

RESEARCH OF THE FINANCIAL EARLY WARNING MODEL OF LISTD LOGISITICS ENTERPRISES IN CHINA

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RESEARCH OF THE FINANCIAL EARLY WARNING MODEL OF LISTD LOGISITICS ENTERPRISES IN CHINA

Thematic Certificate

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ABSTRACT

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 Enterprises in China

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Economic globalization has undoubtedly brought many development opportunities and challenges to Chinese mainland enterprises, the risk of enterprise management has also increased, and the market environment has become more and more complex. With the deepening of China's opening to the outside world and the reform of economic system, especially after China's entry into the WTO, the competition among enterprises is becoming increasingly fierce, and the phenomenon of enterprises falling into difficulties or even bankruptcy liquidation due to financial crisis is increasing. Therefore, we should guard against the gradual development of the financial system. When the financial system is operating normally, we should track and monitor the financial operation process of enterprises, comprehensively analyze the enterprise financial index data, issue early warning signals in advance, and inform the operator of the potential danger faced by the enterprise, in order to avoid or weaken the degree of damage to the enterprise. The financial crisis is one of the most serious risks in the risk of enterprise management. If we don't take precautions in time, it will probably lead to bankruptcy. Since 2015, the economic growth of the Chinese mainland has slowed down, the downward pressure on the economy has increased and economic fluctuations have affected various industries. In this economic environment, how to improve the ability of companies to cope with risks and crises and to take effective preventive measures in advance is of great significance to domestic companies.

In this study, logistics enterprise listed companies in the year 2006-2017 are selected as the research object. A total of 15 enterprise samples of financial crisis are selected, 35 companies with normal financial status are selected as the control group, and the relevant data in the three years prior to the financial crisis are collected, which is used for empirical analysis. Then the non-financial information is introduced into the model construction, the pure financial index model is constructed and the non-financial information model is introduced, and the prediction accuracy of the two models is compared. This is to study whether the introduction of non-financial information can improve the accuracy of early warning model, and try to provide some new ideas for optimizing the construction of financial crisis early warning model in logistics industry.

Keywords: Logistcs enterprises, Financial crisis, Firancial early warning model, Non-financial information



摘要

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经济全球化无疑给中国大陆企业带来了诸多发展机遇和挑战,企业经营风险也 随之加大,市场环境愈加复杂。随着中国大陆对外开放和经济体制改革的深入,特 别是加入世贸组织后,企业之间竞争日益激烈,因财务危机导致企业经营陷入困境 甚至破产清算的现象不断增加。因此我们应防微杜渐,在财务系统正常运作时,就 应对企业财务运营过程进行跟踪、监控,全面分析企业财务指标数据,及早发出预 警信号,将企业面临的潜在危险告知经营者,以避免或减弱对企业的破坏程度。财 务危机是企业经营风险中后果最为严重的风险之一,如不及时加以防备,极有可能 导致企业走向破产.2015年以来中国大陆国民经济增速放缓,经济波动影响着各行 各业。在这种经济环境下,如何提高企业应对风险和危机的能力,提早采取有效的 防范措施对国内企业来说意义重大。而长期以来,物流行业被很多经济学家认为是 资金状况和财务状况相对比较稳健的行业,使得一些潜在的顽疾被忽视掉了。财务 危机预警作为一项前沿理论,多年以来都是针对全行业或制造业上市公司的研究, 对物流行业预警的研究非常有限。为数不多的研究中,也多是针对单个物流企业的 财务状况评价,这对于其他物流企业,尤其是众多中小型物流企业日常的财务风险 防范工作来说,未必有参考价值。因此,针对行业特点进行精确研究十分有必要。

本研究以 2006 年一 2017 年物流企业上市公司作为研究对象,共选取了 15 家财 务危机企业样本,并选取 35 家财务状况正常的企业作为对照组,搜集了财务危机发 生前三年的相关数据,用于实证分析。然后将非财务信息引入到模型构建之中,构 建纯财务指标模型和引入非财务信息的模型,并比较两个模型的预测准确度,以此 来研究非财务信息的引入能否提高预警模型判别的准确率,力求为优化物流行业财务危机预警模型的构建提供一些新的思路。

关键词:物流企业 财务危机 财务预警模型 非财务信息

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At Siam University on May 31, 2018

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1. INTRODUCTION

1.1 Background introduction

Under the circumstance of domestic market economy of the increasingly fierce competition, based on the background of the globalization, financial risk is the one that any companies can't avoid and have to face, always accompanying the life cycles of companies. Financial risks exist objectively in all aspects of the company's production and operation. There are always various financial risks from the financing to the procurement, from the production to the sales, and from the investment to the dividend distribution etc. Risk can not be completely avoided, as long as the company is still running; there are various risks that threat the company's main body. Moreover, the existence of a company takes the creation of value and profitability as its most basic goal and it won't end its own production and operation of companies, the problems on how to make efforts to avoid risks and, reasonably control the potential risks, should be attached great importance by entrepreneurs and scholars.

The development of modern logistics is not only an economic revolution. From the perspective of essence, what the most important is that it also plays a role of "fire" and "accelerator" for modern economic development. With the development of coordinated development in regions and increasingly improvement in industrial division and cooperation, and the continuous enhancement of the socialization and professionalization of production, the modern logistics industry has gradually been widely regarded at another important source of profits after reducing material consumption and increasing labor productivity, and gradually becoming an important basic service industry in the national economic system. On the basis of time, the modern logistics industry can reduce delays in the elimination of delays, and can reduce inventory overstock and out of stock of other industries, speed up the production and the circulation, and also optimize economic process through eliminating the delay and postpone. From the perspective of space, it can

achieve the effective connection between the place of production and consumption of material products, and it can optimize the allocation of resources and industrial structure, promote the efficient and coordinated development of related industries to improve the quality of economic operation and improve the quality of economic operations. Specifically speaking, the function values of the modern logistics, as a value-added activity in social and economic production, include: time effectiveness, space benefit, value-added service benefit, and integration benefit, such four main aspects. However, whether it's the manners of operation or organizational structure, logistics companies have obvious differences from traditional enterprises. For the diversified structures, the diversified mode of operation of modern logistics companies and its construction are similar to the traditional companies, meeting and financial warning model of needs and the features of era , helping them avoid or resolving possible financial crisis that possibly happen, which will have greatly significant practical significance and historical value.

For companies, it's not just a verbal word to avoid risks. What it requires companies to do is that companies have to improve their awareness of prevention, enhance their professional technical capabilities, optimize management, and improve the quality of financial management. It is impossible to completely avoid risks, but it is not uncontrollable. In order to reduce the financial risks of logistics companies, the first task is to start from the management level. Scientific management is a theory of management that analyzes and synthesizes workflows. Its main objective is improving economic efficiency, especially labour productivity. It was one of the earliest attempts to apply science to the engineering of processes and to management. Scientific management is sometimes known as Taylors's after its founder, Frederick Winslow Taylor. Taylor began the theory's development in the United States during the 1880s and '90s within manufacturing industries, especially steel. Its peak of influence came in the 1910s; In 1913 Vladimir Lenin wrote that the "most widely discussed topic today in Europe, and to some extent in Russia, is the 'system' of the American engineer, Frederick Taylor"; Lenin decried it initially as a "scientific' system of sweating" more work from laborers. Taylor died in 1915 and by the 1920s; scientific management was still influential but had entered into competition and syncretism with opposing or complementary ideas. Although scientific management as a distinct theory or school of thought was obsolete by the 1930s, most of its themes are still important parts of industrial engineering and management today. These include: analysis; synthesis; logic; rationality; empiricism; work ethic; efficiency and elimination of waste; standardization of best practices; disdain for tradition preserved merely for its own sake or to protect the social status of particular workers with particular skill sets; the transformation of craft production into mass production; and knowledge transfer between workers and from workers into tools, processes, and documentation, financial management is at the core of each management. Funds are the blood and life of an

enterprise (Wikipedia, 2018). All actions of the enterprise will ultimately be reflected in the financial aspect; therefore, the ultimate purpose of a company is to obtain benefits. Therefore, enterprises should think of their own financial management as their top priority, and attach importance to various phenomenon that exists in the financial management, and establish a defense of financial early warnings so that enterprises can take preventive measures and avoid all unfavorable elements that are not beneficial to the development of enterprises, which should be an important task that enterprises should make efforts and do well in the current situation.

1.2 The purpose and significance of the Research

1. 2. 1 Purpose of the research

The construction of financial warning system in a company is a kind of enterprise management technology regarded as mainstream by academic fields at home and abroad, and has been attached great importance from the business community. The so-called early warning of financial risks begins with the company's financial data and it can discover various issues that are reflected in the business operations. The finance of company is like a cell of a company, spreading throughout the company's entire body and various problems are truly reflected in the financial information of the company. If we design the indexes that can perfectly reflect the major issues of the company as a certain standard, it can remind the decision makers of their vigilance and adopt effective countermeasures as soon as possible so that it will not accumulate over time causing the accumulation of the problems, in the end, the problems are created greater and there is no any solution to solve. In addition, whether it's the investor, the debtor or partners, major customers or even of a company, major customers, and even the government who is in charge of the companies, all of them hope to clear out the truly operational situation of companies through the financial report, which all shows that the construction of financial warning system which is a scientific, reliable, and suitable for the actual situation of the company is very important. At present, due to the background of company, the circumstance of a company facing and different management cultures of companies, it is necessary to do a lot of research work to establish a financial warning system that is truly suitable for companies, and it takes time to observe the applicability of the early warning system. The complex international and domestic economic environment has forced senior executives of enterprises to pay attention to this work and prepare for risk prevention ahead of schedule.

1. 2. 2 The Significance of Research

The paper aims to build an early warning model that is capable of reflecting market conditions for Chinese logistics companies. The main objectives are as follows:

(1)Reduce the significance of logistics companies and management costs, improve operational efficiency and risk aversion, and identify problems in business operations in a timely manner. Compared with general industrial enterprises, logistics enterprises have to bear a lot of transportation and warehousing costs, and logistics companies have the characteristics, such as many business outlets, large business volume, a great number of fixed customers, and small single- business operations, etc and all of these production activities have increased the total cost the company. Increasing the difficulty of the cost management .Therefore, taking the early-warning model as an auxiliary tool for financial management can greatly shorten the time for the management mistakes and can timely and accurate deal the defects in financial management.

(2)Providing financial institutions with corporate reputation and debt paying ability for reference to avoid the occurrence of illegal accounts no other non-performing loans. Logistics companies face greater financial risks in both financing and investment. The average level of financing of logistics companies is greater than other industries, especially in the operational projects arising from transportation and warehousing, the debt paying ability of enterprises directly relates to whether the finance is safe. Due to the high capital investment which can low down the liquidity of the company's capital, it results in short-term production and the shortages of operating capital, greatly increasing the probability of financial risks. Therefore, it is of great significance to adopt financial early-warning models to assist companies in improving their credit ratings and optimizing their capital structure, as well as improving their debt paying ability.

(3)Providing analysis tools which can improve the development status of companies for government departments and providing scientific and objective reference theories for the formulation of macro policies and micro policies and the logistics industry is one of the important industries of the national economy, in addition, the fluctuation of the macro environment will certainly have influence on the development of the logistics industry. In turn, the overall trend of the logistics industry will also affect the changes of the macroeconomic environment to some extent. Therefore, it is rather necessary to establish a reasonable fiscal policy and stabilize the long-term development of the entire industry by means of having good command of the financial status of the industry.

(4)Provide accurate reference for investors and shareholders, and make reasonable investments to avoid unnecessary losses. The asymmetry of information and the lack of professional quality of middle and small-sized shareholders are the main causes of blind investment. Using more intuitive analysis results provides small-sized shareholders with reference opinions of investment risk, which is helpful to small-sized shareholders and investors to invest rationally.

1. 3 Introduction of logistics industry

1. 3. 1 Overview of logistics industry

Logistics is generally the detailed organization and implementation of a complex operation. In a general business sense, logistics is the management of the flow of things between the point of origin and the point of consumption in order to meet requirements of customers or corporations. The resources managed in logistics can include physical items such as food, materials, animals, equipment, and liquids; as well as abstract items, such as time and information. The logistics of physical items usually involves the integration of information flow, materials handling, production, packaging, inventory, transportation, warehousing, and often security. In military science, logistics is concerned with maintaining army supply lines while disrupting those of the enemy, since an armed force without resources and transportation is defenseless. Military logistics was already practiced in the ancient world and as modern military have a significant need for logistics solutions, advanced implementations have been developed. In military logistics, logistics officers manage how and when to move resources to the places they are needed. Logistics management is the part of supply chain management that plans, implements, and controls the efficient, effective forward, and reverses flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customer's requirements. The complexity of logistics can be modeled, analyzed, visualized, and optimized by dedicated simulation software. The minimization of the use of resources is a common motivation in all logistics fields. A professional working in the field of logistics management is called a logistician (Wikipedia, 2018). The term "logistics" first came from the United Kingdom in 1918, and Lord Hame of the United Kingdom in Juniliver established the "Real-time Delivery Co., Ltd." to deliver goods to wholesalers, retailers and users in a timely manner throughout the country. During World War II, the United States began with military needs. In the wartime supply of arms, the term "logistics management" was first adopted, and the arms transportation, supply, and garrison were comprehensively managed. After the Second World War, the word "logistics" was used by Americans in business management and was called "corporate logistics." Corporate logistics refers to the comprehensive management of the company's supply, sales, transportation, storage and other activities.

In the "China National Standard Logistics Terminology of the People's Republic of China" formally implemented on August 1, 2001 in mainland China, the definition of logistics has been defined, that is, the process of physical flow from the place of supply to the place of receipt. According to actual needs, the basic functions of transportation, storage, handling, handling, packaging, distribution processing, distribution, and information processing are organically combined. "There are five main factors in the evaluation of logistics systems: quality, quantity, time, location and price. Quality means that the quality of materials remains unchanged during the logistics process. The quantity refers to the quantity requirements that are in line with the economy and the full-loading of transportation in transportation activities. Time refers to the principle of reasonable cost, timely delivery, and safety and speed. The location refers to the selection of a reasonable consignment and warehouse, avoiding two invalid transportations and multiple transshipments. The price refers to reducing logistics costs as much as possible while ensuring quality and meeting time requirements. On February 25, 2009, the logistics industry became a meeting of the Standing Committee of the State Council to review and in principle pass the tenth industry in the revitalization plan for the top ten industries.

With the development of modern economy and society, the arrival of the Internet era and the rise of e-commerce, more and more people have discovered and valued the value of logistics. The logistics industry is known as the "third profit source" by the industry and is called "the largest industry in the century" by the media body. First, the logistics industry is a complex industry. The logistics industry refers to a complex or converged industry formed by the industrialization of logistics resources. Logistics resources include transportation, warehousing, loading and unloading, handling, packaging, distribution processing, distribution, and information platforms. Transportation includes railways, highways, water transport, aviation, and pipelines. The industrialization of these resources has formed the transportation industry, warehousing industry, loading and unloading industry, packaging industry, processing and distribution industry, and logistics information industry. These resources are scattered in many fields, including manufacturing, agriculture, and circulation. The integration of industrialized logistics resources forms a new logistics service industry. This is a complex industry, it can also be called a converged industry, because the logistics resources of all industries are not simply superimposed, but through optimization and integration, they can achieve 1+1>2effectiveness. Second, the logistics industry is a producer service industry. The productive service industry refers to the industries that provide services for the physical production and service production of the primary, secondary, and tertiary industries.

According to the rules of the industry classification guidelines for listed companies revised by the China Securities Regulatory Commission in 2012, although the logistics industry has not been separately listed as an independent industry, with the development of economic globalization and the rise of the Internet economy, it is believed that the revision of new industry classification guidance rules is also a matter of time. The logistics industry is classified under the transportation, warehousing and postal industry, and the leasing and business services industry. Among them, the industrial catalogs involving the logistics industry under the industry directory of transportation, warehousing and postal industry include road transportation industry, water transportation industry, loading and unloading handling and other transportation agents, warehousing industry and postal industry. The industry directory involving the logistics industry under the Leasing and Business Services Industry Directory includes the leasing industry and the business services industry. In order to unify data collection standards in empirical research, this study uses the industry classification standards of the listed companies of the China Securities Regulatory Commission in 2012 as the scope of the logistics industry.

1. 3. 2 Causes of Financial Risks in the Logistics Industry

Whether it is the transportation, warehousing and postal industry or the logistics industry under the leasing and business services industry, it has the characteristics of large span, strong dynamics and high complexity. The particularity of the logistics industry, especially the logistics industry related to transportation, warehousing and postal industry, determines the specificity of its production and operation. The risks in the logistics industry mainly reflect the following points:

(1) Complex management methods increase financial management difficulty

The logistics industry often does not have stable customer objects and operating tools, and personnel flow frequently. Business cycle is uncertain. The variety of customer goods is complex and diverse. It can involve the rental, purchase of transportation tools and equipment. This makes the storage, management, classification, turnover, accounting and transaction of logistics enterprises' inventory, low value consumable and fixed assets all very important. If all links are not handled properly, it will not only cause confusion in their management, affect the production efficiency, but also cause excessive occupation and waste of corporate funds

The operating cycle of the logistics industry is relatively uncertain. In particular, logistics companies involved in transportation, warehousing and postal services often have large differences in their operating cycles depending on the services they provide. Affected by the uncertain cycle, construction companies are easily affected by factors that cannot be anticipated in advance, such as accidents of force majeure, accidents in the performance of contracts or approvals, indicators, etc. This greatly increases the operational risk of logistics companies. In addition, in an indefinite production cycle, the geographical and time span is large, and the social production division of labor is strong. This requires that construction companies must have comprehensive production capabilities and all-round coordination capabilities.

(2) Mobility of logistics management process increases management costs

The mobility of logistics is mainly reflected in the mobility of large transport equipment and the mobility of technicians. Large transport equipment is an essential production tool for logistics companies. It has the characteristics of large volume, high cost, repeated use, and frequent use. Its total transportation equipment is no less than some manufacturing companies. However, compared with ordinary manufacturing companies, construction companies need to bear the cost of maintenance and repair of large transport equipment, and also need to undertake the transportation and transfer of large transport equipment between different locations. This not only has a huge workload, it also affects the overall progress and increases the total cost. On the other hand, the logistics company is a very labor-intensive industry with high manual labor. It requires a large number of employees with production experience to invest in production and operation. Therefore, the flow and investment of human resources in logistics enterprises are relatively large.

(3) Variability in business content and hard work environment

Logistics companies usually take on multiple businesses at the same time. Each business has a different work place and the operating conditions are more difficult and cumbersome than those of the general industry. These constraints have a relatively high requirement for employees' technical literacy. How to do a good job of human resources management should become an important part of the work preparation. In addition, some business locations may be in harsh environments with extreme cold or high fever. This will lead to disruption of the business cycle over a period of time, affecting the overall business progress and thus affecting the goodwill of the logistics company. This is also a link that logistics companies should pay special attention to.

(4) Potential risks in financial markets increase corporate investment and financing risks

Logistics companies face greater financial risks in both financing and investment. The increase in the amount of financing for logistics companies will be a powerful boost for companies to reduce capital costs, expand the scale of operations, and upgrade production equipment. It contributes to the improvement of the overall output of the logistics industry and also contributes to the steady growth of the entity's national economy. Therefore, for a project with a large amount of financing, the financing capacity and debt-paying ability of the enterprise are crucial. The investment of enterprises in logistics companies is mainly reflected in the investment in fixed assets such as production equipment and transportation tools. High capital investment reduces the liquidity of the company's capital, and may encounter shortages of short-term production and operation funds, increasing the probability of financial risks. Austrian political economist Joseph Schumpeter proposed the role of "innovation" in economic development. He believes that the scale of the company is conducive to innovation. Continental logistics companies are large in scale, but scale advantages have not helped the industry's innovation capability. An important reason for this status quo is that the current mainland logistics industry market is still not standardized and has not formed a well-developed competitive market order. Therefore,

the profitability of the logistics industry is not high, and even large logistics companies can hardly obtain enough capital to invest in innovative activities. Therefore, logistics companies should rationally improve the internal industrial organization structure. The government should strive to build a fair market competition environment and enhance the logistics company's innovation capabilities.

1. 4 The content and framework of research

In this paper, the major research content is to introduce non-financial information into the study of financial crisis early-warning model for listed companies of logistics companies, that's to say, to verify whether the addition of non-financial information can enhance the accuracy of financial crisis early warning in the logistics industry. The main research content can be divided into the following points:

The first chapter is introduction. It mainly introduces the research background, research purpose and research significance of the construction of logistics companies and the optimization of financial crisis warning model. And through the review of the theory and status quo of logistics companies, the development status of Chinese physics enterprises is introduced in detail. At the same time, according to the characteristics of the logistics industry, combining the market perspective, the causes of the financial risks of logistics companies are analyzed. Finally, the overall planning of this article's research content and the framework of writing put forward the possible innovation of this research.

The second chapter is a review for the research of the early warning of financial crisis. It mainly reviews the previous theoretical researches on the early warning of financial crisis, and sorts out the key domestic and foreign research results, which provides the theoretical basis for the following research of the paper.

The third chapter explains the explanation of the research method. First, put forward the research hypothesis of this study. Provide basic preparations for the actual demonstration of the subsequent Chapter IV. Second, determine the research sample, and conduct an accurate demonstration of the source of the sample data and the selection criteria of the sample. According to the selection principle of early warning indicators, the financial indicators and non-financial indicators that can reflect the characteristics of logistics enterprises are initially selected, and the financial early warning indicator system for logistics enterprises is initially established. Finally, a brief introduction of the significance test, factor analysis, logistics regression analysis and other research methods used in this study is explained, and the financial indicators that can fully reflect the characteristics of logistics companies. For the fourth chapter, logistic regression analysis is used to construct logistics company financial crisis warning model. The result of the fourth chapter is the key to the entire study. In this section, this article will use logistics regression analysis method to analyze the financial and non-financial indicators that have been selected by significance test and factor analysis. Use this to build the basic model of logistics model based on pure financial indicators. And introduce non-financial indicators to improve the formula. Finally, use the regression model to test the formula. Test the above basic formula to predict the accuracy of financial crisis.

The sixth chapter is the summary and prospect. First, summarize and sort out the conclusions drawn from empirical research. Second, reflect on the inadequacies of this study and provide reference for future follow-up studies of scholars. Finally, put forward relevant suggestions based on the research conclusions and the development of logistics enterprises.

1.5 The possibly innovation point in this paper

(1)The previous related researches are mostly based on quantifiable financial indicators. In recent years, there are some scholars who have tried to introduce non-financial information into the logistic regression model. However, most studies only introduced one or two non-financial indicators and it didn't show the effect of non-financial information systems on the early warning of financial risks, and the studies of introducing non-financial information are mainly for manufacturing companies, or singly studied the non-financial information of logistics company, which didn't embody the overall general influence of the non-financial indicators to the logistics industry.

Based on the study of financial indicators, and in terms of the features of listed companies of China's logistics companies, the paper has introduced non-financial information on various aspects, such as internal control and corporate governance and other aspects, and also screened out the significant indicators that can distinguish companies from financial crisis. In the end, it has got a beneficial early warning effect by the empirical analysis.

(2)For the selection of samples, the paper takes the listed companies of logistics companies from 2006 to 2017 as the research object, which covers a wide span in time, covers multi-situations of macroeconomic market fluctuations in the logistics industry, and through the comparison between short-term sample studies and single sample study, it can be more macroscopic to exclude some short-term and abnormal affects of market factors.

(3)The time of data collected in this paper is the first two years and three years before the financial crisis and the indicator data of the first two years and the first three years were all significant screened out. There is no data which simply chooses one year to deal with one-time significance test in order to establish a more scientific and effective early warning model.

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 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, 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.



3. RESEARCH METHOD

3. 1 Research methods overview

In this research, it adopts the method of the combination of theoretical induction and empirical verification, qualitative and quantitative combination. However, due to the limitations of theoretical research, the main interpretation of this paper is to the more persuasive empirical research process.

(1) The theoretical induction part is mainly in the systematic review of previous research results, and analyzes the financial risk assessment system of the logistics industry according to the industry characteristics and the current situation, and prepares the theoretical basis for model construction.

(2) The empirical verification part will implement the empirical method that combines qualitative and quantitative research, and adopting quantitative research to guide the qualitative research, then quantitative studies to make up for the qualitative research. Specifically speaking, the selection on indicators, samples and empirical research methods should adopt the qualitative research. However, when selecting the indicators, factor extraction and construction of risk warning model, it can use statistical principles and statistical software (SPSS, Excel, etc.) to do quantitative analysis for data, and use quantitative conclusions to verify the reliability of the theory.

3. 2 Research assumptions

(1) The key of a successful early-warning model lies in its capability to accurately predict future financial crisis. This paper intends to establish a financial early-warning model applicable to listed companies in the logistics industry according to characteristics of this industry. Therefore, it is assumed that the model being established here can predict the probability of financial crisis with high precision. If the model fails to do it, it is considered to be a failure; if not, it is then believed that the model can be applied to the analysis of financial early warning for listed companies in the logistics industry.

(2) Introduction of non-financial information helps to optimize the financial crisis model. In empirical analysis, accuracy of the model before and after the introduction of non-financial information will be compared. If the model is able to predict the crisis with higher accuracy after the information is introduced, it can be believed that introduction of non-financial information in an appropriate way is beneficial to the optimization of the whole financial crisis early-warning model.

3. 3 Determination of research samples

3. 3. 1 Sample date soure

(1) This paper plans to select company samples from Shanghai and Shenzhen A-share listed logistics companies out of the following reasons:

First of all, financial statements of A-share listed companies are easily available. Despite the fact that listed logistics companies only occupy a small percentage among all the logistics companies in Mainland China, there isn't a compulsory mechanism for non-listed companies to publicize their financial reports. As a result, the majority of the logistics companies do not make public their financial reports. Some middle and small companies even fail to prepare their financial statements periodically according to the preparation norms. Therefore, it is unlikely to collect data of these companies through their financial statements in empirical research, and in this paper, samples are selected only from listed logistics companies.

Secondly, sample data of listed companies are fairly reliable. Securities Law in Mainland China sets high requirements on the disclosure of financial statements of listed companies, as well as the forms of disclosure. In addition, all the financial statements must go through external audit. Large quantities of non-listed companies do not disclose their financial statements, nor do they follow the requirements of registered accountants. Consequently, they unavoidably lack necessary professional awareness of preparing and regulating their financial statements, which will result in the low accuracy of financial data. In order to guarantee the validity of sample data, this paper will select samples from listed companies.

Thirdly, data of listed companies are comparable. A-share listed companies use RMB as the measurement unit for Chinese organizations and individuals to make subscriptions or conduct transactions. B-share listed companies are foreign capital stocks listed in Shanghai and Shenzhen, which designate their par values by RMB, and make subscriptions and conduct transactions by foreign currencies (US dollar in Shanghai B shares and Hong Kong dollar in Shenzhen B shares). H shares are foreign capital shares of companies in Mainland China listed and transacted in Hong Kong. We can see from above that measurement units and transaction modes of A, B and H shares are substantially different, which may make it impossible to compare certain financial indexes; additionally, report audit systems in these three markets are quite different. According to China Securities Regulatory Commission, PRC accounting standards shall be applied to the audit of financial reports of A-share listed companies, while the financial reports of B-share and H-share companies are audited by foreign accounting firms in accordance with international accounting standards. Different audit standards surely make it impossible to make comparies are foreign accounting standards share surely make it impossible to make companies.

(2) Empirical data in this paper generally come from annual reports of listed companies issued by Shanghai Stock Exchange and Shenzhen Stock Exchange, GTA data base, RESSET financial data base and finance section of Sina, etc. After the samples are selected, normality test, significance test, factor analysis, Logistic regression test and so on will be carried out on the samples through Excel and SPSS 20.0 software.

3. 3. 2 Sample selection criteria

(1) Quantitative standard of sample selection: in order to avoid data accuracy as much as possible, non-matching approach is adopted in this research for sample selection. In the establishment of financial crisis early-warning system, there are chiefly two approaches of sample selection, matching selection and non-matching selection. In the former approach, companies with crisis and companies with normal finance are drawn according to certain matching ratio. Since matching selection makes it easier to compare and explain the samples, it is frequently used in empirical studies of listed company samples in the whole industry and in manufacturing. Nonetheless, the ratio of companies with crisis and companies with normal finance is far less than 1:1 in reality. In a circumstance where it is impossible to draw the matching samples of these two types, sticking to the principle of matching the industry and asset scales will surely lead to the model's inability to predict. In addition, it also violates the mathematical principle of random sampling. On top of that, the ratio of ST companies and non-ST companies are not fixed in any industry, and there are significant differences in their years, so matching the sample numbers strictly will definitely lead to the neglect of market dynamics, and will undermine the accuracy of the financial crisis early-warning model.

Therefore, in view of the reality that the number of companies with healthy finance is greater than that of those with crisis in logistics, this paper adopts non-matching sampling.

(2) Temporal standard of sample selection: this study covers listed logistics companies from 2006 to 2017. When drawing samples of these companies, there is only one or two samples of companies with crisis in a single year since logistics companies had made full accumulation before they went listed. Even in 2008, when subprime crisis resulted in the trend of company bankruptcy, only ST Lianhua and *ST Jiangquan were available in the category of companies with crisis. This is also the major reason why current studies on financial crisis in Mainland China are restricted to industry-wide and manufacturing companies with crisis. A small number of samples will make it difficult to exclude special factors belonging exclusively to a certain company in empirical study, and will further affect the reliability of financial crisis early-warning model. Thus, in order to obtain an early-warning model applicable to the whole logistics industry, empirical samples are drawn from listed logistics companies from 2006 to 2017.

(3) Defining standard of sampling: in the second chapter of this paper, this study has defined companies with financial crisis as A-share listed companies who receive ST treatment for the first time due to their abnormal financial situation based on previous definitions of financial crisis, as well as the uniqueness of the evaluation criteria of the financial state of listed companies regulated by CSRC. The overall sample environment is composed of A-share listed logistics companies in China from 2006 to 2017.

However, abnormal financial situation is not the only reason why a listed company receives ST treatment. Some other causes and force majeure may also result in ST treatment. Therefore, this study excludes companies receiving ST treatment due to reasons other than financial abnormality so that the overall sample quality is not influenced. Crisis companies being selected should therefore meet the following requirements: it was the first time for them to receive ST treatment, and there was no financial abnormality three years before the treatment; besides, it had been listed for over three years, while for companies with healthy finance which are selected as the samples, there should be no financial abnormality for three years during the observation period should be excluded from the samples.

(4) Sampling term: in order to facilitate data classification and accurate expression of the samples, the year in which the financial situation was "treated specially" for the first time, that is, the year in which the financial crisis occurred according to the definition in this paper, is marked as Year T. Accordingly, the year before the crisis is marked as T-1 Year, and the year before Year T-1 is marked as T-2 Year, and the year before T-2 Year, T-3 Year.

Specific term is as follows: firstly, cross-sectional data of the second and third year before the financial crisis of sample companies broke out, that is, T-3 Year and T-2 Year, are selected, and cross-sectional data of normal companies in 2012 (T-3 Year) and 2013 (T-2 Year) are also selected (the financial situation is relatively good in 2015, without any sign of financial crisis).

Data in T-1 Year is excluded from the empirical analysis because the financial state in T-1 Year could determine whether the listed company in China should receive ST treatment or not. That is to say, we can tell whether the financial crisis occurred or not from the financial statement in T-1 Year directly, which makes it unnecessary to predict. Therefore, data in T-1 Year is not included in the empirical study.

3. 4 Principles for selecting early-warning indexes

Scientific and accurate selection indexes are the must-have carrier and prerequisite in financial crisis early-warning study. Financial indexes primarily come from the annual

reports of listed companies since the deterioration of a company's financial state would surely be reflected in quantifiable financial indexes; non-financial indexes generally come from the notes or other sources except financial statements, and can be divided into quantifiable and unquantifiable indexes. Quantifiable non-financial indexes and financial indexes have similar effects, both of which would go wrong when crisis arises, while unquantifiable non-financial indexes are also closely related to the company's financial state, which can reflect and supervise the operation situation of its financial subject.

In order to select the early-warning indexes which were suitable for the establishment of financial crisis model for logistics companies, previous study results and the frequency of each index being used in preceding literatures are taken into consideration in this study, and indexes were are in accordance with relevant principles, which are shown as follows:

(1) Scientific

Scientific is the primary principle when it comes to the selection of indexes, and to be scientific is to select indexes based on relevant scientific theories. It is necessary to follow the guidance of theories relating to financial risk, and to establish a scientific and accurate index system based on previous results. Financial early-warning indexes must be representative, comprehensive and sensitive enough because they are designed to reflect the financial state of the whole company. Only by including as much information as possible into twenty or thirty indexes can we reflect the abnormal fluctuations in a company's financial information in a broader sense. Accordingly, only by establishing a scientific and reasonable index system can we better interpret the financial dilemma.

(2) Availability and comprehensiveness

In practical researches, it is unavoidable that some financial indexes are not easily available, or some indexes cannot be completely obtained due to information loss. In order to make sure that the indexes of a company are complete and analyzable, it is necessary to choose indexes to which we have easy access. Besides, it is also necessary to replace indexes which are difficult to obtain with relevant alternatives.

The financial crisis of a company is bound to be a complicated issue involving multiple factors, which depends highly on the accurate risk prediction with multiple variables. Therefore, study of multi-variable models has gradually displaced the study of single financial ratio. When choosing indexes, it is necessary to take financial and non-financial indexes like operation situation, financial state, cash flow, development and growth ability and equity structure, etc. into consideration. Apart from these, indexes must be selected in combination with the characteristics of the industry.

(3) Comparability and feasibility

Emphasis must be laid on the comparability during financial index selection, which refers to that the model in this paper and relevant academic theories in the past can draw references from each other, and that analysis and comparisons can be made between them. In order to clarify the research context and evaluate the early-warning model in a reliable and accurate way, ubiquitous indexes are chosen for this research to achieve a unified data standard.

Data ought to be authentic, comparable and feasible. Compared with some non-financial indexes, which are quite difficult to be obtained with intactness, financial indexes are relatively easy to be obtained. Therefore, it is necessary to make a comprehensive consideration before choosing the indexes which are both feasible and suitable for the industry background from various financial indexes.

(4) Reflection of the company's solvency

A company's solvency refers to its ability to pay all kinds of maturing debts (including short-term and long term debts) with its assets, which is frequently used to reflect the mobility of the company under the accrual basis. Solvency, in finance or business, is the degree to which the current assets of an individual or entity exceed the current liabilities of that individual or entity. Solvency can also be described as the ability of a corporation to meet its long-term fixed expenses and to accomplish long-term expansion and growth. This is best measured using the net liquid balance (NLB) formula. In this formula solvency is calculated by adding cash and cash equivalents to short-term investments, then subtracting notes payable. In general, the mobility of a company is positively related to its solvency. In other words, companies with high mobility have strong solvency, especially the short-term one. Such companies have affluent liquid assets to pay the debts, and in turn, it is easier to guarantee the rights and interests of creditors; conversely, if a company has weak solvency, it is inevitable that breaches of contract, such as inability to pay the maturing debts and outstanding debts, will arise frequently, and the company will fall into a financial dilemma, which will further give rise to the financial crisis. However, an overly high mobility does harm to the use efficiency of capitals, gives rise to overstocking of accounts receivable and goods, as well as cash excess, and eventually harms the company's ability to gain profits.

(5) Reflection of the company's profitability

A company's profitability is an important index which reflects its ability to obtain profits with the resources it already has, and it can reflect the company's input-output ratio. Accordingly, some scholars also call it the index of a company's ability of capital appreciation. Profitability index (PI), also known as profit investment ratio (PIR) and value investment ratio (VIR), is the ratio of payoff to investment of a proposed project. It is a useful tool for ranking projects because it allows you to quantify the amount of value created per unit of investment. When the profitability is comparatively high, this company is likely to gain increasingly higher profits (that is, the relative income level is high), to enjoy an affluent mobility and strong solvency. Besides, it is rare for the company to break a contract; on the contrary, when the profitability is relatively low, it will unavoidably impact the company's mobility, and increase the probability of breaches of contract, such as outstanding debts, etc. Profitability is a referential index in terms of a company's management level, financial state and product competitiveness, and therefore, it is necessary to take it into account.

(6) Reflection of a company's operational capacity

A company's operational capacity refers to its ability to run business, and is positively related to the company's asset utilization efficiency and asset management ability. Since this paper focuses on logistics industry, where payable accounts occur frequently and usually come in large amounts, it is extremely necessary for logistics companies to pay extra attention to the turnover rate of payable accounts. When the number of payable accounts is high, the turnover rate will be relatively low, yet as an occupation of the capitals of other subcontracting enterprises and units, payable account can reflect the high market status of logistics companies to some extent

(7) Reflection of a company's level of cash flow

Logistics enterprises, especially those focusing on the service of supply chain, are characterized by high risk, huge and irreversible investment, etc. which result in their heavy reliability on credit business, accompanied by a high asset-liability ratio. Debt Ratio is a financial ratio that indicates the percentage of a company's assets that are provided via debt. It is the ratio of total debt (long-term liabilities) and total assets (the sum of current assets, fixed assets, and other assets such as 'goodwill'). Therefore, in order to guarantee the normal financial operation of a company, it is necessary to guarantee the sustainable development of main-chain capital, and to set high requirements on the company's financing ability as well. Or else, there will be a higher risk of the breakage of capital chain, which will further lead to financial crisis.

(8) Reflection of a company's illiquid assets

Logistics companies generally possess many fixed assets and occupy a huge amount of capital. Although illiquid assets have higher book value, their liquidity is much lower than that of liquid ones. Operation of illiquid assets is high risky due to the complexity of debtor-creditor relationship on it. Therefore, it is advisable to pay extra attention to including indexes that can reflect a company's operation of illiquid assets.

(9) Reflection of a company's ability to develop in future

A company's ability to develop in future is both the prediction and analysis of its development trend and ability to expand and operate in future, which primarily measures the company's potentials in terms of expansion of asset scale, increase of profitability and enlargement of market share, etc. Better development ability in future means lower probability of financial crisis.

(10) Reasonable extraction of non-financial indexes

Method of single financial index is simple and clear, in which it is easy to extract data, to reduce information loss, and to make horizontal comparisons. Nonetheless, it also has

many drawbacks: firstly, single financial index fails to express the information in a comprehensive way; secondly, there is no way to verify the correlation of different financial indexes; thirdly, since it is impossible to distinguish among different risks by single index, multiple indexes must be used together to make the judgment. On top of that, single financial index cannot perform as well as non-financial indexes in terms of the comprehensive expression of information. Since the evaluation of non-financial indexes has already been analyzed in detail, it will not be repeated in this chapter. Accordingly, this study lays emphasis on the exploration of the expressional role that non-financial information plays during the establishment of the early-warning model.

3. 5 Construction of early-warning index systems

3. 5. 1 Preliminary selection of financial indexes

Referring to the financial indexes which were highly pragmatic in previous studies of financial crisis early warning, following the criteria of financial index selection in Chapter 3.4, this paper has tentatively selected the following indexes from six aspects; Debt-paying Ability; profitability, Operating Capacity, Development Capability; EPS index, Earnings per share (EPS) is generally considered to be the single most important variable in determining a share's price. It is also a major component used to calculate the price-to-earnings (P/E) valuation ratio, where the 'E' in P/E refers to EPS. By dividing a company's share price by its earnings per share, an investor can understand the fair market value of a stock in terms of what the market is willing to pay based on a company's current earnings. The EPS is an important fundamental used in valuing a company because it breaks down a firm's profits on a per share basis. This is especially important as the number of shares outstanding could change, and the total earnings of a company might not be a real measure of profitability for investors; cash flow of logistics companies, A cash flow describes a real or virtual movement of money: a cash flow in its narrow sense is a payment (in a currency), especially from one central bank account to another; the term 'cash flow' is mostly used to describe payments that are expected to happen in the future, are thus uncertain and therefore need to be forecasted with cash flows; Cash flows are narrowly interconnected with the concepts of value, interest rate and liquidity.

Indax type	Indax nama	Index
mdex type		code
Debt-paying	Current Ratio	G1
Ability	Quick Ratio	G2

Table 3-1: Primarily select financial systematical index

	Debt Asset Ratio	G3
Drofitability	Profit Rate of Asset	G4
Promability	Earning Rate the Net Assets	G5
Operating	Receivables Turnover Ratio	G6
Conscitu	Inventory Turnover	G7
Capacity	Total Assets Turnover	G8
	Asset maintenance value added rate	G9
	Rate of Capital Accumulation	G10
Davalonment	Growth Rate of Total Assets	G11
Capability	Net Profit Growth Rate	G12
Capability	profit rate	G13
	Per Share Cash Flow From Operations	G14
	Earning Per Share	G15
	Net Assets Per Share	G16
Per Share Index	Undistributed Profit Per Share	G17
	Operational Cash Flow Per Share	G18
21	Net Profit Net Cash Content	G19
Cash Flow Status	Sales Income Cash Content	G20
Cash Flow Status	Net Cash Content of Operating Income	G21
	Total Cash Recovery Rate	G22

3. 5. 2 Preliminary selections of non-financial indexes

Compared to quantitative financial indicator data, non-financial indicators are characterized by lower predictability and quantification. Virtual variables are introduced into this paper to deal with unquantifiable non-financial indexes, and the results of these indexes are designed to be 1 or 0. The broad range from which non-financial indexes can be selected adds to the difficulty of information collection. Compared with financial indexes, which have standard calculation methods, there isn't any definite measurement standard for part of the non-financial indexes in economics and management. Subjective cognition plays a considerable role in the definition of non-financial indexes. Discrete non-financial information can be divided into two categories through macroscopic perspective and microscopic one. In the macroscopic perspective, non-financial information is different in the level of macroscopic environment, such as the competitiveness in the region where the company is located (according to the data on the website of National Bureau of Statistics), the economic development level of this region (regional GDP), while in the microscopic perspective, the non-financial information refers to the standards set according to the operation situation of companies, such as the scale of the company's board of directors, share concentration ratio of the company, etc.

Considering that the introduction of non-financial information is aimed at the exploration of its pragmatic role in optimizing financial early-warning model, this study lays more emphasis on the selection of non-financial indexes from the microscopic perspective, taking into account much non-financial information, such as the company's share structure, governance, internal control and irregularities, etc.

(1) The perspective of corporate governance structure

Corporate governance is the mechanisms, processes and relations by which corporations are controlled and directed. Governance structures and principles identify the distribution of rights and responsibilities among different participants in the corporation (such as the board of directors, managers, shareholders, creditors, auditors, regulators, and other stakeholders) and include the rules and procedures for making decisions in corporate affairs. Corporate governance includes the processes through which corporations' objectives are set and pursued in the context of the social, regulatory and market environment. Governance mechanisms include monitoring the actions, policies, practices, and decisions of corporations, their agents, and affected stakeholders. Corporate governance practices are affected by attempts to align the interests of stakeholders. Interest in the corporate governance practices of modern corporations, particularly in relation to accountability, increased following the high-profile collapses of a number of large corporations during 2001–2002, most of which involved accounting fraud; and then again after the recent financial crisis in 2008. Equity structure, also known as ownership concentration, is the reflection of the nature of shareholders, their shareholdings and relationships. Rankov and Kotlica proposed an idea in 2013 that certain level of ownership concentration would bring more profits to controlling shareholders, and would guarantee their influence over the company's decisions in the meantime. Excessive dispersion of equity will lower the executives' speed of response, weaken their enforcement, and undermine their ability to deal with external crisis. Consequently, large shareholders play a decisive role even in a perfect market environment, and when the executives attempt to impinge the rights and interests of shareholders, they will replace them in order to protect shareholders' common rights. However, overly concentrated equity offers large shareholders the opportunity to impinge the interests of small shareholders for their own benefits by occupying the company's resources, interfering with the decision-making, etc.

As the executive agency, board of directors has great influence on the company's operation efficiency. In terms of enterprise practice, the number of directors is positively related to the company's operation efficiency, with a remarkable effect of talent aggregation. Nevertheless, too many directors will aggravate its redundancy and intensify the divergence. Small cliques inside the board will unavoidably add to the company's burden of management cost, and impact the enforcement of decisions of the listed company. In China, there are different regulations applicable to the board of directors of different types of companies, but the setting of independent directors, who can offer unbiased opinions to the company when there are underlying conflicts of profits in the board, are a common requirement regardless of the scale of the board. Independent directors can also exercise supervision over the company.

Based on the nature of shareholders and the shareholdings of large shareholders above, five indexes which can reflect the equity structure, including shareholding ratio of the first large shareholder, ratio of state-owned shares and so on, are chosen in this study. In the meantime, three non-financial indexes which can reflect the structure of board of directors, including the scale of board of directors and so on, are also chosen.

(2) Internal control and irregularities

Internal control, as defined in accounting and auditing, is a process for assuring achievement of an organization's objectives in operational effectiveness and efficiency, reliable financial reporting, and compliance with laws, regulations and policies. A broad concept, internal control involves everything that controls risks to an organization. It is a means by which an organization's resources are directed, monitored, and measured. It plays an important role in detecting and preventing fraud and protecting the organization's resources, both physical (e.g., machinery and property) and intangible (e.g., reputation or intellectual property such as trademarks). At the organizational level, internal control objectives relate to the reliability of financial reporting, timely feedback on the achievement of operational or strategic goals, and compliance with laws and regulations. At the specific transaction level, internal controls refers to the actions taken to achieve a specific objective (e.g., how to ensure the organization's payments to third parties are for valid services rendered.) Internal control procedures reduce process variation, leading to more predictable outcomes. Irregularities of the company or its management layer will probably harm the sustainable development of the company's normal operational activities, and even breed financial abnormalities in listed companies.

EI	Ta	ıble	3-	2:	Prima	arily	select	non-fina	ncial s	systematica	l index
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Index type Index code	Index name	Index definition
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	K1	Shareholding ratio of the largest shareholder	Thelargestshareholder'sshareholding÷Totalshare capital		
		The proportion of top five	Top five shareholders'		
Fauity	K2	shareholders	shareholding-Total share capital		
Structure	K3	State-owned shares	State-owned shares ÷share capital		
K4		Index Z	Shareholding ratio of the largest shareholder and the second largest shareholder		
	К5	Executive shareholding ratio	Executive holdings÷Total share capital		
Board	K6	Board size	Number of Board		
Structure	K7	Number of independent directors	Number of independent directors		
	K8	Chairman and general manager of two positions concurrently	f concurrently=1, negate=0		
Internal Control and	К9	Audit Opinions	Standard without reservation=1, None=0		
Disclosure of Related Reports	K10	There are major flaws in the disclosure of internal control evaluation report	There are major flaws=1, None=0		
The Securities Regulatory Commission Requires Disclosure of Related Major Issues	K11	Irregularities	There is a violation=1, None=0		

3.6 Determination of explanatory variables in the financial crisis early-warning model

It has been mentioned in Chapter 3.5 that this paper has selected 23 financial indexes and 11 non-financial indexes, and has extracted index data from 50 listed logistics companies, with 15 in the financial crisis group and 35 in the healthy finance group. Too many index data will greatly increase the workload and complicate the model.

This chapter is divided into two part: in the first part, indexes which are preliminarily chosen in Chapter 3.5 are screened, from which indexes with the strongest ability to predict

are selected; in the second part, indexes that remain after the screening are further condensed, and redundant indexes are replaced by several factors so that the model can be simplified and preparations can be made for the establishment of Logistic model in Chapter 4. Specific experiment procedure in this chapter is shown as follows:

Firstly, through significance test, it is determined whether the preliminarily selected financial indexes and non-financial indexes can be applied to the establishment of early-warning model. Before this test, it is necessary to carry out standard normal distribution test. If the result is positive, T-test is used in significance test of index data; if not, non-parametric test is used to determine whether there is significant difference or not.

Next, tests are conducted on indexes which are selected from the significance test to see whether they are qualified for factor analysis. If the result is positive, principal component factors are extracted and Logistic model is established according to them.

3.6.1 Significance test

In significance test, assumption is made in terms of the overall distribution form; then, test is carried out on this assumption according to the sample data to see whether it is reasonable or not. It will be shown in the result whether there are differences between the experiment group and the control group, and whether these differences can be presented significantly. Before the analysis and modeling of index data, significance test is carried out on the selected indexes to select the most significantly different indexes. Indexes without significant difference in both groups should be eliminated since they are proved to be useless to our empirical study.

Significance test is divided into parametric test and non-parametric one. Primarily, T-test is used. T-test makes quantitative test possible, and, since the test efficiency is higher than that of non-parametric test, the accuracy of the test result is relatively higher. However, T-test sets quite strict requirements on sample data, allowing researchers to estimate or examine overall parameters on the premise of normal or Poisson distribution of sample data. Therefore, Kolmogorov-Smirrnov test is carried out on sample data subsequently.

(1) Kolmogorov-Smirrnov test of a single sample

In statistics, the Kolmogorov–Smirnov test (K–S test or KS test) is a nonparametric test of the equality of continuous, one-dimensional probability distributions that can be used to compare a sample with a reference probability distribution (one-sample K–S test), or to compare two samples (two-sample K–S test). It is named after Andrey Kolmogorov and Nikolai Smirnov. The Kolmogorov–Smirnov statistic quantifies a distance between the empirical distribution function of the sample and the cumulative distribution function of the reference distribution, or between the empirical distribution functions of two samples. The null distribution of this statistic is calculated under the null hypothesis that

the sample is drawn from the reference distribution (in the one-sample case) or that the samples are drawn from the same distribution (in the two-sample case). In each case, the distributions considered under the null hypothesis are continuous distributions but are otherwise unrestricted. K-S test is named after two mathematicians from the former Soviet Union. In K-S test, distribution of each variable is tested separately. If the test result of a certain variable is in accordance with a specific theoretical distribution, even distribution, exponential distribution and Poisson distribution are all theoretical distribution functions which can be verified by K-S test. Single-sample K-S test is used in this study for the examination of normal distribution of sample data. When Asymp. sig (2—tailed)>0. 05, it is indicated that the progressive significance is greater than the significance level c (normal significance level is 5%). In other words, this index is normally distributed; conversely, this index is not normally distributed. K-S test results of preliminarily selected indexes two years (T-2 Year) and three years (T-3Year) before the financial crisis of the sample companies are shown in Table 3.3.

Т-3 уе	ear	60 60		T-2 ye	ear		
Cod	Value	Gradual	Determinatio	Cod	Value	Gradual	Determination
e	Z	significance	n	e	Z	significance	Determination
G1	1.936	0.002		G1	3.213	0.000	
G2	1.848	0.033		G2	0.221	0.000	
G3	4.337	0.000		G3	2.379	0.000	
G4	1.112	0.169	Normal	G4	2.324	0.002	
G5	2.823	0.002		G5	2.371	0.000	
G6	3.341	0.000		G6	1.685	0.000	
G7	2.383	0.000		G7	4.019	0.001	
G8	0.844	0.474	Normal	G8	0.809	0.530	Normal
G9	3.178	0.000		G9	1.893	0.000	
G10	4.142	0.000		G10	1.812	0.002	
G11	2.393	0.090		G11	3.275	0.037	
G12	5.182	0.000		G12	3.193	0.000	
G13	3.193	0.000		G13	2.322	0.001	
G14	1.782	0.007		G14	4.445	0.000	
G15	0.154	0.139	Normal	G15	0.901	0.391	Normal
G16	0.595	0.873	Normal	G16	0.641	0.761	Normal
G17	1.244	0.091	Normal	G17	0.794	0.444	Normal

Table 3-3: The inspection result of Kolmogogrow-Smirmoy

G18	2.381	0.024		G18	1.154	0.141	Normal
G19	2.458	0.000		G19	2.173	0.001	
G20	1.905	0.000		G20	1.111	0.166	Normal
G21	2.333	0.001		G21	1.111	0.166	Normal
G22	2.138	0.000		G22	1.987	0.000	
H1	0.889	0.408	Normal	H1	0.878	0.424	Normal
H2	0.916	0.371	Normal	H2	0.752	0.623	Normal
H3	3.826	0.000		H3	3.381	0.008	
H4	4.187	0.000		H4	2.436	0.031	
H5	1.251	0.000		H5	4.272	0.000	
H6	4.354	0.001		H6	2.167	0.000	
H7	1.873	0.000		H7	4.213	0.000	
H8	8.246	0.000		H8	5.234	0.000	
H9	4.342	0.000		H9	2.312	0.051	
H10	1.886	0.017		H10	7.153	0.000	
H11	4.126	0.000		H11	3.113	0.000	

According to Table 3.3, in T-3 Year, there were 5 financial indexes, G4,G8, G15, G16 and G17, that were normally distributed, while two non-financial indexes, H1 and H2, also passed the normal distribution test in T-3 Year; in T-2 Year, there were 7 financial indexes, G8, G15, G16, G17, G18, G20, G21, that were normally distributed, while two non-financial indexes, H1 and H2, also accorded with normal distribution test;

(2) Significance test

Significance of normally distributed indexes is verified by T-test in this study. The test results are shown in Table 3.4 and 3.5.

Index	Value T	Sig.	Significant
G4	2.418	0.019	Significant
G8	3.441	0.000	Significant
G15	4.393	0.000	Significant
G16	7.871	0.001	Significant
G17	7.553	0.003	Significant

Table 3-4: T-test results with T-3 normal distribution indicators

H1	2.175	0.027	Significant
H2	1.314	0.186	Not Significant

 Table 3- 5: T-test results with T-2 normal distribution indicators

Index	Value t	Sig.	Significant
G8	4.453	0.000	Significant
G15	4.782	0.001	Significant
G16	8.213	0.000	Significant
G17	6.887	0.000	Significant
G18	0.127	0.571	Not Significant
G20	-0.113	0.938	Not Significant
G21	-0.121	0.901	Not Significant
H1	2.816	0.007	Significant
H2	1.424	0.144	Not Significant

We can see from Table 3.4 and 3.5 that, in T-3 Year, there were 6 indexes, G4, G8, G15, G16, G17, H1that passed the T-test, and in T-2 Year, G8, G15, G16, G17 and H1 were significantly different.

(3) Non-parametric test

When the samples are not normally distributed, T-test cannot be used for the significance test. In such an occasion, it is necessary to replace T-test by non-parametric test to determine whether ST company samples and non-ST ones accord with the assumption of the same subject. Non-parametric test doesn't have such a high requirement on data as T-test does, so it is unnecessary for indexes to be normally distributed. This method can determine whether two pieces of sample data are significantly differently distributed information. Mann. even with little Whitney test method50, Kolmogorov-Smirnov Z method, Moses limit reaction test, Wald. Wolfowitz run test and so on are all frequently used non-parametric methods.

This paper uses Mann-Whitney U test method as the replacement of T-test to obtain significantly different indexes. Its basic principles are: original samples are divided into two separate sample groups, marked as F(X) and G(Y) respectively; then, two samples with the volume of m and n are extracted, marked as x1, x2, ..., Xm and Y1, Y2, ..., Yn. Observation values of these samples are recorded as X1, X2... Xm and y1, y2... Yn. It is assumed that F(X) = G(Y), and data of both groups are arranged in the ascending order after they are mixed. Rank of each order is thus calculated, followed by the average ranks of both sample groups. Next, we figure out for how many times each rank in the first group

shows up before its counterpart in the second one. Under a given level of significance (normally 5%), SPSS software is used for the calculation of the significance results of the two samples. When bilateral asymptotically probability is smaller than 0.05 (sig<0.05), the result is significant50, suggesting that ST sample and non-ST sample are significantly different with regard to this index. Conversely, the result is the opposite. Both results come from the same totality.

According to Table 3.3, K-S test is carried out on 23 financial indexes and 11 non-financial indexes: in T-3 Year, 7 indexes, G4, G8, G15, G16, G17, G1, G2, have passed the normal distribution test; in T-2 Year, 9 indexes, G8, G15, G16, G17, G18, G20, G21, H1, H2, have passed the test. Next, significance of 26 indexes in T-3 Year and 24 indexes in T-2 Year which fail to pass the K-S test is verified by Mann Whitney U method. The test result is shown in Table 3.6.

distribution							
ar	2 100	T-2 year					
Gradual significance	Determination	Code	Gradual significance	Determination			
1.927		G1	0.006	Normal			
0.211		G2	0.042	Normal			
0.004	Normal	G3	0.000	Normal			
0.134		G4	0.145				
0.364		G5	0.003	Normal			
0.001	Normal	G6	0.008	Normal			
0.000	Normal	G7	0.001	Normal			
0.315		G9	0.000	Normal			
0.008	Normal	G10	0.007	Normal			
0.472		G11	0.000	Normal			
0.364		G12	0.033	Normal			
0.631		G13	0.159				
0.194		G14	0.768				
0.219		G19	0.083				
0.970		G22	0.007	Normal			
0.011	Normal	H3	0.002	Normal			
0.013	Normal	H4	0.063				
0.000	Normal	H5	0.377				
0.021	Normal	H6	0.142				
	ar Gradual significance 1.927 0.211 0.004 0.134 0.364 0.001 0.000 0.315 0.008 0.472 0.364 0.631 0.194 0.219 0.970 0.011 0.013 0.000 0.021	Gradual significance Determination 1.927 Determination 0.211 Normal 0.004 Normal 0.134 Normal 0.364 Normal 0.000 Normal 0.001 Normal 0.000 Normal 0.364 Normal 0.305 Normal 0.315 Normal 0.364 Normal 0.472 Normal 0.472 Normal 0.472 Normal 0.473 Normal 0.194 Normal 0.194 Normal 0.011 Normal 0.013 Normal 0.013 Normal	ar T-2 ye Gradual significance Determination Code 1.927 G1 0.211 G2 0.004 Normal G3 0.134 G4 0.364 G5 0.001 Normal G6 0.000 Normal G7 0.315 G9 G10 0.472 G11 G12 0.631 G12 G13 0.194 G14 G14 0.219 G19 G19 0.970 G22 G11 0.013 Normal H3 0.013 Normal H3 0.013 Normal H4	T-2 yearGradual significanceGradual significance1.927G10.0060.211G20.0420.004NormalG30.0000.134G40.1450.364G50.0030.001NormalG60.0080.000NormalG70.0010.315G90.0000.008NormalG100.0070.472G110.0000.364G120.0330.631G130.1590.194G140.7680.219G190.0830.970G220.0070.011NormalH30.0020.013NormalH50.3770.021NormalH60.142			

 Table 3-6: Index of Mann. Whitney U test that does not meet the normal distribution

H5	0.258		H7	0.986	
H6	0.870		H8	0.830	
H7	0.738		H9	0.004	Normal
H8	0.151		H10	0.674	
H9	0.007	Normal	H11	0.322	
H10	0.863				
H11	0.808				

According to Table 3.6, Mann Whitney U test is carried out on 26 indexes in T-3 Year and 24 indexes in T-2 Year which fail to pass K-S test, and the result shows that, in Year T-3, 6 financial indexes, G3, G7, G9, G11, G21, G22, have passed the significance test, and 3 non-financial indexes, H3, H4 and H9, too; in T-2 Year, 11 financial indexes, G1, G2, G3, X5, G6, G7, G9, G10, G11, G12 and G22, are significantly different, while 2 non-financial indexes, H3 and H9, have also passed the test.

Results of T-test and Mann Whitney U test are compared, and indexes with significance are kept. In T-3 Year, there are 11 financial indexes and 4 non-financial indexes with significance, including G3 (asset-liability ratio), G4 (rate of return on total assets), G7 (inventory turnover), X8 (turnover of total assets), G9 (rate of capital accumulation), G11 (total asset growth rate), G15 (earnings per share), G16 (net asset value per share), G17 (undistributed ratio per share), H3 (rate of state-owned shares), H4 (Z index) and H9 (audit opinion).

In T-2 Year, there are 15 financial indexes and 3 non-financial indexes with significance, including G1 (mobility rate), G2 (speed ratio), G3 (asset-liability ratio), G5 (Net asset yield), G6 (average accounts receivable turnover ratio), G7 (inventory turnover), G8 (turnover of total assets), G9 (rate of capital accumulation), G10 (rate of capital accumulation), G11 (total asset growth rate), G12 (net profit growth rate), G15 (earnings per share), G16 (net asset value per share), G17 (undistributed ratio per share), G22 (total cash recovery), H1 (proportion of the largest shareholder), H3 (rate of state-owned shares) and H9 (audit opinion).

We can see from the tests above that when the financial crisis occurs is negatively related to how many indexes there are which can significantly distinguish between financial crises. That is to say, financial crisis doesn't occur at an abrupt time point; instead, it is a dynamic process where the financial crisis spreads step by step. When it is getting closer to the time of financial crisis, the indexes play a more remarkable role of early warning. As a result, companies ought to make good preparations beforehand to prevent the financial state from worsening to a level impossible to be dealt with.

3. 6. 2 Factor analysis

Through the significance test in last chapter, it is discovered in this study that there are 11 financial indexes and 4 non-financial indexes three years before the financial crisis (T-3 Year) that have significant differences, while there are 15 financial indexes and 3 non-financial indexes two years before the financial crisis (T-2 Year) that have significant differences. In order to guarantee the accuracy of information, it is necessary to keep or omit these indexes with great caution. However, the whole index system is rather intricate, and indexes often contain repetitive information, which will impact the quality of the model. A new round of variable screening is thus required.

Factor analysis is a statistical method where data with multiple variables receive dimension reduction treatment. Dimension reduction refers to that, on the premise that the majority of the information provided by original data structure is kept, this structure is simplified. In brief, most of the information which was originally conveyed by multiple variables is now conveyed by a smaller number of new variables which are not related to each other, and a fundamental and simple conceptual system is thus obtained.

(1) Applicability test

It is a prerequisite in the factor analysis of variables that there should be strong relevance between these variables. If the relevance between these variables is comparatively small or doesn't exist at all, it is then impossible to extract common factors from these variables. Therefore, it is necessary to conduct factor analysis applicability test on the financial variables in T-3 Year and T-2 Year which have already passed the significance test before factor analysis. If these variables pass the test, it is suggested by they are highly related to each other, and can be used in the subsequent factor analysis. Since non-financial index data are not continuous, there is no need to carry out factor analysis on them. Accordingly, factor analysis is only conducted on financial indexes with significance in this chapter.

KMO test is used in this study for the factor analysis of financial variables. KMO test is capable of making comparisons between simple and partial correlation coefficients among the variables, with a result range between 0 and 1. An overly small result indicates that the variable is unsuitable for factor analysis. It is commonly believed that when KMO value is no greater than 0.5, the variable data are not suitable for factor analysis. Results of KMO test are shown in Table 3.7 and Table 3.8, and the KMO values in both years are 0.619 and 0.677 respectively, greater than 0.5. Therefore, they are qualified for factor analysis.

Table 3-7: KMO and Bartlett Test (T-3 Year)

Aiser-Meyer-Olkin sufficient m	0.619	
	Approximate Chi-square	542.198
Bartlet sphericity test	Df.	530
	Sig.	0.001

Table 3-8: KMO and Bartlett Test (T-2 Year)

Aiser-Meyer-Olkin sufficien	0.667	
	Approximate Chi-square	772.241
Bartlet sphericity test	Df.	190
	Sig.	0.005

(2) Determination of factor number

Factor analysis is aimed to obtain principal component factors which can replace original financial variables through linear transformation, the principle behind which is to transform a group of variables (X, for example) into another group of independent and irrelevant variables, and keep the variance unchanged during the transformation. The new group of variables is arranged according to the sequence of variance: the variable with the largest variance is called the first principal component; likewise, the variable with the second largest variance is called the second principal component; rest of the variables is arranged according to this order. Generally speaking, the number of variables equals that of principal components, and each principal component is irrelevant to others. At present, there is no standard method to determine how many principal components can meet the requirement, and the common practice is to take the principal component whose characteristic value is greater than 1 as the initial factor. In this study, 3 principal component factors are eventually extracted from 11 financial indexes in T-3 Year and 5 from 15 indexes in T-2 Year by accumulating variance contribution, factor rotation and factor score, etc., as is shown in Table 3.9 and Table 3.10.

Table 3- 9: Total variance explained (T-3 Year)

	Initial feature value			F	Extract Square and Load			Rotation Squared and Loaded		
Ingred		Doroontogo of	Cumulativa	E	Doromtono of	Cumulativa	Rou	Doroontooo of	Cumulativa	
ionte	Total	Percentage of	Cumulative	Total	Percentage of	Cumulative	Total	Percentage of	Cumulative	
Tents	TOtal	Variance	Percentage	Total	Variance	Percentage	Total	Variance	Percentage	
1	4.120	38.361	38.356	4.120	38.361	38.356	2.839	25.831	25.708	
2	2.104	19.128	57.583	2.104	19.128	57.583	2.569	22.332	48.203	
3	1.201	9.946	67.501	1.201	9.946	67.501	2.243	20.286	68.504	
4	0.895	8.451	77.261							
5	0.765	8.749	83.798							
6	0.601	6.641	95.663							
7	0.419	3.313	97.827							
8	0.151	1.421	98.068							
9	0.144	1.078	98.601							
10	0.110	1.001	99.340							
11	0.032	0.495	100.000							

 Table 3- 10: Total variance explained (T-2 Year)

Incredia	dia Initial feature value		E	Extract Square and Load			Rotation Squared and Loaded		
ingredie	Tatal	Percentage of	Cumulative	Tatal	Percentage of	Cumulative	Tetal	Percentage of	Cumulative
nts	Total	Variance	Percentage	Total	Variance	Percentage	Total	Variance	Percentage
1	5.018	33.465	33.156	5.018	33.156	33.156	4.012	26.836	26.733
2	2.035	13.333	47.583	2.035	13.333	47.583	2.517	17.470	44.204
3	1.779	12.076	59.501	1.779	12.076	59.501	2.243	13.795	58.125
4	1.494	8.435	67.261	1.494	8.435	67.261	1.365	9.138	67.240
5	1.268	7.958	75.798	1.268	7.958	75.798	1.236	9.094	76.351
6	0.904	6.109	81.663						
7	0.781	5.214	87.827						
8	0.637	4.332	91.068						
9	0.472	2.893	94.601						
10	0.135	1.001	99.340						
11	0.133	0.957	97.468						
12	0.073	0.578	99.015						
13	0.051	0.507	99.887						
14	0.017	0.115	100.000						
15	0.000	0.000	100.000						

As is shown in Table 3.9, according to the criterion that the characteristic value of the explanatory factor should be greater than 1, 3 principal component factors can be extracted from 11 financial indexes which have already passed significance test three years before the financial crisis (T-3 Year), whose accumulative explanatory variance is 68.504%, indicating that these 3 factors cover 68.504% of the original indexes. The effect is acceptable and these 3 factors can be the replacement of the 11 financial indexes.

As is shown in Table 3.10, there are 5 characteristic values greater than 1 in the factor analysis two years before the financial crisis (T-2 Year), whose accumulative explanatory variance is 76.351%. Therefore, 15 financial indexes passing the significance test in T-2 Year can be displaced by these 5 factors.

(3) Factor explanation

Apparently, it is not enough only to extract principal component factors from indexes. A reasonable research result should also be able to reflect the relationship between these factors and indexes, as well as the information contained in these factors. Therefore, maximum variance method in orthogonal rotation is introduced into the study, in hope of having a further understanding of the information contained in these factors. Orthogonal rotation is capable of re-allocating the ratio of variance of original financial index information explained by each factor without influencing the fitting degree of data. Consequently, it is capable of solving the one-sidedness of independent and simplified principal component factors. In Table 3.11 and 3.12, more specific definition is given to each factor through orthogonal rotation.

	Ingredients		
	1	2	3
G4	0.817	0.238	-0.255
G15	0.709	0.523	0.027
G11	0.623	0.333	-0.449
G9	0.547	0.157	-0.562
G7	0.544	-0.136	0.189
G8	0.505	0.166	0.218
G17	0.342	0.843	0.095
G16	0.442	0.772	-0.042
G3	0.153	-0.661	0.083
G22	0.209	0.030	0.883
G21	-0.540	-0.214	0.846

 Table 3- 11: Rotating component matrix a (T-3 Year)

We can tell from Table 3.11 that, among the 3 factors in T-3 Year, Factor 1 is chiefly loaded with G4 (rate of return on total assets) and G15 (earnings per share), which reflect the index of the company's ability to gain profits. Accordingly, this factor is defined as F1, factor of profitability; Factor 2 is mainly loaded with G17 (undistributed profit per share) and G16 (net asset value per share), reflecting the company's profit-making ability. Therefore, this factor is defined as F2, factor of profitability; Factor 3 is primarily loaded with G21 (net cash content of operating income) and G22 (total cash recovery), reflecting the company's cash flow. As a result, this factor is defined as F3, factor of cash flow.

		0			·	
	Ingredie	nts				
	1	2	3	4	5	
G11	4.000	-0.277	-0.049	0.075	0.015	
G9	0.868	0.268	0.056	0.065	-0.024	

 Table 3- 12: Rotating component matrix a (T-2 Year)

G10	0.868	0.268	0.056	0.065	-0.024
G5	0.760	0.249	0.057	0.177	-0.209
G16	0.693	0.544	-0.026	0.195	0.303
G15	-0.561	-0.085	-0.023	0.034	0.402
G22	0.308	0.863	-0.054	0.180	0.082
G17	0.085	0.013	-0.103	-0.021	0.023
G3	0.470	0.820	-0.042	-0.005	0.223
G2	0.065	-0.661	0.083	0.003	-0.051
G1	0.023	0.023	0.883	-0.057	-0.022
G7	0.120	0.120	0.094	0.823	0.087
G6	0.064	0.047	0.170	-0.554	0.394
G8	0.211	0.359	-0.154	0.554	0.185
G12	-0.111	0.005	-0.108	0.110	0.847

We can see from Table 3.12 that, among 5 principal component factors in T-2 Year, Factor 1 is greatly loaded with G9 (rate of capital value maintaining and increasing) and G10 (rate of capital accumulation), which are the reflection of the listed company's ability to develop. Therefore, this factor is defined as Q1, factor of development ability; Factor 2 is greatly loaded with G22 (total cash recovery) and G17 (undistributed profit per share), which reflect cash flow and profitability respectively, with a greater relevance with cash flow. Therefore, this factor is defined as Q2, factor of cash flow; Factor 3 is greatly loaded with G1 (mobility rate) and G2 (speed rate), which are the reflection of the listed company's solvency. Therefore, this factor is defined as Q3, factor of solvency; Factor 4 is greatly loaded with G7 (inventory turnover) and G6 (average accounts receivable turnover ratio) and G8 (total asset turnover), which reflect the company's ability to operate. Therefore, this factor is defined as Q4, factor of operation ability; Factor 5 is greatly loaded with G12 (net profit growth rate), which reflects the company's ability to develop. Therefore, this factor is defined as Q4, factor of operation ability; Factor 5 is greatly loaded with G12 (net profit growth rate), which reflects the company's ability to develop. Therefore, this factor is defined as Q5, factor of development ability.

(4) Calculation of factor score

Principal component factors obtained in the research above, together with non-financial variables which have passed significance test, will be taken as the independent variables in the logistic regression early-warning model. Expression of each factor is obtained through the coefficient matrix of component score (as is shown in Table 3.13 and Table 3.14).

Table 3- 13: Component score coefficient matrix (T-3 Year)

	Ingredients		
	1	2	3
G3	0.296	-0.480	0.022
G4	0.330	-0.104	-0.074
G7	0.324	-0.237	0.109
G8	0.220	-0.400	0.158
G9	0.220	-0.087	-0.223
G11	0.200	-0.004	-0.167
G15	0.206	0.101	0.060
G16	-0.002	0.321	0.022
G17	-0.065	0.404	0.070
G21	0.016	0.030	0.387
G22	0.145	-0.015	0.423

According to Table 4.13, expression of each factor in T-3 Year is obtained and is shown as follows:

F1 = 0.296G3 + 0.33G4 + 0.324G7 + 0.22G8 + 0.22G9 + 0.2G11 + 0.206G15 - 0.002G16 - 0.065G17 + 0.016G21 + 0.145G22

 $F2 = -0.48G3 - 0.104G4 - 0.237G7 - 0.4G8 - 0.087G9 - 0.004G11 + 0.101G15 + 0.321G16 \\ + 0.404G17 + 0.003G21 - 0.015G22$

F3 = 0.022G3 - 0.074G4 + 0.109G7 + 0.158G8 - 0.223G9 - 0.167G11 + 0.06G15 + 0.022G16 + 0.07G17 + 0.387G21 + 0.423G22

	Ingredients				
	1	2	3	4	5
G1	0.010	-0.023	0.480	-0.002	0.053
G2	0.007	-0.037	0.486	0.082	0.320
G3	0.211	-0.388	-0.082	0.013	0.195
G5	0.155	0.026	0.014	0.060	-0.133
G6	0.071	0.036	0.080	-0.439	0.384
G7	-0.033	-0.095	0.105	0.642	0.072
G8	-0.035	0.106	-0.040	0.376	0.105
G9	0.231	-0.017	0.020	-0.040	0.006
G10	0.231	-0.017	0.020	-0.040	0.006
G11	0.316	-0.255	-0.014	-0.014	0.060
G12	-0.008	-0.040	0.013	0.084	0.625

 Table 3- 14: Component score coefficient matrix (T-2 Year)

G15	-0.140	0.024	0.025	0.077	0.291
G16	0.117	0.131	-0.006	0.024	0.218
G17	0.006	0.325	-0.052	-0.118	-0.007
G22	-0.021	0.347	-0.051	-0.024	0.018

According to Table 4.14, expression of each factor in T-2 Year is obtained and is shown as follows:

 $\begin{array}{l} Q1 = 0.01G1 + 0.007G2 + 0.211G3 + 0.155G5 + 0.071G6 - 0.033G7 - 0.035G8 + 0.231G9 \\ + 0.231G10 + 0.316G11 - 0.008G12 - 0.14G15 + 0.117G16 + 0.006G17 - 0.021G22 \\ Q2 = -0.023G1 - 0.037G2 - 0.388G3 + 0.026G5 + 0.036G6 - 0.095G7 + 0.106G8 - 0.017G9 \\ - 0.017G10 - 0.255G11 - 0.04G12 + 0.024G15 + 0.131G16 + 0.325G17 + 0.347G22 \\ Q3 = 0.48G1 + 0.486G2 - 0.082G3 + 0.014G5 + 0.080G6 + 0.105G7 - 0.04G8 + 0.02G9 \\ + 0.02G10 - 0.014G11 + 0.013G12 + 0.025G15 - 0.006G16 - 0.052G17 - 0.051G22 \\ Q4 = -0.002G1 + 0.082G2 + 0.013G3 + 0.06G5 - 0.439G6 + 0.642G7 + 0.376G8 - 0.04G9 \\ - 0.04G10 - 0.014G11 + 0.084G12 + 0.077G15 + 0.024G16 - 0.118G17 - 0.024G22 \\ Q5 = 0.053G1 + 0.32G2 + 0.195G3 - 0.133G5 + 0.384G6 + 0.072G7 + 0.105G8 + 0.006G9 \\ + 0.006G10 + 0.06G11 + 0.625G12 + 0.291G15 + 0.218G16 - 0.007G17 + 0.018G22 \\ \end{array}$



4. RESULTS

This chapter aims at complementing and inspecting the positive analysis in Chapter 3. It takes the main component element in Chapter 3 to achieve the research result by Logistic regression analysis. The result is the forewarning crisis model based on pure financial index and the forewarning model of introducing non-financial index. Then it uses back-judge inspection to inspect the accuracy of the two forewarning models in the predicted result of financial crisis.

4. 1 Logistic Regression Analysis

4. 1. 1 Logistic Basic Model Formula

Wikipedia (2018) the basic setup of logistic regression is as follows. We are given a dataset containing N points. Each point I consists of a set of m input variables x1, i ... xm, i (also called independent variables, predictor variables, features, or attributes), and a binary outcome variable Yi (also known as a dependent variable, response variable, output variable, or class), i.e. it can assume only the two possible values 0 (often meaning "no" or "failure") or 1 (often meaning "yes" or "success"). The goal of logistic regression is to use the dataset to create a predictive model of the outcome variable. As in linear regression, the outcome variables Yi are assumed to depend on the explanatory variables x1, i ... xm, i.

The basic formula of Logistic model refers to: $\text{LogitP}=\text{Ln}(P / 1-P)=B_0+B_1X_{1+}$ B₂X₂+·····+ B_KX_K. For briefly expression and the convenient of calculation, the formula can be changed to:

$$P = \frac{e^{(B_0 + B_1 X_1 + B_2 X_2 + \dots B_K X_K)}}{1 + e^{(B_0 + B_1 X_1 + B_2 X_2 + \dots B_K X_K)}}$$

4. 1. 2 The Logistic Regression Analysis Based on the Pure Financial Index

(1) The last three years (T-3 year) regression analysis based on pure financial index model before financial crisis.

Based on the result of obvious inspection and element analysis in Chapter 4, it takes logical regression to analyze 3 main component elements that is abstracted in T-3 year. This research will set the independent variable of the company has financial crisis as 1 and the independent variable of the company has normal finance as 0. So the smaller rate of occurring financial crisis P value means lower financial crisis. In general research, in condition of the ratio of critical samples and non-critical samples as 1:1, the P value will be

set as 0.5. But in this study, the ratio of critical samples and non-critical samples is about 1:2. Therefore, this study set P value as 0.3. When P>0.3, the finance can be normal, conversely, the enterprise has financial crisis, P must be greater than 0.3. Sheet 4.1 to 4.2 refers to Logistic regression analysis result based on pure financial index of T-3 year.

		В	S.E	Wals	Df	Sig.	Exp(B)
	F1	-1.068	0.45	5.633	1	0.017	0.342
	F2	-2.476	0.828	8.925	1	0.002	0.083
Step	F3	0.157	0.347	0.208	1	0.651	1.172
	Constant	-1.233	0.371	10.966	1	0.001	0.289

Table 4-1: Pure Financial Index – Variables in Equation (T-3 Year)

As shown in Table 4.1, the Wals values of F2 profitable competence element and F1 profitable competence element are max, which means the two elements to play a significant function in the model. According to the analytical result of Sheet 5.1, it can be no hard for us to find the forewarning model based on pure financial index of year T-3 is:

$$P = \frac{e^{(-1.233 - 1.068F_1 - 2.476F_2 + 0.157F_3)}}{1 + e^{(-1.233 - 1.068F_1 - 2.476F_2 + 0.157F_3)}} (P < 0.3 \text{ means normal finance, } P > 0.3 \text{ means}$$

critical financial situation).

Table 4- 2: Pure Financial Index – Summary of Models (T-3 Year)

Step	Negative 2 Log	Cox&Snell R	Nagelkerke R
	Likelihood	Square	Square
1	61.815 ^a	0.332	0.468

Table 4.2 is the inspection of degree of fitting of the T-3 year model. The smaller -2 log likelihood means higher fitting degree of the model. The -2 log likelihood based on pure financial index in T-3 year model is 61.815, which means general model fitting degree. The value range of Nagelkerke R is from 0 to 1. When the Nagelkerke R value closes to 1, it has good model fitting degree. The Nagelkerke R value of this study is 0.468. On the whole, above comprehensive fitting degree of forewarning model is not good.

(2) The regression analysis of the model based on pure financial index before two years of financial crisis (T-2 year)

From Table 4.3 to Table 4.4 includes the Logistic regression analytical result based on pure financial index in T-2 year.

	В	S.E	Wals	Df	Sig.	Exp(B)
Q1	-5.791	1.85	9.817	1	0.003	0.002
Q2	-2.455	0.731	11.293	1	0.001	0.087
Q3	0.968	1.071	0.814	1	0.367	2.63
Q4	-0.756	0.685	1.221	1	0.27	0.471
Q5	2.271	1.031	4.849	1	0.027	9.699
Constant	-1.775	0.627	8.001	1	0.005	0.171

 Table 4- 3: Pure Financial Indicators - Variables in the Equation (T-2)

According to the analytical result of Table 4.3, it can find the forewarning model based on pure financial index in T-2 year:

 $P = \frac{e^{(-1.775 - 5.791Q_1 - 2.455Q_2 + 0.968Q_3 - 0.756Q_4 + 2.271Q_5)}}{1 + e^{(-1.775 - 5.791Q_1 - 2.455Q_2 + 0.968Q_3 - 0.756Q_4 + 2.271Q_5)}}$

(P<0.3 means normal finance, P>0.3 means critical financial situation). In this model, the Wals value of cash flow element Q2 is max, which means the element plays a decided role in this model.

Table 4- 4: Pure Financial Index – Summary of Models (T-2)

Step	Negative 2 Log	Cox&Snell R	Nagelkerke R
	Likelihood	Square	Square
1	30.042 ^a	0.565	0.796

Table 4.4 refers to the fitting degree inspection of the model in T-2 year. The -2 log likelihood of T-2 year is 30.042. The model performs general fitting degree, but its model fitting degree result increases in a large number comparing with T-3 year. The Nagelkerke R value in the diagram is 0.796, which increases in a large number comparing with the 0.468 of T-3 year with obviously better fitting degree in T-3 year.

4. 1. 3 The Logistic Regression analysis considering Non-Financial Index

Considering the non-continuity of non-financial index time, the study doesn't abstract the relevant information of non-financial index when analyzing the element analysis. Now it takes the non-financial index of obvious inspection and the abstracted main component element to establish forewarning model with the non-financial index (T3 year) including K1 (The stock ratio of the first biggest stock holders), K3 (National stock ratio), K4 (Z index) and K9 (Auditing opinion). The indicators related to the T-2 year include K1 (Share of the largest shareholder), K3 (Proportion of state-owned shares) and K9 (Audit opinion).

(1) The Forewarning Model Establishment Introduced Non-financial Index of Last Three Years (T-3 year)

		В	S.E	Wals	Df	Sig.	Exp(B)
	F1	-0.752	0.480	2.435	1	0.121	0.473
	F2	-2.421	1.051	5.304	1	0.019	0.089
	F3	0.355	0.582	0.393	1	0.529	1.442
Stop	K 1	0.914	3.282	0.076	1	0.780	2.493
Step	K3	0.188	0.131	2.060	1	0.152	1.207
	K4	-0.043	0.033	1.811	1	0.177	0.957
	K9	-19.429	12086.962	0.000	1	0.999	0.000
	Constant	17.603	12086.962	0.000	1	0.999	44171943.675

 Table 4- 5: Introduces non-financial indicators. Variables in equations (T-3 Year)

According to the study result of Sheet 4.5, it can achieve the Logistic financial forewarning model of comprehensive non-financial index in T-3 year is:

$$P = \frac{e^{(17.603 - 0.752F_1 - 2.421F_2 + 0.355F_3 + 0.914K_1 + 0.188K_3 - 0.043K_4 - 19.429K_9)}}{1 + e^{(17.603 - 0.752F_1 - 2.421F_2 + 0.355F_3 + 0.914K_1 + 0.188K_4 - 0.043K_4 - 19.429K_9)}}$$

By analyzing the Wals value, the profitable element F_2 has the biggest influence in the whole forewarning model.

Table 4- 6: Introduces non-financial indicators. Model summary (T-3 Year)

Step	Negative 2 Log	Cox&Snell R	Nagelkerke R
	Likelihood	Square	Square
1	41.112 ^a	0.495	0.697

According to the study data of Table 4.6, after comprehensive non-financial index, the -2 log likelihood of T-3 year decreases 20.703 with high model fitting degree. The Nagelkerke R value just increases 0.149 with unchangeable model obvious degree. On the whole, after adding non-financial index, the model fitting effect of T-3 year obviously increases.

(2)The Forewarning Model Establishment Introduced Non-financial index of last two years (T-2 year) Before Financial Crisis

	В	S.E	Wals	Df	Sig.	Exp(B)
Q1	-0.570	2.272	8.369	1	0.004	0.001
Q2	-2.781	1.887	2.174	1	0.141	0.061
Q3	1.791	1.456	1.509	1	0.221	5.989
Q4	-0.962	1.062	0.819	1	0.364	0.385
Q5	2.504	1.263	3.941	1	0.046	12.247
K1	-2.324	5.111	0.208	1	0.651	0.099
K3	0.082	0.041	3.645	1	0.055	1.085
K9	-17.518	11625.575	0.000	1	0.999	0.000
Constant	15.676	11625.575	0.000	1	0.999	6421781.598

Table 4-7: Introduces non-financial indicators. Variables in equations (T-2 year)

According to the study result of Table 4.7, it can achieve the Logistic financial forewarning model of comprehensive non-financial index in T-2 year is:

$$P = \frac{e^{(15.676 - 0.57Q_1 - 2.781Q_2 + 1.791Q_3 - 0.962Q_4 + 2.504Q_5 - 2.324K_1 + 0.082K_3 - 17.518K_9)}}{1 + e^{(15.676 - 0.57Q_1 - 2.781Q_2 + 1.791Q_3 - 0.962Q_4 + 2.504Q_5 - 2.324K_1 + 0.082K_3 - 17.518K_9)}}$$

Table 4- 8: Introduces non-financial indicators. Model summary (T-2 Year)

Step	Negative 2 Log	Cox&Snell R	Nagelkerke R
	Likelihood	Square	Square
1	22.025 ^a	0.610	0.869

According to the study data of Sheet 4.8, after comprehensive non-financial index, the -2 log likelihood of T-2 year decreases 7.992 with higher model fitting degree. The Nagelkerke R value just increases 0.1 with unchangeable model obvious degree. On the

whole, after adding non-financial index, the model fitting effect of T-2 year obviously increases.

4. 2 Model regression test

This section selects the relevant data of 15 enterprises having practical financial crisis and 35 logistical enterprises having healthy finance as inspection samples to make confidence test on logical regression model. The final inspection result can be seen in Table 4.9 and Table 4.10.

	Observed		Predicted			
-			Forecast Situation		Predicted Success	
1-3 Voor			Failure	Success	Rate	
Tear	Samula Cata com	Normal	9	26	74.28%	
	Crisis		3	12	80.00%	
	Total Percentage	12	38	77.00%		
	Observed		Predicted			
тэ			Forecast Situation		Predicted Success	
1-2 Voor			Failure	Success	Rate	
rear	Sampla Catagony	Normal	4	31	88.57%	
	Sample Calegory	Crisis	1	14	93.33%	
	Total Percentage		5	45	90.00%	

Table 4-9: Retrospective classification test based on pure financial indicator model

Table 4-	10: Comprehensiv	ve retrospective	classification	test non-fi	inancial i	ndicator
model						

	Observed	Predicted			
т 2	Observed		Forecast Situation		Predicted Success
1-3 Voor			Failure	Success	Rate
rear	Sampla Catagory	Normal	5	30	85.71%
	Crisis		3	12	80.00%
	Total Percentage		8	42	84.00%
T-2	Observed		Predicted		

Year					
			Forecast Situation		Predicted Success
			Failure	Success	Rate
	Sample Category	Normal	2	33	94.28%
		Crisis	1	14	93.33%
	Total Percentage		3	47	94.00%

Comparing Table 4.9 and Table 4.10, in the inspection type of not introduced non-financial index establishment, 12 enterprises of 15 enterprises having financial crisis in T-3 year are predicted successfully with 80% accurate ratio. And there are 26 enterprises of 35 healthy logistical enterprises with healthy finance with 74.28% accurate ratio. Finally, the whole accurate ratio of prediction of T-3 year is 77%.

In T-2 year, there are 14 enterprises of 15 enterprises having financial crisis in T-2 year are predicted successfully with 93.33% accurate ratio. And there are 31 enterprises of 35 healthy logistical enterprises with healthy finance with 88.57% accurate ratio. The whole accurate ratio of prediction of T-2 year is 90%.

Summarizing the above studies, the forecast accuracy rate of the enterprises in the financial crisis of the model for the first two years is 13.33 percentage points higher than the previous three years (T-3 year). Comparing the enterprises having healthy finance in T-2 year and T-3 year, it also increases 14.31 percentage points. The whole accurate ration increases from 77% to 90%, which means to increases 13 percentage points. According to the comprehensive back-judge result, it can easily find that the prediction accurate ration of the model based on pure financial index having a big improvement than T-3 year.

After summarizing the non-financial index, the study has confidence test on the data of 50 sample enterprises in T-3 year. The research result shows that the model prediction accurate ratio of the enterprises having financial crisis is 80%, which has no change with pure financial analytical model. The prediction accurate ratio of the enterprises having normal finance increases from 74.28% to 85.71%. The whole accurate rate increases from 77% to 84%. It is obvious that the forewarning model adding non-financial index can improve the prediction competence of the financial situation of the sample enterprises in T-3 year.

As well, after the whole forewarning models summarizing the non-financial index, the study achieves the similar result when inverse calculating the enterprise samples in T-2 year: the model prediction accurate ratio of the enterprises having financial crisis is 93.33%, which keeps the same with the ratio not adding non-financial index. But the prediction accurate ratio of the enterprises having normal finance increases to 94.28%

comparing with 88.57% before adding non-financial index. Its whole prediction ratio increases to 94% after integrating comparing with 90% before.



5. CONCLUSIONS

5.1 Conclusions

Based on the method of logistic regression analysis, this study builds an alarming model of the financial crisis suitable for the listed logistics enterprises in mainland China. In the process of the whole research, this research mainly probes three aspects: content. The first one is to combine with characteristics of the logistics industry and establish the alarming model of higher discrimination accuracy for the financial crisis in logistics enterprises. The second one is the rational ingress of the non-financial information in the alarming model. It applies the empirical analysis to explore the functions of the non-financial information in the alarming model of the financial crisis. The third is to search for a more sensitive index to the financial crisis of logistics enterprises, which can provide reference and suggestions for enterprises and the academia.

According to the purpose and direction in the thesis, this study chooses the A-share listed companies firstly ST for the abnormity of finance status as the standard definition of the financial crisis. There are 50 selected enterprises samples, including 15 enterprises of financial crisis and 35 enterprises of normal financial situation. At the same time, this thesis integrates the advanced achievements and researches at home and abroad. Targeted at characteristics of the logistics industry in mainland China, this thesis adopts the released annual reports of the sample enterprises which have been audited by the CPA. It selects 22 financial indicators belonging to 7 categories, including the operating capacity, profitability and others. In addition, it takes 11 non-financial indicators from 4 categories for quantitative research, including ownership structure, board structure and others. In the practical research, the SPSS20.0 statistical software is applied for the significance test and factor analysis of financial data and non-financial information. It extracts the principal component factor which can reflect the authenticity of the information. Finally, with the method of logistic regression analysis, it builds an alarming model of the financial crisis suitable for the listed logistics enterprises. It also inspects the accuracy based on the data from the samples. Therefore, the experience and deficiencies in practical studies can be revealed. Reviewing the whole research process, this paper draws the following conclusions:

(1)The financial crises of the listed companies are traceable as there are some signs before they fall into crises. According to the comprehensive financial data, the authentic and accurate financial information of the enterprise can indicates the operating status and financial changes of the enterprise. When the enterprise falls into a financial crisis or at the edge of it, data in the financial statement will inevitable change. This requires the attentions from the managers and shareholders. The timely measures can prevent the approaching crisis. On the other hand, from the respect of non-financial information, it directly reflects the current financial health, although it is unable to be quantified. Moreover, it can enrich and improve the financial crisis alarming system. The authenticity of non-financial information is higher than that of financial information. Therefore, enterprises should attach more importance to its changes.

(2)The closer the financial crisis is to the information, the stronger the warning level of financial and non-financial information is. When comparing the financial crisis in the last two years with the financial crises in the last three years, this thesis finds that, in the financial crisis in the last two years, the alarming indicator passed the significance test of is up to 18. It can extract 5 explanatory variables. In contrast, in the financial crisis in the last three years, the alarming indicator passed the significance test of is only 15. It can merely extract 3 explanatory variables. The result is in line with the research hypothesis. The closer the year to the financial crisis is, the stronger the alarming functions of the annual reports are. Because of the crisis alarming model is based on the listed companies released financial reports, which are audited by the external audit, so the financial reports of listed companies play a relatively more significant role in financial crisis alarming. It is closer to the crisis time and the information of financial reports is abnormal.

(3)The significance indexes vary as the years of the financial crises. The financial reports of enterprises have a rigorous timeliness. Thus, the accuracy of the alarming model based on indicator information is also of strong timeliness. It is necessary to establish the alarming model according to the year.

(4)The time proximity of the financial crisis is proportional to the accuracy of the alarming model. In the empirical study, the accuracy of prediction model decreased from 91.9% in T-2 years to 77% in T-3 years, falling by 21.9%. The financial situation of the T-1 year is the main evidence to judge whether A-share listed companies the mainland China should be ST in the next year. Therefore, the financial statements of T - 1 year can predict whether the financial crisis will occur. It is also of the highest accuracy to predict the financial crisis in three years. As a whole, the short-term prediction effect of the model is higher than the long-term forecast. As a result, it indicates that the falling into the financial crisis of the enterprises is a process of gradual deterioration of the financial situation.

(5) The introduction of non-financial information has improved the accuracy and scientificity of the financial crisis warning model. It can be concluded from the results of the crisis model test results that introducing the non-financial information into the financial crisis alarming model gains higher accuracy of crisis predictions, compared with the financial crisis alarming model only constructed by the financial information. The accuracy of the model T-2 years increases by 2.7 % in contrast with the model before the non-financial information is added. In T-3 years, the accuracy of the model increased by 8.1 % in contrast with the model before the non-financial information is added. Obviously,

introduction of the non-financial information can optimize the financial crisis alarming model.

5. 2 Limitations and Prospects

(1)The number of samples is limited. For consideration of enlarging the samples, this research selects the samples from 47 listed enterprises from 2006 to 2017. Among them, 34 enterprises are of normal financial situation. However, the overall sample scale remains limited. The crisis alarming model may still be influenced by individual factors, influencing the accuracy of the model. Moreover, the non-listed logistics companies cannot be included in the samples of the research. Therefore, it is necessary to expand the scope of external disclosure of the financial report of logistics enterprises. Encourage the financial disclosure of small and medium-sized construction enterprises can improve the overall financial transparency of the logistics industry.

(2)The selection of indicators is subjective. The index selection is based on the previous research experience of scholars at home and abroad. However, it is still influenced by subjectivity. In particular, the selection of non-financial indicators cannot adopt the method of quantitative evaluation. Henceforth, it requires later scholars jointly study and explore how to select indexes more scientifically and rationally.

(3)The selections of non-financial information are limited. At present, the selection of non-financial indicators is based on the released financial reports of the companies. The channels are narrow channels and the selections are limited selection. The scope of non-financial indicators selection is too narrow, so the indicators can only reflect the partial financial situation of the enterprise. It is difficult to conduct the enterprise researches with full view. Therefore, how to expand the research scope of non-financial information may become the future research direction for scholars.

5. 3 Related Suggestions

(1)Attach importance to the non-financial information evaluation function on the financial situation of the enterprise and the internal audit on the financial crisis of the enterprise is regularly carried out according to the financial ratio. The single financial ratio has strong timeliness. Moreover, it bears the individual difference for different enterprise subjects and the weakness of partial expressions. On the contrary, the content of the financial information is the relatively comprehensive. Therefore, apart from establishing the financial crisis alarming system, the enterprise should attach importance to the information exposed in the financial reports. It should construct a sound internal audit system and set the internal audit department. Moreover, the evaluation and supervision

over the quality of the internal audit on a regular basis is critical. Attentions should be paid to the business level training of enterprise audit staff, do the professional audit team can be built.

(2)Enterprises should pay enough attention to the management of development strategy. The management strategy is the long-term or short-term development strategy and development goal of the enterprise management based on the current operating conditions of the enterprise. Business strategy management can be divided into two parts, which are rational formulation and effective practice. When formulating business strategy, the market environment, enterprise strength, competitors and other factors should be emphasized. In the macro perspective of policy support, when the construction market present positive development trend, we should seize the opportunity to occupy the market more efficiently. But the management strategy should not be aggressive, when the enterprise development prospects are uncertain. If the enterprise scale and capital accumulation mismatch the aggressive expansion, the crisis should be reasonably avoided and the pros and cons should be objectively weighed. When the enterprise enters into the mature period of industrial development with the abundant of capital accumulation and the superior internal management system, strategic development plans should be reasonably formulated. In addition, it is necessary to mobilize all the resources to support and implement proposals.

(3)It is necessary to establish the corporate culture and a good image of competitiveness. Corporate culture and competitiveness image mutually promote and reinforce each other. Corporate culture is the scientific value and spiritual outlook expressed within the enterprise organizations, which can inspire the sense of belonging, honor and responsibility of enterprise staff. The competitiveness image is embodied in the external part of the enterprise. Good reputation is conducive to the establishment of in-depth development relationship with partners. It can expand the cooperative communities. High-quality credit rating helps to broaden the financing channels of enterprises and obtain loans from financial institutions. Both investors and commercial banks are more willing to put money into enterprise of higher levels of credit. Therefore, it requires the logistics enterprises in timely provide accurate, authentic and sound financial information and cash flow to commercial banks. So, at a crucial moment, the crisis can be avoided.

(4)The overall quality of management and staff should vigorously be promoted. The management level is the administrative center of the enterprise, the chief designer of the enterprise development, whose responsibility is to formulate the development plan and establish the reasonable enterprise internal management system. Managers are like the masters of the ship. The enterprise employees are at the forefront of the enterprise organization. They are the executors of the specific plan of the enterprise, who are like the

sailor of the big ship. The designer needs the version of global development vision and the reserved professional knowledge and skills, while the executors must have the specific operation professional qualities. Henceforth, enterprises should pay attention to the personnel training of internal personnel. The enhancement should include not only the upgrading of enterprise hardware, but also the promotion of soft skills of enterprises. In a word, talent is the drive and core component of long-term development.

(5)The debt structures of the enterprises should be optimized. The average level of asset-liability ratio in the logistics industry is relatively higher, because of the high level of the overall financing in construction enterprises. The retained earnings of enterprises can hardly meet the needs of enterprises to develop and expand, so it needs the boosting from the external financial resources. As a result, a sound financing channel is essential. However, the introduction of financing capital has also raised the level of corporate debt and increased the operational risk of enterprises. Therefore, it is necessary to establish a sound debt structure and capital structure level according to the capacity of the enterprises, which can ensure the sufficient cash flow and promote the expansion strategy of the enterprise.



REFERENCES

- Altman, E.I. (1968). Financial Ratios Discriminant Analysis and the Prediction of Corporate Bankruptcy. *Journal of Finance*, 9(4), 584-679.
- Altman, E.I., & Robert, G.H. (1977). P-ZATA Analysis: A New Model to Identify Bankruptcy Risk of Corporations. *Journal of banking and Finance*, 1, 29-54.

Beaver, W.H. (1966). Financial Rations as Predictors of Failure. *Supplement to Journal* of accounting Research, 1(33), 71-111.

Carmichael, D.R. (1972). The Audition's Reporting Obligation. *Auditing Research Monograph*, 1, 39-42.

Chang, L. (2007). General Analysis of Corporate Financial Crisis. *Finance Monthly*, 34, 15-24.

Deakin, E.B. (1972). A Discriminant Analysis of Prediction of Business Failure. *Journal* of Accounting Research, 24(5), 167-169.

- Edward, A. (1968). Discriminate Analysis and the Prediction of Corporate Bankruptcy. *Journal of Finance*, 23(4), 589-609.
- Erasmo, C., &Wilfrido, R. (2010). Wind Speed Forecasting in three Different Regions of Mexico, using a hybrid ARIMA–ANN model. *Renewable Energy*, 35(12), 2732-2738.
- Fang, F. (2009). An Analysis of the Construction of Early Warning System for Financial Crisis in Small and Medium-sized Enterprises. *Business Report*, 4, 33-35.
- Ftzpatrick, P.J. (1932). A Comparison of Rations and Successful Industrial Enterprises with Those of Failed Firms. *Certified Public Accountant*, 2, 598-605.
- Gao, P., &Zhang, D. (2010). Empirical Study on the Corporate Failure Discrimination Model. *Statistical Research*, 2, 37-39.
- Gu, Q., &Liu, S. (1999). Financial Crisis Business Investment Behavior Analysis and Countermeasures. *Accounting Research*, 12(3), 12-13.

James, S. (1981). The Probability of Bankruptcy: A Comparison of Empirical Predictions and Theoretical James Model. *Journal of Banking and Finance*, 7(9), 317-344.

- Jiang, G., &Wang, H. (2005). Is it A "ST" If Listed Companies Lose Money for Two Consecutive Years? *Economic research*, 3, 24-28.
- Luo, L. (2012). An Empirical Study on Credit Rating of Listed Companies in China Based on Z Value Model. *The Study of Finance and Economics*, (6).
- Martin, D.E. (1977). Warning of Bank Failure: a Legit Regression Approach. *Journal of Banking and Finance*, 3, 249-276.
- Shan, G. (2012). Analysis of the Causes and Countermeasures of Corporate Financial Crisis. *Business Manager*, (08), 15-24.
- Tomasz, K. (2013). Early Warning Models against Bankruptcy Risk for Central European and Latin American Enterprises. *Economic Modeling*, 31, 22-30.
- Turalay, K. (2010). The 2007–2009 Financial Crisis, Global Imbalances and Capital Flows: Implications for Reform. *Economic Systems*, 34(1), 3-21.

- Turetsky, H.F., &Ewen, M.R. (2011). An Empirical Investigation of Firm Longevity: A Model of the Extant Predictions of Financial Distress. *Review of Quantitative Finance and Accounting*, (23), 323-343.
- Wikipedia (2018). Scientific Management. Retrieved May 8, 2018, from https://en.wikipedia.org/wiki/Scientific_management
- Wikipedia (2018). Logistics. Retrieved May 8, 2018, from <u>https://en.wikipedia.org/wiki/Logistics</u>
- Wikipedia (2017). Altman Z-score. Retrieved December 9, 2017, from https://en.wikipedia.org/wiki/Altman_Z-score
- Wikipedia (2018). Multinomial logistic regression. Retrieved May 11, 2018, from https://en.wikipedia.org/wiki/Multinomial_logistic_regression
- Wikipedia (2018). Artificial neural network. Retrieved May 16, 2018, from https://en.wikipedia.org/wiki/Artificial_neural_network
- Wikipedia (2018). Logistic regression. Retrieved May 1, 2018, from https://en.wikipedia.org/wiki/Logistic regression
- Xu, L. (2006). The Influencing Factors and Management Countermeasures of Corporate Financial Crisis. *Journal of Anhui University of Technology*, (7).
- Wang, Q. (2016). An Analysis of Anhui's Private Finance Risk Based on BP Network Model. *Journal of Mudanjiang Normal University*, (1), 35-37.
- Yang, H. (2011). A Review of Researches on Financial Crisis Early Warning Based on Non-financial Variables and Qualitative Factors. *Communication of Finance and Accounting*, 5(22), 31-33.
- Zhou, S. (1996). Early Warning Analysis of Financial Crisis in F-Fraction Model. *Accounting Research*, 3(8), 15-17.
- Zheng, Q. (2015). Research on Non-financial Indicators in Early Warning of Corporate Financial Crisis. *Rural Economy and Science*, 10(5), 17-19.

Appendix

Securities Code	Compony Nomo	First time by
Securities Code	Company Name	ST Year
000520	*ST FengHuang	2013
601919	*ST YuanYang	2013
600179	*ST HeiHua	2010
600556	ST HuiQiu	2016
600654	*ST ZhongAn	2017
600767	*ST YunSheng	2017
601519	*ST ZhiHui	2017
600358	*ST LianHe	2013
000681	*ST YuanDong	2006
600149	*ST FangZhan	2016
600212	*ST JiangQuan	2008
600603	*ST XingYe	2006
600701	*ST GongXin	2009
600817	ST HongSheng	2007
600617	ST LianHua	2008

Appendix 1 The table of financial crisis corporate sample

Appendix 2 The table of normal financial corporate sample

Securities Code	Company Name	Securities Code	Company Name	Securities Code	Company Name
002245	Aucksun	600676	SJY.	000900	XDTZ
600794	ZFTC	002210	Feima Intl	600057	Xiangyu
600611	DZT	601188	HTDC	300013	XNWL
000828	DGKG	002682	LZGF	600692	YT
300240	Feiliks	600798	NBMC	000088	YPH
002320	HNSS	600180	CCS	002627	YCJYJT
000548	HIG	600018	SIPG	600119	Y.I.C.
300350	HPF	600125	CRT	600787	CMST
603128	CTS Logistics	600270	Sinoair	000996	ZGZQ
600650	Jinjiang Invest	600662	Qiangsheng Holding	600153	C&D INC.
200053	Chiwan Base	601107	Sichuan Express	002357	Fulin Transportation
600561	Jiangxi	603569	Changjiu		
000501	Changyun		Logistics		