2. LITERATURE REVIEW

2. 1 Literature review on definition of financial crisis

2. 1. 1 The definition of financial crisis in foreign academic circles

The theoretical study of financial crisis in foreign countries is earlier than that of Chinese Mainland, and the relevant theories are more abundant. At present, there are four major classifications of financial crisis definitions in foreign academic circles: financial failure, financial crisis, financial depress and bankruptcy. The first three of them have roughly the same definition, but just have a different level of financial disadvantage. In the study of many scholars, financial crisis can also be called financial distress, and the specific definition is distinguished by different research conditions and cognitive level.

Beaver (1966), a leading American accountant, is the first man to define the financial crisis. He defines the financial crisis as several cases: bankruptcy, bankruptcy is not the only legal status that an insolvent person may have, and the term bankruptcy is therefore not a synonym for insolvency. In some countries, such as the United Kingdom, bankruptcy is limited to individuals; other forms of insolvency proceedings (such as liquidation and administration) are applied to companies. In the United States, bankruptcy is applied more broadly to formal insolvency proceedings. In France, the cognate French word “banqueroute” is used solely for cases of fraudulent bankruptcy, whereas the term “faillite” (cognate of "failure") is used for bankruptcy in accordance with the law; Bond default, in finance, default is failure to meet the legal obligations (or conditions) of a loan, for example when a home buyer fails to make a mortgage payment, or when a corporation or government fails to pay a bond which has reached maturity. A national or sovereign default is the failure or refusal of a government to repay its national debt; overdraft bank account or do not pay the preferred stock dividends, Preferred stock (also called preferred shares, preference shares or simply preferred) is a type of stock which may have any combination of features not possessed by common stock including properties of both an equity and a debt instrument, and is generally considered a hybrid instrument. Preferred stocks are senior (i.e., higher ranking) to common stock, but subordinate to bonds in terms of claim (or rights to their share of the assets of the company) and may have priority over common stock (ordinary shares) in the payment of dividends and upon liquidation. Terms of the preferred stock are described in the articles of association. This is the earliest definition of a financial crisis and until now, scholars at home and abroad still have different opinions on the concept of financial crisis, and they have not formed an authoritative concept.

Edward (1968) simply defines the financial crisis as “enterprise enters the legal bankruptcy process”, that is, the enterprise declares bankruptcy in law, or the enterprise is restructured or taken over by another enterprise. Deakin (1972) defines financial crisis as three forms that is the company has gone out of business, the company cannot pay its debts, and the company has been liquidated because of its debts. Carmichael (1972) not just from the perspective of bankruptcy or liquidation, but he defines the financial as four forms: liquidity shortage, equity shortage, debt default and fund shortage (In particular, the lack of liquidity has resulted in weak short-term solvency). James (1981) defines the financial crisis as the inability to pay interest on the due debt. Debt is money owed by one party, the borrower or debtor, to a second party, the lender or creditor. The borrower may be a sovereign state or country, local government, company, or an individual. The lender may be a bank, Credit Card Company, payday loan provider, business, or an individual. Debt is generally subject to contractual terms regarding the amount and timing of repayments of principal and interest. A simple way to understand interest is to see it as the "rent" a person owes on money that they have borrowed, to the bank from which they borrowed the money. Loans, bonds, notes, and mortgages are all types of debt. So, in the financial crisis study of the 1970s and early 1980s, most foreign scholars believe that financial crisis is equal to bankruptcy, unable to pay off debts and be liquidated and so on. These conditions are close to the end of the business life of the enterprise, and the financial situation of the enterprise has reached the point of exhaustion. Reheard Morris has greatly expanded the scope of the definition in 1998, he defines ten situations that should be considered as financial crisis: bankruptcy liquidation, debt restructuring,the company is taken over, seeking the asset preservation, the decline in credit ratings, reservations in the auditor's report(An Adverse Opinion Report is issued on the financial statements of a company when the financial statements are materially misstated and such misstatements have pervasive effect on the financial statements. In Audit Report after Scope paragraph but before Opinion paragraph, Basis for Adverse Opinion paragraph is added. In Opinion paragraph the wording changes to, "Because of situations mentioned in Basis for Adverse Opinion paragraph, in our opinion the financial statements of XYZ Co. Ltd. as mentioned in first paragraph does not give true and fair view are not free from material misstatements.), the company weakens some industries, profit margins are below market levels, reducing dividend distribution, stock suspension and so on. This is the most widely defined financial crisis in the current mainstream definition. Turetsky (2011) and Ewen (2011) believe the sharp drop in cash flow from continued operations is a sign of the beginning of the financial crisis. Crises tend to be accompanied by declines in earnings, defaults or debt restructuring etc. Tomasz (2013) considers bankruptcy as the worst part of the financial crisis, and the define crisis before the bankruptcy as the financial crisis. Therefore, it is not hard to find that in the post-1980s research, a growing number of scholars are starting to move from corporate bankruptcy to the worsening financial situation on the eve of bankruptcy.

To sum up, the scholars have different definitions of financial crisis, the first reason is the differences in personal understanding, and the second is based on the need of research. Foreign scholars' definition of financial crisis can be divided into the following three types: The first is that a financial crisis equals bankruptcy, so the enterprise that enters legal bankruptcy procedure is the division standard; the second view is that it is too hasty to equate a financial crisis with bankruptcy. Companies, before formally entering the statutory bankruptcy process, often in the situation such as running at a loss, unable to repay due debts, default, large-scale asset restructuring, etc., so the scholars like Carmichael believe that financial distress is more appropriate for the judgment of financial crisis; The third definition includes two different financial situations which are the financial distress and the bankruptcy.

2. 1. 2 The definition of financial crisis by domestic scholars

There is still a certain gap in the financial crisis warning research between domestic scholars and foreign scholars, and the research was gradually developed in the mid 1990s. The definition of financial crisis is divided into two categories: bankruptcy (the end of the business life of company) and financial distress (the stage of financial deterioration).

Gu (1999) and Liu (1999) choose two criteria: technical failures and enterprise bankruptcy. The bankruptcy of an enterprise is the legal bankruptcy, and the enterprise is unable to repay the due debts. While the technical failure is less severe, in this state, the situation of the enterprise is not optimistic, and the fund operation is unreasonable, which may cause the enterprise bankruptcy due to the inability of repaying the matured debts. Unlike legal bankruptcy, technical failures often haven't reached the level of insolvency in the balance sheet, and the total amount of assets is still greater than the total amount of liabilities, but it greatly increases the possibility of future financial failure due to the unreasonable structure of the assets. Gao (2010) and Zhang (2010) start with the bank loan that the enterprise borrows, and they take whether enterprises can pay their principal and interest on time as the criterion. Xu(2013) namely enterprise's bankruptcy due to the inability of paying off debts, he reintroduces the viewpoint of enterprise assets accounting, he argues that after estimation, if the realizable assets are still unable to repay the matured debts, then the enterprise will be in crisis. So far, the academic circle defines the financial crisis is still centered on the idea of bankruptcy.

China Mainland's economic environment is different from that of foreign countries, and the stock listing rule in Shanghai and Shenzhen stock exchange is- “for listed companies with abnormal financial status or other conditions, there will be special handling of their stock transactions." this is often used by mainland scholars to define the financial crisis. The first reason is that it is easy to obtain data under this definition; the second reason is that this special treatment (ST) can be approximated as a state of financial distress, which is more reasonable and easier to quantify than simply defining the financial crisis as legal bankruptcy. The measure of legal bankruptcy is difficult to exclude the non-real bankruptcy of enterprises from the strategic bankruptcy. Therefore, the current research in China mainly uses ST enterprises as a sample of crisis enterprises. However, taking whether the listed company is "st" as the criterion also has its inherent limitations. First, the rule of "special treatment" has been applicable to listed companies since 1998, and the data before 1998 is basically difficult to collect and could not be applied in the study. Second, according to the relevant regulations formulated by the Chinese Securities and Futures Commission, listed companies that have run at a loss for two consecutive years will be specially marked as "special treatment", but the study by Jiang (2005) and Wang (2005) shows that companies with negative net profit for two years are not necessarily in a financial crisis, they believe that simply equating the financial crisis with ST is bad for accuracy and preciseness of the study, moreover, by constructing the profit and loss model that reflects the profit volatility, they believe that the loss is not entirely dependent on profitability. Third, the case of corporate "backdoor listing" is common in mainland in Chinese mainland. Because the listing qualification is rare, the phenomenon of selling backdoor is common, which has led to a small number of the real bankrupt listed companies as defined by foreign researchers.

Chang (2007) divides financial crisis into acute financial crisis and chronic financial crisis. The acute financial crisis refers to the sudden negative impact in the normal operation of the enterprise, while chronic financial analysis is the process of deteriorating financial situation, and most mainland enterprises belong to the latter. Fang (2009) believes that financial crisis is a broad concept and a dynamic process of circulation. If economic failure is the beginning of financial crisis, then bankruptcy is the extreme state of financial crisis, or we could say it is the end result of the financial crisis. Financial crisis should be in the dynamic state between these two states. Shan (2012) has adopted a similar idea, he has made new standards, namely whether profitability is substantially weakened and whether companies are in a state of sustained loss. The new bankruptcy law takes the light financial crisis into account, which supports the definition of taking ST treatment as a financial crisis (Turalay, 2010). Since then, due to the need of empirical research, the mainland financial crisis and related researches have now taken the ST enterprise as a research sample of crisis enterprises.

2. 2 Literature review on forewarning model of financial crisis

The research on the method of distinguishing financial crisis and early warning model has gone through the following four stages.

(1)Single variable decision method

It refers the analysis method that taking a certain financial index as the criterion to judge whether the enterprise is in the financial crisis. Fitzpatrick (1932) uses 19 companies as a sample to validate enterprise samples in a single financial indicator, he concludes that the two financial ratios: net profit shareholder equity and stockholder's equity debt have the highest accuracy in predicting financial crisis. In 1966, Beaver uses 79 healthy companies and 79 crisis companies as sample; he tests the single variables of these companies over the past decade and finds the best three groups of financial ratios in predicting financial crisis: cash flow total assets, net profit total assets, cash flow net assets. Among them, cash flow total assets have the best forecast effect, and it has more than 70% accuracy rate in the five years before the crisis, far higher than any other single variable. But the study also has its shortcomings, meaning that when the variable is applied to a company with an abnormal financial state, the actual prediction effect will be reduced.

There is no doubt that the use of a single financial indicator is the easiest way to understand, moreover, the data extraction is easy, the information loss is minimal, and the horizontal comparison between samples is easy. But the disadvantages are also obvious: First, it is very one-sided to use single financial indicators to express information. Second, the correlation between multiple financial indicators lacks the necessary validation. Third, a single indicator does not have the ability to distinguish risk in particular situations, it must distinguish the risk by a combination of indicators.

(2) Multivariate linear determination model

More and more researchers are not satisfied with the one-sided shortcoming of single variable model, which is difficult to apply to the comprehensive analysis of financial risk. Under this background, the multivariate linear determination model emerged gradually in the 1970s, and among them, the most representative is the Akman's z-value model (Altman, 1968).The principle of the Z-value model is to select a set of data rates that can reflect the different aspects of the business, and give them different coefficients based on the characteristics of each ratio. Wikipedia (2017) The Z-score is a linear combination of four or five common business ratios, weighted by coefficients. The coefficients were estimated by identifying a set of firms which had declared bankruptcy and then collecting a matched sample of firms which had survived, with matching by industry and approximate size. Altman applied the statistical method of discriminant analysis to a dataset of publicly held manufacturers. The estimation was originally based on data from publicly held manufacturers, but has since been re-estimated based on other datasets for private manufacturing, non-manufacturing and service companies. Then, these ratios are summarized and weighted to obtain the scoring formula. Finally, the critical value of the enterprise from normal state to the risk state is set for evaluation. Alrman (1977) and Heldeman (1977) study that 53 bankrupt enterprises and 58 non-bankruptcy enterprises through the z-value model; moreover, they optimize and develop the z-value model and establish a ZETA model with higher prediction accuracy. Chinese scholars' major breakthrough in the study of linear determination model is the improvement of z-value model and the optimization of index selection. Zhou (1996) first took the cash flow factor into account; he selects 62 companies to build models, improves the z-value model, and establishes the F-score model. He eventually selects 4,160 companies to verify the accuracy of the model's pre-judgment crisis; the result shows a success rate of up to 70%. Luo (2012) select that the financial data of 75 listed companies to establish the Fisher model; he has selected 27 financial indicators such as net working capital and earnings before interest and tax to establish a determination model. The determination rate of the year before the financial crisis is as high as 100%.

Although the multivariate linear determination model overcomes the shortcomings of the single-variable model, the prediction accuracy is also improved; it also increases the difficulty of establishing the model. When constructing the multivariate linear determination model, the sample must be matched by the financial crisis group and the financial normal group, and the matching standard is high. The collected sample data must be in a normal distribution, and the covariance should be equal. Rigorous research conditions prompt scholars to explore new models in order to replace the multiple determination models.

(3) The multivariate logistic regression model

The sample data used in the multivariate logistic regression model does not need to be in a normal distribution, and there is a lot of scope in the selection of enterprise samples. Wikipedia (2018) in statistics, multinomial logistic regression is a classification method that generalizes logistic regression to multiclass problems, i.e. with more than two possible discrete outcomes. That is, it is a model that is used to predict the probabilities of the different possible outcomes of a categorically distributed dependent variable, given a set of independent variables (which may be real-valued, binary-valued, categorical-valued, etc.).Multinomial logistic regression is known by a variety of other names, including polytomous LR, multiclass LR, softmax regression, multiple legalities, maximum entropy (MaxEnt) classifier, conditional maximum entropy model. The prediction accuracy of the model is higher than that of decision method and multivariate linear determination model. Martm (1977) build that the Logistic regression model for banking through 25 financial ratios. The results show that the 6 ratios, such as net profit/total assets, have significant predictive power in these 25 financial ratios. Compared with the linear determination model, the logistic regression model has fewer restrictions on the selection of indexes, so the domestic scholars have produced many achievements in the construction of index system. Yang (2011) construct that a logistic regression model by selecting the financial data of 10 ST listed companies and 69 untreated normal companies. He has selected a total of 25 financial indicators such as profitability, development capacity, earnings management, capital structure, leverage ratio, and macroeconomics, and finally extracts 9 explanatory factors. Zheng (2015) selected that a total of 26 financial indicators such as solvency, profitability, growth ability, and management efficiency to construct a logistic regression model in 2015. This model has an accuracy of 87.5% before the occurrence of a financial crisis.

The multivariate logistic regression model has become a new favorite among domestic and foreign scholars because of its wide applicability and high accuracy. However, many scholars have proposed that when the model is constructed, it is easy to ignore the common linear problem between financial ratios. Moreover, there is a strong subjectivity in the selection of financial ratios.

(4) Artificial neural network decision method

Artificial neural network model is a kind of computational mechanism with the characteristics of pattern recognition, self-organization, self-adaptation and self-learning. Wikipedia (2018) artificial neural networks (ANNs) or connectionist systems are computing systems vaguely inspired by the biological neural networks that constitute animal brains. For example, in image recognition, they might learn to identify images that contain cats by analyzing example images that have been manually labeled as "cat" or "no cat" and using the results to identify cats in other images. They do this without any a priori knowledge about cats, e.g., that they have fur, tails, whiskers and cat-like faces. Instead, they evolve their own set of relevant characteristics from the learning material that they process. An ANN is based on a collection of connected units or nodes called artificial neurons (a simplified version of biological neurons in an animal brain). Each connection (a simplified version of a synapse) between artificial neurons can transmit a signal from one to another. The artificial neuron that receives the signal can process it and then signal artificial neurons connected to it. In common ANN implementation, the signal at a connection between artificial neurons is a real number, and the output of each artificial neuron is calculated by a non-linear function of the sum of its inputs. Artificial neurons and connections typically have a weight that adjusts as learning proceeds. The weight increases or decreases the strength of the signal at a connection. Artificial neurons may have a threshold such that only if the aggregate signal crosses that threshold is the signal sent. Typically, artificial neurons are organized in layers. Different layers may perform different kinds of transformations on their inputs. Signals travel from the first (input), to the last (output) layer, possibly after traversing the layers multiple times. Moreover, the neural network model has very low selection requirements for the sample data itself, and no samples are required to satisfy the normal distribution, even the dispersion of the sample data is large, we also can use the model and the detailed relationship between independent variables and dependent variables is not required. The first neural network model is BP neural network, which is developed in the late 1980s and is developed on the basis of bionics. This neural network model has no requirement on the distribution of sample data and can be used to process quantized data and non-quantified data, so the good practicability makes it quickly be introduced into the financial credit risk evaluation, which is called the favorite of international academic circles. In the 1990s, neural network model is widely used in financial risk research. The models with more research results are the artificial neural network, BP neural network, SVM algorithm and so on. Erasmo (2010) and Wilfrido (2010) use that BP neural network to solve the shortcoming of the z-value model in predicting the bankruptcy of the company. They then set up the ANN algorithm based on the study of Altamn and extract five financial ratios. The results reveal a significant gap in financial ratios between financial health companies and financial abnormal companies in the first three years of the financial crisis, and the forecast accuracy of the bankruptcy crisis has reached over 80%. The ANN model can minimize the error rate that misjudges a crisis company as a normal company, so it is more accurate than the multiple discriminant models, and its applicability is also significantly enhanced. According to Wang (2006), establishes a three-level BP neural network model from the type of financial risk to study the efficiency of Anhui's private finance. The model provides a scientific basis for controlling the operation risk of private finance and has high practicability.

2. 3 The comments the domestic and foreign research

The so-called "different styles within ten miles, different custom within hundreds of miles", is that different research system has different definition of financial crisis. Domestic and foreign academic circles have not had a unified understanding of this concept, but the substance of its expression is largely identical but with minor differences , and the main difference lies in the difference in the severity of the financial situation of the enterprise, or the specific manifestation of the financial crisis. In short, its main manifestations are legal bankruptcy, closing down, or unable to repay debt owed by the company after the application for liquidation. But these forms of manifestations are often thought to be the end of the enterprise life, and it is difficult to provide clear sample boundaries, which make the subjective factors seep into the selection process of the sample. Therefore, in the study of the early warning model of the financial crisis in the mainland, the most important and clearest criterion is: “Listed Company with abnormal financial status are special treated.” This definition method has many advantages, it not only simplifies the sampling process, more important is that it can scientificly and clearly reflect the financial deterioration process of listed enterprise, not just focus on the end of the life cycle.

In the selection of financial warning indicators during the study of financial crisis, domestic and foreign scholars have experienced the process from single variable index to multi-variable index, have experienced the process from the financial statement index based on the accrual basis of debt to combining cash flow index based on cash basis, and have experienced the process from financial indicators to the introduction of non-financial indicators. In the process of development, each study is based on summarizing the results of previous research, and considering the problem is more scientific and more reasonable, they always try to solve the one-sidedness defect of early warning model, and improve the wide application of risk early warning model in different industries, different enterprise types and external economic environment.

Based on the continuous development of the early warning model, the financial risk warning model has also been developed and improved to the maximum extent. Single variable financial index has simple forecasting function; it has the advantages of simple data collection, convenient operation and intuitive result. However, the forecast result of single variable financial index is not stable, and when a variable or sample output changes, it often produces a different effect. Therefore, the researchers gradually explore the application of the multivariate determination analysis method to replace the single variable financial indicator prediction, so that the accuracy and practicality of the model's early warning have been improved and evolved. However, the theoretical basis of multivariate determination analysis is the linear relationship between financial status and financial indicators, and it remains to be seen whether this theoretical foundation is reliable. In order to solve the problem of sampling difficulty and short forecast period of multivariate determination analysis model, scholars at home and abroad have gradually carried out the exploration and research of logistic regression model and neural network model.

By combing the development of the early warning indicator system and the early warning model system, we can see that there are deficiencies and defects in the research of Chinese scholars in this field: First, the bankruptcy mechanism of the company is not yet perfected, and “the special treatment” of listed companies only indicates that the company's continuous losses, but not the legal bankruptcy. And the companies that actually go into liquidation process of bankruptcy will not retain the qualification of listed companies, so its financial reporting data is often closed to the public, and researchers have difficulty getting it. Therefore, in the mainland if corporate bankruptcy is used as a standard to define the corporate crisis, it is almost impossible to conduct financial analysis on the bankrupt enterprise. The second is that the early warning research on subdivided industries is not enough, and most of the research is still concentrated in the industries such as industry-wide or manufacturing industries with sufficient samples. For example, as the financial crisis warning model of logistics companies discussed in this paper's topic, mainland scholars rarely explore this field, and there is very little research results. Third, there are few systematic studies on non-financial indicators. These shortcomings also provide a direction for our future research.