

**Bankruptcy Prediction: Theoretical
Framework Proposal**

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***Abstract:* Bankruptcy prediction studies lack a strong theoretical framework but were driven by empirical testing and exploration of new econometric models to identify potential bankrupt firms. This paper examines this phenomenon by reviewing existing literatures and proposed a theoretical framework to govern the direction and future development of this area of finance. Liquidity, Profitability and Wealth Theory, Cash Flow Theory, Merton Model, & Gambler's Ruin Theory were investigated. Liquidity, Profitability and Wealth theory was discovered to be most popular.**

***Keywords:* Bankruptcy prediction,**

**theoretical framework, Merton Model,
Gambler's Ruin**

I. INTRODUCTION

Unlike theory of capital structure which was developed from (Miller & Mogdiliani, 1958) theoretical proposition, bankruptcy studies started with empirical testing to find whether a firm is likely to go into bankruptcy or their financial health is deteriorating. Most bankruptcy prediction model can only classify a firm as bankrupt or non- bankrupt but it cannot explain the reason a firm goes into bankruptcy or why some ratios are more effective in predicting bankruptcy than others. Basically bankruptcy prediction studies lack a strong theoretical framework but were driven by empirical testing and exploration of new econometric models.

The benefit of having a strong theoretical framework is that it focuses on explaining the observation rather than repeating the process with different tools just to prove that it is a fact. Without a doubt firms that has a potential to go into bankruptcy display similar traits and features but what theory can explain this repeated occurrence? A scientific theory is "a well-substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment." (National Academy of Sciences, 1999)

Instead of explaining the pattern exposed by the empirical results, each empirical result has to be evaluated on its own merits and the present state of the bankruptcy prediction field of study is without direction and each research keep revolving around replicating the same empirical tests without addressing the real research problem. Perhaps this explains the voluminous research in this area because there is no clear definition or scope to govern the kind of research that would fall under the bankruptcy prediction study.

The purpose of this paper to review the development of bankruptcy prediction literatures and provides a theoretical framework that could support future direction and growth of bankrupt prediction or business failure analysis as a field of study from the point of view of established finance theory.

The benefit of linking bankruptcy prediction study to the other main stream finance theory

such as capital structure and efficient market hypothesis is that it gives a bigger picture as to what the studies is trying to achieve. It also explained as to the reason there are so many bankruptcy studies that focus on statistical model.

II. LITERATURE REVIEW

A. Early Accounting Ratios Research

Single standalone accounting ratios have been examined since at least the 19th century (Dev 1974). However a few studies started to receive attention during the 1930 to 1965 time period. Starting with the Bureau of Business Research (BBR) published bulletin in 1930 which study the ratios of failing industrial firms. Then FitzPatrick (1932) compared 13 ratios of failed and successful firms (19 of each firm status). He found that, in the overwhelming majority of cases, the successful companies displayed favorable ratios while the failed firms had unfavorable ratios when compared with "standard" ratios and ratio trends.

Smith and Winakor (1935) analyzed ratios of 183 failed firms from a variety of industries in a follow-up study to the BBR's 1930 publication and in 1942, Merwin published his study focusing on small manufacturers. He reported

that when comparing successful with failing firms, the failing firms displayed signs of weakness as early as four or five years before failure.

Chudson (1945) studied patterns of financial structure in an effort to determine if there was a "normal" pattern. He reported that there was no "normal" pattern to financial structure on a general, economy-wide level. In 1962, Jackendoff compared the ratios of profitable and unprofitable firms. He reported that the following two ratios are higher for profitable firms than for unprofitable firms: the Current Ratio and Net Working Capital to Total Assets. Also, profitable firms had lower Debt-to-Worth ratios than unprofitable firms.

These early studies laid the groundwork for the studies that followed (Bellovary, Giacomo & Aker, 2007).

B. Modern bankruptcy prediction research

Beaver (1966) compared the mean values of 30 ratios of 79 failed and 79 non-failed firms in 38 industries. He then tested the individual ratios' predictive abilities in classifying bankrupt and non-bankrupt firms. Beaver found that Net Income to Total Debt had the highest predictive ability (92% accuracy one year prior to failure), followed by Net Income to Sales (91%) and Net Income to Net Worth, Cash Flow to Total Debt, and Cash Flow to Total Assets (each with 90% accuracy). Beaver suggested the possibility that multiple ratios considered simultaneously may have higher predictive ability than single ratios - and so began the evolution of bankruptcy prediction models.

Univariate means that you are assuming that the response variable is influenced only by one other factor. Multivariate means that you are assuming that the response variable is influenced by multiple factors

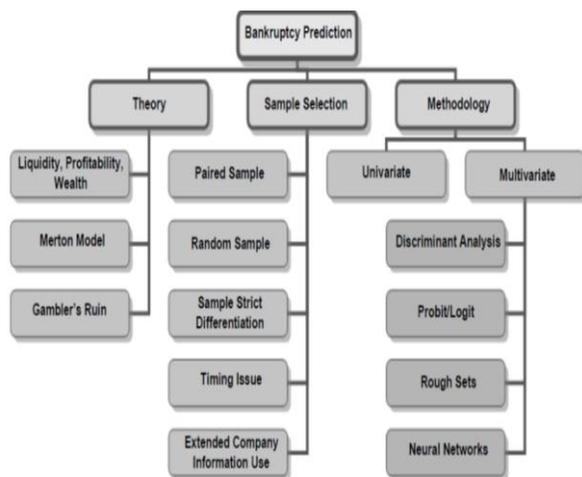
	Discriminant Analysis	Logit Analysis	Probit Analysis	Neural Networks	Other
1960's	2	0	0	0	1
1970's	22	1	1	0	4
1980's	28	16	3	1	7
1990's	9	16	3	35	11
2000's	2	3	0	4	3
Overall	63	36	7	40	26

Altman (1968) used discriminant analysis to develop a five-factor model to predict bankruptcy of manufacturing firms. The "Z-score", as it was called, predicted bankruptcy if the firm's score fell within a certain range. Altman's Z-score model had high predictive ability for the initial sample one year before failure (95% accuracy). However, the model's predictive ability dropped off considerably from there with only 72% accuracy two years before failure, down to 48%, 29%, and 36% accuracy three, four, and five years before failure, respectively. The model's predictive ability when tested on a hold-out sample was 79%

Two papers which review the research performed on manufacturing firms (Jones, 1987; Dimitras et al., 1996) provides a comprehensive summaries of bankruptcy prediction research and model development. (Bellovary, Giacomo & Aker, 2007) extend

their works by outlining the considerable body of research concerning the development of bankruptcy published in models developed for internet firms, casinos, contractors, hospitals, savings and loans, and banks both in the US and internationally

Three distinct areas of research can be discerned: the choice of variables or sample characteristics, choice of methodology and application of the model (Chart 2).



Various methodologies have been applied to improve their predictive power, beginning with the pioneering study of Beaver (1966) which presented the univariate approach of discriminant analysis. Different methodologies were introduced to ensure greater accuracy such the multiple discriminant approach (MDA) developed by Altman (1968), logistic regression, Logit (Ohlson, 1980; Dimitras, Zanakis, and Zopounidis, 1996), and prohibit regression, Probit (Zmijewski, 1984). Lately other models using artificial intelligence and data mining techniques, such as neural network, NN (Lacher et al, 1995), genetic algorithm, GA (Shin and

Lee, 2002) and expert systems, ESs (Leonard, 1993) have been used to ensure the highest level of predictive accuracy.

The numerous methodologies proposed has not produced a single superior econometric model that can dominate the prediction of business failures. The advancement in technology creates opportunities to develop a more powerful econometrics model but until we decide on the level of accuracy needed, more powerful models will not help. The next of concern bankruptcy prediction research is the application of such model in solving industry problem.

Predicting corporate bankruptcy is critical for many users of financial statements such as banks, creditors, investors, credit rating agencies, underwriters, auditors and regulators. Predicting potential bankruptcy enables corrective actions to be taken by management, investors, creditors, regulators, and shareholders (Brabazon and O'Neill, 2004). It is important for institutional investors who are buying corporate bonds to know the risk of bankruptcy, both prior and subsequent to their purchase (Lifschutz & Jacobi, 2010).

Ivan Kitov developed and tested statistically and econometrically a deterministic model predicting share prices of selected S&P 500 companies (Kitov, 2010). The study have found that there exists a linear link between various subcategories of consumer price index (CPI) and some share prices, with the latter lagging by several months. Kitov was able to build a reliable quantitative model by using standard and simple statistical procedures.

III. DEFINITION OF BANKRUPCY

The first issue that needed to be resolved or agreed upon before moving on is the definition of bankruptcy. The few early studies published in the 1930 to 1965 used the term "failing firms or business failure" but it did not specify in legal terms "are these firms bankrupt" or simply underperform as compare to the more successful firms. According to (Bellovary, Giacomino & Aker, 2007).while the studies did not specifically address bankruptcy prediction; the results are

significant to the development of bankruptcy prediction models.

Karels and Prakash (1987) reported that there is a diverse set of definitions of failure used for prediction studies. Many studies define failure as actual filing for bankruptcy or liquidation; others define failure as suffering financial stress or an inability to pay financial obligations. The term bankruptcy was first used in (Beaver, 1966) and ever since study of business failures are called bankruptcy prediction even when it did not provide the definition of failure used for the research. This variance in the definition of failure can make it difficult to compare models. However, in general, they referred to deterioration to a firm financial position and bankruptcy the ultimate "failure."

IV. PROPOSITION OF THEORETICAL FRAMEWORK

A. *Liquidity, Profitability and Wealth*

The most popular theory for bankruptcy prediction is really a notional one. The theory is elaborated implicitly from financial measures in contrast to an economic concept being translated into a measure. This notional theory emanates from the perception of financial ratios as indicators of a firm's health. When the firm's indicators are "good" it is perceived as healthy, but it is perceived as unhealthy and at risk of bankruptcy if the indicators are poor.

Three major categories of these indicators: liquidity, profitability and wealth. A positive and high measurement of these three implies a lower risk of bankruptcy. The obvious weakness of this notional theory is its generality. On the flip side, however, this "weakness" ensures that the theory does not conflict with, and is inclusive of other more prescriptive theories.

However, entrance or exit of a company does not always mean physical inclusion in or exclusion from an industry. Entrance or exit can be observed as increase or decrease in operations, resource raise or shortage, or change in field of activity.

In this context, competition process could be

perceived as remaining or inclusion of efficient resources in the industry and exclusion of inefficient ones from the industry. For example, decreasing demand in some products can cause reserved production resources shift into other production processes or shutdown of a production facility. For large scaled companies, exit process could be defined as restructuring of allocations of production resources. In this context, market economies and competition can be described as a flow or a movement from inefficient processes to efficient processes. Theoretically, in highly competitive markets; insolvency, default, bankruptcy, mill shutdown so called financial distress is rarely observable (Hashi, 1997).

B. *Cash Flow Theory*

The "theory" behind the model can best be explained within the framework of a "cash-flow". Beaver (1966:80) writes: "The firm is viewed as a reservoir of liquid assets, which is supplied by inflows and drained by outflows. The reservoir serves as a cushion or buffer against variations in the flows. The solvency of the firm can be defined in terms of the probability that the reservoir will be exhausted at which point the firm will be unable to pay its obligations as they mature (i.e., failure)".

It was argued that firms with a positive cash flow are able to raise their capital and borrow from the capital market, while firms with a negative or insufficient cash in flow are unable to borrow and therefore facing the risk of default. According to this argument, a firm is assumed to go bankrupt (default) whenever the current year profit or cash flow is negative or less than the debt obligations or whenever the sum of its current year profit and the expected value of equity (without current income) is negative (less than zero) (Scott, 1981).

C. *Merton Model*

The Merton theory models the equity as a call

option on the assets where the strike price is the value of liabilities. In Merton's original formulation (Merton 1973), debt has an unambiguous maturity, and the option value is computed with this singular date. When the market value of assets falls below a certain level, the firm will default. On the upside, the equity owners keep the residual value, just like an equity option. Under the Merton model, the firm's future asset value has a probability distribution characterized by its expected value and standard deviation. The number of standard deviations the future value of assets is away from the default point is the 'distance to default' and the greater the value of the firm and the smaller its' volatility, the lower the probability of default.

D. Gambler's Ruin

Wilcox (1971) used the gambler's ruin to develop his framework to predict default risk. The model assumed that the firm's financial state could be defined as its adjusted cash position or net liquidation at any time. According to the gambler's ruin model the time of bankruptcy is based on the inflows and outflows of liquid resources. The value of equity is a reserve, and cash flows either add to or drain from this reserve. In the case of a bankruptcy, the reserve is used up.

Scott (1981) argued that if the current cash flows are able to predict the corporate financial position, then past and present cash flows should be able to determine and predict corporate default.

The model comes from a well-known statistical problem, and intuitively captures the default scenario for a firm. If one approaches a roulette wheel with X dollars and bets \$1 with a 50% probability of receiving \$2 or \$0, what is the probability of losing all X dollars after N bets?

The gambler's ruin problem, first proposed by (Dubins-Savage, 1965) and subsequently by a number of others (Heath et.al.1987; Orey et.al. 1987; Pestien-Sudderth, 1985 and Sudderth-Weerasinghe, 1989).

Wilcox set up a model where cash flow was with either positive or negative values, and the reserve is the value of book equity. One then computes the probability of default given the cash flows. The "distance to default" in this theory is the sum of book equity and expected cash flow divided by the cash Flow volatility.

V. CONCLUSION

The bankruptcy prediction studies are in a desperate need for a theoretical framework The large number of statistical model has been proposed but none has been selected as a superior econometrics model for bankruptcy prediction research. Perhaps a clear agreement on one or a few econometrics models would be helpful to bring focus on the problem.

Since bankruptcy terminates a firm existence, bankruptcies prediction studies will always be of interest to academic and practitioners alike. The application for it is growing but it desperately requires a theoretical framework to guide and govern its development. As it is currently the bankruptcy prediction research is all things to all people.

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