while its Z-score moved downward. Then, in 1989, there was a sharp drop in Wang's Z-score (1.50) that placed it in the "bankrupt" sector. Overall, the Z-score tracked the decline of Wang Laboratories. Although Wang's Z-score remained above 2.99 for four years, and above 1.81 for seven years, the Z-score showed a constant deterioration each year. To potential investors, this deterioration should have invoked a concern about Wang's survivability.

EXHIBIT 5
Z-SCORE



David Glassman, an associate of Stern Steward & Company (the firm credited with creating EVA) defines EVA as: "The controllable earnings ... reflect the value added after paying for all the inputs: materials, labor, energy, and capital. This system treats capital as a cost, just like salaries" (1993, p.24). Thus, the key to EVA is that the cost of equity capital, as well as the cost of debt, must be considered.

The calculation of EVA largely depends upon determining two items: the amount of capital employed and the cost of capital. Operating profits after taxes are also required for the computation, but normally these figures are readily available. As defined by EVA, total capital employed includes such things as equipment, real estate, working capital, research & development, and employee training.

Under EVA, a company normally has two capital costs, debt and equity. The cost of debt is the interest rate charged by the bondholders, the bank, or other lenders. The cost of equity capital is what the company's shareholders could be earning elsewhere. Generally, shareholders "earn about six percentage points more on stocks than on government bonds .... more if you're in a riskier than average industry" (Stewart, 1995, p.118). If a company has both debt and equity, as most companies do, then its true cost of capital is the weighted average of the two.

The weighted average cost of capital is multiplied times the total capital employed, and this figure is subtracted from the initial component of after-tax net operating profit. The resulting number is EVA. Or as Walbert stated: "A Company with a positive EVA is earning more than its cost of capital and thus creating wealth" (1993). If EVA is negative, the firm is destroying capital.[2]

Since different accounting methods can be used to determine the EVA variables, operating profit and total capital employed, three models were developed to calculate EVA. These alternatives allowed the determination of the sensitivity of EVA to the variables employed. COMPUSTAT variables for the three models were utilized as follows:

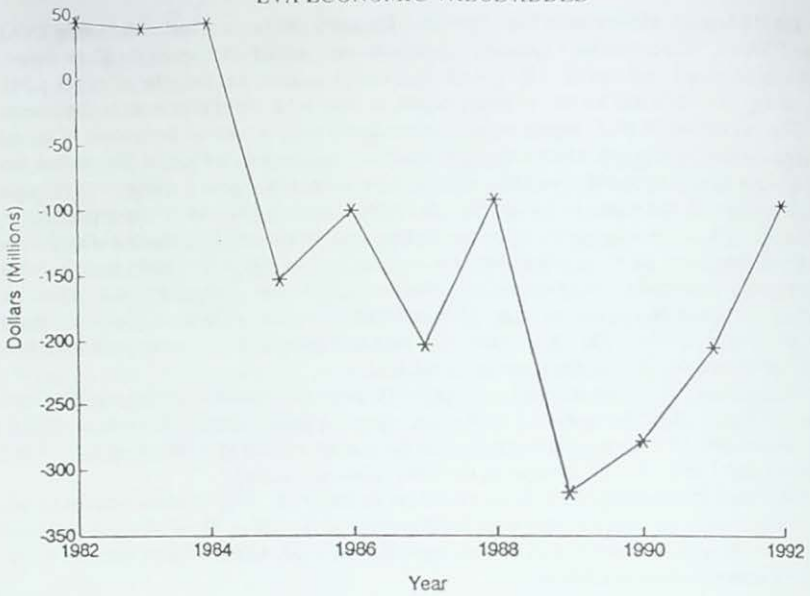
Model	Operating Profit	Total Capital
One	Operating Income After Depreciation	Total Assets Minus Current Assets
Two	Operating Income After Depreciation	Total Assets
Three	Operating Income Before Depreciation	Total Assets

However, there were no significant differences in the outcomes of the three models. Therefore, only the first of the three models developed is presented in Exhibit 6. See Appendix A for further information on the calculation of EVA.

As shown in Exhibit 6, for the first three years of the study, Wang Laboratories reported (EVA) profits from its operation. However, in fiscal year 1985, Wang's EVA dropped sharply to a real loss of over $150 million. The next year, there was a slight recovery in Wang's EVA, but there still was a real loss in EVA of over $100 million. Although there were other slight recoveries in the amount of its yearly "negative" value, Wang's EVA earnings remained negative 10 until its bankruptcy in 1992. In the year Wang reported its worst EVA, fiscal year 1989, Wang's Z-score fell to 1.50, classifying it in the likely bankrupt sector.

EXHIBIT 6

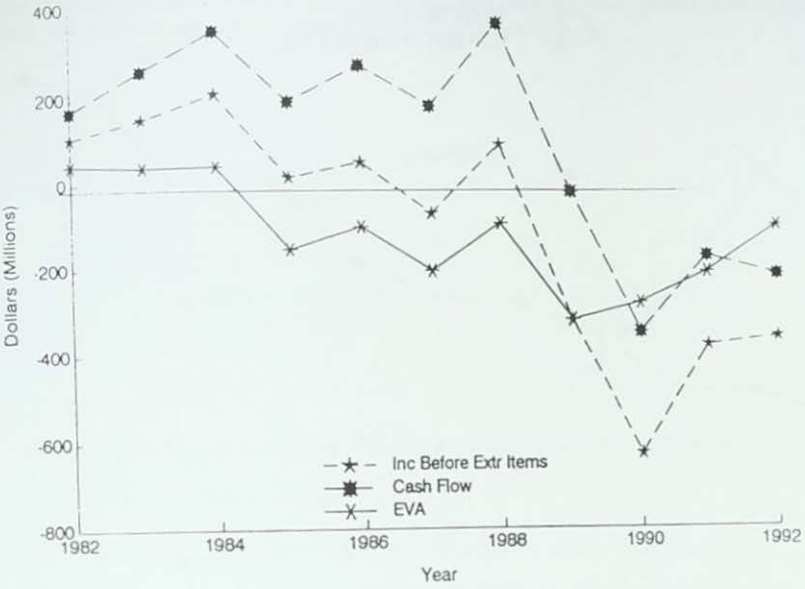
EVA ECONOMIC VALUE ADDED



In Exhibit 7, Wang Labs' income before extraordinary items, traditional cash flows from operations, and EVAs for fiscal years 1982 to 1992 are presented for comparison. All three variables tend to move in the same direction; however, a closer examination reveals some interesting differences. Wang's EVA turned negative in fiscal year 1985 and remained negative over the study period. In contrast, Wang Labs continued to report a positive cash flow for several years. Wang experienced its first negative cash flow in 1989, but it was a comparatively small outflow of $18 million. It was not until 1990 that Wang Labs incurred a significant negative cash flow, two years before its bankruptcy.

In contrast to cash flow, Wang's income before extraordinary items had a closer relationship to EVA. In 1985, the year EVA became negative, Wang Labs reported a small profit of $15.5 million, which contrasted noticeably with its profit of over $200 million the year before. In 1987, two years before its first negative cash flow, Wang reported a loss before extraordinary items of $70 million and incurred a negative EVA of $200 million. In 1989, when its negative cash outflow was only $18 million, Wang reported a loss of over $300 million and a negative EVA of over $300 million. So, overall, Wang's EVA tracked operating income closer than did cash flow.

EXHIBIT 7
EVA, CASH FLOW, AND INCOME BEFORE EXTR. ITEMS



STOCK PRICES

Stock prices or security returns are often (e.g., Beaver, 1968; Aharony, Jones, and Swary, 1980; Foster, 1986) regarded as indicators of the likelihood of the financial distress of a company. Aharony, Jones, and Swary (1980) found that investors adjusted to the deteriorating financial conditions of companies over approximately a four-year period. Beaver (1968) reported that investors forecasted financial failure for a company earlier than the traditional financial ratios.

In Exhibit 8, the movement in the value of Wang's common stock is contrasted with the movement in the Standard & Poor's 500 Index over the study period. During a period in which the trend of the S&P's 500 Index was upward, the trend of Wang's common stock price was steadily downward. From early 1984 to late 1986, Wang's common stock dropped from over $35 a share to around $12 a share. Wang's stock price stabilized for approximately a year, then the stock began another decline in value that continued to the year of Wang's bankruptcy, at which time it was selling for less than $1 per share.

In their case study of the bankruptcy of W. T. Grant Company, Largay and Stickney (1980) found that the stock price of W. T. Grant remained steady until approximately two and a half years before it filed for bankruptcy. In fact, four years before its bankruptcy, W. T. Grant's common stock was selling at record highs. In Kochanek and Norgaard's (1988) study of the bankruptcy of Charter Company, they found that the stock price did not drop dramatically until two weeks before the actual filing of the bankruptcy petition. In contrast, the price of Wang's common stock began to collapse nearly eight years before Wang Labs filed for bankruptcy. Five years before Wang's bankruptcy, the market price of Wang's common stock was only 33 percent of what it had been four years before. Two years before its bankruptcy, Wang's stock was selling at only eight percent of what it had sold for seven years before. In the case of Wang Laboratories, the price movement of its common stock was quite consistent with the deterioration of Wang's financial condition.

EXHIBIT 8
WANG STOCK PRICE vs S&P 500

CONCLUDING COMMENTS

This case examined the growth and ultimate bankruptcy of Wang Laboratories. Several traditional predictors of bankruptcy were examined for their effectiveness in predicting the financial distress of Wang Labs. Solvency ratios were found to be poor predictors of bankruptcy. Liquidity ratios were found to be more efficient in predicting failure than solvency ratios. Cash flows by themselves were found not to be important predictors of long-range corporate failure. However, the cash flow to total debt ratio gave clear signs of financial distress for at least three years prior to Wang's bankruptcy. Z-scores were found to be valuable in predicting financial distress, especially if the trend of the Z-score was used as a basis for analysis. An additional method of analyzing potential financial distress, Economic Value Added, was introduced, and it was found to be a useful leading indicator of financial distress. Finally, the price movement of Wang's common stock was consistent with the deterioration of Wang's financial condition.

APPENDIX

This Appendix provides an explanation of the calculation of Economic Value Added (EVA) for Model One. The following equation is a general description of the calculation:

$$\begin{matrix} Net \\ Operating \\ Profit \end{matrix} = \begin{matrix} Operating \\ Profit \end{matrix} - Taxes$$

$$EVA = \begin{matrix} Net \\ Operating \\ Profit \end{matrix} - \left[WACC \times \begin{matrix} Total \\ Capital \\ Employed \end{matrix} \right]$$

In detail, using the Compustat variables where applicable, we calculate EVA as follows:

EVA = (OIADP - TXT) - [WACC x (AT - ACT)]

WACC = [MVE / (MVE + MVD)] x CE + [MVD / (MVE + MVD)] x ATCD

MVE = CSHO x PRCC

MVD = LT

ATCD = BTCD x (1 - TXT / PI) ; subject to TXT > 0 and PI > 0, otherwise ATCD = BTCD

CE = BTCD + 6%

where:

OIADP	=	Operating income after depreciation *
TXT	=	Total income taxes *
AT	=	Total assets *
ACT	=	Total current assets *
WACC	=	Weighted average cost of capital
MVE	=	Market value of equity
CSHO	=	Common shares outstanding *
PRCC	=	Year-end closing stock price *
MVD	=	Market value of debt
LT	=	Total liabilities *
CE	=	Cost of equity (based upon bond yield plus risk premium approach)
ATCD	=	After-tax cost of debt
BTCD	=	Before-tax cost of debt = Actual cost of long-term debt based on Moody's Industrial Manual ratings of Wang Laboratories bond rating classifications
PI	=	Pretax income *

* Indicates the use of a COMPUSTAT variable

ENDNOTES

[1]It is not always reasonable to assume that the financial characteristics of a random sample of firms is the same as those analyzed in Altman's (1968) original sample. Therefore, it may be preferable to re-estimate the discriminant function using a recent sample from the specific industry in question. Unfortunately, it is not always possible to find enough firms that have recently filed for bankruptcy to conduct an industry discriminant analysis. In this paper, the authors are faced with this situation. However, further research by Altman (1983, 1984) indicates that this situation is not a major problem. Altman computed Z-scores for a sample of firms in five different countries, using both the original Z-score equation and a revised model. Altman found the correct classification rate (95%) was higher when using the original equation than when the revised model was used.

[2]For an interesting and thorough discussion of the determination and use of EVA by several major corporations, see Shawn Tully's (1993) article in **Fortune**.

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