South Asian Journal of Management Sciences
Vol: 16(2): 170-187, 2022
DOI: 10.21621/sajms.2022162.03

Modeling Risk and Return Framework using Distress Risk: A Conceptual Framework

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Abstract: *This research aims to propose extension of existing asset pricing models by including distress risk anomaly to enhance their predictive ability. It explores in detail the shortcomings of existing asset pricing models and deviation between theoretical and empirical evidences. The limitations of Capital Asset Pricing Model (CAPM) lead to the development of various asset pricing models with the inclusion of different risk factors. Our literature survey search found that distress risk is a missing component which has not been included in any asset pricing models. Therefore, this research proposes a risk and return framework with an extension of Fama and French, three-factor model, Cahart model and Fama and French five-factor model. This study justifies the inclusion of distress risk and proposes a measure to evaluate different distress risk models. Our proposed model will be not only be useful for academicians in future empirical testing, investors in developing their investment strategies but will also help regulators to gain beneficial information for policy decisions.*

Keywords: *Asset pricing, distress risk, anomaly.*

Introduction

Conventional finance claims that investors require higher returns against higher risk. Till early 20th century investment decisions were primarily based on returns without considering risk. Asset pricing models were initiated by researchers after 1950s. Sharpe (1964); Lintner (1975) proposed the first single factor model known as Capital Asset Pricing Model (CAPM). This model is still used extensively and considered as the standard asset pricing model. Despite its fame, this model was rejected repeatedly by various researchers due to its inadequacy to predict stock returns accurately. To overcome the anomalies proposed by CAPM model, multiple factor capital asset pricing models were developed including Fama and French three factor model, Cahart's Momentum model and Fama and French five factor model. All these models are derived through Sharpe's CAPM model and included various factors like size, value, momentum, profitability and investment in assets. Inclusion of these variables to the initial model was also not able to determine the stock

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returns completely (Shen, Liu, Wang, & Zhou, 2020).

Two school of thoughts exists when it comes to assessment of stock returns. The first school is based of neo-classical theories which claims that stock returns can be calculated and markets are efficient (Sharpe, 1964; Lintner, 1975; Campbell, Hilscher, & Szilagyi, 2008) while the other school belongs to behavioral finance which promotes that it is difficult to calculate future returns as investors are irrational. Neo-classical model still argues that stock returns can be determined efficiently if the capital asset pricing model is developed effectively. However, the inefficiency of the existing models makes it difficult for the investors to effectively plan their investment decisions.

In the last few decades, researchers concluded that companies with small size and high book to market value witness's abnormal equity returns. Fama and French (1993), along with other researchers highlighted that distress risk effects size and book-to-market anomaly. Dichev (1998) was the first researcher to conclude that high distress risk companies reap considerably lower returns than low distress risk companies. His research on US industrial firms confirmed the existence of distress risk premium. Later, a number of researches investigated the relationship of distress risk and stock returns by using different distress risk proxies. Rational school is still unable to conclude the relationship between two variables, thus concluding distress risk to be a new type of anomaly (Campbell et al., 2008).

The puzzle of distress risk revolves around three main themes. First, interpreting negative distress risk premium, second understanding the relationship of distress risk and stock returns and third if distress risk can justify other risk return anomalies as well. Fama and French (1993); Franzen, Rodgers, and Simin (2007); Griffin and Lemmon (2002), established research strategies to explain anomalies by employing several distress risk methods but the theoretical literature is unable to explain low returns of high distressed stocks.

Puzzle of distress risk has an important role in developing new financial theories as well as practical world. Substantial profits can be earned by investors by utluizing distress risk trade strategies. From the standpoint of financial theory, the distress puzzle probes Efficient Market Hypothesis (EMH) and the comprehensiveness of asset pricing models. In the presence of efficient market, why low distress risk companies outperformed high-risk companies? If current asset pricing models are comprehensive in nature then why they are unable to address distress risk puzzle? The research on relationship of distress risk and stock return may offer new findings of EMH and recommend new asset pricing models, which have superior ability to determine asset prices.

Apart from using proxy of factors used in capital asset pricing models, researchers used different methods and models to calculate distress risk. Distress risk is represented by bankruptcy risk, which can be calculated through accounting, market and hybrid distress risk models. Superiority of these models are still disputed as different empirical studies provide different results. If distress risk is known by the company at an earlier stage it can help the company in restructuring to avoid bankruptcy. It will also help investors in making right investment decisions and also policy making agencies to take due precautions to help the companies in avoiding bankruptcy and disruption in the economy. The controversial relationship of distress risk and stock return can also be because of different ways of assessment and calculation of distress risk (Boubaker, Hamza, & Vidal-García,

2018; Idrees & Qayyum, 2018). It is therefore, necessary to understand distress risk and return relationship due to increase in distress risk and bankruptcies faced by the companies globally in the last two decades.

The broader objective of this research is to propose a capital asset pricing model including distress risk, in which distress risk model is not randomly taken but is selected through Receiver Operating Curve (ROC). The finalization of distress risk model will help companies in evaluating their distress risk profile to safeguards themselves from bankruptcy, investors in protecting their current investments and strategizing their future investments and policy makers as well as regulators in safeguarding macro economic factors.

The study will not only help all the stakeholders in determining the distress risk position of the company but will also help them in analyzing the distress risk and stock return relationship. The proposed model of this research will serve the future empirical studies conducted on not only on the assessment of distress risk models but also on the relationship of distress risk and stock returns.

Literature Review

This section is divided into two part comprising of theoretical background and empirical studies.

Theoretical Background

Asset pricing theories are divided into two broad categories, namely; Neo-Classical asset pricing theories and Behavioral Finance. Asset pricing models are established under the umbrella of Neo-classical asset pricing theories (Çelik, 2012). This research only analyzes the theories and models developed under Neo classical asset pricing theories and also presents the advancement of these models. The below figure demonstrates the different divisions of Neo-classical theories. Model and theories related to this study are highlighted.

Neo-classical theories originated in 1960s based on efficient market hypothesis. The models based on Neo-classical asset pricing theories are developed on the basis of three models. First, general equilibrium theory which states that higher risk leads to higher returns. Second, mean variance theory propagates that investors require risk premium for additional risk (Markowitz, 1952) and third, asset pricing models should include risk free rate (Tobin, 1958).

Using the knowledge of initial models, absolute and static asset pricing models were developed.

Absolute and Static Asset Pricing Models

Absolute and Static asset pricing models are mostly used to determine asset pricing. These models calculate price an asset at a single point in time. These models include single factor model and multiple factor models based on arbitrage pricing theories. The first single factor

model CAPM was introduced by Sharpe (1964); Lintner (1975) and is given by:

$$R_i = R_f + \beta(R_m - R_f) + \epsilon \quad (1)$$

Where: R_i is the return of the security, R_f is the risk free rate, β is the sensitivity of individual security's return, R_m is the market return and ϵ = error.

Arbitrage pricing theories (APT) including multiple factor models were established due to inability of the single factor model to determine stock prices efficiently. These models include various micro and macro-economic factors in the initial asset pricing model of CAPM. The distinct difference between CAPM and APT is the number of factors impacting the returns. APT models included macroeconomic as well as fundamental factors.

Multiple arbitrage pricing models were established due to empirical failure of CAPM. The first model which became popular was Fama and French three factor model which included market risk, size and value factors. The model propagated that returns of firms are impacted by size, value and market risk.

The model is given by:

$$(R_{i,t+m} - R_{f,t+m}) = \beta_1 + \beta_{MKT} R_m R_{ft+m} + \beta_{SMB}(SMB)_{t+m} + \beta_{HML}(HML)_{t+m} + \epsilon \quad (2)$$

Where; dependent variable is the excess return of the security, $R_m R_f$ is the excess return of index over one-year treasury stock, SMB is size premium and HML is the value premium. Fama and French three factor model outperformed CAPM model (Molay et al., 2000) but its empirical performance against other asset pricing models is still indecisive. The inconsistency of results led to other models.

Cahart Momentum Model was introduced by Cahart in 1997. The model is an extension of Fama and French three factor model. The factor of momentum was included in the former model.

The model is given by:

$$(R_{i,t+m} - R_{f,t+m}) = \beta_1 + \beta_{MKT} R_m R_{ft+m} + \beta_{SMB}(SMB)_{t+m} + \beta_{HML}(HML)_{t+m} + \beta_{MOM}(MOM)_{t+m} + \epsilon \quad (3)$$

Where; dependent variable is the excess return of the security, $R_m R_f$ = excess return of index over one-year treasury stock, SMB is the size premium, HML is the value premium and MOM is the momentum of the stocks.

Fama and French five factor model (2015) included two more variables in Fama and French three factor model (1993). The variables included were profitability and investment in assets.

It is given by:

$$(R_{i,t+m} - R_{f,t+m}) = \beta_1 + \beta_{MKT} R_m R_{ft+m} + \beta_{SMB}(SMB)_{t+m} + \beta_{HML}(HML)_{t+m} + \beta_{RMW}(RMW)_{t+m} + \beta_{CMA}(CMA)_{t+m} + \epsilon \quad (4)$$

Where; dependent variable is the excess return of the security, $R_m R_f$ is the excess return of index over one-year treasury stock, SMB is the size premium, HML is the value premium, RMW is the profitability premium and CMA is the investment premium. The new model proposed by Fama and French answers anomalies of the earlier model (Fama & French, 2015) but its efficiency through empirical researches still needs to be validated.

Methods to evaluate Asset Pricing Models

Two techniques have been popular to measure asset pricing models. The first methodology to evaluate asset pricing models was proposed by Fama and MacBeth (1973). The technique involves computing beta and risk premia of factors involved in the model. The technique involves three steps. In the first step portfolio is developed. In the second step beta is computed while the third step involves testing period. Various researchers utilized this technique to investigate risk and return (Bauer & Agarwal, 2014; Eisdorfer, Goyal, & Zhdanov, 2020).

The second method was proposed by Pettengill, Sundaram, and Mathur (1995) called Pettengill Conditional Approach. This technique extended CAPM model by including business cycle effects. The third step of Fama and Macbeth was later changed after analyzing the strength of this technique. In the third step regression was included.

Pettingill Conditional Approach is given by:

$$R_{it} = \lambda_{0t} + \lambda_{1t}\beta_{1t}D + (1 - D) + \epsilon_{it} \tag{5}$$

Where; D = 1 if $(R_{mt} - R_{ft})$ is positive and D = 0 if $(R_{mt} - R_{ft})$ is negative.

Financial Distress Risk

Several definitions have been given by researchers to define distress risk. Few of the prominent definitions are given below:

According to capital asset pricing theories, systematic risk should be compensated with equivalent returns. Since researchers regard financial distress risk as systematic risk therefore companies having higher financial distress risk should offer higher returns. Despite the theoretical justification, empirical researches offer divergent results (Anginer & Yıldızhan, 2010).

There are various methods to predict bankruptcy which is a proxy of financial distress risk. These include statistical models, artificial intelligence and theoretical models. Most of the researches utilize statistical models (Aziz & Dar, 2006), among which accounting, market and hybrid models are the most prominent models.

Accounting Based Models

The first accounting based distress risk model was proposed by Altman in 1968. In his model he replaced individual accounting ratios with comprehensive valuation through mul-

tiple discriminate analysis. He analyzed 66 USA manufacturing companies for the period of 1946-65 by using 22 ratios. His final model is known as z-score and is given by:

$$z = 1.2WCTA + 1.4RETA + 3.3EBITTA + 0.6MCTL + 1.0STA \tag{6}$$

where; WCTA is the working capital to total assets, RETA is the retained earnings to total assets, EBITTA is the EBIT to total assets, MCTL is the market value of equity to book value of liabilities and STA is the sales to total assets. The model declared that companies which have score of more than 2.6 are healthy, companies having score between 1.1 to 1.6 are in grey area while companies having score of less than 1.1 are financially distressed.

$$z = 1.2WCTA + 1.4RETA + 3.3EBITTA + 0.6MCTL + 1.0STA$$

Gorgon LV Springate developed Springate model in 1978 by using multi discriminate analysis on 40 companies in Canada. He used four ratios and his final model is given by:

$$S = 1.03WCTA + 3.07EBITTA + 0.66EBTCL + 0.4ROA \tag{7}$$

Where; WCTA is the working capital to toal assets, EBITTA is the EBIT to total assets, EBTCL is the earnings before taxes to current liabilities and ROA is the return on assets. The model declared that companies having S score of more than 0.862 are healthy while companies having S score of less than 0.862 are financially distressed.

Ohlson (1980) used logit model by replacing multi discriminant analysis. He investigated 105 insolvent and 2058 financially stable companies for the period of 1970-1976. The model stated that company having probability of more than 0.038 is considered to be financially distressed. It is given by:

$$0 = \left\{ 1 + exp\left(- \begin{pmatrix} -1.3 - 0.4OSIZE + 6.0TLTA - 1.4WCTA \\ +0.1CLCA - 2.4OENEG - 1.8NITA \\ +0.3FUTL - 1.7INTWO - 0.5CHIN \end{pmatrix} \right) \right\}^{-1} \tag{8}$$

Where; size is total assets , TLTA is the total liability to total assets, WCTA is the working capital to total assets, CLCA is the current liabilities to current assets, OENEG is One if total liabilities exceed total assets, zero otherwise, NITA is the net income to total assets, FUTL is the Funds provided by operations to total liabilities , INTWO is one if net income is negative for the last two years, zero otherwise and CHIN is the $N_{it} - NIt1/N_{it} + N_{it-1}$, where N_{it} and NIt1 is the net income for the most recent and the preceding year respectively.

Zmijewski (1984) proposed probit model by utilizing three ratios. He studied 81 distress and 1600 financially stable companies in USA for the period of 1972 to 1978. The model proposed that companies having score of more than 0.5 are financially stable and is given by:

$$P = \Phi(-4.336 - 4.513NITA + 5.679TLTA + 0.004CACL) \tag{9}$$

Where; NITA is the net income to total assets, TLTA is the total liability to total assets and CACL is the current assets to current liabilities.

Grover proposed Grover Score (2001) by reexamining the Altman Z-score. The models examined thirteen ratios before finalizing the three essential ratios. The model studied 35 financially distressed and 35 stable companies for the period of 1982 to 1996. The company is healthy is G score is more than 0.01. It is given by:

$$G = 1.650WCTA + 3.404EBITTA - 0.016ROA + 0.057 \tag{10}$$

Where; WCTA is the working capital to total assets, EBITTA is the ebit to total assets, ROA is the net income to total assets.

The main advantages of accounting based models include:

1. Bankruptcy is based on financial numbers from financial statements
2. Audit limits window dressing

The disadvantages of accounting based models include:

1. Accounting assumes companies to be going concerns (Hillegeist, Keating, Cram, & Lundstedt, 2004; Agarwal & Taffler, 2008a).
2. Financial data can evaluate past performance but cannot accurately predict future performance (Mallikarjuna & Rao, 2019).
3. There might be a difference between market and book value (Agarwal & Taffler, 2008b).
4. Management can do window dressing of financial statements (Zaidi, Akhter, & Akhtar, 2018).

Market Based Models

Hazard models of market based models resolved the problem of static models related to accounting for time. These models claim that they are better able to predict financial distress when compared to accounting based models (Hillegeist et al., 2004; Kealhofer, 2003).

The organization of market-based models is identified by the option pricing approach of Black and Scholes (2019) and the derivative pricing model of Merton (1973) (BSM). In this model company's equity is stated as firm's assets call option with total liabilities taken as the strike price. Termination of call option affirms the bankruptcy of the company. McDonald (2002) describes the probability using a standard normal cumulative distribution as:

$$P = N\left(\frac{-ln\frac{V_A}{X} + (\mu - \delta - 0.5\sigma_A^2)T}{\sigma_A\sqrt{T}}\right) \tag{11}$$

Where; P is the probability of default, N(·) is the cumulative normal density function, VA is the value of assets, X is the face value of debt, μ is the expected return, δ is the dividend rate, σA is the asset volatility and T is the time to maturity. The model recognized VA, μ , and σA as a measurement of default probability.

Crosbie and Bohn (2003) utilized Merton's Hazard model, but used Moody's KMV data base instead of utilizing a cumulative distribution. The data base has data of 250,000 company years and over 4700 bankruptcies.

Bharath and Shumway (2008) proposed a naive alternative of the market based model to compute the default score. The model took asset volatility as the weighted average of debt and equity volatility, where debt volatility is the linear function of equity volatility. Proxy of expected stock returns is previous year stock returns. They stated that naïve distance approach is superior to the standard market hazard approach. It is given by:

$$Pnaive = N(-DDnaive) = N\left(\frac{-ln\frac{MTA}{TL} + (ER1y - 0.5\sigma^2_{naive})T}{\sigma_A naive\sqrt{T}}\right) \tag{12}$$

The advantages of market based models include:

1. Stock price reveals the financial position of inefficient markets (Sukesti et al., 2021)
2. Includes information which are not part of accounting data.
3. Market prices imitate future cash flows.
4. They are not dependent upon sample and time (Agarwal and Taffler, 2008).
5. Management cannot do window dressing of market-based data.

The disadvantages of market based models include:

1. At times, stock volatility is not observable.
2. There is always a question of the reliability of market data.
3. BSM framework undertakes that zero-coupon bond matures at the end of the forecasting horizon, which in most cases does not hold.

Hybrid Models

Both accounting and market based models offers different types of advantages. Shumway (2001) used US-listed companies on NYSE and AMEX for the period of 1963 and 1992. Shumway (2001) proposed the first hybrid model which is given by:

$$P_{i,t} = \frac{e^{\alpha_t + \beta X_{i,t}}}{1 + e^{\alpha_t + \beta X_{i,t}}} = \frac{1}{1 + e^{-\alpha_t - \beta X_{i,t}}} \tag{13}$$

Where; $P_{i,t}$ is the probability at time t that company will go bankrupt in $t + m$, β is the coefficient vector and X is the explanatory variables

Chava and Jarrow (2004) further upgraded the hazard model by taking industry-specific variables. The advantages if hybrid model includes:

1. Theoretical literature supports that combining both types of data will enhance the predictive ability of the models.
2. Hazard models are time-independent and allows a bankruptcy risk valuation at each point in time.

The disadvantages include:

1. Since these models use both types of data, problem of multicollinearity might exist.

Empirical Researches

The empirical researches on Fama and Frech, three factor model, Cahart momentum model, Fama and French, five factor model along with distress risk are discussed below:

Size and Value - Fama and French, Three Factor Model

Size premium is one of the most controversial effect on stock returns. It states that returns of stocks of small cap companies outperform large cap companies. It is one of the most popular theory among equity managers but empirical evidences does not point in one direction. The first debate on size premium started with research of Banz (1981), followed by number of researches on the same topic (Blume & Stambaugh, 1983; K. C. Chan, Chen, & Hsieh, 1985; K. Chan & Chen, 1988). The most prominent was the research by Fama and French (1993) where the size premium was regarded as an essential risk factor, along with market and value premium. The small cap companies by definition should be more riskier and therefore should reap higher returns but recent literature gives different results. The difference in empirical evidence and literature can be because of quality of the firms which means that returns of small cap companies will outperform returns of large cap companies if the portfolio is restricted to high quality companies (Deb & Mishra, 2019; Asness, Frazzini, Israel, Moskowitz, & Pedersen, 2018). Value premium states that return of stocks of high book to market value outperforms the returns of stocks having low book to market value.

Fama and French (1993) declared the size (SMB) and value (HML) captures financial distress risk. Fama and French - three factor model declares that negative relationship exists between size and distress risk while positive relationship exists between book to value and default risk. A number of researches validated the relevance of Fama and French - three factor model and significance of size and value to calculated returns (Agarwal & Taffler, 2008a; Boubaker et al., 2018). Sehrawat, Kumar, Nigam, Singh, and Goyal (2020) conducted his research on 500 indian listed companies for the period of 2003-2019 and found the model to have higher predictive ability than CAPM model. Likewise researches conducted by Deb and Mishra (2019); Karp, Van Vuuren, et al. (2017) to compare the Fama and French three factor model with CAPM also concluded that the model provides more accurate results than CAPM. However, some researches indicated that relevance of SMB and HML are dependent upon the economic conditions and cycles. Changes in economic cycle can impact high book to market firms with higher risk. According to behavioral

finance, effect of HML and SMB are due to extrapolation of past trends (Lakonishok, Shleifer, & Vishny, 1994) as well as investor irrationality.

Momentum - Cahart Momentum Model

The velocity of stock's price change is called momentum. It helps investors in examining the trend of price changes. Its impact on stock returns was first observed and over the years this was considered as an essential factor to calculate stock returns (Griffin & Lemmon, 2002; Griffin, Ji, & Martin, 2003). According to behavioral finance, momentum effect is due to market inefficiency and investor psychology. Some researches attributed conservatism bias, representative heuristic, and self-attribution bias to be the responsible factors for momentum effect while others stated that momentum effect only occurs when investors are optimistic.

Fama and French - three factor model was extended by Carhart (1997) by including momentum factor (MOM) to capture previous winners and losers. A number of researches criticized Cahart model as empirical researches indicated that it is unable to explain stock returns even after the inclusion of momentum factor (Çelik, 2012).

Misra and Mohapatra (2014, 2015, 2020) initiated a series of researches to establish the presence of momentum at index as well as portfolio level. Their first research (214, 2015) confirmed the existence of momentum at portfolio level. Their second study (2020) investigated Cahart model and found contradictory results as previously advocated in Cahart as well as Fama and French three factor model. Ghiyasvand, Darabi and Hamidian (2020) also investigated the momentum effect in the Tehran Stock exchange using the Carhart model for the period of 2008 to 2017. The study concluded that market conditions directly impact stock returns and emphasized that stock returns are higher in bullish market and lower than bearish market. Rashid, Fayyaz and Karim (2019) studied the Pakistan stock exchange for the period of 2000 to 2013 by including investor sentiment to the Carhart model. The study found that both momentum and investor sentiment has significant impact on stock returns though momentum enjoys positive relationship with stock returns while investor sentiment enjoys negative relationship with stock returns.

Profitability and Investment in Assets - Fama and French, Five Factor Model

Criticism on Fama and French three factor model as well as Cahart momentum model led to the development of Fama and French five factor model (Zeren, Yilmaz, & Belke, 2019; Nguyen, Nguyen, Ho, & Ngo, 2019; Ozkan, 2018). The model is an extension of previous three factor model. The new model included profitability (RMW) and investment (CMA). Empirical researches based on five factor model shows inconclusive results regarding its validity. The new two added factors lacked the explanatory ability to explain returns in Japan and Asia Pacific but are significant in markets like United States and Europe (Cakici, 2015).

Mosoeu and Kodongo (2019) examined the model in selected emerging and developed countries and found that the model fails to deliver in pricing of country portfolios. The

model was criticized to ignore momentum effect and its influence on asset pricing. The model's explanatory power varies with market and time (Huang, 2019) and fails to differentiate between stocks having high average returns with those investing conservatively in assets.

Munir, Sajjad, Humayon, and Chani (2020) studied the five factor model for the period of 2012-2017 for Pakistan stock exchange. The study concluded that all factors except book to market value enjoys significant relationship with stock returns. The study declared that five factor model is able to explain returns.

Financial Distress Risk

Traditional finance theory postulates positive risk and return relationship. Puzzle of distress risk demonstrates negative distress risk and return relationship (Fama & MacBeth, 1973; Fama & French, 2015, 2015). Anomaly related to distress risk and return still remains a puzzle for some researchers while others refuse to contemplate it as a dispute. Some researches explains that negative distress risk premium is due to low betas of companies going through bankruptcy process (Garlappi, Shu, & Yan, 2008), while some states that the relationship is still disputed due to ambiguity in the calculation of distress risk. Most common proxy of distress risk. Researches analyzing relationship of distress risk and asset pricing using various bankruptcy models is discussed below:

A number of researches have utilized accounting, market and hybrid bankruptcy models to understand the relationship of distress risk and return. Some of the empirical researches are mentioned below:

Chhapra, Zehra, Kashif, and Rehan (2020) analyzed the relationship of distress risk for and 901 listed stocks in Pakistan from 2001 to 2016. To measure distress risk, Olson O score was applied which was used to extend Fama and French three factor model. The study concluded that higher distress risk brings higher returns to investors.

Shen et al. (2020) examined the distress risk and asset pricing puzzle by investigating 456 equity REITs of United Stated for the period of 1982 to 2017. The research used four approaches to estimate distress risk. These approaches included Altman Z-score, Ohlson O-score, Merton's option pricing model and failure probability. The study concluded that market based models perform better than accounting based models. Also, the stud confirmed the existence of negative distress risk premium.

Eisdorfer et al. (2020) analyzed the distress risk anomaly in 20 developed and 14 emerging countries of MSCI for the period of 1992 to 2010 including 26,584 firms. The research employed Merton's distance to default model (1974) to analyze distress risk and Fama and French, three factor model (1973) model to observe the relationship of distress risk and asset pricing. Negative distress risk was observed in developed countries while in emerging countries higher distress risk leads to higher returns.

Boubaker et al. (2018) investigated the stock returns of French listed companies for the period of January 1995 to December 2012 using CAPM as well as Fama and French three factors along with its augmentations. The research was conducted on twelve portfolios arranged according to book to market value, size, leverage and distress risk. The explanatory power of variables was also tested to evaluate distress risk. The research con-

cluded that size and value premium does capture distress risk. Still, distress risk is only significant in assessing the stock returns of distressed firms, while leverage risk premium is only significant for high leverage firms.

Number of other empirical researches also analyzed the relationship of distress risk with stock returns and found insignificant relationship of distress risk and return (Idrees & Qayyum, 2018), while others concluded negative relationship between distress risk and return (Gao, Parsons, & Shen, 2018).

Methodology

This research aims at developing a model of capital asset pricing including distress risk. The efficiency of the model can be assessed through beta coefficients and R square. This research adopts qualitative research approach to propose a capital asset pricing model which can be used for developing as well as developed countries.

The model developed by this research utilizes secondary data of accounting, market as well as macro-economic variables to investigate all manufacturing, non-financial companies as distress risk models are different for financial and service sector companies. The secondary data is easily available on Bloomberg as well as Thomson Reuters for all current as well as delisted companies listed on stock exchanges.

Estimating Distress Risk

The paper proposes three models of capital asset pricing model including distress risk premium. To measure distress risk, accounting, market and hybrid models are utilized. Altman's z-score model is used as it was the first distress risk model developed and still is the most popular model. Also, the data required by Altman is easily available and investors still use this model to compute insolvency. Mathematically it is given by:

$$z = 1.2WCTA + 1.4RETA + 3.3EBITTA + 0.6MCTL + 1.05STA \tag{14}$$

The first variable working capital to total assets refers to liquidity while second variable, retained earning to total assets refers to leverage. Third variable ebit to total assets refers to productivity while fourth variable market value of equity to total liabilities refers to changes in market value. The fifth variable if sales to total assets refers to asset efficiency.

Market distress risk model used is developed by Bharath and Shumway (2008) which is adopted from Merton's models and researches prove that it predicts bankruptcy more accurately. It is mathematically given by:

$$Pnaive = N(-DDnaive) = N\left(\frac{-ln\frac{MTA}{TL} + (ER1y - 0.5\sigma^2_{naive})T}{\sigma_A naive\sqrt{T}}\right) \tag{15}$$

Where; Pnaive is the probability of default, ER1y is the return over the previous year, TL is the total liabilities, T is 1 year as this model has a time horizon of 1 year, MTA is the market value of common equity and market value of total debt and σE is the equity volatility given by SIGMA

The hybrid model used in the research is given by Bharat and Shumway and is given by:

$$P_{i,t} = e_t^{\nu+\beta X_{it}}/1 + e_t^{\nu+\beta X_{it}} = 1/1 + e_t^{\nu+\beta X_{it}} \quad (16)$$

Where; $P_{i,t}$ is the probability at time t that company will go bankrupt in t+m and is coded 1 in case company failed, β is the Coefficient Vector and X is the Explanatory variables including accounting variables market variables and macroeconomic variables.

To evaluate distress risk models Receiver Operating Characteristics Curve (ROC) technique is used. This technique evaluates the appropriateness of prediction parameters (Chava & Jarrow, 2004; Agarwal & Taffler, 2008b). To study the predictive ability of two models area under the ROC curve (AUC) is required to be calculated. Wilcoxon statistic (Hanley & McNeil, 1982) is utilized to calculate AUC. The test simply evaluates the accuracy of each model based on past data.

Proposed Models of Cross Sectional Regression

The study proposes to compare Fama and French three factor model, Cahart Momentum model and Fama and French five factor model with and without including distress risk. The three capital asset pricing models including distress risk which should be tested in future empirical researches to finalize the model which has the highest predictive and explanatory ability based on adjusted R square and t-test.

Model 1

$$(R_{i,t+m} - R_{f,t+m}) = \beta_1 + \beta_{MKT} R_m R_{ft+m} + \beta_{SMB}(SMB)_{t+m} + \beta_{HML}(HML)_{t+m} + \beta_{DR}(DR)_{t+m} + \epsilon \quad (17)$$

Where; $R_{i,t+m}$ is the return of firm i in year m for portfolio year t, $R_{f,t+m}$ is the annual treasury bill rate for the year t+m, $\beta_{MKT} R_m R_{ft+m}$ is the return difference of share index and annual treasury bill rate during the year t+m, SMB is the historic returns of small cap companies with large cap companies (size factor), HML is the historic returns of value stocks (high book to price ratio) over growth stocks (low book to price ratio) and DR is the historic return of high distress risk companies over low distress risk companies.

Model 2 is an extension of Cahart model.

Model 2

$$(R_{i,t+m} - R_{f,t+m}) = \beta_1 + \beta_{MKT} R_m R_{ft+m} + \beta_{SMB}(SMB)_{t+m} + \beta_{HML}(HML)_{t+m} + \beta_{MOM}(MOM)_{t+m} + \beta_{DR}(DR)_{t+m} + \epsilon \quad (18)$$

Where; $R_{i,t+m}$ is the return of firm i in year m for portfolio year t, $R_{f,t+m}$ is the annual treasury bill rate for the year t+m, $\beta_{MKT} R_m R_{ft+m}$ is the return difference of share index

and annual treasury bill rate during the year t+m, SMB is the historic returns of small cap companies with large cap companies (size factor), HML is the historic returns of value stocks (high book to price ratio) over growth stocks (low book to price ratio), MOM is the historic returns of highest momentum stocks over lowest momentum stocks for the prior year and DR is the historic return of high distress risk companies over low distress risk companies.

Where; $R_{i,t+m}$ is the return of firm i in year m for portfolio year t, $R_{f,t+m}$ is the annual treasury bill rate for the year t+m, $\beta_{MKT}R_mR_{ft+m}$ is the return difference of share index and annual treasury bill rate during the year t+m, SMB is the historic returns of small cap companies with large cap companies (size factor), HML is the historic returns of value stocks (high book to price ratio) over growth stocks (low book to price ratio), RMW is historic returns of most profitable company over least profitable company, CMW is the historic returns of aggrieve investment company over conservative investment company, and DR is the historic return of high distress risk companies over low distress risk companies.

Model 3

$$(R_{i,t+m} - R_{f,t+m}) = \beta_1 + \beta_{MKT}R_mR_{ft+m} + \beta_{SMB}(SMB)_{t+m} + \beta_{HML}(HML)_{t+m} + \beta_{RMW}(RMW)_{t+m} + \beta_{CMA}(CMA)_{t+m} + \beta_{DR}(DR)_{t+m} + \epsilon \quad (19)$$

Where; $R_{i,t+m}$ is the return of firm i in year m for portfolio year t, $R_{f,t+m}$ is the annual treasury bill rate for the year t+m, $\beta_{MKT}R_mR_{ft+m}$ is the return difference of share index and annual treasury bill rate during the year t+m, SMB is the historic returns of small cap companies with large cap companies (size factor), HML is the historic returns of value stocks (high book to price ratio) over growth stocks (low book to price ratio), RMW is historic returns of most profitable company over least profitable company, CMW is the historic returns of aggrieve investment company over conservative investment company, and DR is the historic return of high distress risk companies over low distress risk companies.

Model 4

This model includes all the variables included in the previous three models and should be evaluated with or without distress risk as well.

$$(R_{i,t+m} - R_{f,t+m}) = \beta_1 + \beta_{MKT}R_mR_{ft+m} + \beta_{SMB}(SMB)_{t+m} + \beta_{HML}(HML)_{t+m} + \beta_{MOM}(MOM)_{t+m} + \beta_{RMW}(RMW)_{t+m} + \beta_{CMA}(CMA)_{t+m} + \beta_{DR}(DR)_{t+m} + \epsilon \quad (20)$$

Hypotheses

The following hypotheses has been formulated from theoretical and empirical literature review of distress risk and return. These hypothesis are formed based on past theoretical asset pricing models as well as empirical researches.

H_1: Market premium has a significant impact on stock returns.
H_2: Size has a significant impact on stock returns.
H_3: Value has a significant impact on stock returns.
H_4: Momentum has a significant impact on stock returns.
H_5: Investment in assets has a significant impact on stock returns.
H_6: Profitability has a significant impact on stock returns.
H_7: Distress risk has a significant impact on stock returns.

Conclusion and Future Recommendations

This research paper gave an overview of the theories and models related to asset pricing and also shed light on more recent developments. The aim of the paper was to formulate a model which can determine asset pricing more accurately. Most asset pricing models include different risk factors which investors bear so that they can be compensated for them. Literature provides number of other risk factors which can be included in the asset pricing model without providing sufficient empirical support.

One type of risk which has been discussed in literature time and again is distress risk but to date no established asset pricing model has included this risk factor. According to theory distress risk should have a significant impact on asset pricing but several empirical researches report anomalies. One reason for this anomaly can be due to lack of consensus on the superiority of various models provided in the past. This research provides an overview of different distress risk models and also provides criteria to ascertain their efficiency to establish the superiority of one model. Second, reason for the anomaly can be because of the inefficient existing asset pricing models.

The research not only provides justification for an extension to existing three asset pricing models by including distress risk but also proposes three asset pricing models namely; Fama and French three factor model, Cahart momentum model and Fama French five factor model to be combined along with distress risk to analyze in future researches the accuracy of the new models. A number of anomalies exists in case of asset pricing which current theories are unable to entirely explain. The future empirical researches conducted on the models presented will also help in understanding the existence and reasons for these anomalies.

The model proposed by the research can be used in empirical researches to help companies, investors as well as creditors to evaluate the impact of distress risk on stock returns. It will also help academicians in understanding if distress risk premium exists in real world or it is limited to theories proposed in finance. Understating the distress risk profile of the company will help companies in restructuring, government agencies to help companies and sectors and investors to make investment decisions.

Future studies can utilize these models, by empirically testing them to finalize the most efficient capital asset pricing model. The models developed can be used to compare the impact of distress risk on stock returns for developing, emerging and developed countries. It can also interesting to compare the distress risk and return relationship between conventional and Islamic indexes.

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