Predicting Financial Distress:

A Case of Chinese Listed Manufacturing Companies during Financial Crisis

By

CHEN, Pimin

THESIS

Submitted to
KDI School of Public Policy and Management
in partial fulfillment of the requirements
for the degree of

MASTER OF PUBLIC POLICY

2015

Predicting Financial Distress:

A Case of Chinese Listed Manufacturing Companies during Financial Crisis

By

CHEN, Pimin

THESIS

Submitted to
KDI School of Public Policy and Management
in partial fulfillment of the requirements
for the degree of

MASTER OF PUBLIC POLICY

2015

Professor Tae-Hee Choi

Predicting Financial Distress:

A Case of Chinese Listed Manufacturing Companies during Financial Crisis

By

CHEN, Pimin

THESIS

Submitted to
KDI School of Public Policy and Management
in partial fulfillment of the requirements
for the degree of

MASTER OF PUBLIC POLICY

Committee in charge:

Professor Tae Hee CHOI, Supervisor

Professor Shun WANG

Professor Sang Moon HAHM

Approval as of July, 2015

ABSTRACT

Predicting Financial Distress: A Case of Chinese Listed Manufacturing Companies during Financial Crisis

By

Chen Pimin

As well know “world factory”, Chinese manufacturing sector is sensitive to foreign demand. Facing the substantially decreasing foreign demand during the 2008 financial crisis, many manufacturers encountered financial distress or even bankruptcy. Many factors may affect a firm to encounter financial distress, including the firm’s characteristics, performance, risk management, economic development and market trend. Financial distress prediction can function in the way of alarming in advance, correcting poor management, and building immune system. The purpose of this research is to differentiate the financial performance between healthy companies and distressed companies, and to determine factors which possess the ability to predict financial distress when the economy encounters depress.

In this paper, distressed manufacturing companies and healthy companies from both SSE and SZSE are examined during 2007-2008. Using logit regression model, the paper shows that liquidity, profitability and financial leverage possess significant powers to predict the probability of financial distress a company may encounter during financial crisis.

Moreover, healthy companies have better performance on profitability, liquidation with lower financial leverage than distress companies do.

ACKNOWLEDGEMENTS

My deepest gratitude goes first and foremost to my parents, Chen Jinjia and Lin Chai. Without them, I would not have come so far in my education. Secondly, I would also express my heartfelt gratitude to my supervisors, Professor Choi Tae Hee and Professor Wang Shun, for their professional guidance and patience in supervisions. Thirdly, I would also give special thanks to my professor at class of Advance Research Seminar, Professor Wook Sohn. Without his consistent and illuminating instructions, this thesis would not have reached its present form.

TABLE OF CONTENTS

LIST OF TABLES

1. Introduction

1.1 Background

Since China is well known for its manufacturing sector which accounts for half of China's GDP, widely known as "The World Factory," the health status of manufacturer plays a crucial role in Chinese economic development. Chinese manufacturing sector depends on exporting; thus, manufacturing companies are sensitive to foreign demand. Facing the substantially decreasing foreign demand during the 2008 financial crisis, many manufacturing companies encountered financial distress or even bankruptcy.

Before China's Reform and Opening up in 1978, state-owned and state holding enterprises were dominant in every industrial sector. Even though China started the reform of state-owned enterprises decades ago, state-owned enterprises still enjoy unfair advantages in many areas compared with private companies, especially in preferential lending treatment, fiscal subsidies and monopolies resources. In other words, financial distress is more costly and has more severe effects on private companies than on state-owned companies because the latter enjoy financial support from the government. Therefore, predicting the probability to encounter financial distress during financial crisis for private manufacturing companies is a *sine gua non* for success.

With rapid development of securities market in China, public private companies have been flourishing out. Certainly, stock markets have greatly broadened the financing channel and improved the level of management. However, factors, such as poor market strategy, high financial leverage or economy depression, also seriously damage the firms' ability to generate main revenue, leading to financial distress or even bankruptcy. Financial distress, a condition

that occurs when a firm is unable to fulfill the promises to pay off maturity debts, highlights shortcomings of a company's poor management and greatly harms the interests of corporations' shareholders and creditors.

According to the new regulations of Shanghai Stock Exchange (abbreviated as SSE) and Shenzhen Stock Exchange (abbreviated as SZSE) in 1998, the firms which encounters abnormal financial conditions would be treated specially by the Stock Exchange until their profitability was recovered. In April of 1998, "Liaoning Wuzi (000051)" became the first specially treated company by SZSE. Since then, the number of ST companies has been increasing year by year. In 2001, "TP Shuixian (600625)" became the first delisted company by China Securities Regulatory Commission (abbreviated as CSRC) because it was not able to improve its financial performance within required period. In recent two years, the number of ST companies sharply increased to 60 each year. The main reason CSRC stated is that their net profits are negative in two consecutive accounting years. In order to take ST hat off as soon as possible and return to normal listed companies, the special treatment gives listed companies huge pressure to improve the business operation, clean up toxic assets, and generate profit. However, it will be very costly for ST companies to take off the hat since the relationships among suppliers, customers, and investor have been seriously destroyed. In other words, compared with healthy ones, ST companies need to pay more to obtain the same level of profitability.

The health condition of listed companies will not only have great impact on interior operation management, but also closely linked with external relationship. Firstly, the health condition of listed companies will directly affect not only the performance in the securities

market but also the interests of investors. Once the CSRC announced the special treatment for a listed company, the stock price of the company would be crashed, severely damaging shareholders' value and undermining the interest of investors. Knowing the information that a company has a very high probability to fall distress in advance, the investors could take measures promptly to minimize the lost.

Secondly, the health condition of listed companies will also affect the credit policy from the suppliers. As we know, to stimulate the sales of products, suppliers may give certain period of credit to buyers or may accept non-cash payment from buyers, such as commercial paper or mortgaged-backed securities, allowing buyers to ease their instant liquidity strains. Therefore, predicting the financial distress a company may encounter in the future will allow its suppliers to take actions in advance, such as shortening the period of credit or only accepting the cash payment.

Thirdly, the health condition of listed companies will also affect the consumers' confidence. The special treatment from regulators may damage the reputation not only in the capital market but also in the competitive market among consumers, where consumers may easily switch their consumption to its competitors, thus making it more difficult to collect cash from products and generate enough revenue from operating activities.

1.2 Research Problem

In order to provide for managers, lenders and other investors the timely information about the health of private manufacturing corporations, this paper examines explanatory variables which possess significant predictive power to alert companies before they fall into financial distress. Clearly, many factors may affect the probability that a firm encounters

financial distress, including the firm's characteristics, performance, risk management, economic development and market trend. For example, Opler and Titman (1994) show that high level of financial leverage would significantly lead to financial distress. Liquidity on the other hand, possesses the ability to predict whether the firm is able to convert its assets into cash in time. [1] Moreover, during financial crisis, a firm may face inadequate loans from banks, decreasing market demand, and arising bad debts from accounting receivable, thus leading to financial distress. Therefore, how to objectively evaluate the listed manufacturing companies' financial status, how to compare which factors obtain the abilities to differentiate the financial performance between healthy companies and distressed companies, and how to determine and combine together with those factors to predict financial distress when the economy is depressed in the future are the main purposes of this paper.

1.3 Research Question

The main focus of this paper, therefore, is to determine the factors which have significant explanatory power to predict the probability of Chinese private manufacturing firms to encounter financial distress during financial crisis. Furthermore, another purpose of this paper is to objectively evaluate the listed manufacturing companies' financial status, and to compare which factors obtain the abilities to differentiate the financial performance between healthy companies and distressed companies.

1.4 Claim

The reason of financial distress the listed companies encounter may be a sudden debt

[1] Tim C. Opler and Sheridan Titman, "Financial Distress and Corporate Performance," *The Journal of Finance* 49, no.3 (1994):1015-1040, http://eds.b.ebscohost.com/eds/pdfviewer/pdfviewer?sid=6b1070cc- a743-42d8-a1fc-473ee19d9197%40sessionmgr110&vid=1&hid=105.

crisis or other unexpected problems. For example, British Bahrain Bank with a history of 223 years declared bankruptcy because of failure in its dealer's cogency in the stock index futures in 1995. Therefore, such unpredictable financial distress happens without any warnings. Another reason of financial distress may also be progressive financial deterioration. For example, before bankruptcy, W.T.Grand Company has been gradually deteriorated its financial status for many years, such as dropping accounts receivable turnover rate, and declining profit margins, leading to the fact that the bond price and stock price fell sharply. Therefore, such predictable financial distress happens gradually with obvious warnings.

Financial distress prediction can function in the way of alarming in advance, correcting poor management, and building immune system. A good financial distress prediction model can help managers comprehensively diagnose the troubles as well as formulate short-term, medium-term and long-term enterprise strategy, eventually making the enterprise out of the woods. Thus, combining these factors in our empirical models will strengthen our predictive power to alert the companies before they fall into financial distress and help managers to identify causes of distress and take measures to control these causes in advance.

2 Literature Review

2.1 Defining Financial Distress

How to define “financial distress” is a controversial issue in academic literatures. Financial distress prediction models should use the event of bankruptcy as the primary outcome, but also include the time when a company fails to meet its financial obligations[2]. Whitaker (1999) defines financial distress as the first year in which a firm's cash flow is less

[2] Mario Hernandez Tinoco and Nick Wilson, “Financial Distress and Bankruptcy Prediction Among Listed Companies,” *International Review of Financial Analysis* 30 (2013): 394–419, doi: 10.1016/j.irfa.2013.02.013.

than current maturities of long-term debt[3]. Certainly, a firm whose cash flow is not able to cover the debts will face a liquidity crisis that may lead the firm into costly financial distress. On the other hand, Asquith, Gertner and Scharfstein (1994) consider a firm financial distressed based on interest coverage ratios. More specifically, if in any two consecutive years, a firm whose earnings before interest, tax, depreciation, and amortization (EBITDA) is less than its reported interest expense, or if in any one year, whose EBITDA is less than 80 percent of its interest expense[4], will be financially distressed. Similarly, Andrade and Kaplan (1998) define financial distress as the first year that a firm's EBITDA is less than financial expenses[5]. In other words, a firm with low interest coverage ratios has higher probability to default. Jae Kwon Bae (2012) expands the definition of financial distress, and assets that financial distress is a term in corporate finance used to indicate a condition when promises to creditors of a company are broken or honored with difficulty[6].

Regarding the researches on the financial distress of Chinese manufacturing companies, many papers consider a firm falls into distress when the firm was specially treated by the stock exchange in the first place. Because according to Chinese regulations, when a company

---

[3] Richard Whitaker, "The Early Stages of Financial Distress," *Journal of Economics and Finance* 23, no.2 (1999): 123–132, http://eds.b.ebscohost.com/eds/pdfviewer/pdfviewer?sid=1caa56a1-f087-494f-bfbb-e1cb5cc5984d% 40sessionmgr113&vid=1&hid=105.

[4] Paul Asquith, Robert Gertner and David Scharfstein, "Anatomy of Financial Distress: An Examination of Junk-Bond Issuers," *Quarterly Journal of Economics* 109, no.3 (1994): 625–658, http://eds.b. ebscohost.com/eds/ pdfviewer/pdfviewer?sid=cf26eec3-291f-4f92-b6f5-5faab94c2d4f%40sessionmgr113&vid=1&hid=105.

[5] Gregor Andrade and Steven N. Kaplan, "How Costly Is Financial Not Economic Distress? Evidence from Highly Leveraged Transactions that Became Distressed," *Journal of Finance* 53, no.5 (1998): 1443–1493, http:// eds.b.ebscohost.com/eds/pdfviewer/pdfviewer?sid=ce649251-9dfd-4e76-9709-5a2be7084103%40sessionmgr198&vid=1&hid=105.

[6] Jae Kwon Bae, "Predicting Financial Distress of the South Korean Manufacturing Industries," *Expert Systems with Applications* 39, (2012): 9159–9165, www.elsevier.com/locate/eswa.

encounters loss in two consecutive years, the stock exchange will give the company a special treatment (we called such companies as the ST Companies). Another reason this paper regards special treatment from Stock Exchange as an indicator of financial distress is that Chinese stock markets have not built sound delisted system. In other words, even though the listed companies are seriously insolvent for years, delisting the companies never will be the first option. Instead, special treatment is one of common supervisions to urge the distress companies to improve their financial status. Chen (1998) selects 27 healthy companies and distressed companies respectively using the financial statement data from 1995 to 1997, and claims that debt ratio, returns on net assets, liquidity ratio, working capital ratio and total assets turnover possess the significant power to predict the financial distress three years before special treatment[7]. Wu and Lu (2001) adopt six explanatory variables using logistic regression analysis to predict the financial distress, and build the empirical model using financial statement data one year before special treatment:

$$Y = 0.3883 + 0.1065\ X1 - 2.7733\ X2 + 0.537\ X3 + 0.1970\ X4 - 0.3687\ X5 - 0.1388X6;$$

Where Y is the probability of financial distress, X1 is the profit increasing index, X2 is the returns on the total assets, X3 is the liquidity ratio, X4 is the ratio of long-term liability to stakeholders' equity, X5 is the working capital, X6 is the turnover of total assets[8].

2.2 Predicting Models

The financial distress predicting has long been of great interest to both scholars and

[7] Jing Chen, "An Empirical Analysis of the Listed Company Financial Deterioration Prediction," Accounting Analysis, no.4 (1999).

[8] Shinong Wu and Xianyi Lu, "Financial Distress Prediction Model Research on Chinese Listed Companies," Economy Research, no.6 (2001).

entrepreneurs based on empirical methods and historical data. Beaver (1966) first uses univariate analysis to predict corporate financial distress and find out that different financial ratios have different discriminant ability[9]. Recently, several methods have been applied to build prediction models, including discrimination analysis, neutral network and logistic regression. Discrimination function analysis is useful in determining whether a set of variables is effective in predicting category membership[10]. Beaver (1966) predicts the failure probability using the financial statement data of 79 failure companies and 1200 non-failed companies[11]. In a similar story, by using linear discrimination model named Z-score within five financial ratios, Altman (1968) finds that all firms having a Z score of greater than 2.99 clearly fall into the "non-bankrupt" sector, while those firms having a Z score below 1.81 are all bankrupt[12]. Similarly, Fitzpatrick studies financial distress of nonfinancial companies of USA listed in stock exchange. By using discrimination function analysis to check the financial condition of these companies, Fitzpatrick creates financial conditional score (FCS) and finds that financially distressed companies used equity more frequently than that of debt and those companies which covered operational loss from external sources failed against those companies which invested in funds[13].

---

[9] William Beaver, "Financial Ratios as Predictors of Failure," *Journal of Accounting Research* 4, no.3 (1966): 71-111, http://eds.b.ebscohost.com/eds/pdfviewer/pdfviewer?sid=a7050cf3-e99d-48d0-bce6-5a5b88515ee0%40sessionmgr 111&vid=1&hid=105.

[10] Samuel B. Green and Neil J. Salkind, *Using SPSS for Windows and Macintosh: Analyzing and Understanding Data* (New Jersey: Prentice Hall, 2008), 89.

[11] *IBID*

[12] Edward I. Altman, "Financial Ratios Discriminant Analysis and the Prediction of Corporate Bankruptcy," *Journal of Finance* 23, no.4 (1968): 589-609, http://eds.b.ebscohost.com/eds/viewarticle? data=dGJyMPPp44rp2%2fdV0%2bnjisfk5Ie46bNNtK%2bvTK%2bk63nn5Kx94um%2bT62otkewpq9Mnq64SLawsUqet8s%2b8ujfhvHX4Yzn5eyB4rO0SrSvs1Cyq7c%2b6tfsf7vb7D7i2Lt68t6kjN%2fdu1nMnN%2bGu6q0Tbaqs0qk3O2K69fyVe7a5F7z4ups4%2b7y&hid=105.

[13] P. Fitzpatrick, "A Comparison of the Ratios of Successful Industrial Enterprises with Those of Failed

However, Coats and Fant (1993) point out those two assumptions of MDA are particularly problematic:

First, MDA requires that the decision set used to distinguish between distressed and viable firms must be linearly separable. In the instance, however, where two ratios are considered together, the threshold separating the classification regions is a line; with more than two ratios, the threshold is a plane. Second, MDA does not allow for a ratio's signal to vacillate depending on its relationship to another ratio or set of ratios. In other words, ratios are treated as completely independent[14].

Summarily, those two assumptions are impractical and unrealistic in the real world. To avoid such assumption restrictions, Coats and Fant propose a "neural network" (NN) analysis of the same ratios used by MDA, and show that the NN models consistently correctly predict auditors' findings of distress at least 80% of the time over an effective lead time of up to four years[15]. A NN model consists of an interconnected group of artificial neurons, and processes information using a connectionist approach for computation. The advantages of NN over the statistical methods are often attributed to its strong mapping ability based on the network structure[16]. Compared with other statistical methods, the process of NN model construction need not consider the statistical relations among variables. Such an advantage of NN is supported by the conclusion of Lin (2009) that indicates NN can achieve higher prediction accuracy if the data does not satisfy the assumptions of the statistical approaches[17].

Companies," *The Accountants Publishing Company* (1932).

[14] Pamela K. Coats and Franklin L. Fant, "Recognizing Financial Distress Patterns Using a Neural Network Tool," *Financial Management* 22, no.3 (1993): 142-155, http://eds.b.ebscohost.com/eds/ pdfviewer/pdfviewer?sid=48c9ab75-d8ba-4f88-95cb-4525f60b194c%40sessionmgr114&vid=1&hid=105.

[15] *IBID.*

[16] Jie Sun, Hui Li, Qing-Hua Huang, and KaiYu He, "Predicting Financial Distress and Corporate Failure: A Review from the State-of-the-Art Definitions, Modeling, Sampling, and Featuring Approaches," *Knowledge-Based Systems 57,* no.2 (2014): 41-56, doi:10.1016/j.knosys.2013.12.006.

[17] T.H. Lin, "A Cross Model Study of Corporate Financial Distress Prediction in Taiwan, Multiple Discriminant Analysis, Logit, Probit and Neural Networks Models," Neurocomputing 72, no.16-18 (2009): 3507–3516, http://refhub.elsevier.com/S0950-7051(13)00386-9/h0360.

However, neutral network is not good at explanation for specific explanatory factors[18]. Compared to statistical methods, far more sample data are needed to train a relatively stable. NN model, and too much duplication of training easily leads to over-fitting, which decreases the stability of cross-sample prediction[19]. In addition, NN is often criticized by practitioners for its difficulty of understanding because the complex network structure seems to be a black-box for the decision makers[20]. Therefore, logistic regression model has been widely applied. Ohlson (1980) builds a risk prediction model using logistic analysis associated with Multiple Discriminant Analysis (MDA) with the data between 1970 and 1976, and concludes that the predictive powers of linear transforms of a vector of ratios seem to be robust across estimation procedures[21]. Unlike Multiple Discrimination Analysis, the logistic regression model seems easier to understand since the logistic score, taking a value between 0 and 1, was interpretable in a probabilistic way[22]. On one hand, the Logistic model could be applied to predict the Financial Distress for its binary dependent variable, which is known as the probability to be financially distressed. On the other hand, the independent variables in the Logistic model do not need to follow the assumption of normal distribution and equal covariance.

---

18 Pamela K. Coats and Franklin L. Fant, "Recognizing Financial Distress Patterns Using a Neural Network Tool," 142-155.

19 Jie Sun, Hui Li, Qing-Hua Huang, and KaiYu He, "Predicting Financial Distress and Corporate Failure: A Review from the State-of-the-Art Definitions, Modeling, Sampling, and Featuring Approaches," 41-56.

20 *IBID.*

21 James A. Ohlson, "Financial Ratios and the Probabilistic Prediction of Bankruptcy," *Journal of Accounting Research* 18, no.1 (1980): 109-131, http://eds.b.ebscohost.com/eds/pdfviewer/pdfviewer? sid=80459736-2f4b-43b7-a3d0-82a46a8d1566%40sessionmgr114&vid=1&hid=105.

22 Jae Kwon Bae, "Predicting Financial Distress of the South Korean Manufacturing Industries," 9159–9165.

2.3 Explanatory Variables

2.3.1 Financial Leverage

Besides the different methodologies are applied to the researches, the precision of the predictive model also depends on the explanatory variables we choose. Particularly, financial leverage has been the most discussed factor resulting in financial distress recently. Opler and Titman find a positive relationship between financial leverage and firm performance during a financial crisis. They claim that highly leveraged firms lose substantial market share to their more conservatively financed competitors and are suffering the most in times of economic downturns[23]. In other words, compared with conservatively financed firms, highly leveraged companies bear more financial burdens which may lead them to liquidity crisis when economy goes down. Andrade and Kaplan (1998) find that high leverage is the primary cause of distress. Poor firm performance and, then, poor industry performance play much smaller roles[24]. Similarly, Graham et al. (2011) advocates for a positive relationship between financial leverage and financial distress during times of a financial crisis together with Moody's EDF model and the traditional trade off theory which value a heavily borrowing capital structure during times of financial crisis as to reduce financial flexibility and increase the probability to encounter financial distress[25]. In other words, without the high financial leverage, the sample firms in their paper would stay healthy compared to other firms in the industry.

Different from theories that consider positive relationship between financial leverage

[23] Tim C. Opler and Sheridan Titman, "Financial Distress and Corporate Performance," 1015-1040.

[24] Gregor Andrade and Steven N. Kaplan, "How Costly Is Financial Not Economic Distress? Evidence from Highly Leveraged Transactions that Became Distressed," 1443–1493.

[25] John. R Graham, "Financial Distress in the Great Depression," *The Journal Financial Management* 40, NO. 4 (2011): 821-844, http://www.nber.org/papers/w17388.

and probability of financial distress, the traditional trade-off theory states the importance to balance between the costs of debt and the tax saving benefits of debt. The trade-off theory asserts that a firm chooses the optimal proportion of debt finance and equity finance to weight cost and benefits. More specifically, on one hand, the major advantage for debt financing lies the fact that interest on debt is tax deductible compared to other external financing. On the other hand, the major disadvantage of debt financing is an increased risk to encounter financial distress related to debt financing and additional bankruptcy. The trade-off theory argues for an optimal capital structure consisting of an appropriate level of borrowing and equity. Farma and French (2002) test the predictions of the traditional trade-off theory for U.S nonfinancial firms during 1965-1999, and show that more profitable firms have less market leverage together with firms with more investment opportunities[26]. Fama and French (2002) assert that profitable firms with many investment opportunities will not take on as much debt as less profitable firms[27]. In conclusion, the trade off theory states that, while taking advantage of the tax shield benefit from debt financing, firms need pay extra attention on carefully design the capital structure so that the distance between the tax benefit and the cost of future financial distress is in optimum.

Even though financial leverage has been considered as an indispensible factor to financial distress, other factors might also contribute to financial distress. This study tests the hypothesis:

H1= Financial leverage possess the ability to predict the probability to encounter

[26] Eugene F. Fama and Kenneth R. French, "Testing Trade-Off and Pecking Order Predictions About Dividends and Debt," *Oxford Journals, Review Financial Studies 15*, no. 1(2002): 1-33, doi: 10.1093/rfs/15.1.1.

[27] *IBID*

financial distress.

2.3.2 Liquidity

Liquidity is defined as the ability to convert an asset to cash quickly at a price that is close to its fair value.[28] Current asset is defined as those assets that are expected to be converted into cash within one year in the normal course of business, including cash, accounts receivable, inventory, marketable securities, prepaid expenses and other liquid assets that can be readily converted to cash[29]. Meanwhile, quick assets obtain higher level of liquidity, including cash and cash equivalent, marketable securities, and accounts receivable, which presumably can be quickly converted to cash at close to their book values.

Platt (1999) argues that current and fixed assets have different bankruptcy characteristics. The current assets usually yield relatively lower returns, but at the same time are exposed to a lower bankruptcy risk than fixed assets[30]. On the other hand, fixed assets have a higher bankruptcy risk because they are less liquid, but at the same time are associated with higher return potential[31].In other words, an increase in liquid assets will reduce the earnings of assets while a decrease in liquid assets will improve the bankruptcy risk, thus both results will increase the probability to default. Therefore, Platt (1999) argues that bankruptcy can eventuate from a firm's asset mix being too heavily weighted towards either current or fixed assets[32]. John (1993) analyzes the relationship between the costs of financial distress and the

[28] "Market Liquidity," Wikipedia, the free encyclopedia, accessed DEC 27, 2013, http://en.wikipedia.org/wiki/Market_liquidity.

[29] Teresa. A John, "Accounting Measure of Corporate Liquidity, Leverage and Cost of Financial Distress," *Journal of Financial Management 22*, No. 3(1993): 91-100, http://www.jstor.org/stable/3665930.

[30] H.Platt, Why Companies Fail: Strategies for Detecting, Avoiding and Profiting from Bankruptcy (The US: Beard Books, 1999).

[31] *IBID.*

[32] *IBID*

level of maintained corporate liquidity. She declares a firm to be financial distressed when the currently available liquid assets are severely inadequate to meet the current obligations of its hard financial contracts[33]. In the same respect, Graham measures liquidity as the ratio of a firm's current assets, also called liquid assets to total assets. The ratio shows how much of a firm's assets that are convertible into cash within one year in the normal course of business[34]. Thus, this ratio is used to capture the degree of liquidity.

To test whether liquidity significantly affects the probability of financial distress, the paper tests the hypothesis as below:

H1= Liquidity possess the ability to predict the probability to encounter financial distress.

2.3.3 Profitability

Profitability, which reflects the final result of business operation, is the primary goal of all business. None of enterprise could survive without the ability to generate profits. Opler and Titman (1994) argue that the probability to encounter financial distress is directly linked with the loss in sales indicating that a decrease in profitability contributes to a decrease in the overall confidence in the firm's products. Consequently, the reduced confidence results in costumer loss from the increasingly competitive market, which thereby improves the probability that a firm may encounter financial distress[35]. Thus, profitability is a strong indicator to maintain the confidence from investors and consumers. Sufficient evidence is

[33] Teresa A. John, "Accounting Measure of Corporate Liquidity, Leverage and Cost of Financial Distress," *91-100*.

[34] John R. Graham, Sonali Hazarika, and Krishnamoorthy Narasimhan, "Financial Distress in the Great Depression," *The Journal Financial Management* 40, NO. 4(2011): 821-844, http://www.nber.org/papers/w17388.

[35] Tim C. Opler and Sheridan Titman, "Financial Distress and Corporate Performance," 1015-1040.

found that the lack of profitability is strongly related to bankruptcy which goes along with Altman's theory that profitability is one of the major factors possessing the ability to predict financial distress[36].

Storey et al. (1987) test the relationship between profitability and size, and determine an opposite effect where small firm's profitability decreases with a decrease in size, whereas large firms tend to increase their profitability with a decrease in size[37]. Additionally, Storey et al. advocate that the current profitability of a small growing firm does not necessarily reflect its "true" profitability and therefore not contributes to an increased risk of encounter financial distress[38]. On the other hand, Graham et al. measure the profitability of a firm as a ratio between earnings before interest and tax and total assets. This ratio is one of the most important measures since it captures the efficiency of operations regardless of how capital is financed as the financial costs are not included[39]. Hence, the hypothesis which is further tested is:

H1= Profitability possess the ability to predict the probability to encounter financial distress

Granted, several scholars have argued that a sudden change in an external environment during an economic crisis, such as domestic and foreign demand dropped without any notice, or the accessibility of financial resource from creditors and investors suddenly shrinked, will

---

[36] T. Shumway, "Forecasting Bankruptcy More Accurately: A Simple Hazard Model," *The Journal of Business 74, No. 1* (2001)*:101-124.* http://ssrn.com/abstract=171436.

[37] David J. Storey, Kevin Keasey, Pooran Wynarczyk, and Robert Watson, "The Performance of Small Firms: Profits, Jobs and Failures," *University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship*, (1987) http://ssrn.com/abstract=1496201.

[38] *IBID*

[39] John R. Graham, Sonali Hazarika, and Krishnamoorthy Narasimhan, "Financial Distress in the Great Depression," 821-844.

make the individual financial distress prediction models biased and meaningless. Specifically, they claim that during financial crisis even healthy companies which were considered before the crisis may encounter financial distress or even bankruptcy. Davies (1962) argues that in an economic downturn many people experience injustice and frustration because they no longer have things valued in the past[40]. Indeed, financial crisis will make investors lose every confidence in the market and the assets they hold. Once they scrambled to collect money by dumping assets, the price of assets would drop sharply, contributing to more serious financial distress. Certainly, it is true that an economic distress may drag a healthy company into financial distress; however, more firms enter financial distress as the result of poor management rather than economic distress. Economic distress just accelerates such process. For example, the companies having poor management, like high financial leverage, may face greater uncertainty and volatility from the external surroundings. Opler and Titman also find that most high leveraged companies bear higher interest expenditure, thus lacking financial flexibility and easily being attacked by low liquidity[41] resulting from the economy distress. From this prospective, combining the factors inside and outside the firm makes the predicting models more precise.

2.4 Methodology

The predicting model this research adopts is the logistic approach suggested by Graham et al.

A logistic regression model is a regression analysis used when a binary dependent

[40] James C. Davies, "Toward A Theory of Revolution," *American Sociological Review* 27, no.1 (1962): 5–19, http://www.jstor.org/stable/2089714.

[41] Tim C.Opler and Sheridan Titman, "Financial Distress and Corporate Performance," 1015-1040.

variable is classified into one of two groups using explanatory variables[42]. Logistic regression can examine whether there is significant relationship between a binary dependent variable and independent variables. The binary dependent variable is just able to have two values which for this study are 1 (distress) or 0 (non-distress)[43]. The explanatory factors include financial status, overall industrial performance, and macro economic development. The model can be constructed in the following way:

$$Y\,(1,0) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_i X_i + u \qquad (1)$$

Y is the binary dependent variable, α is an intercept and βs show the impacts of independent variables Xn. Based on prior researches, independent variables Xi include leverage (debt/equity), liquidity (current assets/total assets, net cash flow from operating activities /current liability), profitability (EBIT/total assets, net income/total revenue), and size (total assets).

While estimating the logistic regression, the probability functions are used to determine which factors possess the ability to predict whether a firm is likely to encounter financial distress. Because the observed values of Y and X do not follow a normal distribution (showed next part) and the predicted probability must satisfy [0,1], we reform the equation (1) as following (writing β and Xi for the column vectors $(\beta_0, \beta_1, \beta_2, \ldots\ldots \beta_p)'$ and $(1, X_{1i}, X_{2i}, \ldots\ldots X_{p1})'$:

$$Y = \mathrm{Ln}\left(\frac{P_i}{1-P_i}\right) = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_p X_{pi} + u$$

$$P_i = \frac{\exp(X_i'\beta)}{1+\exp(X_i'\beta)}$$

[42] Russell Davidson and James G. MacKinnon, *Econometric Theory and Methods* (London: Oxford University Press, 2004), 451.

[43] *IBID*

Mantel et al. claim that an additional positive characteristic of the logistic regression is the non-requirement of normal distributed data[44], something is rare that the case concerning financial data.

2.5 Significance

It is important for lenders, investors and managers to timely know that whether a company is financially healthy or has a minimal risk of default. Firstly, for lenders, developing effective predicting models could help them to set the required minimal interest rate to get correspondingly risk premium. Secondly, for shareholders, developing accurate predicting models could enable them to calculate the volatility of stock price and better supervise to improve the management, thus recognizing risk ahead, adjusting and reallocating their investment portfolios. Thirdly, this research may have many implications for managers to improve the ability to identify causes of distress and take measures to control these causes in advance. For example, using the model, managers can adjust the financial leverage and collect sufficient cash flow at early stage to meet debt payment before falling to financial distress.

3. Analysis and Discussion

3.1 Determination of sample

The majority of ST companies are highly related with their poor financial performance in consecutive two years. Thus, in this paper, we consider a firm financially distressed when the firm is specially treated by the stock exchange. (According to Chinese regulations, when a company encounters consecutive two- year loss, the stock exchange will give the company a

[44] Nathan Mantel and Charles Brown, "Alternative Tests for Comparing Normal Distribution Parameters Based on Logistic Regression," *Biometrics 30,* No. 3(1974): 485-497, http://www.jstor.org/stable/2529202.

special treatment (called ST Company) to alarm investors about the high risk to default). This article selects 44 manufacturing ST companies from both SSE and SZSE during 2007-2008 as the research objects. These firms are further investigated to determine which firms are healthy two years before financial crisis but encounter distress while were specially treated in the first place during investigating period. To stimulate the proportion of ST companies to healthy companies in the stock markets, this paper tries to find out 132 healthy manufacturing companies which obtain comparable assets with ST companies. To be more specific, firstly, this article eliminates the healthy companies whose range of total assets exceeds that of ST companies. Secondly, we find out that there are 11 distressed companies listed in SZSE, and 33 distressed companies listed in SSE. Thirdly, to stimulate such distribution of distressed companies, this article uses the "data distribution function- sampling" from Excel to randomly select 33 healthy companies listed in SZSE and 99 healthy companies listed in SSE from our refined data base.

This paper focuses on the time three years before financial crisis happened. One reason is that the longer period we use, the less accurate of prediction will be since the precision of prediction model is very sensitive to external changes. Another reason this paper focuses on three years before financial distress is that it is enough time for managers to take necessary measures to improve their financial performance if our logistic model has significant predictive power. The following shows the manufacturing companies we select in our dataset:

Table1: Data Sample

Distressed firms	Healthy firms		
000657	000035	600201	600600

000673	000050	600231	600601
000725	000066	600235	600605
000799	000401	600238	600615
000920	000425	600249	600617
000922	000513	600255	600619
000935	000522	600276	600633
000971	000559	600290	600658
000982	000565	600293	600660
200160	000569	600309	600671
200512	000598	600331	600676
600057	000609	600355	600680
600080	000612	600356	600688
600094	000620	600366	600725
600139	000659	600380	600731
600155	000661	600388	600737
600198	000676	600397	600747
600207	000731	600398	600760
600212	000807	600408	600764
600217	000810	600409	600765
600329	000852	600423	600768
600372	000901	600425	600781
600401	000912	600468	600782
600462	000923	600485	600789
600466	000957	600486	600794
600552	000970	600486	600809
600568	002003	600487	600812
600579	002008	600499	600815
600599	002009	600523	600829
600604	002018	600529	600850
600608	002025	600530	600850
600610	002036	600537	600888
600699	600059	600550	600963
600716	600061	600559	600978
600722	600077	600560	600987
600757	600081	600565	002019
600792	600103	600565	600127
600793	600107	600580	600346

600854	600111	600582	600363
600870	600117	600584	600389
600876	600130	600590	600539
600984	600143	600592	600580
600988	600151	600596	600626
900953	600163	600597	600689

3.2 Logistic Regression

3.2.1 Data Description

Our dataset consists of 44 distressed manufacturing companies and 132 healthy manufacturing companies during 2007-2008 financial crisis. Data is taken from China Stock Market & Accounting Research (CSMAR Database). Besides independent variables we discussed before, here we include control variables to mitigate the effect of omitted variables. These are PMI index to capture the convergence hypothesis that a country with more thriving manufacturing sector tends to have lower chance for manufacturing firms to encounter financial distress than a country with lower value of PMI index, GDP growth rate to capture the effect of economy expanding on the probability of financial distress, and total assets to capture the convergence hypothesis that companies with larger size are less likely to fall into financial distress.

Table2: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Current Ratio	528	1.3599	1.1988	0.0230	17.6773
Quick Ratio	528	0.9483	0.9444	0.0222	11.0597
Cash Ratio	528	0.0188	2.7406	-62.5108	1.8897
Leverage	528	1.4128	2.8609	-32.4321	30.0635
EBIT Ratio	528	0.0243	0.1791	-1.6742	1.4281
Profit Ratio	527	-0.0553	1.3961	-27.0535	11.1626
Lnassets	528	21.1170	0.8658	18.4933	24.1408
PMI	528	51.3000	1.0718	49.9000	52.5000

GDP	528	11.3667	1.0635	10.1000	12.7000

3.2.2 Sample Distribution Test

Before moving to the logistic regression, this paper uses “Shapiro-Wilk” to check whether our variables are following normal distribution.

Table3: The Results of Shapiro-Wilk W Test for Normal Data

Variable	Obs	W	V	z	Prob>z
Current Ratio	528	0.5605	155.2830	12.1580	0.0000
Quick Ratio	528	0.5931	143.7700	11.9720	0.0000
Cash Ratio	528	0.0536	334.4080	14.0060	0.0000
Leverage	528	0.4689	187.6380	12.6140	0.0000
EBIT Ratio	528	0.5407	162.2690	12.2640	0.0000
Profit Ratio	527	0.1521	299.0710	13.7360	0.0000
Lnassets	528	0.9957	1.5270	1.0190	0.1540
PMI	528	0.9824	6.2230	4.4060	0.0000
GDP	528	0.9979	0.7570	-0.6720	0.7493

From the table, at 1% significant level, except Lnassets and GDP, the Z value of the rest of variables is larger than its critical value, which means our majority explanatory variables are not significantly following normal distribution, as a result, we can’t use T test to determine whether there is significant difference of explanatory variables between non-distressed group and distressed group. Because the observed values of Y do not follow a normal distribution and the predicted probability must satisfy [0, 1], our model reforms as following:

$$Y = Ln\left(\frac{P_i}{1 - P_i}\right) = \alpha + \beta 1X1i + \beta 2X2i + \cdots + \beta pXpi + u$$

3.2.3 Correlation between variables

Multicollinearity is a statistical issue which occurs when several independent variables in a multiple regression model are closely correlated to one another. It does not affect how the overall independent variables predict the dependent variable, but it may give incorrect

results about how the individual independent variable affects the dependent variable[45].

Table4: Pairwise Correlations Matrix

Variables	Current Ratio	Quick Ratio	Cash Ratio	Leverage	EBIT Ratio	Profit Ratio	Lnassets	PMI	GDP
Current Ratio	1								
Quick Ratio	0.9632	1							
Cash Ratio	-0.0312	-0.051	1						
Leverage	-0.1566	-0.1601	0.0087	1					
EBIT Ratio	0.1779	0.1839	-0.3141	0.1214	1				
Profit Ratio	0.0611	0.0555	0.002	0.1338	0.6539	1			
Lnassets	-0.2032	-0.2216	0.0958	-0.0216	0.0866	0.0292	1		
PMI	0.0169	0.0202	0.051	-0.0217	0.033	0.0163	-0.0049	1	
GDP	0.0401	0.0445	-0.0052	-0.0191	-0.078	-0.0164	-0.051	0.4219	1

The interpretation of the correlation matrix is done using a rule of thumb which states correlation between the independent variables ranging between -0.7 and +0.7 will not affect the regression analysis[46]. Our results show that, except the correlation between current ratio and quick ratio, correlations among other variables rang within the intervals and thus the Multicollinearity risk is low.

3.2.4 Mean Difference Test

From the first step, we know our variables are not following normal distribution. Thus, this article selects the nonparametric test---Wilcoxon test, to find out the differences between control group and ST group.

Table5: The Results of Two-Sample Wilcoxon Rank-Sum (Mann-Whitney) Test

[45] S.Körner and L.Wahlgren, Mer om regression Statistisk Dataanalys (Lund: Studentlitteratur AB,2006), 386.

[46] Stephanie Göransson and Thomas Hernqvist, "Encounter Financial Distress in the Crisis 2008-2009,"(master's thesis, Lunds university, 2012, 31), http://lup.lub.lu.se/ student-papers/record/2798127.

Variables	Healthy		Distressed		Difference		
	Mean	SD	Mean	SD	Mean Difference	Z-Value	P-Value
Current Ratio	1.5223	1.3125	0.8725	0.5171	0.6499	8.8450	0.0000
Quick Ratio	1.0711	1.0350	0.5797	0.4192	0.4914	8.0060	0.0000
Cash Ratio	0.0094	3.1640	0.0472	0.1681	-0.0379	6.8880	0.0000
Financial Leverage	1.1326	1.0184	2.2533	5.3711	-1.1207	-6.6450	0.0000
EBIT Ratio	0.0603	0.1191	-0.0836	0.2659	0.1439	11.4300	0.0000
Profit Ratio	0.0765	0.5814	-0.4498	2.5690	0.5262	11.7430	0.0000
Lnassets	21.1053	0.8552	21.1519	0.8994	-0.0466	-0.9730	0.3306

Except Lnassets, P values of the rest of our explanatory variables are smaller than the 5% significant level, which means our explanatory variables are significantly different between non-distressed group and distressed group within comparable assets.

Overall, non-distressed companies show higher average value of our financial indicators, indicating that, on the whole, healthy companies have better performance on profitability, liquidation with lower financial leverage. Furthermore, distressed firms show negative EBIT ratio and profit ratio, indicating that poor profitability may seriously damage their ability to repay debts.

3.2.5Logistical Regression

We estimate the following regression model:

$$Y = \mathrm{Ln}\left(\frac{P_i}{1-P_i}\right) = \alpha + \beta_1 \text{Quick Ratio}_{1i} + \beta_2 \text{Cash Ratio}_{2i} + \beta_3 \text{Leverage}_{3i} + \beta_4 \text{EBIT Ratio}_{4i} + \beta_5 \text{Income Ratio}_{5i} + \beta_6 \text{Lnassets}_{6i} + \beta_7 \text{PMI}_{7i} + u$$

Quick Ratio=Quick Assets/Current Assets;

Cash Ratio=Net Cash Flows from Operating Activities / Current Assets;

Leverage=Total Liability/Total Equity;

EBIT Ratio=EBIT/Total Assets;

Income Ratio=Net Income/Operating Revenue;

Where $i = 1,2,...,n$ is a company index. Both *Quick ratio* and *Cash Ratio* are indicators of liquidity. Quick ratio is equal to the rate of quick assets to current liabilities, whereas Cash Ratio is measured by net cash flows from operating activities to current liabilities. *Leverage* is a measure of the quality of financial status, a degree utilizing debts to finance assets. *EBIT Ratio* is an essential indicator of profitability, a measure of ability that assets have to generate earnings before interest and tax. *Income RATIO* is a measure of contribution to profit from main revenue. *Lnassets* is an indicator of a company's size. *PMI* is an abbreviation of purchasing managers index, reflecting the overall change of manufacture sector activity. We expect that $\beta_1 < 0$: the higher quick ratio, the higher liquidity, less likely fell into distress; $\beta_2 < 0$: the higher cash ratio, higher ability to meet maturing debt obligations, less likely fell into distress; $\beta_3 > 0$: the higher financial leverage, higher probability to default ; $\beta_4 < 0$: the higher EBIT ratio, the higher efficiency using assets leads to higher profitability, less likely to be distressed; $\beta_5 < 0$, higher net income from main revenues, higher ability to generate profit, less likely to default; $\beta_6 < 0$ larger size of company, less likely to be distressed; $\beta_7 < 0$ lager PMI, better external environment for companies to expand, less likely to fall into distress; $\beta_8 < 0$ higher economy growth rate, less likely to be distressed.

Table6: Logistical Regression Results

Variables	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
Quick Ratio	-1.1411***	0.3273	-3.49	0.0000	-1.7825	-0.4997

Cash Ratio	-0.2623**	0.1070	-2.45	0.0140	-0.4719	-0.0526
Financial Leverage	0.1740***	0.0611	2.85	0.0040	0.0544	0.2937
EBIT Ratio	-11.6316***	1.7385	-6.69	0.0000	-15.0389	-8.2242
Profit Ratio	0.3336	0.2033	1.64	0.1010	-0.0649	0.7320
Lnassets	0.0810	0.1456	0.56	0.5780	-0.2044	0.3663
PMI	0.2259*	0.1278	1.77	0.0770	-0.0245	0.4763
GDP	-0.1892	0.1271	-1.49	0.1360	-0.4383	0.0598
_cons	-11.4658*	6.7646	-1.69	0.0900	-24.7242	1.7926

Notes: ***, ** and * indicate significance at 1%, 5% and 10% respectively.

The logistic regression table displays the estimated coefficients, standard error of the coefficients, z-values and p-values together with a 95% interval of the odds ratio. As we see from the table, in the 10% significant level, quick ratio, cash ratio, financial leverage, EBIT ratio and PMI Index could be good indicators which have significant effects on the probability that a firm may fall into distressed condition. In the case the p-value of the statistics profit ratio, assets and GDP is insignificant, suggesting that there is not sufficient evidence to reject the null hypothesis where the predictor coefficient is equal to zero.

3.3 Results Discussion

3.3.1 Liquidity

In order to capture the influence of liquidity on the probability of a company encountering distress, liquidity is measured in two different perspectives. On the one hand, the quick assets, including cash, marketable securities and accounts receivable, could be liquidated into cash at book value in a short time. Consequently, quick ratio is a major indicator of the ability to repay the short-term debt obligations, thus determining whether a company encounters financial distress in the short term. Even if the company shows ability to pay the debt in the long run, the coming-due debt default still will drag the company into

distress, or even bankruptcy. Our model shows that there is significant relationship between the quick ratio and the probability of financial distress. The coefficient is equal to -1.1411, the higher the quick ratio, the stronger ability to repay the short term debt, then less likely to be distress, which is also supporting the convergence hypothesis.

On the other hand, liquidity is also measured in its ability to generate cash flow from operating activities to cover current liabilities. According to the results of our logistic regression, cash ratio significantly affect the probability of financial distress at 5% level, which means sufficient cash reserves are essential financial resources to ensure the payment of over-due debt. In our model, the coefficient is equal to –0.2623, which means the larger amount of cash generated, less likely to fall into distress. Therefore, the ability of an enterprise to repay due debts not only depends on the quick assets, but also depends on reserving enough cash.

3.3.2 Financial Leverage

There is a traditional trade-off theory in determining an optimal debt level between the advantages and disadvantages of borrowing money. On one hand, financial leverage could increase the shareholder's returns on investment by not issuing more shares of stocks. The company could also be benefited from tax advantages associated with borrowing. On the other hand, related to prior research, financial leverage used to be a major contributor to financial distress. For example, Graham et al. (2011) advocate that according to their results, it is only financial leverage and credit rating which possess the ability to predict financial distress.[47] Our paper shows consistent results, the financial leverage possesses the significant

[47] John R. Graham, Sonali Hazarika, and Krishnamoorthy Narasimhan, "Financial Distress in the Great Depression," 821-844.

power to predict the probability to encounter financial distress at the 1% significant level, with the argument Graham made. More specifically, a heavily leveraged company could be more vulnerable to a financial crisis, possessing a higher risk of encountering financial distress。

3.3.3 Profitability

In order to determine whether profitability possess the ability to predict the probability of encounter financial distress, our research considers earnings before interest and tax on total assets as explanatory variable of distress. The test produces significant results which imply that EBIT ratio is also a significant factor which obtains strong ability to predict the probability of financial distress. EBIT is one of the main available financial sources to satisfy stakeholder's interests. In other words, a low or negative EBIT ratio implies that the firm is less likely to meet stakeholder's interests. Specifically, if the enterprises have inability to generate EBIT in long term, their solvency will become worse, leading to financial trouble. Therefore, generating sufficient earnings before tax and interest is an essential way to keep adding values into enterprises' stakeholders. From our table, the absolute value of the coefficient is the highest among our independent variables, which equals to -11.6316, indicating that EBIT ratio is an essential factor to affect the probability of financial distress.

3.3.4 The PMI Index

In order to capture the effect of external manufacturing industry on the financial distress of the sample manufacturing companies, our paper tests that whether PMI index has significant power to predict the probability of encounter financial distress. Our results show that the impact of PMI also has significant predictive power on the probability of financial

distress at 10% significant level. Surprisingly, the coefficient is equal to 0.2259, indicating that the higher values of PMI before financial crisis, the higher probability for a company to encounter financial distress later during our investigated period, contracting our hypnosis. The reason might be that when manufacturing sector is booming, investors or managers become over optimistic about their investment. They borrow more money to purchase new machines, hire more labors and enlarge their product lines. However, once external environment suddenly worsen such as financial crisis drive down the domestic and forensic demand, it will be more difficult for them to change the operation, collect fully receivables, reduce the fixed cost or shrink their supply.

Therefore our model is:

$$Y = \mathrm{Ln}\left(\frac{P_i}{1-P_i}\right) = -11.4658 - 1.1411\text{Quick Ratio}_{1i} - 0.2622\text{Cash Ratio}_{2i}$$
$$+0.174\text{Leverage}_{3i} - 11.6316\text{EBIT Ratio}_{4i} + 0.2259\text{PMI}_{5i} + u$$

3.4 Model Test

Table7: Classification Table

ST	Predicted	Correct	Percentage Correct
0	132	127	96.21%
1	44	38	86.36%

Our empirical model could successfully estimate 38 distressed companies to encounter financial stress during financial crisis among 44 distressed companies. The percentage precise is approximately equal to 86.36%. Using our model, we can accurately diagnose 127 healthy companies among 132 non- distressed companies. The percentage precise is 96.21%. Overall, among 176 distressed and non-distressed companies, our model could successfully predict that whether 165 companies encounter financial distress. The overall percentage precise is equal to 93.75%.

4. Conclusion

In order to provide for managers, lenders and other investors the timely information about the health of private manufacturing corporations, this paper examines explanatory variables which possess significant predictive power to predict the probability of Chinese private manufacturing firms to encounter financial distress during financial crisis. Furthermore, another purpose of this paper is to objectively evaluate the listed manufacturing companies' financial status, and to compare which factors obtain the abilities to differentiate the financial performance between healthy companies and distressed companies.

This article selects 44 manufacturing ST companies and 132 healthy companies from both SSE and SZSE during 2007-2008 as the research objects. According to Chinese regulations, when a company encounters loss in consecutive two years, the stock exchange will give the company a special treatment. Thus, this paper considers a firm financially distressed when the firm was specially treated by the stock exchange in the first place during our investigating period.

Using logistic regression model, our paper shows that liquidity, profitability and financial leverage possess significant powers to predict the probability of financial distress a company may encounter during financial crisis. The results show that our explanatory variables are significantly different between non-distressed group and distressed group within comparable assets, indicating that there is significant different financial performance between healthy firms and distressed firms. Furthermore, our research also finds that healthy companies have better performance on profitability, liquidation with lower financial leverage than distressed companies do. In addition,

Firstly, liquidity is defined as the ability to convert assets into cash within one year at price close to its fair value. Platt (1999) advocates that the risk of financial distress is directly related to the firm's mix of assets indicating that a firm increases its risk to encounter financial distress does not necessarily have to depend on being heavily weighted towards fixed assets but also towards current assets[48]. In order to capture the influence of liquidity on the probability of a company encountering distress, liquidity is measured in two different perspectives. On the one hand, according to logistic regression results, quick ratio is significant at 1% level, further indicating that the more quick assets a firm has in its total assets, the less likely the firm may encounter financial distress. Thus quick ratio is a major indicator of the ability to repay the short-term debt obligations, thus determining whether a company encounters financial distress temporarily. On the other hand, as another indicator of liquidity, cash ratio, a ratio of Net Cash Flows from Operating Activities to current assets, significantly affect the probability of financial distress at 5% level, indicating that sufficient cash reserves are essential financial resources to ensure the payment of over-due debt. Therefore, the ability of an enterprise to repay due debts not only depends on the quick assets, but also depends on reserving enough cash.

Secondly, there is contradicting views about the effect of financial leverage on financial distress. On the one hand, according to prior researches, financial leverage has been considered as a major contributing factor to financial distress. Graham et al. (2011) advocate that it is only financial leverage and credit rating which possess the ability to predict financial distress[49]. On the contrary, the traditional trade-off theory states the importance to balance

[48] Harlan David Platt, Why companies fail.

[49] John R. Graham, Sonali Hazarika, and Krishnamoorthy Narasimhan, "Financial Distress in the Great

between the costs of debt and the tax saving benefits of debt. In other words, the trade-off theory argues for an optimal capital structure consisting of an appropriate level of borrowing and equity. However, our empirical results show financial leverage is significant at 1% level, indicating that a heavily borrowed company could be more vulnerable during a financial crisis, thus leading to a higher risk of encountering financial distress.

Thirdly, reflecting the final result of business operation, profitability is the primary goal of all business. EBIT ratio, a ratio of earnings before interest and tax to total assets, is one of the main available financial sources to satisfy its stakeholder's interests and capital appreciation. The results show that EBIT ratio is also a significant factor at 1% level, possessing strong ability to predict the probability to be distressed.

Lastly, our empirical results also show that there is significant positive relationship between PMI index and the probability of encounter financial distress at 10% level, indicating that the probability of financial distress a company may fall becomes higher when the manufacturing economy abruptly depressed after years of booming. However, our paper shows that the firm's size doesn't affect the probability of encountering financial distress since our distressed companies and healthy companies have comparable assets.

Depression," 821-844.

Bibliography

Altman, Edward I. “Financial Ratios Discriminant Analysis and the Prediction of Corp orate Bankruptcy.” *Journal of Finance* 23, no.4 (1968): 589-609. http://eds.b.ebsco host.com/eds/viewarticle? data=dGJyMPPp44rp2%2fdV0%2bnjisfk5Ie46bNNtK%2bv TK%2bk63nn5Kx94um%2bT62otkewpq9 Mnq64SLawsUqet8s%2b8ujfhvHX4Yzn5ey B4rO0SrSvs1Cyq7c%2b6tfsf7vb7D7i2Lt68t6kjN%2fdu1nMnN%2bGu6q0Tbaqs0qk3O 2K69fyVe7a5F7z4ups4%2b7y&hid=105.

Andrade, Gregor., and Steven N. Kaplan. “How Costly Is Financial Not Economic Di stress? Evidence from Highly Leveraged Transactions that Became Distressed.” *Jo urnal of Finance* 53, no.5 (1998): 1443–1493. http://eds.b.ebscohost.com/eds/pdfvie wer/pdfviewer?sid=ce649251-9dfd-4e76-9709- 5a2be7084103%40sessionmgr198&vid =1&hid=105.

Asquith, Paul., Robert Gertner, and David Scharfstein. “Anatomy of Financial Distress: An Examination of Junk-Bond Issuers.” *Quarterly Journal of Economics* 109, no. 3 (1994): 625–658. http://eds.b.ebscohost.com/eds/pdfviewer/pdfviewer?sid=cf26eec3 -291f-4f92 -b6f5-5faab94c2d4f%40sessionmgr113&vid=1&hid=105.

Beaver, William. “Financial Ratios as Predictors of Failure.” *Journal of Accounting Re search* 4, no.3 (1966): 71-111. http://eds.b.ebscohost.com/eds/pdfviewer/pdfviewer? sid=a7050cf3-e99d-48d0-bce6-5a 5b88515ee0%40sessionmgr111&vid=1&hid=105.

Chen, Jing. “An Empirical Analysis of the Listed Company Financial Deterioration Pr ediction.” Accounting Analysis, no.4 (1999).

Coats, Pamela K., and Franklin L. Fant. “Recognizing Financial Distress Patterns Usin g a Neural Network Tool.” *Financial Management* 22, no.3 (1993): 142-155. http: //eds.b.ebscohost.com/eds/pdfviewer/pdfviewer?sid=48c9ab75-d8ba-4f88-95cb- 4525f6 0b194c%40sessionmgr114&vid=1&hid=105.

Davidson, Russell., and James G. MacKinnon. *Econometric Theory and Methods*. Lon don: Oxford University Press, 2004.

Davies, James C. “Toward a Theory of Revolution.” *American Sociological Review* 27, no.1 (1962): 5–19. http://www.jstor.org/stable/2089714.

Fama, Eugene F., and Kenneth R. French. “Testing Trade‐Off and Pecking Order Pre dictions About Dividends and Debt.” Oxford Journals, Review Financial Studies 1 5, no. 1 (2002): 1-33. doi: 10.1093/rfs/15.1.1.

Fitzpatrick, P. “A Comparison of the Ratios of Successful Industrial Enterprises with Those of Failed Companies.” The Accountants Publishing Company (1932).

Graham, John. R. “Financial Distress in the Great Depression.” The Journal Financial Management 40, NO. 4 (2011): 821-844. http://www.nber.org/papers/w17388.

Green, Samuel B., and Neil J. Salkind. *Using SPSS for Windows and Macintosh: Ana lyzing and Understanding Data.* New Jersey: Prentice Hall, 2008.

Göransson, Stephanie., and Thomas Hernqvist. “Encounter Financial Distress in the Cri sis 2008-2009.” master’s thesis., Lunds university, 2012. http://lup.lub.lu.se/ studen t-papers /record/2798127.

John, Teresa. A. “Accounting Measure of Corporate Liquidity, Leverage and Cost of Financial Distress.” Journal of Financial Management 22, No. 3 (1993): 91-100. h ttp://www.jstor.org/stable/3665930.

Körner, S., and L.Wahlgren. Mer om regression Statistisk Dataanalys. Lund: Studentlitt eratur AB, 2006.

Lin, T.H. “A Cross Model Study of Corporate Financial Distress Prediction in Taiwan, Multiple Discriminant Analysis, Logit, Probit and Neural Networks Models.” Ne urocomputing 72, no.16-18 (2009): 3507–3516. http://refhub.elsevier.com/S0950-70 51(13) 00386-9/h0360.

“Market Liquidity,” Wikipedia, the free encyclopedia, accessed DEC 27, 2013. http://e n.wikipedia.org/ wiki/Market liquidity.

Mantel, Nathan., and Charles Brown. “Alternative Tests for Comparing Normal Distrib ution Parameters Based on Logistic Regression.” Biometrics 30, No. 3(1974): 485 -497. http://www.jstor.org/stable/2529202.

Ohlson, James A. “Financial Ratios and the Probabilistic Prediction of Bankruptcy.” *J ournal of Accounting Research* 18, no.1 (1980): 109-131. http://eds.b.ebscohost.co m/eds/pdfviewer/pdfviewer?sid=80459736-2f4b-43b7-a3d0-82a46a8d1566%40session mgr114&vid=1&hid=105.

Opler, Tim C., and Sheridan Titman. “Financial Distress and Corporate Performance.” *The Journal of Finance* 49, no.3 (1994): 1015-1040. http://eds.b.ebscohost.com/ ed s/pdfviewer/pdfviewer?sid=6b1070cc-a743-42d8-a1fc-473ee19d9197%40sessionmgr11 0&vid=1&hid=105.

Platt, Harlan David. Why Companies Fail: Strategies for Detecting, Avoiding and Prof iting from Bankruptcy. The US: Beard Books, 1999.

Shumway, T. “Forecasting Bankruptcy More Accurately: A Simple Hazard Model.” Th e Journal of Business 74, No.1 (2001): 101-124. http://ssrn.com/abstract=171436.

Sun, Jie., Hui Li, Qing-Hua Huang, and KaiYu He. “Predicting Financial Distress and Corporate Failure: A review from the State-of-the-Art Definitions, Modeling, Sa mpling, and Featuring Approaches.” Knowledge-Based Systems 57, no.2 (2014): 4 1-56. doi:10.1016/ j.knosys.2013.12.006.

Storey, David J., Kevin Keasey, Pooran Wynarczyk, and Robert Watson. “The Perform ance of Small Firms: Profits, Jobs and Failures.” University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Referenc e in Entrepreneurship (1987). http://ssrn.com/abstract=1496201.

Tinoco, Mario H., and Nick Wilson. “Financial Distress and Bankruptcy Prediction am ong Listed Companies.” *International Review of Financial Analysis* 30, no.12 (20 13): 394–419. doi: 10.1016/j.irfa.2013.02.013.

Whitaker, Richard. “The Early Stages of Financial Distress.” *Journal of Economics an d Finance* 23, no.2 (1999): 123–132. http://eds.b.ebscohost.com/eds/pdfviewer/ pdf viewer? sid=1caa56a1-f087-494f-bfbb-e1cb5cc5984d%40sessionmgr113&vid=1&hid= 105.

Wu, Shinong., and Xianyi Lu. “Financial Distress Prediction Model Research on Chin ese Listed Companies.” Economy Research, no.6 (2001).