International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 06, 2020
ISSN: 1475-7192

REVIEW ON DEVELOPMENT IN FINANCIAL DISTRESS MODELING

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***ABSTRACT**--Financial distress is an important but undesired event of company life. If the company does not take necessary action to avoiding financial distress, then it can lead company towards bankruptcy and business windup. In past there are several studies have been carried out to figure out that what are main causes which lead companies into financial distress and eventually become bankrupt. Since 1966 till present there are several researchers investigated the causes of financial distress and developed several prediction models. This study included only those studies, which significantly contributed in the literature of financial distress. Moreover, Selected studies highlighted new variable and opted new statistical techniques.*

***Keywords**--Financial distress, Prediction Model, default prediction.*

I. GENERAL OVERVIEW

Every business entity started its operating with progressive intension that how to get maximize the profit and how to sustain or increase its growth. However, due to bad financial and operating policy or due to many unseen risk factors, businesses could not achieve their goals. In addition to that in modern corporate world most of companies running their business on credit basis so delaying in payments against these credit / bank loans are main causes of financial distress and bankruptcy. Financial distress can be avoided by simply opting precautionary measures before its occurrence and these distress or bankruptcy events can be predicted my several econometric and computer-based models. The topic of financial distress has constantly been a point of attention by many investigators. Therefore, a large number of literature is available on financial distress and bankruptcy (Gillani, Ramakrishnan, Raza, & Ahmad, 2018) .

II. DEVELOPMENT PHASES

Since 1966 the financial distress models have been evolved through many different procedures for example some researchers used different statistical models and some researchers added new variables. Pioneers of this issue

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Received: 22 Sep 2019 | Revised: 13 Oct 2019 | Accepted: 15 Jan 2020

were Beaver (1966) and Altman (1968). The next section presents in detail the chronology of 17 most important researches in the area of financial distress and its predictions as shown below (figure 1.1).

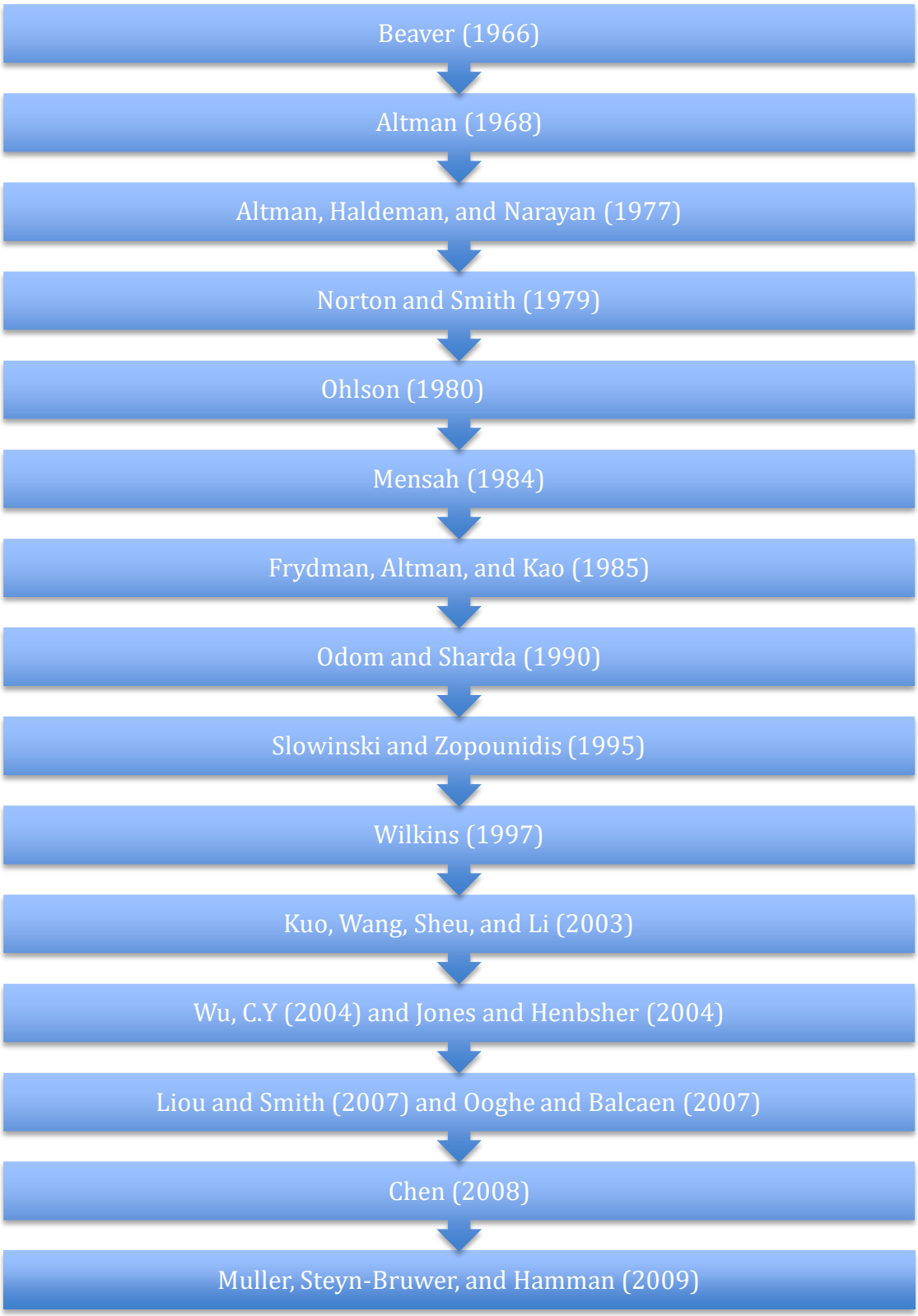

Figure 1.1: Flow Chart

2.1 Beaver (1966)

Beaver (1966) was the first researcher who incorporated financial ratios for predicting financial distress on the bases of data derived from financial statements. His study was empirical verification of financial statements for the purposes of predict financial distress of firms. Beaver defined 'failure' as the firms are said to be the failure when they are not able to pay their obligations when mature. So, any firm is considered to be a failure if it fails in payment claims against bond and its preferred stock dividends, bankruptcy or an overdrawn from banks accounts.

From 1954 to 1964 time period, 79 firms faced financial failure. Prior the failure of the firms, five years Data of these firms were obtained from the financial statement. Total assets and industry classified all the firms in this study were big in the term of assets value moreover firms. These unsuccessful companies were functioned in 38 diverse sectors with average total assets worth 6 Million USD. A sample of the study was selected as select one failed and one non-failed firm having the same value of total assets in the same industry.

Based on availability of data, Beaver used 30 financial ratios. He used three criteria for selecting ratios, first criteria was based on that select most frequent used ratio in last 19 studies regarding analysis of financial statement. secondly, next criteria was that the ratios were well performers. Third criteria was based on the cash-flow concept. However, Beaver excludes those ratios having the same meaning and eventually he divided 30 ratios into six final groups named as net income ratios, the liquid asset to total assets ratios, cash flow ratios, debt to total assets ratios, liquid assets to current debt ratio and turnover ratios.

In the analysis portion, one ratio was chosen from each group and these were the current ratio, net income to total assets, cash flow to total debt, working capital to total assets, no-credit interval and, total debts to total assets. First Beaver used profile analysis to sketch the difference between failed and non-failed firms. Secondly, on the basis of financial ratios, he did dichotomous classification test to predict the status of firm failure moreover financial ratios were viewed for the purpose of assessing the predictive ability of firm failure. Ratios analysis was good predictive before five years failure occurrence. Beaver used univariate analysis; it might be only assessed the prediction ability of one ratio.

2.2 Altman (1968)

Statistical techniques to evaluate the firm performance had progressively become more famous, after Beaver's study. So Altman (1968) tried to develop linkage between statistics techniques and financial ratios. His methodology used was in univariate in nature and ratio analysis focused on a single signal of an impending problem, additionally, such sort of univariate analysis can consider only single measurement.

In order to address this drawback, he introduced multiple discriminant analysis (MDA). The MDA method is commonly applied to classify an data into several sets, that based on their distinct features (Rettig, 1964). The foremost improvement of MDA technique is that I can deal with cataloguing problems and instantaneously evaluate its whole variables summary (Altman, 1968).

Altman took a sample consisting of 66 manufacturing companies which was further divided equally into bank defaulters and non-bank defaulter's sets, and data was gathered from the period 1946 to 1965. Ratios were

classified into 05 different categories 1) profitability 2) solvency 3) liquidity 4) leverage and 5) activity. Finally, MDA was applied to predict bankruptcy by Altman (1968).

Z = X1*0.12 + X*20.14 + X3*0.033 + X4*0.006 + X5*0.999

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 debt

X5 = sale / total asset Z = index (Z score)

Altman's Z score model stipulated prediction two years before financial failure. According to this model there are three types of zones. As far as first zone is concern, if Z score is more than 2.99 then it should be considered as non-bankruptcy area. If Z score comes between range of 1.81 to 2.99 it is the zone of inexperience/tolerance and finally if Z score comes less than 1.18 then it is vulnerability situation for firm, and it can be treated as bankruptcy zone. Though the discriminant analysis is extensively used, but there are few drawbacks linked with its suppositions. Multivariate discriminant analysis (MDA) needs three basic suppositions. First independent variable must be multivariate, and these must be normally distributed (Richardson and Davidson, 1984) but realistically this assumption is overlooked which may reason of major biasness (Deakin, 1972, 1976; Eisenbeis & Avery, 1972). The second supposition talks about variance-covariance matrices, these matrices must be identical in both bankrupt and non-bankrupt groups. The last supposition is about the preceding of likelihood of default and the misclassification.

2.3 Altman, Haldeman and Narayanan (1977)

As Altman had already developed a model in 1966 but later in continuation of previous model, Altman, Haldeman, and Narayanan (1977) established a new model. This model added inclusive contributions and current refinement in discriminant techniques. The sample of 53 bankruptcy firms and 58 non-bankruptcy firms was taken from 1969 to1975. Before this study, most of the previous studies used small value of assets but Altman, Haldeman, and Narayanan used relatively large sample average worth 100 USD million. New ZETA model had the ability to predict bankruptcy of both mechanized and retailing companies five years earlier the occurrence of a firm failure.

Furthermore, Altman Haldeman and Narayanan developed a model which contained seven determinants. This model highlighted not only the accuracy of several validation measures but also efficiently categorized its test sample. Variables of this model are given as follow

X_1 = return on assets (EBIT / total assets)

X_2 = stability of earning (normalized measure of the standard error of estimate around ten years' trend in X_1)

X_3 = debt service (EBIT / interest payment)

X_4 = cumulative profitability (retained earnings / total assets)

X_5 = liquidity (total current asset / total current liabilities)

X_6 = capitalization (common equity/ total capital)

X_7 = size (total assets)

Received: 22 Sep 2019 | Revised: 13 Oct 2019 | Accepted: 15 Jan 2020

Comparing this ZETA model with the previous model of Altman (1968) we can see ZETA model had more correct prediction ability in bankruptcy classification from 1 to 5 years, however, in case of non-bankruptcy Altman's older model was slightly accurate than ZETA model when a direct comparison was possible.

2.4 Norton and Smith (1979)

Many researches had been carried out to predict financial distress by using different financial ratios but it was not considered that these financial ratios were based on financial statements, which were prepared by same accounting methods or different. Norton and Smith (1979) incorporated diverse accounting method to predict financial distress. They made a comparison between ratios calculated on the basis of historical cost with those ratios which were computed on the basis of general price level (GPL) .

In this study sample of 30 bankrupts and 30 non-bankrupt firms was taken from 1971 to 1975. Inflation was very high in this period. The non-bankrupt firm was chosen for each defaulted firm. As per two criteria, firstly; a bankrupt firm and its matched firm should be in the same sector and from the same year. Secondly, a non-bankrupt firm should have the same value of assets as its matched firm 32 financial ratios were calculated from both financial statements prepared either on GPL adjusted method or traditional historical cost method. Researchers used linear MDA for predicting bankruptcy. Two discriminant function is established on both historical cost and general price level ratios. Norton and Smith found that both accounting methods having ability to predict the bankruptcy, they did not find any significant evidence that GPL method is more accurate method than historical cost method. In fact, they found that GPL was slightly good in some years but on the other hand slightly bad in other some years.

2.5 Ohlson (1980)

Before the Ohlson's (1980) , the MDA was most common and popular technique for predicting financial distress (e.g. Altman, 1968, Altman, Haldeman and Narayanan, 1977). However Ohlson (1980) pointed out some problems in MDA like output of MDA is a type of score which had less spontaneous clarification as it was an ordinal discriminatory tool, secondly certain statistical requirement is compulsory on the distributional properties of the predictor and some issues associated to the similar procedures that have been used in MDA frequency. By keeping in mind these issues, Ohlson used the logistic model, which was far less demanding than MDA model.

2.6 Mensah (1984)

Prior to Mensah (1984) study, most studies used MDA technique but these were an inconsistency to mention the comparative prominence of several financial ratios and the value of their related coefficients. Mensah (1984) attempted to assess the relative prominence of said issues in an empirical setting and found some new factors, which might be, incorporated in future studies.

Firstly, Mensah reviewed previous studies; according to these studies, the external macroeconomic variables can affect the results of financial distress models. Mensah founded three macroeconomic variables comprising, trade cycle, interest rate and inflation. The sample of failed firms was taken from period 1972 to 1980.

Secondly, he classified firms on the basis of assets and industry and by matching criteria; he took 110 pairs of the firm from mining, contraction and retail sectors. Third, by keeping in mind the drawback of MDA model, he used logistic regression because it allows the statistical implication of all variables which are individually estimated (Mensah, 1984). Furthermore, analyzed factor which were taken on 38 financial ratios to find out most important ratio.

Since the insufficient focus on the procedure of stationary through the unlike economic environment, Mensah combined data which is consist on four times to study to examine that either time factor effects the model or not. Finally, Mensah reached three conclusions first prediction models their accuracy and structure differed across the different economic environment. Next, this study concluded that different models were suitable firm in the different industry even for similar environment condition. At the last considering multicollinearity might obtain more useful results as by reducing it.

2.7 Frydman, Altman and Kao (1985)

Frydman, Altman, and Kao (1985) presented a new classification procedure named as Recursive Partitioning Algorithm (RPA). This is computerized and nonparametric classification technique based on pattern recognition and it has also a quality of both univariate and multivariate classification techniques. This study is basically a comparison of RPA with the discriminant analysis in the context of financial distress. The main purpose of the study was not to find out best prediction model but it focused on the quality of potential alternative classification techniques.

The sample of 58 bankrupts and 142 non-bankrupt firms were taken from manufacturing and retail sector. Firms were investigated from 1971 to 1981 and years were also randomly selected and did not same as years of bankrupt entities. In this study, 20 financial ratios were used which had been discovered substantial for predicting financial distress by many researchers. Current study opted two PRA models (PRA1 and PRA2) with comparing discriminant models. As far as discriminant analysis models are concern two models were made named as DA1 and DA2 correspondingly and then RPA models and DA method were matched and analyzed in detail.

Finally, in this study it was found that classification correctness of PRA was really more than a conventional discriminant structure. Though, this study did not claim that PRA could always better perform than others statistical methods. The PRA have not continues scoring system abilities of MDA (Frydman et al., 1985)

2.8 Odom and Sharda (1990)

Although, in the area of medicine and life sciences and technology the Artificial Neural Network (ANN) is a prevalent method which has been widely applied (Atiya, 2001). This computer based technique has significant effect on predicting event and signal processing (Lippmann, 1987). Like other predictions models (e.g MDA, logistic analysis and RPA) artificial neural networks is another prediction technique used for business disaster. Odom and Sharda (1990) were former who developed ANN in business studies for bankruptcy prediction.

The purpose of this research was to do comparison between neural network and conventional method (MDA). The study by Altman (1960) was used as standard so same ratios were used in Odom and Sharda's study. A sample of 65 bankrupt firms and 64 non-bankrupt firms were taken from 1975 to 1982, and then two sub-samples were

established from total 129 companies. The first sub-samples of 74 companies consists of 38 failed and 36 successful companies were taken as instruction for both MDA and ANN. The next subsample contained 27 bankrupts and 28 non-bankrupt companies were taken as sample. The result of comparing MDA with ANN showed that ANN performed better in predicting the firm failure in both subsamples. Moreover, the neural network was more effective than MDA in using minor sample size.

2.9 Slowinski and Zopounidis (1995)

This model was developed by different methods on the basis of 'rough set'. The idea of a rough set was to explain set of firms having set of quantitative (ratios) and qualitative elements (Ahn, Cho, & Kim, 2000).In this study rough set methodology was pertained to analyze financing decisions taken by Greek industrial development bank.

This bank (ETEVA) is basically financing industrial firms in Greece. Beside tradition financing activities ETEVA is involving in a merger, treasury services, underwriting, and syndication loan arrangement. ETEVA needed to assess the financial risk of enterprises.in this regard Slowinski and Zopounidis selected 39 firms classified them into three groups of risk for the year 1988.number of 20 firms were placed in acceptable group (low-risk group),09 firms were placed in unacceptable group (failure firms) and remaining 10 firms were placed in uncertain group.

All above said firms were evaluated by all total 12 qualities, which comprised of 06 qualitative and 06 consisted of quantitative in nature. All of them are mentioned as manager's work proficiency, firm's niche market divided by location, organization-personnel, methodical construction facilities, competitive advantages of firm, market elasticity, EBIT divided by total assets, debts divided assets, debt divided by cash flow, net income divided by net worth, general and administrative expense divided by sale and interest expense divided by sale .Slowinski and Zopounidis (1995) established that the thought of rough set is a good technique for predicting financial distress because it considers both quantitative and qualitative variables while previous models like MDA used or incorporate only quantitative variables only.

2.10 Wilkins (1997)

When firms start violation of debt covenant then it is usually assumed that firm is going to face financial distress or firm is standing at the first stage of bankruptcy. Succeeding this research significance, many studies also examined that how investors, mortgagees, managers and other stakeholders react to incident of debt covenant violation (Beneish & Press, 1993, 1995a, 1995b; K. C. Chen & Wei, 1993).

Wilkins (1997) studied auditor's answers on debt covenant violation. He took data from 159 firms from annual reports regarding debts covenant two years prior and two years after the financial distress.in this study, univariate analysis was conducted to find out the relationship between lender and auditor's answers to initial debt covenant and then also check the relationship between their decisions when initially financial distress occurred.

This study found that auditor's first qualification decision could be a good signal about financial distress, even this financial failure event may not occur in near future (Raza, Ramakrishnan, Gillani, & Ahmad, 2018). Moreover, he

found that lender's action had partially influenced on auditors action while firms experienced technical default and waiver decision may not have a significant impact on auditor's qualification decision

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Kuo, Wang, Sheu, and Li (2003)

In this study, 105 SMEs were selected as sample and data were collected from 1993 to 1995. This selected sample was then further divided into two groups the first group was to develop the predicted model and second was used to verify the model. As far as types of variable are concerns there were 15 firm-specific ratios were analyzed included financial leverage, interest coverage ratio, and assets insurance ratios, fixed asset ratio, expense ratio, total asset turn over, profitability ratio, net profit margin, assets turn over, quick ratio, account receivable turn over, short-term liquidity ratio, and operating revenue ratio (Kuo et al., 2003). Furthermore, beside the financial ratios, five non-financial determinants were also included (Kuo et al., 2003).

In methodology part, the MWW test was used to make separation between financial failed and successful SME and then factors analysis was used to extract the common factor, after that logistic regression was applied to establish the final model and lastly T-test was used to do a judgement of model's efficacy for both original sample group and control sample group. This study concluded that both financial and non-financial ratios were useful in categorizing defaulted and non-defaulted SMEs.

2.12 Wu, C.Y (2004)

Cheng-Ying (2004) also used financial ratios along some non-financial variables to predict the flop of business. He used 31 failed firms and 31 non-failed firms were taken as a sample from the period 1995 to 2000. These firms were listed in Taiwan Stocks Exchange (TSE) in different industries. He considered independent variable as dummy that showed 01 as bankrupt firm and 0 as non-bankrupt firms. Independent variables are classified into financial and non-financial variables. 18 ratios were used as financial such as long-term capital ratio to fix assets, debts ratio, quick ratio, current ratio, inventory turnover, account receivable turnover, total asset turnover, sale to fix assets, return on total equity, return on assets, net profit before taxes to capital issue, operating profit to capital issue, net profit margin, earnings per common share cash flow adequacy ratio, cash flow ratio and cash reinvestment ratios. Beside financial ratios 03 variables related to non-financial. Wu C.Y applied factor analysis on selected ratios only. He finalized variable having highest loading in each factor, then non-financial variables was added in logistic regression. This study concluded that accurate cataloguing for likelihood model constructed on both financial and non-financial variable was superior than model having only financial determinants.

2.13 Jones and Hensher (2004)

Prior to 2004, most of studies were depend on either dichotomic logistic analysis (MDA) or rudimentary logistic models (MNL). The central constraint of default prediction studies was that there was not identification advancement for discrete choice modeling. Jones and Hensher (2004) applied most innovative discrete choice model. The main purpose of this study was to do a comparison between the predictive ability of mixed logistic and standard logistic.

The benefit of mixed logistic models is that's it can detect both observed and unobserved heterogeneity. In addition, the likelihood of failure of business is found by the help of power of each independent variable with a fixed parameter from the distribution of the individual firm parameter. This mixed model had three states. The state zero was non-failed firms, state one was failed and state two was for potentially may come in bankruptcy zone.

Jones and Hensher (2004) established two samples first for estimation and second for validating models. The first sample was taken from 1996 to 2000, for zero state 2838 firms, for state one to 78 firms and for a state, two 116 firms were selected. The second sample was taken from 2001 to 2003.in this sample 4980, 119 and 100 firms were selected in state 0, 1 and 2 correspondingly. As far as result of this study is concern that it was revealed that mixed logistic is better than a standard approach like MNL (Jones & Hensher, 2004).

2.14 Lion and Smith (2007)

The industrial related factors have been considered as important factor in designing of financial distress models. Before 2007 most the studies were considering merging the sub-sectors into a single industrial sector. The main purpose of Lion and Smith's study was to find out the dissimilarities, which exist through the industrial sector and recognize those sub-sectors such combination was unconsidered.

On the bases of previous studies, those variables were selected which were most common and found efficient. These variables were liquidity, profit margin, and rate of return, turnover ratio, and productivity. Data was collected from 1973 to 2002.Liou (2007) used FTSE worldwide cataloguing system to compare businesses between different sectors and sub-sectors. Moreover, five more economic groups integrated like general industry, IT, and basic industrial goods and it also supplementary 17 explicit industrial sectors were designated.

Liou and Smith studied the relationship between ratios and sectorial performance. They applied Z-score failure model in order to find out the arrangement of desclassification error and their relationship with industrial sectors. The outcomes highlighted sub-sectors whose enclosure would make conventional models susceptible to error and gave propositions related to their constant enclosure for modeling.

2.15 Ooghe and Balcaen (2007)

For the purpose of resolving the matter that whether financial distress models can be used for other data sets. Furthermore, Ooghe and Balcaen (2007) studied the performance of 07 different models on the dataset defaulted firms in Belgium. The core perseverance of this study was to uncover the best combination of both factors and methods which have the best predictive ability over the time from 1995 to 1999. Moreover, in this investigation all bad coefficient was ignored which were responsible for poor results, therefore only re-estimated coefficients were incorporated. Ooghe and Balcaen (2007) computed ratios and added variables from X_1 to X_{40} for the purpose of re-estimation process. Scores of both discriminant and logistic were computed to find out the performance of each model.

The validation results revealed that come likelihood models good when these were applied to a new dataset. Additionally, this study recommended a mixture of some sorts of variables that can predict good outcomes. However, these combinations cannot explain the predictive performance.

2.16 Chen (2008)

Unlike the previous studies, the purpose of H.-H. Chen (2008) research was to find out the special impact of the corporate governance on bankruptcy. Since Ohlson's (1980) , many researchers used logistic regression for predicting financial distress but few researchers highlighted the logistic regression is not performed well as its predictive accuracy was low (Platt, 1995; Van Gestel et al., 2006). Consequently, Chen (2008) added the CG in the logistic regression to find out whether this factor could enhance the productivity ability. Moreover, corporate governance is key factor in company performance (Latief, Syed, & Syed, 2014).

Information Transparency and Disclosure Ranking System (ITDRS) ranked all listed companies on credit rating parameters. In this study these ranking were used to evaluate corporate governance, a lower rank means the bad status of corporate governance and vice versa. H.-H. Chen (2008) collected data from 23 bankruptcy firms and 56 non-bankrupt firms. This study incorporated financial ratios and corporate governance as an independent variable in the logistic regression.

This study had two distinguishing features, first was an evaluation of different timescale impact of CG on financial distress prediction and other characteristics was easy ranking system formed by Taiwan Stock Exchange Corporation. In addition to these two features, H.-H. Chen (2008) used two more specifications, first, he used comprised traditional financial ratios alone as independent ratio secondly and took corporate governance as an independent variable. If we take an overview of the result, it reveals that by adding corporate governance into logistic regression that accuracy of predicting financial distress is enhanced. The result of this study shows that by adding corporate governance the result of the model for one year is promoted from 94.2% to 97.1% and in models, for three and four years the accuracy is promoted from 91.3% to 95.7% and 89.9% to 95.7% respectively.

2.17 Muller, Steyn-Bruwer and Hamman (2009)

Prior the study of Muller, Steyn-Bruwer, and Hamman (2009) numerous researchers carried out research regarding financial distress by using a different technique. However, very few researchers have agreed that which technique is most accurate and what variables (ratios) could be added for getting better predictive results. Thus Muller, Steyn-Bruwer, and Hamman studied that either some particular technique could produce better results than other techniques or not.

In this study researchers summarized three different types of predictive models, they classified as statistical models, artificial intelligent expert system models and theoretical model. According to of Adnan Aziz and Dar (2006), 64 percent researchers used statistical models, 25 percent and 11 percent researchers used artificial intelligent expert system (AIES) and theoretical models respectively. So around 90 percent researches were conducted by using statistical and AIES models, therefore, Muller et al. (2009) conducted their research by comparing previously said two models.

This study found that different techniques had different predictive ability Statistic technique like Multiple Discriminant Analysis (MDA) and technique related artificial intelligent expert system like Recursive Partitioning (RP) correctly predicted the failure firms with the lowest normalized cost of failure (NFC). On the other hand,

neural network (NN) and logistic analysis (LA) had the overall high predictive ability but also high NFC. Moreover, this study also found that if we select the year before distress as a subdivision can produce better predictive result rather than we choose economic period as a subdivision.

III. CONCLUSION

Since, Fitzpatrick (1932) there vast literature is available of financial distress and causing behind business failure. Due to different financial crisis, both developed and developing economies faced heavy losses especially in banking and corporate sectors. For the purpose of highlighting the factors causing business failure, many researchers initially found different firm's internal factors (financial ratios). Later on, some research studies added external factors (macroeconomic variable). Moreover, some researcher argued that firms fail not only due to firm financial factors but also non-financial factors (corporate Governance) might be cause in business failure. Besides incorporating new variables, the prediction models have also been went through different statistical and econometrical revolutionary process. Initially, univariate analysis was used then multivariate data analysis (MDA) technique was adopted and then Logistic regressions overcome the issues. In recent, computer programming e.g. artificial neural networks (ANN) significantly contributed in predicting financial distress.

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Received: 22 Sep 2019 | Revised: 13 Oct 2019 | Accepted: 15 Jan 2020

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Received: 22 Sep 2019 | Revised: 13 Oct 2019 | Accepted: 15 Jan 2020

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