2. Literature Review

The existing literature on predicting default risk can be categorized into three major approaches namely, accounting based approach, option based approach and hybrid approach. These models make use of firm-specific information in predicting default. A separate strand of literature considers systematic factors in the form of industry and macroeconomic variables in predicting default.

2.1 Accounting based models

The initial studies on the prediction of various forms of financial distress such as corporate defaults and bankruptcy have mainly relied on the data from the financial statements namely financial ratios. In this context, the pioneering works have been those of Altman and Beaver. Beaver (1966) tested the usefulness of accounting data in the form of financial ratios in predicting financial distress. He used a paired sampling approach consisting of 79 distressed and 79 non-distressed firms in the U.S. In his study he used univariate analysis as a statistical technique to assess the predictive ability of individual ratios. This involved comparing the mean values of six individual ratios relating to the financial health of a firm i.e. cash flow to total debt, net income to total assets, total debt to total assets, working capital to total assets, current ratios, and the no-credit interval. Out of these ratios, he found cash flow to total debt as being the most significant in predicting distress. In a subsequent study Beaver (1968) investigated if changes in market prices of stocks can also be used to predict distress and provided evidence on the ability of investors to forecast distress earlier as compared to financial ratios.
While Beaver (1966) assessed the predictive ability of various financial ratios on an individual basis using univariate analysis, Altman (1968) attempted to combine a set of financial ratios and assessed how well they could discriminate between distressed and non-distressed firms. Using a sample of 33 bankrupt and 33 non-bankrupt firms, he employed multivariate discriminant analysis (MDA) as a statistical technique to discriminate between distressed and non-distressed firms. He classified financial ratios into categories such as liquidity, profitability, leverage, solvency, and activity ratios and developed the following discriminant function to classify firms as bankrupt and non-bankrupt.

\[ Z = .012X_1 + .014X_2 + .033X_3 + .006X_4 + .999X_5 \]

Where,

\( Z \) = Discriminant score

\( X_1 \) = Working capital/Total assets

\( X_2 \) = Retained earnings/Total assets

\( X_3 \) = Earnings before interest and taxes/Total assets

\( X_4 \) = Market value of equity/Book value of total debt

\( X_5 \) = Sales/Total assets

The discriminant score was popularly termed as the Z-score. It was a weighted average of five financial ratios that indicated the overall financial health of the firm. The Z-score of 2.675 was found to optimally discriminate between the two categories of firms and was chosen as a cut-off point. Firms with a Z-score of more than 2.675 were classified as being bankrupt and those with a value less than 2.675 as being non-
bankrupt. The Z-score was found to be useful in predicting bankruptcy with fairly high degree of accuracy.

Notwithstanding the growing popularity of the Altman (1968) Z-score model, Altman et al. (1977) argued in favour of developing a new model to suit the changing business environment and incorporate the recent developments in the profile of distressed firms. One such development was the changing asset size of firms going bankrupt. Consequently, they developed a model for bankruptcy prediction known as the ZETA model using seven variables with some of the variables drawn from Altman (1968) and introducing certain new variables such as stability of earnings, debt service, cumulative profitability and size. Out of these new set of variables, cumulative profitability was found to be the most significant in predicting bankruptcy. Overall, the ZETA model was found to be more accurate in predicting bankruptcy as compared to that developed by Altman (1968). Altman (2000) re-assessed the accuracy of the Z-score model in predicting defaults and bankruptcies for various sample periods between 1969 and 1999. He found the model to be robust even after 30 years of its development.

While the use of multiple discriminant analysis was gaining ground as a well accepted statistical technique, Ohlson (1980) made one of the first attempts to use conditional logit analysis for bankruptcy prediction. He used nine variables namely, size, total liabilities to total assets, working capital to total assets, current liabilities to current assets, indicator variable for total liabilities exceeding total assets, net income to total assets, funds from operations to total liabilities, indicator variable for negative income in the last two years and change in net income. Out of these nine ratios he found
size, total liabilities to total assets, net income to total assets and working capital to total assets as being statistically significant in predicting bankruptcy.

Zavgren (1985) used conditional probability models like logit and probit for distress prediction. Conditional probability models help in deriving the probability of a dichotomous dependent variable based on the coefficients of the predictor or independent variables. Using a matched sample of 45 distressed and 45 non-distressed firms, he found ratios relating to efficiency or turnover as being the most significant in predicting bankruptcy. Additionally, he found the acid test ratio (quick assets to current liabilities) to be highly significant and negatively related to the probability of bankruptcy. This ratio indicates the ability of a firm to meet obligations maturing in the short-run. Leverage, measured by debt to total capital, was also found to be highly significant. He concluded that financial ratios could prove to be highly significant in predicting the risk of bankruptcy.

Lennox (1999) also used the logit and probit models to predict bankruptcy. He found financial ratios relating to leverage and profitability as being important predictors of bankruptcy. He concluded that a firm is more likely to go bankrupt when it has lower profitability, higher leverage and is faced with cash flow problems. Johnsen and Melicher (1994) used variables from Beaver (1966) and Altman (1977) in their study. Instead of a binary classification (bankrupt and non-bankrupt) of financially distressed firms, they included an additional category of financially weak firms in their study. Financially weak firms were defined based on the S&P stock rankings of B (below average), B- (lower) or C (lowest). They compared the results of a two-state/binomial model (bankrupt and non-bankrupt) with those of a three-state/multinomial model.
(bankrupt, financially weak and non-bankrupt). They found that the addition of the third category to the outcome space (dependent variable) improved the prediction ability in terms of reducing the misclassification of firms. In other words, the three-state model was found to be better in discriminating between bankrupt and non-bankrupt firms.

Zmijewski (1984) addressed certain methodological issues related with financial distress prediction models. He examined two types of estimation biases namely, choice-based sample bias and sample selection bias. The choice-based sample bias is caused due to oversampling of distressed firms. Sample selection bias originates from the use of sample selection criterion based on availability of complete data pertaining to distressed firms. He found that the presence of these biases did not seem to affect the statistical inferences or overall classification rates.

Begley et al. (1996) re-assessed the accuracy of the original models of Altman and Ohlson using data from the 1980s. They compared the original versions of these models with their respective re-estimated versions. They found that in general, Ohlson's model outperformed the Altman's model. Additionally, they demonstrated a change in the relative importance of the variables such as leverage and cash flow in the re-estimated versions of the models. Specifically, leverage was found to have a reduced effect on the probability of bankruptcy and liquidity had gained higher weightage in the re-estimated models. They attributed this change to developments such as changes in the acceptable level of debt and increased focus on free cash flows in the 1980s. The acceptance of increased levels of debt during the 1980s was partly
attributed to the merger and takeover activity during the decade and partly to the revision in the perceived benefits of additional leverage.

Several recent studies have also tested the accuracy of the traditional accounting based models, particularly the Altman model, in various developing countries including India. Bandyopadhyay (2006) assessed the default risk of Indian corporate bonds using three different modified versions of the original Z-score model. He also estimated the default probabilities by combining both financial and non-financial variables like firm age, ISO certification and group affiliation. He concluded that such a combination leads to more accurate default prediction. In a recent study, Bhunia and Sarkar (2011) used financial ratios and multiple discriminant analysis for distress prediction of Indian firms. Their study was restricted to a small sample of private sector pharmaceutical companies. They concluded that ratios relating to profitability and liquidity are significant in predicting distress.

Xu and Zang (2009) tested whether the accounting based models (Altman’s Z-score model and the Ohlson’s O-score) previously developed for predicting bankruptcy of U.S. companies could also useful for bankruptcy prediction of Japanese companies. They found that although not all the variables in these models were significant these models did establish the fact that financial statements contain important information regarding the deterioration of a company’s financial status. Wang and Campbell (2010) confirmed the usefulness of the Z-score model in predicting bankruptcy of Chinese firms. Lifschutz and Jacobi (2010) assessed the reliability of two different versions of the Altman model for bankruptcy prediction for a sample of publicly traded firms in Israel. They argued in favour of the Altman model due to its simplicity
and low cost of application. Alkhatib and Al Bzour (2011) also found support for the Altman model for bankruptcy prediction of firms in Jordon.

Ugurlu and Aksoy (2006) analyzed a number of accounting variables for predicting financial distress in Turkey and found EBITDA to total assets ratio as the most important predictor. As an indicator of the earning power of the assets this ratio had a negative relationship with the probability of distress. Rashid and Abbas (2011) found that financial ratios such as sales to total assets ratio, EBIT to current liabilities ratio and cash flow ratio are the most significant in predicting corporate bankruptcy in Pakistan. Beaver et al. (2005) reinforced the utility of accounting information in predicting corporate distress. They showed that there has been only a slight decline in the predictive ability of financial ratios over a period of 40 years from 1962-2002.

While most traditional models use information from the accrual based financial statements namely, profit and loss statement and balance sheet, other models emphasize that cash flow based information provides incremental value in predicting financial distress. The empirical evidences on such models are mixed. Casey and Bartczak (1985) find that operating cash flow data does not lead to higher accuracy in prediction of bankruptcy over accrual-based ratios. Gilbert et al. (1990) combine variables from Altman (1968) and Casey and Bartczak (1985) and show that cash flow based variables improve the predictive power of the models. On the other hand, Ward (1994) argues that the usefulness of cash flow information varies from industry to industry. He shows that cash flow information is more useful for predicting financially distressed firms in mining and oil and gas industries as compared to a control group of firms in other industries. They attribute this industry-specific utility
of cash flow information to the investment needs of a particular industry such as making large investments in long-term assets for generating cash flows in the future.

Some of the recent studies also validate the importance of cash flow based information in predicting distress. Jantadej (2006) uses combinations of cash flow components i.e. operating, financing and investing cash flows to predict financial distress. Maux and Morin (2011) show that the bankruptcy of Lehman Brothers was predictable from its cash flow statements for the period 2005 to 2007. They provide evidence on how consistent inability to generate cash flows and undue reliance on external financing can lead to financial distress. Kordestani et al. (2011) also argue that cash flow statements are subject to less manipulation and its components are reliable predictors of financial distress. A summary of the studies based on the accounting based models is presented in Table 2.1.
Table 2.1 Summary: Accounting based models of default prediction

<table>
<thead>
<tr>
<th>Category</th>
<th>Studies</th>
<th>Variables used</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Altman et al. (1977)</td>
<td>EBIT/Total Assets, Stability of Earnings, EBIT/Interest Expense, Retained Earnings/Total Assets, Current Assets/Current Liabilities, Equity/Total Capital, Log (Total Assets)</td>
</tr>
<tr>
<td></td>
<td>Ohlson (1980)</td>
<td>Log (Total assets/GNP price-level index), Total Liabilities/Total Assets, Working Capital/Total Assets, Current Liabilities/Current Assets, Dummy variable for Total Liabilities exceeding Total Assets, Net Income/Total Assets, Funds provided by operations/Total Liabilities, Dummy variable for negative net income for the last two years, Change in Net Income</td>
</tr>
<tr>
<td></td>
<td>Zavgren (1985)</td>
<td>Total Income/Total Capital, Sales /Net Plant, Inventory/Sales, Receivables/Inventory, Cash/Assets, Quick assets/Current Liabilities, Debt/Total Capital</td>
</tr>
<tr>
<td><strong>Cash flow based models</strong></td>
<td>Casey and Bartczak (1985)</td>
<td>Cash flow from operations/Current liabilities, Cash flow from operations/Total liabilities</td>
</tr>
<tr>
<td>Gilbert et al. (1990)</td>
<td>Variables from Altman (1968) and Casey and Bartezak (1985)</td>
<td></td>
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<tr>
<td>-------------------------</td>
<td>------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Ward (1994)</td>
<td>Cash flow from operating activities, Cash flow from investment activities, Cash flow from financing activities</td>
<td></td>
</tr>
<tr>
<td>Jantadej (2006), Kordestani et al. (2011)</td>
<td>Combinations of cash flow components i.e. operating, investment and financing cash flows</td>
<td></td>
</tr>
</tbody>
</table>

### 2.2 Option based model

Traditional accounting based default prediction models have been criticized on several grounds. They rely on the financial statements which are backward looking as they measure past performance of the firm and may not be very informative about the future status of the firm. The asset valuations are sometimes misleading due to the adoption of certain accounting principles such as conservatism. Moreover they fail to incorporate a measure of asset volatility (Hillegeist et al., 2004; Vassalou and Xing, 2004; Bystrom, 2006). As pointed out by Beaver et al. (2005) existing financial ratios fail to capture various intangible assets and financial derivatives.

Option based modelling of default has turned out as a popular approach to overcoming the problems associated with the traditional accounting based models. The option based model, also known as the contingent claims analysis (CCA) approach is derived from the works of Black and Scholes (1973) and Merton (1974). Under this approach the equity of a firm is considered as a call option on the value of firm’s assets with the strike price equal to the face value of the debt. If at the maturity of the debt, the value of the firm is above the face value of the debt the equity holders choose to exercise their option by repaying the debt. But if the value of the firm is below the face value of the debt the equity holders opt to leave their option unexercised thereby defaulting on the repayment of the debt. The probability of
default is given by the probability that the option is out-of-the-money and remains unexercised. This is equivalent to applying the Black Scholes and Merton framework for finding out the probability of the option being out-of-the-money using the market value of the firm’s assets and equity, face value of the firm’s debt, volatility of the firm’s value and equity, risk-free interest rate and time to maturity of the firm’s debt as input variables.

Various studies provide empirical evidence on the performance of the option based model. However, the results are mixed. Some studies strongly favour the approach whereas others argue against it. Charitou and Trigeorgis (2002) find that the option model based variables such as book value of total liabilities, market value of the firm’s assets and volatility of firm value are crucial in predicting default. Apart from the option based variables, they find that variables such as profitability and cash-flow to liquidity are also significant in predicting financial distress. Delianedis and Geske (2003) find that risk neutral probabilities of default estimated using the option models contain significant leading information about rating migrations and defaults.

Crosbie and Bohn (2003) elaborate on the methodology followed by the Moody’s KMV Corporation for calculating a default measure known as EDF (expected default frequency). The measure is calculated using the Vasicek-Kealhofer (VK) model which is a variant of the Merton model. The model uses equity prices and information from the financial statements as inputs to calculate the distance-to-default. The distance-to-default is the number of standard deviations the firm’s asset value is away from the default point i.e. book value of the liabilities. The corresponding probability of default is estimated using empirical data. The measure is
shown to perform well even for firms which are traded less actively and are closely held.

Kealhofer (2003) provides strong support for the Black-Scholes-Merton approach to credit risk, as demonstrated by the KMV model, and shows that EDFs are more powerful as compared to agency debt ratings in predicting default. Kealhofer and Kurbat (2002) also show that the Merton approach outperforms Moody’s ratings and various accounting ratios in prediction of defaults. Additionally, it also already includes information related to ratings and accounting ratios. Stein (2005) shows that the Merton model is not complete in terms of its ability to capture important aspects related to firm performance. He finds that additional information might be more useful for discriminating between defaulters and non-defaulters.

Hillegeist et al. (2004) find that the option based model outperforms both the accounting based Altman’s (1968) Z-Score model and Ohlson’s (1980) O-score model. They find that the option based model contains significantly more information as compared to the two accounting based models. They show that these findings are robust to various modified versions of the two accounting based models. However, Agarwal and Taffler (2008) find that there is no significant difference in the predictive accuracy of the Z-score model and the Merton model for a sample of firms in UK. They conclude that both the models hold unique information related to firm failure.

Reisz and Perlich (2007) find that accounting-based measures such as the Altman’s Z score are more relevant for short-term bankruptcy prediction, whereas market-based
structural models are more appropriate for medium- and long-term default predictions. Gharbhor et al. (2006) find the option model to be superior to the accounting based Altman Z-score model for a sample of Australian firms. Patel and Vlamis (2006) also find support for the option based models of default prediction for a sample of real estate firms in the U.K. Additionally, they find that high leverage and high asset volatility are the two driving forces of default. Duffie, Saita and Wang (2007) include the option model based distance-to-default as a covariate in their times-series model of default prediction and find it to be dominating the other covariates in the model.

Other studies that find support for the option based models in predicting financial distress include Trussel (1993) and Hao (2006). Marin (2008) examines how a firm’s risk management activities affect its probability of financial distress as measured by the option pricing framework. Li (2009) uses the option pricing approach to value the firm’s equity before and after bankruptcy filing.

Vassalou and Xing (2004) study the effect of default risk on equity returns. They estimate default likelihood indicators for a sample of firms using the contingent claims methodology and find that default risk is closely related to the size and book-to-market characteristics of a firm and it is a systematic risk priced in the cross section of equity returns. On the other hand, Campbell et al. (2008) find that distress risk is not properly priced by the equity market and financially distressed firms are characterised by high market betas and low average returns. They find that the distance-to-default measure based on the model of Moody’s KMV and the structural
default model of Merton (1974) does not improve the explanatory power of their model.

Du and Suo (2007) find that the distant-to-default based on the Merton model is not effective in capturing information related to the firm's credit quality from the equity market. Bharath and Shumway (2008) assess the contribution of the Merton DD model by examining the relative importance of its functional form and the solution procedure adopted to arrive at the unknown input variables i.e. value of the firm and its volatility. In other words, they assess whether the forecasting ability of the model is sensitive to the approach used to estimate the two unknown variables. For this purpose, they develop a naïve alternative to the classic Merton DD model using the model’s functional form. Basically, this alternative uses the same inputs as that of the Merton DD model but does not require solving for the two unknown variables. The finding that this naïve alternative is statistically significant and performs better than the Merton DD model provides evidence that the functional form of the model is more important than the solution procedure for obtaining the inputs to the model. Triandafil et al. (2009) assess default probabilities for a sample of 35 firms listed on the Romanian Stock Exchange using the Merton model. They examine the differences in the distance-to-default across different industries and investigate how financial ratios affect the distance-to-default.

The use of Merton model for predicting the default risk is not restricted to firms in the non-financial sector alone. Koutsomanoli-Filippaki and Mamatzakis (2009) assess the default risk of listed banks in the European Union using the Merton model. They argue that the distance-to-default may serve as an early warning system for financial
instability as well as operational inefficiency. Huang et al. (2010) use the KMV model for estimating the default risk of Chinese banks.

2.3 Hybrid Models
Although the option based approach to modelling default risk has been endorsed by many researchers as an improvement over the accounting based models, it has its own limitations. The Merton model has been criticized for being based on unrealistic assumptions about market efficiency, perfect liquidity and lack of arbitrage conditions. The firm’s asset value is assumed to follow lognormal distribution, all of the firm’s liabilities mature in one year, the firm’s liabilities consist of only one single zero-coupon bond and refinancing and renegotiation of firm’s debt obligations is not allowed. Some of the other limitations of the Merton model include holding of absolute priority in the event of default, costless liquidation of the firm and constant default boundary (Benos and Papanastasopoulos, 2007; Papanastasopoulos, 2006; Hildegeist et al. 2004).

The evidence on the effectiveness of the accounting based models and the option based models in modelling default risk has been mixed. This has motivated researchers to propose hybrid models that combine accounting variables with variables drawn from the option pricing framework. These models are gradually evolving as a mechanism to integrate the merits of both the approaches. Sobehart et al. (2000) elaborate on Moody’s Public Firm Risk Model that incorporates ratings, financial statement data and market information. They show that this model enhances predictive value over and above the Merton model. Loffler (2007) argues in favour of
combining market based measures of default risk such as Expected Default Frequency (EDF) with ratings to improve the prediction of defaults.

Falkenstein and Boral (2001) show that a hybrid model that combines the Merton model and the net income to assets ratio outperforms the Merton model. Sobehart and Keenan (2001) argue that hybrid models outperform market-based models and help in overcoming the shortcomings of the structural models of default risk. Sobehart and Keenan (2002) compare the Merton model (KMV’s implementation) with the hybrid model described in Sobehart et al. (2000). Using a sample of non-financial firms from U.S. they show that the hybrid model outperforms the equity-based model.

Papanastasopoulos (2006) compares the performance of accounting based model, option based model and hybrid model in assessing the default risk of listed firms in U.S. and Canada. He finds that the hybrid model outperforms the models based solely on accounting variables or option based variables. He concludes that market information is most useful when combined with accounting information in estimating default risk. In a related research Benos and Papanastasopoulos (2007) develop a new risk neutral distance-to-default metric by modifying some of the questionable assumptions of the Merton approach. They find that when financial ratios and accounting variables are added to this metric in a hybrid model the predictability of the defaults is improved. This leads them to conclude that financial ratios and accounting variables hold considerable incremental information about the credit quality of the firm over and above the risk neutral distance-to-default metric.
Dionne et al. (2008) combine variables from the Merton approach and accounting ratios in their hybrid model for a sample of publicly listed firms in Canada. They show that the hybrid model outperforms the structural model and the accounting model in default prediction. Li and Miu (2010) develop a hybrid model combining variables from the Altman (1968) z-score model with the Merton’s distance-to-default. They find that the distance-to-default variable has a higher statistical significance in explaining the default events for firms with relatively high credit risk and the z-score is more significant in predicting bankruptcies of firms with relatively low credit risk. A summary of the studies based on hybrid models is presented in Table 2.2.

**Table 2.2 Summary: Hybrid models of default prediction**

<table>
<thead>
<tr>
<th>Study</th>
<th>Variables used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sobehart et al. (2000)</td>
<td>Credit rating, Net income/Assets, Log(Assets), Working capital/Assets, Liabilities/Assets, Stock price volatility, Equity growth rate, Net income/Equity, Distance to Default</td>
</tr>
<tr>
<td>Falkenstein and Boral (2001)</td>
<td>Net income/Assets, Distance to Default</td>
</tr>
<tr>
<td>Papanastasopoulos (2006)</td>
<td>Liabilities/Market value of assets, Net income/Market value of assets, Cash/Current liabilities, Free cash flow/Total sales, Ln(Total assets)</td>
</tr>
<tr>
<td>Benos and Papanastasopoulos (2007)</td>
<td>Free cash flow/ Total sales, Net income/Total Assets, Ln(Total assets), Total Debt/Total Assets, Distance to Default</td>
</tr>
<tr>
<td>Loffler (2007)</td>
<td>Expected Default Frequency (EDF), Credit rating</td>
</tr>
<tr>
<td>Dionne et al. (2008)</td>
<td>Merton KMV PD, EBITDA/Sales, Net value/Total Liabilities, Debt/Assets</td>
</tr>
<tr>
<td>Li and Miu (2010)</td>
<td>Altman Z-score, Distance to Default</td>
</tr>
</tbody>
</table>
2.4 Macroeconomic and Industry factors

Several studies consider only firm level variables in predicting financial distress but only a limited number of studies investigate the effects of industry and macroeconomic factors. Some studies that examine the impact of macroeconomic factors in predicting financial distress have been motivated by situations of economic crisis which lead to massive bankruptcies. For instance, Tirapat and Nittayagasetwat (1999) study financial distress in the context of the 1997 economic crisis in Thailand. They incorporate the firms’ sensitivity to macroeconomic variables such as the growth of production manufacturing index, inflation or changes in the consumer price index, changes in interest rates and changes in money supply along with the firms’ financial characteristics for predicting financial distress. They argue that higher a firm’s sensitivity to economic shocks the more vulnerable it is to experiencing financial distress. They find that such sensitivity is crucial in separating financially distressed companies from the non-distressed ones.

Tsai et al. (2009) show that macroeconomic factors such as currency supply change ratio, interest rate change ratio, consumer price index change ratio and stock exchange index change ratio lead to improved financial distress prediction over financial ratios. Bonfim (2009) shows that macroeconomic variables such as GDP growth rate, loan growth and stock market prices variation are important in explaining defaults. However, Jackman (2011) finds that macroeconomic information is already incorporated in the accounting variables and thus contributes marginally to bankruptcy prediction.
Giesecke et al. (2011) show that stock market returns and changes in stock market volatility have significant predictive ability for default rates for corporate bond defaults in the U.S. over a 150 year period. They further show that macroeconomic variables such as changes in Gross Domestic Product (GDP) are useful for forecasting default rates but other variables such as inflation and the growth rates of industrial production and consumption are not so significant. Additionally, they find that credit spreads do not have much predictive ability for default rates.

In a recent study, Figlewski et al. (2012) consider the impact of three categories of macroeconomic variables on corporate defaults and credit rating transitions. The three categories include variables representing general economic conditions (unemployment rate, inflation, NBER recession indicator, Chicago Fed National Activity Index), direction of the economy (real GDP growth, growth of industrial production, change in consumer sentiment) and financial market conditions (interest rates, stock market performance, corporate credit spread, corporate bond default rate). They conclude that macroeconomic variables significantly increase the explanatory power of their model. Specifically, they find that the variables relating to the direction of economy and financial conditions play a more important role in modelling downgrade transitions than the variables relating to general economic conditions.

Chava and Jarrow (2004) show that the industry effect, incorporated as industry dummy, is significant in improving the predictive ability of the model. Other studies that incorporate the industry effect in the form of industry dummies include Lennox (1999) and Bandyopadhyay (2006). Bhimani et al. (2010) incorporate non-accounting
variables such as firm size, firm age and industry dummies along with accounting ratios in their model for default prediction for privately held firms in Portugal.

Other studies examine the impact of industry-wide distress on creditor recoveries (Acharya et al., 2007) and the contagion and competitive effects of bankruptcy announcements on other firms in the same industry (Lang and Stulz, 1992; Tew, 2009). Acharya et al. (2007) find that recoveries for the creditors of defaulted firms are significantly reduced as a result of distress at the industry level. The recoveries are all the more affected by specificity of the assets.