INCREASING FINANCIAL HEALTH STABILITY FOR LOGISTICS COMPANIES IN THAILAND

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นางสาวจารุวรรณ ส่งแสง

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วัตถุประสงค์ของการวิจัยนี้คือ 1) เพื่อหาปัจจัยที่เพิ่มเสถียรภาพสุขภาพทางการเงินในระยะยาว และ 2) เพื่อพัฒนารูปแบบของการมีสุขภาพทางการเงินในระยะยาวให้กับบริษัทโลจิสติกส์ในประเทศไทย จากการศึกษาส่วนใหญ่ใช้อัตราส่วนทางการเงินเพื่อศึกษาปัจจัยที่มีผลต่อสุขภาพทางการเงิน มีเพียงไม่กี่ปัจจัยที่ไม่ใช่อัตราส่วนทางการเงินเช่นอายุและขนาดที่ได้รับการกล่าวถึง การศึกษาวิจัยในครั้งนี้ได้พิจารณาทั้งตัวแปรที่เป็นอัตราส่วนทางการเงินและที่ไม่ใช่ทางการเงินที่มีผลต่อประสิทธิภาพทางการเงินของบริษัทโลจิสติกส์ในประเทศไทย การศึกษาได้ครอบคลุมอัตราส่วนที่ไม่ใช่ทางการเงินที่น่าสนใจอันได้แก่ อายุ ขนาด สัญชาติของผู้ถือหุ้น เครือข่ายของบริษัทในด้านโลจิสติกส์ อัตราการเติบโต (ประกอบด้วยอัตราการเติบโตของยอดขาย / อัตราการเติบโตของกำไร / อัตราการเติบโตของสินทรัพย์ / อัตราการเติบโตของความรับผิด) และการเปลี่ยนแปลงของอัตราการเติบโต การศึกษาเป้าหมายประกอบด้วย 110 บริษัทโลจิสติกส์ในไทยที่ลงทะเบียนจากกรมส่งเสริมการค้ากระทรวงพาณิชย์ในประเทศไทย .Multiple discriminant analysis (MDA) ถูกนำมาใช้เป็นเครื่องมือในการวิจัย ด้วยโปรแกรม SPSS โดยใช้ข้อมูล จาก พ.ศ. 2551-2556 Multinomial Logistic Regression Analysis (MLRA) เป็นอีกหนึ่งเครื่องมือที่ใช้ในการวิจัย โดยใช้กับตัวแปรที่มีนัยสำคัญจากผลของ MDA ในการศึกษาประกอบด้วย 2 กรณี โดยกรณีที่ 1 ใช้ตัวแปรทั้งหมดพร้อมกันในการวิจัย และกรณีที่ 2 แยกวิเคราะห์ตัวแปรทางการเงินและตัวแปรที่ไม่ใช่การเงิน ผลการศึกษาพบห้าปัจจัยหลักที่ส่งผลกระทบต่อสุขภาพทางการเงิน อันได้แก่ RETA, BVETL ขนาดสัญชาติของผู้ถือหุ้นและจำนวนผู้ถือหุ้น ส่วนปัจจัยรองได้แก่ CFD อายุ และเครือข่ายทางด้านโลจิสติกส์ของบริษัท ผลการวิจัยนี้อาจจะถูกนำมาใช้เพื่อเพิ่มสุขภาพทางการเงินของบริษัทโลจิสติกในประเทศไทยมีเสถียรภาพมากขึ้นแบบยั่งยืนต่อไป

สาขาวิชา การจัดการด้านโลจิสติกส์ ลายมือชื่อนิสิต .....

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JARUWAN SONGSANG: INCREASING FINANCIAL HEALTH STABILITY FOR LOGISTICS COMPANIES IN THAILAND. ADVISOR: PROF. KAMONCHANOK SUTHIWARTNARUEPUT, Ph.D., CO-ADVISOR: ASSOC. PROF. PONGSA PORNCHAIWISESKUL, Ph.D., pp.

The objectives of this paper are: 1) to identify the factors that determine long-term financial stability, and 2) to develop a model of long-term financial health for logistics companies in Thailand. While many studies have referred to financial ratios as factors affecting financial health, only a few non-financial ratios such as age and size have been mentioned. This paper considers both the financial and non-financial ratios that affect the financial performance of logistics companies in Thailand. The study has covered some interesting non-financial ratios such as the nationality of shareholders, type of networking, growth rate (consisting of sales growth rate/profit growth rate/asset growth rate/liability growth rate) and the variable of growth rates. The sample consists of 110 logistics companies in Thailand enlisted from the Department of International Trade Promotion Ministry of Commerce. Multiple discriminant analysis (MDA) was used as the research instrument. MDA by SPSS was applied to analyze the 5-year data from 2009-2013. Multinomial logistic regression analysis (MLRA) was another tool applied after getting the significant variables from MDA. There are two cases in the study consisting of Case 1 that applied all variables at the same time, and Case 2 applied financial variables and non-financial variables separately. The results that show the five major robust factors that impact financial health are RETA, BVETL, Size, Nationality of Shareholders and No. of Shareholders, while the minor factors are CFD, Age and Type of Network. The output of this research together with the appropriate model could be used to increase the financial health of logistics companies in Thailand.

Field of Study: Logistics Management Student's Signature .....

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CHAPTER 1

INTRODUCTION

1.1 Background and motivation

Thailand is recognized by the World Bank as “one of the great development success stories” in social and development indicators. Due to its geographical location the country has gained an advantage in becoming a logistics hub of South East Asia.

According to Office of the National Economic and Social Development Board (NESDB), the logistics industry in Thailand consists of the following five categories:

1. Freight Transportation and Forwarding Group

This group of companies provides transportation services by land, rail, sea and air transportation. The services consist of domestics and oversea transportation. Transportation by road is the most popular for domestic transportation.

2. Warehousing/Inventory Management and Packing Group

The services consist of providing and managing storage, a distribution center, labeling and packing. Some companies own a warehouse but most of them rent one.

3. Non-Asset Based Logistics Services Group

Most companies in this group provide custom clearance, shipping, paper-less for import and export business.

4. Information and Communication Technology/ Consulting Group

This group provides logistics solutions and Logistics software. The growth in this group has increased over the last 10 years more than other groups.

5. Courier and Postal Services Group

The number of companies in this group is few and they provide services both domestics and oversea parcels.

According to the Ministry of Commerce (2011), about 65% of the registered companies fall into group 1 (freight transportation and forwarding). Most of the

registered companies are SMEs with registered capital of less than THB 5 million and are family owned. About 45% of the total companies are located in Bangkok. However, the big players in Thailand are mostly foreign multinational companies.

Logistics is an important industry in Thailand, generating about 3% of Thailand's GDP in 2008 and between 2-3.5% for the next several years (NESDB). In terms of logistics cost compared to GDP, Thailand's cost is nearly 20% of GDP – still considered high according to (Alexandre M. Rodrigues (2005)). In contrast, the US level is single digit. Compared with its neighbors such as Singapore (8%) or Malaysia (13%), the country is also higher.

As can be seen in the below table, logistics in Thailand has continued developing as seen from the decline in logistics cost in the percentage of GDP from 18.1% to 14.7% within 12 years' time.

Table 1.1 : Logistics cost of Thailand vs GDP

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Logistics cost of Total GDP (%)	18.10%	16.70%	16.10%	15.80%	17.10%	17.80%	17.10%	17.10%	15.10%	15.20%	14.50%	14.70%
GDP(million THB)	5,133,502	5,450,643	5,917,369	6,489,476	7,092,893	7,844,939	8,527,197	9,080,466	9,041,551	10,104,821	10,540,134	11,375,349
Logistics cost (million THB)	929,164	910,257	952,696	1,025,337	1,212,885	1,396,399	1,458,151	1,552,760	1,365,274	1,535,933	1,528,319	1,672,176

From National Economic and Social Development Board

The cost of logistics is considerably high and higher in percentage to GDP when compared to the country's neighbors. Therefore, all parties including the government and private sector must give priority to this sector. The country needs to accelerate and improve its system to compete more effectively on a global scale. In order to improve the logistics sector, the cost of logistics needs to be reduced and also focus on improvement in terms of performance. The financial performance has benefited considerably from people in various areas of business to further the organization's health and its survival. As financial health is the backbone of the business, high performance reflects management effectiveness and efficiency in making use of company's resources, and this, in turn, contributes to the country's economy as a whole (Naser & Mokhtar, 2004).

Financial health refers to the well-being of a business as measured by adequate financial analysis (Parson) It measures the overall financial status of a firm that includes the total assets the firm owns and income the firm has to pay out to cover regular and other expenses. Financial health existentially embodies uncertainty which can have both potential benefits and costs associated with it. Stable financial health not only means that the finances adequately fulfill the role in allocating all assets, income, costs and risks in the short term, it should also refers to smooth functioning over the long run.

Over the past 80 years, there have been many studies conducted to find a prediction model to predict financial distress. Most of the studies have concentrated on financial ratios starting with the work of Ramser and Foster (1931), Fitzpatrick (1932), Winakor and Smith (1935), Merwin (1942) who attempted to identify the influence of financial ratios as indicators of financial distress. Since then, Beaver (1966), Altman (1968) and many more researchers have focused on the area.

Financial ratio is one of the financial factors, while other financial aspects could also influence financial health. In terms of growth rate, it cannot be concluded that the higher growth, the better the financial health of the firm as it depends on what kind of growth. Growth could be considerend in terms of sales growth, revenue growth, total asset growth and total liability growth. The growth could differ each year. It is interesting to know whether stable growth impacts financial health or not. This study takes variation in growth for the four above dimensions into consideration as well. Apart from the influence of financial variables on financial health, not many studies have addressed non-financial variables. Previous studies considered firm age (Argenti, 1976; Knight, 1976; Altman, 1977; Laitinen, (1992, 2005); Arindam Bandyopadhyay, 2006), firm size (Keasey and Watson, 1987; Shumway, 2001; Laitinen, 2005; Mine, 2006; Han Donker, Bernard Santen & Saif Zahir, 2009 and Shuk-Wern Ong, 2011), Network (Arindam Bandyopadhyay, 2006; Y.Wu, 2010), variation in corporate name, (Taw wan et al, 2014). The nature of the logistics sector in Thailand – the big players are foreign companies with the percent of foreign owned logistics companies increasing from 49% in 2008 to 70% in 2013 (Chackrit Duangphastra, 2013). Also the

total assets of the top 20% big players dominate 80% of all total assets in this sector. This study utilizes nationality of shareholders and number of shareholders as non-financial variables. Some companies diversify their business into different logistics services so as to be able to reduce business risk and possibly affect long-term financial stability. The network of firms is also considered in the study.

1.2 Research objective

In order to increase the competitive advantage of the logistics sector in Thailand, this study examines the following two objectives:

(1) To find the factors determining long-term financial stability.

(2) To develop a long-term financial health model for logistics companies in Thailand.

1.3 Research gap

Of previous studies, those on financial distress have investigated the data collected from listed firms where almost all the firms are big companies, while almost all of the logistics companies in Thailand are not listed on the stock market. This study collects data from non-listed firms, including small and medium firms.

To date, there has been no specific study on financial health for the logistics sector in Thailand. This study will be empirical research into this sector. The studies of Thai business financial health have focused on the technology industry (Puagwatana & Gunawardana, 2005), on financial firms from the Bank of Thailand (Reynolds, Fowles, Gander, Kunaporntham, & Ratanakomut, 2002), on no specific sector but distressed listed firms on the Thai stock market (Tirapat, 1999), and on large and small listed companies on the Thailand stock market (Ponsgat, 2004).

Previous studies mostly analyzed financial ratios in their models while this study includes financial ratios and the other financial variables of sales growth, rrevenue growth, total assets, growth, total liability growth and variation of sales growth, variation of rrevenue growth, variation of total asset growth, variation of total liability

growth and also non-financial variables of firm age, firm size, network of the firm, and corporate governance (nationality of shareholders, number of shareholders).

There are at least seven well established tools used from the previous studies such as univariate discriminant analysis, multivariate discriminant analysis, logistic regression analysis, probit model, neural network model, Black–Scholes–Merton option pricing model (BSM) and hazard models mentioned in Chapter 2. These studies either used one tool or compared the results from each tool; however, this study used the two tools of multivariate discriminant analysis to screen the significant variables first and apply multinomial logistics regression analysis to determine the long-term financial stability of logistics companies in Thailand.

All of the previous studies divided data into two groups: healthy and unhealthy. However, this study classified data into three groups: unhealthy, normal and healthy. The rationale is presented in Chapter 2.

1.4 Research scope

The sample in this paper comprised all logistics companies registered with the Department of International Trade Promotion Ministry of Commerce, Royal Thai Government totaling 110 companies. The data came from financial statements, balance sheets, profit and loss sheets for 6 years (2008-2013). Due to the growth and variation of growth calculated by comparing to the previous year (t and t-1), the results of the raw calculated data were from 2009-2013. Secondary data was collected from a reliable website (http://corpus.bol.co.th).

1.5 Research methodology

Data – after the historical data was collected, the most popular 10 financial ratios out of 40 significant financial ratios from previous studies were selected under all classifications of the 4 financial ratio groups of liquidity, profitability, leverage/solvency and efficiency/activity group.

The other 8 financial variables not financial ratios that are growth rate and variation in growth rate were calculated from the raw data and 5 non-financial variables of 110 companies collected.

Methodology – as mentioned regarding the research gap, the multivariate discriminant analysis model was the most practical, effective method and widely used in the whole financial distress prediction system and logistics regression analysis was also popular for academic purposes. Kim et al (2002), Cho et al (1995) and Sun & Lee (2008) pointed out that the mix of multiple models improves performance and accuracy. This study used multiple discriminant analysis (MDA) to screen significant variables affecting the financial health of the firms and multiple logistics regression analysis (Logits) to identify long-term stable financial health.

1.6 Research contributions

Stable financial health is essential for the company as sustainable health allows the firm to continue to function productively and can have a good effect in leading to greater health. Previous studies on the financial health model have shown multiple discriminant analysis to have a high accuracy in predicting as well as being a practical method. However, the prediction is only short term and not long term and does not consider the stability of financial health. Multiple logistics regression has been shown to have high prediction accuracy in the long term. Therefore, the mixed method applying both tools in this study could be useful in its academic contribution. In addition, this research proposes new, other financial and non-financial factors that could lead the way in identifying a long term financial health model for logistic companies in Thailand

The results of the study might be used for the strategic improvement of firm competitiveness in gaining a competitive advantage for the Thailand logistics industry and thereby leading to suitable strategic management for AEC competition and the sustainable financial health of logistics companies in Thailand.

This study consists of the following five chapters:

Chapter 1- Introduction

Starting from the background and motivation of the research, followed by research objective, research gap, research scope, research methodology and research contribution.

Chapter 2- Literature Review

Review of the literature of studies on financial health both in terms of financial health studies and variables, key models, model selection and variable selection.

Chapter 3- Methodology and Model Development

Presenting data used, research process, criteria of separation between each group, sample size, case separation, methodology developed and marginal effect analysis.

Chapter 4- Data Analysis and Results

Demonstrate and analysis of results for case 1 (obtaining all financial variables and non-financial variables at the same time) and case 2 (obtaining financial variables and non-financial variables separately). Each case consists of two parts: part I (using multiple discriminant analysis) to identify the significant variables affecting the financial health of logistics companies in Thailand from the data and also identify a model with factors determining the long term financial health in part II (using multinomial logistics regression analysis) and marginal effect.

Chapter 5- Discussion and Conclusions

This chapter presents the results from each case, comparing the results between case 1 and case 2, marginal effect analysis from cases, robustness and marginal effect, radar chart of marginal effect, comparing the results of this study with previous studies, research limitations, future study, implications and conclusions.

CHAPTER 2
LITERATURE REVIEW

Financial health determines how successful the company has been with money. There are many factors that need to be considered when measuring financial health. There is some wording that has been used to denote distress, for instance, failure, failed, unhealthy etc. where the meaning is essentially the inability of the firm to pay its financial obligations that could lead to bankruptcy at the end. In order to have warning indicators before the firm becomes bankrupt, financial health prediction is one tool used to predict the future financial health of the company. There have been many studies on the prediction of financial distress. This chapter reviews the studies of financial heath from the past, key models, the selection of models in this study, significant variables from previous studies and the chosen variables in this study.

2.1 Financial health studies

The prediction of financial distress has been studied by many researchers over the last 70 years. The early research (Ramser and Foster, 1931; Fitzpatrick, 1932; Winakor and Smith, 1935; Merwin, 1942) concentrated on the comparison of the financial ratios in failed and non-failed firms and concluded that the poorer ratios affected the failed firms. The research changed with the pioneering study by Beaver started with 30 financial ratios and identified 6 financial ratios considered to be important consisted of cash flow/debt, net income/total assets, total debt/total assets, working capital/total assets, current assets/current liability, current ratio and the no-credit interval. Each ratio was analyzed separately by univariate analysis and classification analysis. Beaver found that the failure status of firms can be correctly predicted to a much greater degree than expected from random prediction. This suggests that financial ratios could be useful in the prediction of failure for around five years prior to failure. Beaver (1968a) extended his earlier work to examine the differences in the

predictive ability of the ratios indicating that non-liquid asset measures predict failure better than liquid asset measures and that there are also differences in the predictive power of ratios among the liquid asset measures.

A pioneering study in financial health was done by (Edward I Altman, 1968), a professor at New York University. Altman developed his classic multivariate insolvency prediction model (MDA) using a sample of 33 bankrupt firms and 33 non-bankrupt firms from manufacturers in USA. There were 5 significant variables composed of working capital/total assets (liquidity), retained earnings/total assets (leverage), earnings before interest and taxes/total assets (profitability), market value equity/book value of total debt (solvency) and sales/total assets (activity) analyzed with multiple discriminant analysis where variables were combined simultaneously to analyze the prediction. Altman found that his model outperformed Beaver's ratios in terms of multiple discriminant analysis being the tool to identify which combinations of financial ratios predict bankruptcy best while the univariate approach by (W. H. Beaver, 1966) only analyzed financial ratios separately which might lead to less prediction accuracy. For example, the firm has poor profitability and/or solvency ratios that may be considered as potential bankruptcy or unhealthy while the liquidity ratio is above average with the actual situation of the firm possibly not being considered serious.

Deakin (1972) applied the same variables as Beaver (1966) but developed the method using multiple discriminant analysis.

Pinches, Mingo, & Caruthers (1973) classified useful ratios according to seven factors: return on investment, capital turnover, financial leverage, short-term liquidity, cash position, inventory turnover, and receivables turnover.

Altman, Haldeman, & Narayanan (1977) reviewed 53 bankrupt companies (half manufacturers half retailers) and 53 non-bankrupt companies from the same sectors.

7 financial ratios were significant (return on assets = earnings before interest and tax/asset, stability of earnings, debt service = log (earnings before interest and taxes/total interest, payment), cumulative profitability = retained earnings/TA, liquidity = working capital / TA, capitalization = 5 year average equity/TC and size = TA, using multi discrimination analysis.

Beerman (1976, as cited in Borlea, 2013) published one of the first German statistical classification models for insolvency analysis. Beerman matched 2 groups of 21 firms which operated or failed in 1966-1971 and analyzed 10 ratios but grouped them in 5 factors encompassing profitability, cash flow, fixed asset growth, leverage and turnover.

Weinrich (1978, as cited in Altman, 1984) attempted to construct risk classes to predict insolvency using 44 failed and 44 healthy firms in 1969-1975. He used univariate and multivariate methods and found net worth/debt ratio the best factors.

Altman & Ribeiro (1979) studied firms in Brazil in textiles, furniture, pulp and paper, retail stores, plastics, metallurgy and others. Five important variables were suggested: working capital/total asset (liquidity), total equity-capital contributed by shareholders (CCS)/TA, earnings before interest and taxes/total assets (profitability), market value equity/book value of Total debt (solvency), sales/total assets (activity).

Knight (1979, as cited in Altman, 1984) interviewed 72 key persons from 72 manufacturing, service, retail and construction sectors (his questions were why small businesses fail and how to decrease such failures). His study found that a firm usually fails in the early stages: 50% of all failed firms did so within 4 years and 70% within 6 years. Almost all failures have some type of managerial incompetency.

Bilderbeek (1977, 1979, as cited in Altman, 1984) observed 5 important financial ratios: retained earnings/total assets, added value/total assets, accounts

payable/sales, sales/total assets, and net profit/equity. The sample comprised 38 distress firms in 1950-1974 and 52 non-distress firms in The Netherlands. Out of 20 ratios, there were 5 main variables: retained earnings/total assets, added value/total assets, accounts payable/sales, sales/total assets, and net profit/equity.

Van Frederikslust (1978, as cited in Altman, 1984) studied f 20 stress and 20 non-stress firms in the textile, metal processing, machinery, construction, retailing and miscellaneous sectors between 1954 and 1974. Two variables were significantly involved: liquidity ratio (external coverage) and profitability ratio (rate of return on equity).

(Ohlson, 1980) constructed a logistics regression model considering the probability of being a failed or unfailed firm using data from 105 failed and 2058 unfailed firms during 1970- 1976 and found that if total liability to total asset, current liability to current asset and negative income for the last two year was high, there would be a high possibility of bankruptcy. While size, working capital to total asset, net income to total asset, funds are provided by operation to total liability and net income for the most recent period were high, the possibility of bankruptcy was not that high.

Cahill (1981, as cited in Altman, 1984) conducted research in Ireland, using a sample of 11 listed companies (1970-1980) and variable names as per audit comment : unsuccessful merger activity, significant investment, asset expansion by debt. The results showed that asset expansion by debt caused Irish firm failures.

Altman and Lavallee (1981, as cited in Altman, 1984) applied the multiple discriminant analysis method on a sample of 27 unhealthy and 27 healthy firms in manufacturing, retail and wholesale in 1970-1979. The significant variables were sales/total assets, total debt/total assets, current assets/current liabilities, net profits after tax/total debt, rate of growth of equity/rate of asset growth.

Chen and Shimerda (1981, as cited in Altman, 1984) reviewed 26 articles that classified 65 financial ratios incorporated in predictive studies between 1966 and 1975, and reported that 41 financial ratios were considered to be important.

Ko (1982, as cited in Altman, 1984) identified the 5 significant variables of EBIT/sales, inventory turnover 2 years prior/inventory turnover of 3 years prior, standard error of net income (4years), working capital/total debt, market value equity/total debt.

Altman, Hatzell and Peck (1995, as cited in Altman, 1984) modified Altman's original model (1968) for the emerging country model (based on Mexico) with variables changed from the 5 ratios to the 4 ratios of working capital/total asset (liquidity), retained earnings/total assets (leverage), earnings before interest and taxes/total assets (profitability), book value equity/book value of total debt (solvency).

Tiparat (1999) used a logit–based model on a sample of 55 failed and 341 non–failed firms listed in the Thailand stock market. Focused on macro–economic factors and financial ratios.

Persons (1999) studied both financial statement and non–financial statement modelling for the finance industry in Thailand between 1993 and 1996 with 41 finance companies (26 distressed and 15 surviving). A logit model was developed and the degree of classification accuracy of the model accurately predicted 96 percent of distress and 87 per cent of surviving finance firms in the first year.

Reynolds, Fowles, Gander, Kunaporntham, & Ratanakomut (2002) developed the probability of business failure of Thai financial firms using 3 models (probit, logit and accumulative logit model) on a sample of 91 financial firms (56 failed and 35 non–failed companies) from 1993-1996. Data was collected from the Bank of Thailand. The findings showed no differing ability in prediction between the three models.

Abolfazl (2003) reviewed the original model from Altman (1968) and Ohlson (1980) for 80 companies listed on the Teheran stock exchange, using data from 1998-2005. The research found that one year before bankruptcy, Altman's prediction accuracy was higher than Ohlson's model. For two and three years before bankruptcy, Ohlson's prediction accuracy was higher than Altman's model. Then the research modified both models using the same data and found that between multiple discriminant analysis (MDA) and logistic regression analysis (LRA), for 1, 2, 3 years before bankruptcy, the LRA technique showed higher accuracy than the multi discriminant analysis (MDA) technique.

Ponsgat (2004) compared the accuracy of using Altman's model (1968 – multiple discriminant analysis) and Ohlson's model (1980 – logistic regression analysis) with 60 distressed/ 60 non-distressed firms from the Thailand stock market. The compared samples were in the same industry and of the same asset size from 1998-2003. The results proved that there was no significant difference in terms of predictive power between Ohlson's (1980) model and Altman's (1968) model.

Puagwatana & Gunawardana (2005) investigated the probability of the business failure of companies in the technology industry in Thailand using 12 failed and 12 non–failed companies from the Department of Business Development of the Ministry of Commerce. With a binomial logit model, the final model was developed based on Altman's (1968) model and one new ratio (net income (loss) to amount of shares).

Erkki (2005) conducted research on manufacturing, construction, hotel & restaurant, transport & storage & communication and services companies in Finland in 1997-2001. The important variables were size, industry, and age plus 7 financial ratios: low profitability/high growth rate (the growth of the firm= annual percentage change in net sales, profitability (return on investment, the net profit to net sales ratio), cash flow (cash flow to net sales, cash flow to total debt), the equity ratio, cash flow to

debt ratio, quick ratio or short-term liquidity (shareholder capital to total assets). The chosen variables were largely comparable with the covariates used in previous failure studies (Mossman, Ell, Swartz, and Turtle 1998; Turetsky and McEwen 2001).

Mine & Haken (2006) used a sample of 27 distressed and 27 non-distressed companies during 1966-2003 in his development with two statistics methods: multiple discriminant analysis and logistic regression. There were 6 important variables for multiple discriminant analysis: EBITDA/ total assets, EBIT/sales, fixed asset turnover (fixed assets / equity), return on equity (long-term debt / total debt, return on paid capital, BV of equity/BV of total assets), size, and tax burden. While the logit model identified 11 significant predictors, which are indicators of the degree of economic distress (EBITDA/TA, EBITS/sales), solvency (sales/current asset, market value of equity/book value of total liabilities), liquidity (net working capital/long-term debt, sales/working capital, long-term debt/total debt), trade creditors' coordination (account payable note payable/TA, sales/BV of net tangible fixed assets), return on equity (net income/equity, BV of fixed assets/BV of equity, (EBIT/paid capital), tax burden (Other income before taxes/other income after taxes), and size (total assets/1000)/WPI).

Bandyopadhyay (2006) studied the panel data of 104 Indian corporations for the period of 1998-2003, selecting 27 unhealthy firms and 27 healthy firms from 11 industries (food products/sugar/tea/tobacco/beverages, paper, textile, chemical, machine/electrical/computers, metal/non-metal, auto/parts, power, diversified, service and other manufacturing). Six financial ratios were found: working capital/TA, cash profit / total assets, solvency ratio (TA/ total borrowings plus current liabilities and provisions minus advance payment of tax), operating profit/TA, capital turnover ratio (Total sale/TA), equity market value/book value. The following non-financial variables were taken from the existing literature about corporate solvency: age of the firm, group ownership, and ISO quality certification (ISOD) and control variables-

industry characteristics. He referred to Altman's Z-score using multiple discriminant analysis for his new model.

Sookhanaphibarn et al. (2007) developed the NNA-based model from 41 financial firms listed on the Thailand stock market during 1993-2003. There were 30 financial variables and 7 ownership variables (such as family and control rights) applied in the study. Three NNA approaches were developed to identify the classification ability of the model consisting of: 1. Learning Vector Quantitation 2. Probabilistic Neural Network and 3. Feedforward Network. The result revealed that the optimal set of inputs is between five and nine variables in all three approaches.

Guo-ming, Yuan, & Ling (2007) applied the canonical discriminant analysis method of the multivariate discriminant analysis for a new model on the data from manufacturing firms listed on the Chinese stock market (25 unhealthy and 25 healthy companies). The 19 financial indicators of conventional financial ratios reflected the capability of solvency, profitability, asset management, business development and equity. Of 19 indicators, only 5 were working: 1. Return on assets, 2. Assets turnover, 3. Net assets per share, 4. Profit-cash cover, and 5. Cash flow-to-current-debt.

Donker, Santen, & Zahir (2009) developed a model from 33 stress firms and 144 non-stress firms listed on the Amsterdam stock market from 1992-2002. There were 7 variables for this model: % of shares held by management and the trust office, % of shares held by family, % of shares held by other institutes of investors such as bank insurance etc., % of shares held by other blockholders, size (BV of TA), debt (% of BV of TD/BV of TA), cash flow (change in cash flow / BV of TA), and payout (% total dividend/net income). The results showed that the accounting data (size, debt, cash flow and payout) have significant influence on the likelihood of financial distress.

Wu, Gaunt, & Gray (2010) used the Black–Scholes–Merton option-pricing model as tools and found that a comprehensive model including key accounting information, market data, and firm-characteristics significantly outperforms models from the extant literature. Key account information consisted of (a) profitability variable: EBITTA = earnings before interest and taxes to total assets; SALES = sales to total assets; NITA = net income divided by total assets; CHIN (change in income) = (Nlt -Nlt-1)/ INIt1|+|NIt-1I) where NIt is net income for the most recent period; (b) liquidity variable: WCTA = working capital to total assets; CLCA = current liabilities to current assets; FUTL = income from operations after depreciation divided by total liabilities; INTWO = net income compared with the previous 2 years; (c) leverage variable: RETA = retained earnings to total assets; MVETL = market equity to total liabilities; TLTA = total liabilities to total assets; OENEG= total liabilities exceed total assets TLMTA = total liabilities to market value of total assets. Firm characteristics consisted of firm size and network.

Šarlija and Jeger (2011) conducted research on a sample of 2,000 small and medium enterprises in Greece from 2006-2009 using the logistic regression method. The results showed that during a recession, the model changed and the companies adjusted their financial strategy; hence, two models fitted a three-year period. There were 5 significant variables for 2006 and 2007 and 4 ratios for 2008 as follows: 1. Net profit/equity ratio (ROE) composed of turnover ratios and profitability ratios. 2. The operating revenues/operating expenses ratio referring to total revenues and total expenses. 3. The LT assets/ (equity + LT liabilities) ratio. 4. Liabilities/total assets ratio. 5. Equity/sales ratio. For 2008, the 4 ratios were: total revenues/total assets, total revenues/short-term assets, (short-term assets-inventory)/sales (all three ratios were activity ratios) and one leverage ratio (equity/total assets).

Alifiah (2013) attempted to predict financial distress of trading and services companies in Malaysia using logit modell with macroeconomic and financial ratios

variables. There were 5 variables in the model : debt ratio, total assets turnover ratio, working capital ratio, net income to total assets ratio and base lending rate.

Almajali, Alamro, & Al-Soub (2012) used multiple regression and identified four variables (leverage, liquidity, size, management competence index) as having a positive statistical effect on the financial performance of Jordanian Insurance companies.

Tuvadaratragool (2013) applied integrated a multi-measure (IMM) approach (which comprised the emerging market score model, comparative ratio analysis and ratio trend analysis) and the logit model as a benchmarking measure with companies listed on the Thai stock market from 2003-2008. The study found that financial statement ratios can be used to signal business failure in the Thai context in normal economic circumstances.

2.2 Key models

In previous studies, various models have been developed in the academic literature using many techniques. The key models began with univariate analysis (Beaver, 1966) where paired-samples between failure and non-failure firms were utilized. This method is easy to use as it is not complicated using a uni-raio but there could be interaction between ratios which limits this model. Two years later, Altman (1968) created a bankruptcy prediction model using multiple discriminant analysis with more financial ratio variables taken into account at the same time. This model has been widely used in many countries. In 1980, Olson introduced the logistics regression function predicting the probability of bankruptcy. Zzmijewski applied the probit regression analysis function in 1984. These logit and probit regression analyses were also widely used. The complex interconnected variables model was proposed by Weebos (1924) under the artificial neural network (ANN) This model was frequently utilized for classification and prediction (Wu, Yang, & Liang, 2006) by

considering advanced multiple regression analysis for the complex and non-linear data relationship (Jogt, 1993). The later models used sophisticated functions such as the Black–Scholes–Merton option-pricing model (BSM), hazard model and others were obtained but due to their complexity and difficulty of use, these models have not been frequency utilized.

The table below summaries the key models for predicting bankruptcy or business failure. This table is only indicative of the significant research and is not a list of all that have researched this field of study.

Table 2.1 : Summary of key models with researchers

Type of Model	Authors
Univariate Analysis	Fitzpatrick (1932), Merwin (1942), Walter (1957), Beaver (1966), Weinrich (1978), Bontemps (1981)
Discriminant Analysis	Altman (1968), Von stein (1968), Edmister (1972), Deakin (1972), Blum (1974), Mader (1975, 1977), Beerman (1976), Moyer (1977), Altman, Halderman & Naarayanan (1977), Collongues (1977), Bilderbeek (1977,1979), Weinrich (1978), Knight (1979), Altman, Baidya and Riberio-Dias (1979), Gebhardt (1980), Bontermps (1981), Altman, Lavallee(1981), Ko (1982), Altman (1983), Booth (1983), Rose&Giroux (1984), Casey & Bartczak (1985), Lawrence & Bear (1986), Poston, Harmon & Gramlich (1994), Altman, Hartzell & Peck(1995), Grice & Ingram (2001), Abolfazl (2003), Pongsatat, Ramage & Lawrence (2004), Puangwatana (2005), Arindam (2006), Gunawardana, Raine & Haken (2006), Mine & Haken (2006), M. Kannadhasan (2007), Qian Guo-ming et al (2007), Alkhatib & Al Bzour (2011, Obaid (2011)

Type of Model	Authors
Logistic Regression Analysis	Ohlson (1980), Collins & Green (1982), Ingram & Frazier (1982) Hamer (1984), Harrel & Lee (1985), Gentry et al (1985), Lo (1986), Zmijewski (1988), Kamakura (1988), Gessner (1988), Malhortra (1988), Luther (1998), Mine U ggurlu (2006), Han Donker (2009), Monti (2009), Christidis et al (2010), Nataša Šarlija (2011), Alifiah et al (2012)
Probit Regression Analysis	Zmijewski (1984), Yobas et al (2001)
Artificial Neural Network Analysis	Webos (1974), Lee et al (1996), Zahedi (1996), Shin and Lee (2002), Sexton et al (2003), Wu et al (2006), Sookhanaphibarn et al (2007)
Hazard Analysis	Shumway (2002)
Black–Scholes–Merton Option Pricing (BSM)	Hillegeist et al (2004), Wu et al (2010)

2.3 Model selections

The models that both the business and academic communities often rely on were developed by Altman (1968) and Ohlson (1980).

According to Qian Guo-ming, Feng Yuan, Zhou Ling (2007), the multivariate discriminant analysis model (MDA) is the most practical and effective method and financial distress prediction models based on discriminant analysis play a better role in the whole financial distress prediction system. Res (2013) compared MDA (Altman) and a logistic regression analysis-logit (Ohlson) approach on Iranian listed companies.

They observed that MDA has higher accuracy than logit in predicting financial health over a one-year observation, two-year observation and three-year observation. Also, Ponsatat et al (2004) applied an MDA with 60 failed and 60 non-failed firms from Thai listed companies and found that the accuracy rate of MDA was between 59%-75%. Puagwatana and Gunawardana (2005) also focussed on 12 failed and 12 non-failed technology firms in Thailand from non-listed companies with the accuracy rate of the MDA approach in all three observation years higher than 77.8%. Also, similarly, Grice (2001), Puagwatana and Gunawardana (2005) and Grice & Infram (2003) revealed the accuracy rate of MDA for the first-year observation to be 83.5% with a decline in the following year.

Xiao, Yang, Pang, and Dang (2012) found that a multiple bankruptcy prediction model improved the prediction and Kim, Kim, and Lee (2002) and Cho and Kim (1995) mentioned a combination of multiple models as reducing the variance of estimated error and also improving the whole recognition performance. Also Sun and Li (2008) mentioned that the mix improves prediction accuracy and stability through an empirical experiment with listed companies in China. Therefore, this present study used a mixed-model approach of multiple discriminant analysis (MDA) and multinomial logistics regression analysis (MLRA). MDA is efficient and accurate for short-term prediction and MLRA is efficient and efficient over the long term. Both models are popular, frequently appear in literature, accurate and easy to use.

2.4 Variables

The previous literature on financial distress identified many variables that proved important in predicting bankruptcy. No one exact variable has been used to predict company failure (Barnes, 1987; Altman, 1993; Mohamed, Angi, & Sanda, 2001). Most of them used financial ratios as the initial variables. A few studies involved non-financial factors and financial distress such as: in Canada (Knight, 1979) the type of managerial incompetency account was considered; in the Netherlands size was found to significantly influence financial distress with a negative effect while high management shareholders reduced financial distress and large outside shareholders

and trustees reduced the probability of financial distress (Donker, Santen, & Zahir, 2009). Age of the firm is also a significant variable affecting bankruptcy as young firms have higher possibility of failure than old firms (Knight 1979). Hence, non-financial variables also significantly influence financial health. This study classifies variables into two groups, namely:

1) Financial Variables

2) Non-Financial Variables

2.4.1 Financial Variables

The variables concerning financial data calculated from financial statement documents consisted of financial ratios and other financial variables.

2.4.1.1 Financial Ratio Variables

Financial ratio is a number measure of financial status indicating the strength and weakness of a firm. It also indicates management efficiency. The numbers are calculated from the financial statement. There are four main groups of financial ratios: liquidity ratio, profitability ratio, leverage or solvency ratio, and efficiency or activity ratio.

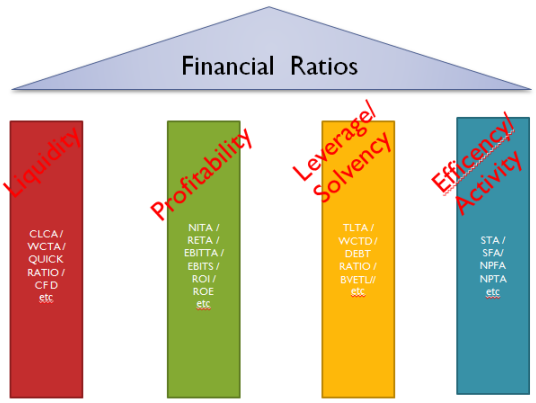

Figure 2.1 : Financial Ratios

Figure 2.1 shows a sample of the ratios in each group.

1. Liquidity ratios: This ratio measures a firm's ability to pay short-term obligations. Higher values of Liquidity ratios are likely to be associated with healthier firms.

2. Profitability ratios: This group of ratios show a firm's ability to generate profits from its expenses and other relevant costs incurred during a specific period of time. Healthy firms normally have high profitability ratios.

3. Leverage or solvency ratios: These ratios measure the firm's capacity to meet its long-term financial commitments. A healthy firm usually posts adequate leverage. Most of the ratios aim to examine a company's financial structure. These shows the levels of a company's assets are financed by funds borrowed from outside and funds from owners.

4. Efficiency or activity ratio: These measure a firm's effectiveness of the firm's use of its resources (assets, leverage, liabilities or other such balance sheet items). Higher values of efficiency or activity ratios are likely to be associated with healthier firms.

Table 2.2 shows a summary of the financial ratios with formula and researchers who found these ratios as significant from their studies.

Table 2.2 : Summary of financial ratio variables with formulas and references

Financial Ratio Variables	Ratio	Formular	Reference
Liquidity ratios	CACL (Current ratio)	Current assets/current liabilities	Shuk-Wern Ong (2011), Altman and Lavallee (1981)).
	SHCTA (Quick ratio)	short term liabilities-share holder capital/Total assets	Laitinen (2005)
	CLCA	Current liabilities/Current assets	Altman (1977), Ohlson (1980), Betts and Belhoul (1987)

Financial Ratio Variables	Ratio	Formular	Reference
	CFD (Cash flow to total debt)	EBITDA/total liabilities	Shuk-Wern Ong (2011), Beaver (1966), Von stein (1968), Beerman (1976), Laitinen (2005)
	INVTO	Inventory turn over ratio	von stein (1968), Beerman (1976), Ko (1982)
	STENI	Standard error of Net Income	Ko (1982)
	ARS	accounts receivable/sales	Bilderbeek (1977,1979)
	WCTA	Working capital/total asset	Altman (1968, 1977), Altman, Baidya and Riberio-Dias (1979), Ohlson (1980), Altman, Hatzell and Peck (1995), Hillegeist et al. (2004), Arindam Bandyopadhyay (2006)
Profitability ratio	NITA	Net income/total asset	Beaver (1966), Ohlson (1980), Betts and Belhoul (1987)
	EBITTA (Return on asset)	Earnings before interest and tax (EBIT)/total asset	Altman (1968, 1977), Altman, Baidya and Riberio-Dias (1979), Altman, Hatzell and Peck (1995), Hillegeist et al. (2004)
	RETA (Cumulative profitability)	Retain earnings / total asset	Altman (1968, 1977), Bilderbeek (1977, 1979), Altman, Hatzell and Peck (1995)
	ROE (Return on equity)	EBT/equity	Van Frederikslust (1978)

Financial Ratio Variables	Ratio	Formular	Reference
	TECTA	Total equity-capital contributed by shareholders(CCS)/TA	Altman, Baidya and Riberio-Dias (1979)
	EBITS	EBIT/Sales	Ko (1982)
	CPTA (Cash profit ratio)	ETA+depre+amortaization/Total assets	Arindam Bandyopadhyay (2006)
	OPTA	operating profit/Total assets	Arindam Bandyopadhyay (2006)
	NPEQT	Net Profit/Equity	Bilderbeek (1977,1979)
	NITL	net income/total liability	Zmijewski (1984), Betts and Belhoul (1987), Shumway (2001).
Leverage or Solvency ratio	TLTA	Total liabilities/total assets	Shuk-Wern Ong (2011), Beaver (1966), Altman and Lavallee (1981), Hillegeist et al. (2004)
	MVEBVTL	Market value of equity / Book value of total liabilities	Altman(1968), Altman, Baidya and Riberio-Dias (1979), Arindam Bandyopadhyay (2006)
	BVETL	Book value of equity/total liabilities	Altman, Hatzell and Peck (1995)
	Capitalizatio n	5 year avr equity/Toal capital	Altman (1977)
	TDTA	Total debt/Total assets	Beaver (1966), Altman and Lavallee (1981)
	STDSTD	Short term debt(t)/Short term debt(t-1)	Van Frederikslust (1978)
	EBTTD	– Earning before tax/Total debt	Altman and Lavallee (1981)
	TATB (Solvency ratio)	TA/ total borrowings plus current liabilities and provisions minus advance payment of tax	Altman and Lavallee (1981)

Financial Ratio Variables	Ratio	Formular	Reference
	WCTD	working capital/total dept DTA - Total debt/Total assets	Chen and Shimerda (1981), Ko (1982)
Efficiency or Activity ratio	SCA (Current asset turnover)	Sales/current assets	Shuk-Wern Ong (2011)
	STA	Sales/total assets	Shuk-Wern Ong (2011), Altman, Baidya and Riberio-Dias (1979), Altman and Lavallee (1981)
	DSR	Days sales in receivable - Receivables/(sales/365)	Shuk-Wern Ong (2011)
	AVTA	Added value/total assets	Bilderbeek (1977, 1979)
	CFA	(Cash flow to assets - Earnings before interest, taxes, depreciation and amortization) - (EBITDA)/total assets	Shuk-Wern Ong (2011)
	CTS	Cash flow to sales	Laitinen (2005)
	CTA	Cash flow/Total assets	Arindam Bandyopadhyay (2006)

2.4.1.2 Other Financial Variables

In addition to financial ratios, previous studies by Beerman (1976, as cited in Borlea, 2015), demonstrated fixed assets growth (FAG) as a significant variable for financial health. Also, the differences between equity growth rate and asset growth rate (EGAG) are considered an important factor in Altman & Lavalee's (1981) study. In 2005, Erkki commented that low profitability to high growth rate (LPHGR) is important in financial health (the growth of the firm = annual percentage change in net sales) as shown in Table 2.3. A logically higher growth rate on sales and profit should result

in greater financial health for the company. However, a high growth rate for assets and liabilities is still in doubt. For the owner's point of view, the value of a firm depends on its future growth in earnings but for creditors, they are interested in the firm's ability to pay future obligations.

Business risk is often expressed in terms of earnings fluctuations. High flection or high variation cause the firm's finances to be unstable. Stability of earnings (SOE) is important to the firm as the variation of the firm's growth measures the potential weakness of a firm. The earnings level declines which could reduce its ability to meet its financial commitments (Altman 1997). Therefore, sustainable growth potential is analyzed to ascertain long-term financial health.

Table 2.3 : Summary of other financial variables with formular and reference

Other financial variables	Ratio	Formular	Reference
	FAG	fixed asset growth	Von stein (1968)
	EGAG	(equity growth rate – asset growth rate)	(Altman and Lavallee (1981)
	LPHG	Low profitability/high growth rate	Laitinen (2005)
	SROA (Variation of Growth)	Stability of earning = standard error of EBIT/TA	Altman (1977)

2.4.2 Non-Financial Variables

Apart from financial variables which in general can be theoretically considered as significant factors in the prediction of distress, it is worth considering non-financial variables as in the real world, the firm is not only impacted from financial factors but also from other non-financial factors.

Even though the company is healthy, it may not be sustainable which depends on many factors. This paper considers the following non-financial variables as important factors that might affect the stability of financial health. They are:

1. Company Age

Baum (1989), Barron (1999), and Ranger-Moore (1997) identified processes affecting older firms and predicted that failure increases with age. Age may also bring about senescence (caused by high internal friction, political and precedence that obstructs action and reliable performance, lowering firm performance and survival chances). Old firms might have more experience and benefit from reputation effects that might earn higher margins on sales. Knight interviewed 72 key persons from the manufacturing, service, retail and construction sectors. He found that a firm usually fails in the early stages of its life (Knight, 1979 as cited by Altman, 1984). Erkki (2005) has shown that the financial distress process may be different for young firms due to the lack of capital and cash flow generation. Altman (2000) stated that a young firm probably shows low retained earnings because it has no time to build up its cumulative profits. This is precisely the situation in the real world. The incidence of failure is much higher in a firm's earlier years (40-50 percent of all firms that fail do so in the first five years of their existence (Dun and Bradstreet, annual statistics).

Conversely, Liargovas and Skandalis (2008) argued that old firms might be inert and stuck in routines which might generate less profitability. Therefore, age could be one of the factors affecting the financial health of the companies. It looks like no conclusion as to how age affects the financial health of the firms can be definitively reached. The age of the firm is often recognized as an important variable affecting financial distress. Keasey and Watson (1991) and Shumway (2001) have used age as a

covariate in a financial distress model. Argenti (1976) describes the failure processes associated with the age of the firm. Also, many more researchers have used this variable in their studies, such as Argenti (1976), Erkki (1992), (2005) and Arindam Bandyopadhyay (2006).

2. Company Size

Sauvage (2003) found that larger firms tend to have more power than smaller firms in market penetration; thus, they gain more profit. They also probably invest in information systems in order to attain a competitive edge and to take the lead in the global supply chain network. Smaller firms, however, could attain more profit with innovation. Small firms more likely to survive, perhaps because they have relatively more to lose financially and are less connected politically, and thus they are more cautious about lending (Reynolds et al, 2002). Smaller firms usually have fewer financial and managerial resources than larger firms. Company size is significantly correlated with performance (Zhu & Zhou, 2007).

Size of the firm can influence the financial distress process. Altman halderman & Narayana, 1997; Ohlson, 1980; Betts & Belhoul, 1987; Keasey & Watson, 1987 Sumway, 2001; Turetsky & McEwen, 2001 and Erkki, 2005 have provided evidence on the significance of the size affecting firm health. Beaver et al (2005) propose that, other things being equal, large firms have a smaller probability of bankruptcy. However, a few studies considered company size as total assets (Altman et al, 1997; Ohlson, 1980; Keasey and Watson, 1987; Erkki, 2005; Mine U ggurlu, 2006; jam Dpmler et al., 2009) or used total assets in logarithmic form. However, as logistics companies in Thailand consist of both assets based and non-asset based firms, this study considers register capital as the size of the company.

3. Type of Network

According to Drucker (1998), Christopher (1998) and Bowersox (1997), in the new era of emerging competition the success of a single business will depend on management's ability to integrate the company's network of business relationships. Supply chain management refers to the management of multiple relationships across

the supply chain which is not through a one-to-one or business-to-business relationship but a network of multiple business and relationships (Lambert & Cooper, 2000). As shown in Figure 2.2, the supply chain network structure shows the relationship between the focal company and members of the focal company supply chain where the horizontal relationship on the left hand side of the focal company are suppliers and the right hand side are customers. The vertical relationship between each tier is also to be considered. Tier 1 indicates the relationship is close to the focal company while tiers 2 and 3 are less close. The success of the company concerns the relationship of all the supply chain, both horizon and vertical companies, and not only within one company but also inter-company. In this study, the sample is considered the focal company and the network of the sample could be the suppliers or customers of the sample. The network considers the relationship of the focal company shareholders as the shareholders of the network company. If such companies are related to the logistics company, the sample is considered a company with a logistics network.

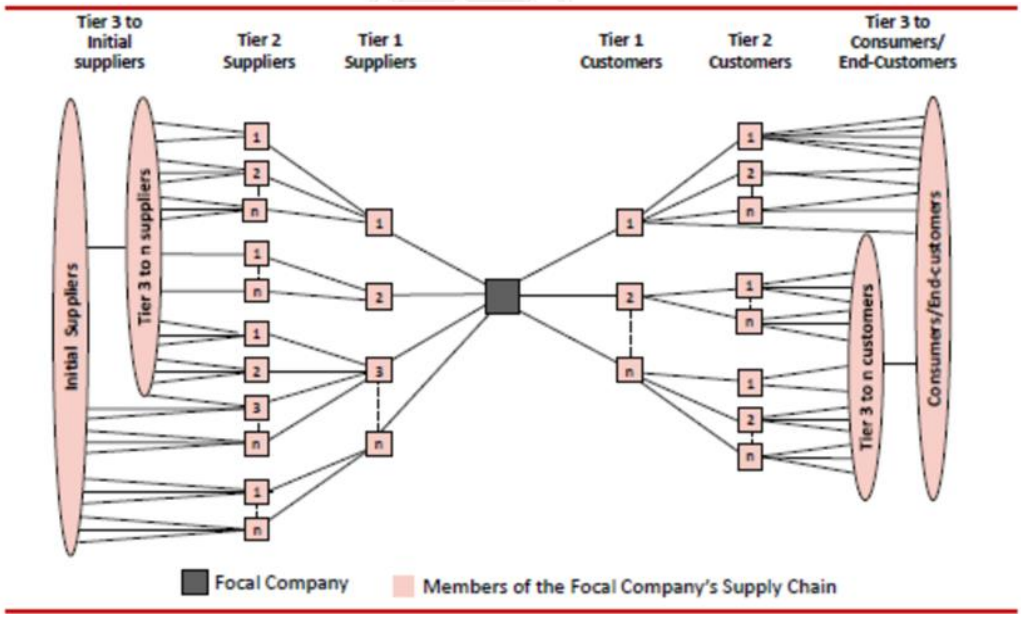

Figure 2.2 : Supply chain network structure (Lambert and Cooper, 2000)

There are also a number of papers that propose models of firm network/diversification to predict bankruptcy. For example, (Rose, Andrews, and Giroux (1982)) proposed managers use diversification to reduce the risk of

bankruptcy. Denis et al. (1997) measured corporate diversification by the number of business segments. According to Beaver et al. (2005), more corporate diversification have smaller probabilities of bankruptcy. Therefore, the network of the firm might help to predict the future financial health of the firm.

4. Nationalities of Shareholders

Steen, Pedersen, & Torben (1996) studied nationality and ownership structures for the 100 largest companies in six European nations (Denmark, France, Germany, Great Britain, the Netherlands and Sweden). They found no indication that ownership affects company performance in terms of financial health. Nieves Lindia Diaz-Diaz et al (2008) found no significant differences between the innovation of foreign-owned firms and those of domestically owned firms. However, the percentage of foreign ownership of logistics companies in Thailand increased from 49% in 2008 to 70% in 2010 (Duangphastra, 2011). It appears that financial results are attractive to foreign investors in logistics companies in Thailand. Therefore, the nationality of the shareholder might affect financial performance.

2.5 Variables selection

There have been many variables obtained in the models to predict financial distress as there have been many studies over the last 70 years. This study summarizes only the significant variables from the previous studies and groups them in the table below.

Table 2.4 : Summary of significant variables from previous studies of bankruptcy prediction

Researchers	Variables												
	Financial Variables												
	Financial Ratios						Other Financial Variables		Non-Financial Variables				
	Liquidity	Profitability	Solvency/Leverage	Efficiency/Activity	Growth Rate	Variation	Company age	Company size	Network	Nationality of Shareholder
Beaver (1966)	**CFD, CACL**												
	WCTA, NCI	**NITA**	TDTA										
Altman (1968)		**RETA**	**MVEBVTL**	**STA**									
	WCTA	**EBITTA**											
George (1973)		**RETA**	EBITTI					Y					
	WCTA	**EBITTA**											
Beerman (1976)													
	CFD			INVTO	FAG								
Altman, Haldema and Narayanan (1977)		**RETA**	log (EBITTI)										
	WCTA	**EBITTA**	EQTTC			SOE		Y					
Bilderbeek (1977, 1979)				AVTA									
The Netherland(5/20)	ARS	**RETA**	NPEQT	**STA**									
Van Frederikslust (1978)													
The Netherland		ROE	STDSTD-1										
Altman, Baidya and Riberio-Dias (1979)		**EBITTA**											
	WCTA	TECTA	**MVEBVTL**	**STA**									

Researchers	Variables									
	Financial Variables						Non-Financial Variables			
	Financial Ratios				Other Financial Variables					
	Liquidity	Profitability	Solvency/Leverage	Efficiency/Activity	Growth Rate	Variation	Company age	Company size	Network	Nationality of Shareholder
Ohlson (1980)	FUTL, **CACL**	CHIN								
	WCTA, INTWO	**NITA**	**TLTA**					Y		
Altman and Lavallee (A&L) 1981 (11) canada	**CACL**		TATB							
			TDTA, EBITTD	**STA**	EGAG					
Ko (1982)			MVETD	STENI						
		EBITS	WCTD	INVTO						
Zmijewski (1984)										
	CACL	**NITL**	**TLTA**	TLTA						
Altman, Hatzell and Peck (1995) Mexico		**RETA**								
	WCTA	**EBITTA**	**BVETL**, BVETD							
Shumway (2001)			**TLTA**							
		NITL						Y		
Hillegeist et al. (2004)										
	WCTA	**EBITTA**	TLMTA							
Erkki (2005)	**CFD**, **CACL**	NPNS		CTS						
	SCTA	ROI			LPHG		Y	Y		

Researchers	Variables									
	Financial Variables						Non-Financial Variables			
	Financial Ratios				Other Financial Variables					
	Liquidity	Profitability	Solvency/Leverage	Efficiency/Activity	Growth Rate	Variation	Company age	Company size	Network	Nationality of Shareholder
Bandyopadhyay (2006)		CPTA	TATB							
India	**WCTA**	OPTA	**MVEBVTL**	**STA**			y		Y	
Mine U ggurlu (2006)		EBITPC, ROE, ROPC	FASE, BVEBVTA,SCA, SETA	STFA, FAE						
Turkey	WCLTD, SWC	EBITDATA, EBITS	**BVFABVE, LTDTD, MVEBVTL**	OIBOIAT, SBVTFA				Y		
			TATB, CLAPT	OPTA						
Bandyopadhyay (2006)	**WCTA**	**NITA**	MVEBVE	**STA**			y		Y	
Qian Guo-ming et al										
(2007)	**CFD**	ROA		ATO						
Nieves Lidia Diaz-Diaz										
et al (2008)										Y
	CLCA, FUTL	EBITA	RETA, **MVETL**	**STA**						
Y.Wu (2010)	**WCTA**, INTWO	**NITA**, CHIN	TLTA,OENEG,TLMTA					Y	Y	
				TRTE, ES,TRTA						
Natasa Sarlija(2011)		ROE	TATL, LTA, ETA	STAS						
			TLTA	DSR, CFA						
Shuk-Wern Ong (2011)	**CFD**			SCA, **STA**						

ARS = account receivable/sales

AVTA = added value/total assets

BVETL = book value equity/total liability

BVEBVTA = book value equity/book value of total assets

BVFABVE = book value of fixed asset/book value equity

BVTDBVTA = % of book value of total debt/book value of total assets

CACL = current ratio, current assets/current liability

CCL = cash/current liability

CF = cash flow

CFA = EBITDATA =earnings before interest, tax,depreciation,amortization/total assets

CFD = cash flow/debt

CFTA = %change in cash flow/book value of total assets

CHIN = (NI for the most recent period -NIof the last period/
'sum of the absolute figures of nominator)

CLCA = current Liability/current asset

CPTA = cash profit/total assets

CTA = cash flow/total assets

CTS = cash flow/sales

DSR = days sales in receivable = Receivables/(sales/365)

EBITPC = earnings before interest/paid capital

EBITS = earnings before interest/sales

EBITTA = earnings before interest and tax/total assets

EBITTD = earnings before interest, tax/total debt

EBITDATA = earnings before interest, tax, depreciation and amortization/total asset

EBITTI = earnings before interest and tax/total interest payment

EBTTD = earnings before tax/total debt

EGAG = equity growth rate - asset growth rate

EQR = equity ratio

EQTTA = equity/total capital

FAE = fixed asset/equity

FAG =fixed asset growth

FASE = fixed assets/shareholders' equity

FUTL = fund from operation/total liability

INTWO = income for the last 2 years

INVTO = inventory turn over

LPHG = Low profitability/high growth rate
(The growth of the firm= annual percentage change in net sales while the return on investment and the net profit to net sales ratio measure profitability)

LTDTD = long term debt/total debt

MVEBV = equity market value/book value

MVEBVTL = market value equity/book value total liability

MVETD = market value equity/total debt

MVETL = market value of equity/total liability

NITA = net income/total assets

NITL = net income/total liability

NPEQT = net profit/equity

NPNS = net profit/net sales

OENEG = total liabilities exceed total assets

OIBOIA = other income before taxes/other income after taxes

OPTA = operation profit/total assets

PAYOUT = %total dividend/net income

RETA =retained earnings/total assets

ROE = return on equity

ROPC = return on paid capital

SCA = sales/current assets

SCTA = shareholder capital to total assets

SETA = book value of equity/book value of total assets

SFA = Sales/BV of net tangible fixed assets

SHCTA = shareholder capital to total assets

SOE = stability of earning

STA = sales/total assets

STDSTD-1 = short term debt t/short time debt t-1

STENI = standard error net income

STFA = sales/net tangible assets

STLTA = short-term liquidity(shareholder capital)/to total assets

SWC = sales/networking capital

TATB = total assets/ total borrowings plus current liabilities and provisions

TATB minus advance payment of tax

TDTA = total debt/total assets

TECTA	= (total equity-capital contributed by shareholders)/total assets
TLTA	= total liability/total assets
TOAS	= (Total assets/1000)/wholesale price index
WCLTD	= working capital/long term debt
WCLTD	= Net working capital/long term debt
WCTA	= working capital/total assets
WCLTD	= working capital/long terms debt
WCTD	= working capital/total debt

Similar to most researchers, selected variables were based on their popularity and frequent appearance in the literature and predictive ability in previous research studies.

This study selected variables from popular significant variables from previous studies as highlighted in Table 2.4. The 10 financial ratios were selected based on their significance and being the most recognized financial ratios in earlier studies. Other interesting financial variables are growth rate, variation in growth rate and 5 non-financial variables might significantly affect the stability of the financial health of logistics companies in Thailand.

Therefore, a total of 23 variables were selected for this study. The selected variables consisted of 18 financial variables and 5 non-financial variables as follows:

1) Financial variables

Of 18 financial variables, there were 10 financial ratios and 8 other financial variables.

1.1 Selected financial ratios comprised of 10 variables

- Liquidity ratios

This group of ratios measures how the company can pay off their current liabilities or short-term debt. This study chooses ratios in this group as follows:

CACL (current ratio) - current assets/current liabilities.

This ratio measures a company's ability to pay off its short-term obligations. The ratio is calculated by dividing current assets by current liabilities. Current assets consist of

cash, marketable securities, receivables, and inventories. Current liabilities consist of payables, current maturities of long-term debts and other liabilities payable within one year (Palat 1989; Brigham & Ehrhardt 2008). A high ratio means a healthy company.

- WCTA: working capital/total assets

This ratio examines the net liquid assets of the firm relative to the total assets and measures the company's ability to manage the liquidity. The ratio is calculated by dividing working capital by total assets. Working capital is the difference between current assets and current liabilities (Beal, Goyen & Shamsuddin 2008; Brigham & Ehrhardt 2008; and Frino, Amelia & Chen, 2009). A high ratio means a healthy company.

- CFD (cash flow to total debt): EBITDA/total liabilities

This ratio measures a firm's ability to pay short-term debts. The ratio is calculated by dividing cash flow by total liabilities. Cash flow is calculated from net income plus depreciation, depletion and amortization. A high ratio (more cash flow than liabilities); means a healthy company (Beaver, 1968; Laities & Erkki, 2005; Shuk-Wern Ong, 2011).

- Profitability ratios

This group of ratios measures how well the company generates profit from their operations.

There are four ratios in this study as follows:

NITA - net income/total assets

This ratio measures how efficiently a company can manage its assets to produce profits during a period. The ratio is calculated by dividing net income by total assets during a period. In other words, the return on assets ratio or ROA measures. A high ratio, means a healthy company.

EBITTA (return on assets) - earnings before interest and tax (EBIT)/total asset

This examines the company's ability to generate profits from its asset base. This measures the profitability of the firm and highlights the level of productivity from borrowed funds. This variable has proven to be extremely helpful in assessing firm performance in several past multivariate studies including two by Altman (1968, 1973) and by the leading univariate study by Beaver (1967).

This ratio is a measure by dividing earnings before interest and tax by total assets. The costs of financing and paying tax are excluded in order to assess the true earnings–generating capacity of assets from operations (Brigham & Ehrhardt, 2008; and Palat, 1989). A high ratio means a healthy company.

RETA (cumulative profitability) - retain earnings / total assets

This ratio reflects the extent to which assets have been paid for by company profits. This measures cumulative profitability over time and leverage. This ratio is calculated by dividing earnings before interest and tax by total assets. A high ratio means a healthy company (Altman, 1977; Altman, Hatzell and Peck, 1995; Bilderbeek, 1977, 1979).

NITL - net income/total liability

This ratio is the benefit obtained from an investment. In other words, the return on investment ratio or ROI measures. The ratio is calculated by dividing net income by total liability. A high ratio means a healthy company(Zmijewski, 1984; ; Betts & Belhoul, 1987; Shumway, 2001)

- Leverage or solvency ratio

This group of ratios measures how a company operates their funds. Some companies borrow from creditors, loans or from shareholders' investments. Ratios in this group are as follows:

TLTA - total liabilities/total assets

This ratio measures the proportion of total debts a company has relative to total assets.

This ratio is calculated by dividing total liabilities by total assets – the so-called "debt ratio". (Gibson and Frishkoff (1986)) mentioned that 'from a long–term debt–paying ability perspective, the lower this ratio, the better the company's position'.

BVETL – book value equity/total liability

This ratio measures how much the total asset can decline in value before total liabilities exceed the book value of equity. This ratio is appropriate for a firm that is not a listed company. This ratio is derived by dividing book value equity by total liability. The higher the ratio the healthier the company (Altman, 1995).

- Efficiency or activity ratio

This group of ratios measures how effective the company manages their assets (Palat, 1989; Brigham & Ehrhardt, 2008). The selected ratios in this group are as below:

STA - sales/total assets

This ratio measures the sales generating ability of the company's assets. This ratio is calculated by dividing sales by total assets. In other words, the total assets turnover ratio. This ratio indicates the productivity of total assets. An increase in the ratio means a healthy company.

1.2 Selected other financial variables

There are no precise significant variables of other financial variables from previous studies as this variable depends on the focus of each research work. Business growth refers to the process of improving a company's success. Growth rate is a measure of the rate of change that a company goes through from one year to another. Growth can be measured in terms of the revenue of the business, profit or cost, or utilization of their resources.

Growth Rate: This study focuses on 4 aspects consisting of sales growth rate, profit growth rate, asset growth rate and liability growth rate. Growth rate measures the percentage comparison between the year (t) and the prior year (t-1).

-Sales growth considers the difference between sales for the present year and last year in percentage: (Sales (t) – Sales (t-1)/ Sales (t-1)) * 100

-Net profit growth considers the difference between net profit for the present year and last year in percentage: (Net Profit (t) – Net Profit (t-1)/ Net Profit (t-1)) * 100

-Total asset growth is the difference between total assets for the present year and last year in percentage: (Total Asset (t) – Total Asset (t-1)/ Total Asset (t-1)) * 100

-Total liability growth is the difference between total liability for the present year and last year in percentage: (Total Liability (t) – Total Liability (t-1)/ Total Liability (t-1)) * 100

Variation in Growth Rate is a measure of the change of growth rate from one year to another. The study considers the variation of sales growth rate, variation in profit growth rate, variation in asset growth rate and variation in liability growth rate. Variation is measured from the difference of growth rate between the year (t) and the prior year (t-1). The absolute will be taken in this variable group as no direction is considered but only the power of change.

-Variation of sales growth considers the difference between sales growth for the present year and the sales growth last year: Absolute Sales Growth (t) – Sales Growth (t-1)

-Variation of net profit growth considers the difference between net profit growth for the present year and net profit growth for the last year: Absolute Net Profit Growth (t) – Net Profit Growth (t-1)

-Variation of total asset growth considers the difference between total asset growth for the present year and total asset growth for the last year: Absolute Total Asset Growth (t) – Total Asset Growth (t-1)

-Variation of total liability considers the difference between total liability growth for the present year and total liability growth for the last year: Absolute Total Liability Growth (t) – Total Liability Growth (t-1)

Hence, a total of 8 other financial variables were selected in this study, further divided into 2 groups as follows:

1. Growth Rate, consisting of sales growth, profit growth, asset growth and liability growth.
2. Variation of Growth, consisting of variation of sales growth, variation of profit growth, variation of asset growth and variation of liability growth.

2). Non-Financial Variables

This study includes significant non-financial variables from past studies, consisting of company age, size, network, nationalities of shareholders plus number of shareholders in this study.

The variables characterizing each company are:

- Age: Company Age

This variable calculates the year from the company's registered date until September 2014.

- Size: Company Size

This variable calculates the registered amount of each company in Thai baht (million).

-Type of Network

In this study, the network of the firm is considered in terms of the logistics network. If the shareholders of that company were the shareholders of other logistics companies, the company was classified as having a logistics network. The study applied "1" for a company with a logistics network while "0" represents no logistics network.

-Nationalities of Shareholders

The research separated the nationalities of shareholders into two groups: Thai (local) and non-Thai (international) companies. If one of the shareholders of the company was not of Thai nationality, that company was considered a non-Thai company. The

study applied “1” for a Thai company while “0” is a non-Thai or international company.

-Number of shareholders

As the number of shareholders increases, there may be more conflict between shareholders and other parties in the firm that might cause the firm to become unhealthier. Whereas a family-owned firm with fewer shareholders might have less conflict among shareholders meaning the firm can be easily managed and become healthy. On the other hand, more shareholders might generate more good ideas which benefit the firm. This study would like to identify whether the number of shareholders affects the financial health of the firm or not. This variable is obtained by the number of parties in the company and not the number of stocks in the firm. The party as a shareholder could be a company or person, for example, the firm has 1,000 stocks consisting of 500 stocks belonging to holding company A, 300 stocks owned by Mr. A, 150 and 50 stocks owned by Miss B and Mr. C respectively. In this case, the number of shareholders is 4 parties.

CHAPTER 3
METHODOLOGY AND MODEL DEVELOPMENT

Chapter 2 reviewed the literature on financial health studies, key models and significant variables from previous studies, model selection and variable selection. This chapter explains the data used, research process, criteria of separation, sample size, case separation and methodology.

3.1 Data used

The real secondary data was obtained from a reliable website on financial reporting (http://corpus.bol.co.th). The data was collected from all registered logistics companies under the Department of International Trade Promotion Ministry of Commerce, Royal Thai Government. The sample was composed of 110 registered companies from 2008-2013. Financial ratio aspects were calculated from balance sheets and income statement accounts. Data consisted of information from 110 companies over 6 years. As the growth variable was calculated between present year compared to previous year, data from the 6 years was generated for 5 years from sales growth in 2009, calculated from the difference of sales in 2008 and 2009. Therefore, after calculation, the raw data from 6 years could generate a sample of 5 years. Finally, the sample of 110 companies over 5 years provided a total sample size of 550.

There are two types of data in this study. Quantitative data is about the data or information that can be measured and written down using numbers, and qualitative data, which is about data or information that can't be measured.

The quantitative data in this study consisted of financial ratio, growth rate, variation of growth rate, size, age and the number of shareholders of each company and can be measured using figures.

The qualitative data comprised the type of nationality of the shareholders and type of network of the company. Some of this data was collected from www.corpus.bol.co.th, company websites and some from company staff interviews.

3.2 Research process

The research was carried out in two parts as follows:

Part I

The first part was to screen the significant variables out of the total 23 variables from 110 logistics companies. A sample of 550 was calculated from the data from 2008 to 2013. The multiple discriminant analysis tool (MDA) was employed in this part.

Part II

This part was to develop a model of long-term financial health for logistics companies in Thailand and to identify factors that determine long term financial stability by developing multinomial logistic regression analysis for the significant variables from part I.

The multinomial logistic regression analysis model helps researchers predict the probability of an occurrence of an event of interest. In this study, there are three events that the company can fall into: Unhealthy, Normal and Healthy groups.

The research process was carried out step by step as shown in Figure 3.1

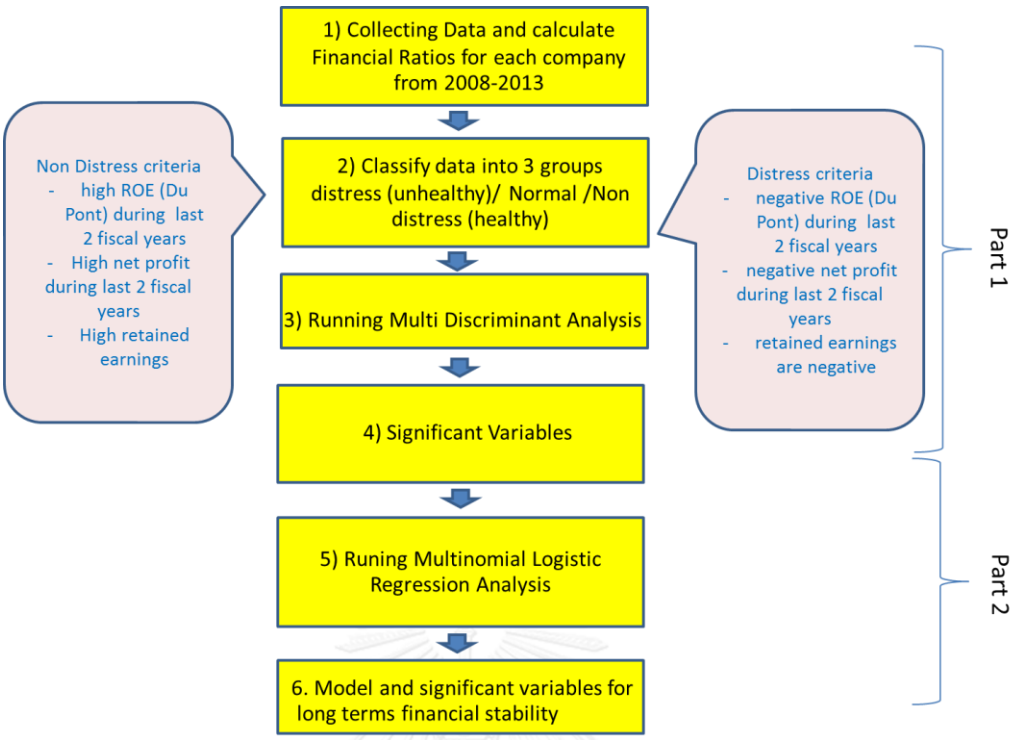

Figure 3.1 : Process of research flow chart: part I and part II

Generally, the steps were carried out in the following order.

Part 1

1) Collecting both qualitative and quantitative raw data. The financial variables were calculated from the balance sheet and profit and loss statement (6-year data from 2008-2013).
2) Classifying data into 3 groups (Distressed (Unhealthy)/ Normal / Undistressed (Healthy))
3) Using Multi Discriminant Analysis (MDA) to screen significant variables
4) Results from MDA then used for the variables for part 2

Part 2

5) Using multinomial logistic regression analysis (MLRA) to identify significant variables
6) The results from step five were used in the model and were significant variables for the long-term financial health stability of logistics companies

Unlike previous studies, this study divided data into 3 groups:

- Distressed or Unhealthy group, namely group 0.
- Normal group, namely group 1
- Non-distressed or Healthy group, namely group 2

While the previous literature separated the data into two groups of Distressed and Non-distressed. The reason why this research separates the data into 3 groups is that in one variable, the significant impact might be on only Unhealthy, or only Healthy or both and might occur in a different manner. Therefore, dividing the data into 3 groups will cover these points of significance. The criteria of separation will be mentioned later in this chapter. In order to identify the significant variables that ascertain the difference between the distressed group, normal and non-distressed group, the multiple discriminant analysis (MDA) method was used at this stage. Multinomial logistics regression analysis (MLRA) was used to identify what specific variables could help financial health stability for the long-term financial health of logistics companies in Thailand.

3.3 The criteria of separation

3.3.1 The criteria of Unhealthy companies

a. The company demonstrated negative ROE (Du Pont) during the last two fiscal years.

b. The company had negative net profits during the last two fiscal years (Ohlson, 1980).

c. The retained earnings are negative (Hu Gang, 2009) or shareholders' profits are less than their registered capital in the year 2008.

Companies that meet at least 2 out of the above 3 conditions fall into the Unhealthy group.

3.3.2 The criteria of Healthy companies

a. The company showed positive ROE (Du Pont) during the last two fiscal years.

b. A company with positive net profits during the last two fiscal years (Ohlson, 1980)

c. The retained earnings are positive.

3.4 Sample size

The sample size guidelines for multinomial logistic regression indicate a minimum of 10 cases per independent variable (Schwab, 2002). Since the independent variables in this study are 23 variables, the total cases should be a minimum of 230. The initial plan was for a sample of 550 from 5 years of 110 companies. The number of Unhealthy and Healthy companies for each year is the same number, whereas the Normal companies is the rest of the companies that do not fall in either the Unhealthy or Healthy groups for each year.

Table 3.1 : Summary of the sample number in each group-initial plan

	Groups			
Year	Distressed Group(0)	Normal Group (1)	Non Distressed Group(2)	Total
2009	25	60	25	110
2010	21	68	21	110
2011	23	64	23	110
2012	25	60	25	110
2013	26	58	26	110
Total	120	310	120	550

According to Table 3.1, the initial plan to use data from 2008 onward, according to Growth Rate and Variation in Growth Rate, were calculated from the observed year compared to the previous year (as mentioned in Chapter 2). Therefore, the Growth Rate and Variation in Growth Rate began from 2009 to 2013. The total data of 550 consisted of 120 in the Distressed group, 310 in the Normal group and 120 in the Undistressed (Healthy) group. However, after collecting real data, there was missing data in some variables due to some companies not reporting their financial statements to the revenue department for some years. Finally, as presented in Table 3.2, the full and complete data for this study constituted a sample size of 463 consisting of 98 in the Unhealthy group, and 267 and 98 in the Normal and Healthy groups, respectively. The sample size was still higher than the minimum 230; thus, the study could continue as planned.

Table 3.2 : Summary of sample sizes in each group according to actual completed data

Year	Groups			
	Distressed Group(0)	Normal Group (1)	Non-Distressed Group(2)	Total
2008-2013	98	267	98	463

3.5 Case separation

Most of the past studies emphasized financial ratios; however, in the real world not only financial factors impact the financial health of firm but all factors impact financial health at the same time. Therefore, this study conducted two cases: consisting of Case 1 and Case 2.

Case 1) Running the whole financial variables together with non-financial variables at the same time.

Case 2) Running the financial variables separately from non-financial variables. This case is referred to in most of the previous studies using financial variables as the significant variables.

Cases 1 and 2 consisted of Part I and part II as shown below.

The results of both parts for both cases are mentioned in Chapter 4, while the discussion is given in Chapter 5.

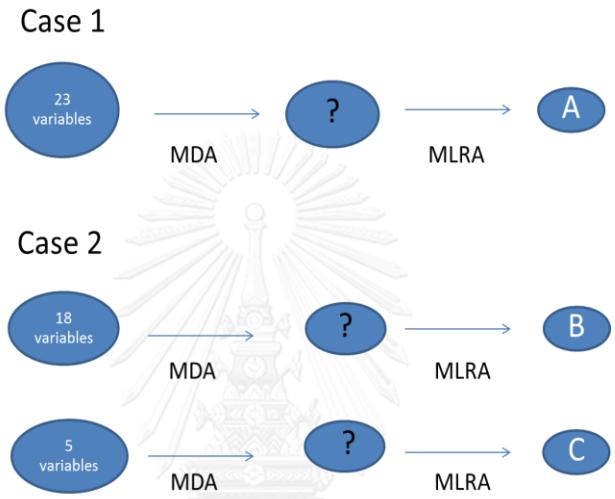

Figure 3.2 : frame work for case 1 and case 2

3.6 Methodology

As mentioned in Chapter 2, this study obtained two tools: multiple discriminant analysis (MDA) and multinomial logistic regression analysis (MLRA).

3.6.1 Multiple discriminant analysis

Multiple discriminant analysis (MDA) is a multivariate statistical method, used for classifying observations based on two or more independent variables (Johnson & Wichern, 2002). In general, the purposes of multiple discriminant analysis are:

(1) For detecting variables that allow to discriminate between different groups.

(2) For classifying cases into different groups

The discriminant function detects the variables that allow discrimination between different groups and interprets how the functions separate the groups.

Number of discriminant functions = k-1,

k = number of groups, p = number of variables

The standard discriminant function is as follows:

* $D_F = a_0 + a_iX_j + a_iX_j + a_iX_j + ..+ a_pX_p$ ---------- (3.1)

Where * D_F = discriminant function use for discriminant group of logistics companies in Thailand,

a_0 = constant,

a_i= coefficients of each independent variable; i=1,2,....p

X_j =predictors or independent variables; j=1, 2,.p

We will get a (standardized coefficient) for each variable in each the discriminant function which can be interpreted as meaning that the larger the "a" (standardized coefficient), the greater the contribution of the respective variable to the discrimination between groups. We can identify the nature of the discrimination for each discriminant function by looking at the mean for the functions across groups. We can also visualize how the two functions discriminate between groups by plotting the individual scores for the two discriminant functions.

The discriminant classification function is used for the prediction of each company that falls into each group as follows:

$D_{LTk} = b_0 + b_iX_j + b_iX_j + b_iX_j + ..+ b_pX_p$ ----------(3.2)

Where * D_{LTk} = discriminant score (Financial health level) of Logistics companies in Thailand,

b_0 = Constant,

b_i = discriminant coefficients or weights; i=1,2,....p

X_j =predictors or independent variables; j=1,2,...p

k = 0,1,2

Number of discriminant equations = k

The prediction depends on the score of D_{LTk}, the company will be predicted to the group with the highest score.

The purpose of using multiple discriminant Analysis in this study is to detect the variables that allow discriminating between different groups which will not concentrate on the forecast, therefore, the results from multiple discriminant analysis are the significant variables to be taken as the input variables in part II.

3.6.2 Multinomial logistic regression

Multinomial logistic regression is used to find out the probability of a category of a dependent variable based on multiple independent variables.

Multinomial logistic regression analysis models can be obtained by the following:

Logit Response Function:

$g_0 = \ln (p_0/p_1) = \beta_{00} + \beta_{01}X_1 + \beta_{02}X_2 + \beta_{03}X_3 + \ldots + \beta_{0p}X_p$ ----------(3.3)

$g_2 = \ln (p_2/p_1) = \beta_{20} + \beta_{21}X_1 + \beta_{22}X_2 + \beta_{23}X_3 + \ldots + \beta_{2p}X_p$ ----------(3.4)

Where g0, g2 = log odd or logit

$\Pr (Y=j/x) =$ ----------(3.5)

Where j = 0, 2

Pr = Probability of the outcome of the interest

$\sum^{2}_{j=0} \Pr (Y=j|x) = 1$ ----------(3.6)

The feature of the multinomial logistics regression model is that it estimates the k-1 model; k is the level of the outcome. In this study k = 3 as there were 3 groups (Unhealthy, Normal and Healthy); therefore, the estimated model would be 2 models. This study treated the Normal group as the reference group – represented by (1), Unhealthy group represented by (0) and Healthy group represented by (2). Hence, the estimated two models were a model for Unhealthy relative to Normal

and a model for Healthy relative to Normal. Since the parameter estimates are relative to the reference group, the standard interpretation of the multinomial logistic regression is for a unit change in the predictor variable, the logit of outcome relative to the reference group is expected to change by its respective parameter estimate (in log-odds units) given the variables in the model are held constant.

The estimated multinomial logistics regression coefficients for the models are called β_i.

A positive regression coefficient (β_i) implies that one unit of the variable increases given the other variables in the model are held constant, the multinomial log-odds (the probability of the outcome) would be expected to increase by β_i. A negative regression coefficient ($-\beta_i$) implies that one unit of the variable increases given the other variables in the model are held constant, the multinomial log-odds would be expected to decrease by β_i.

The odds ratio of multinomial logistics regression is the exponential of the coefficients. The odds ratio of a coefficient indicates how the risk of the outcome falling in the comparison group compares to the risk of the outcome falling in the reference group changes with the same variable. The interpretation can take 3 directions.

1. If the odds ratio >1, the risk of the outcome falls in the comparison group relative to the risk of the outcome falling in the reference group increases as the variable increases. In other words, the comparison outcome is more likely.

2. If the odds ratio <1, the risk of the outcome falling in the comparison group is relative to the risk of the outcome falling in the reference group decreases as the variable increases. Or the outcome is more likely to be in the reference group.

3. If the odds ratio is equal to 1, the outcomes of both events are equally likely to happen.

3.6.3 The marginal effect analysis

This is the method to analyze the complexity of a system being affected by marginal manipulation of its comprising variables. In this study, marginal analysis is considered by analyzing the probability of the firm in the group that is affected by the significant variables.

From equation (3.5), $Pr(P_0)= (e^{g0(x)}/ (e^{g0(x)+}1+e^{g2(x)})$

$Pr(P_2)= (e^{g2(x)}/(e^{g0(x)}+1+e^{g2(x)})$

$Pr (P_1) = 1-Pr0-Pr2$

$Pr (P_0)$ = Probability of the outcome of the firm in the Unhealthy group

$Pr (P_1)$ = Probability of the outcome of the firm in the Normal group

$Pr (P_2)$ = Probability of the outcome of the firm in the Healthy group

Marginal Analysis of X(i)

$(\partial P_0)/\partial x = P_0(1- P_0)_{\beta 0} - P_0P_{2\beta 2}$ ----------(3.7)

$(\partial P_2)/\partial x = P_2(1- P_2)_{\beta 2} - P_0P_{2\beta 0}$ ----------(3.8)

Where X = Significant variable

Equation 3.7 shows the probability of the firm in the Unhealthy group that is affected by X.

If the result is positive, the interpretation is that x positively affects the probability of the firm falling in the Unhealthy group.

If the result is negative, the interpretation is that x negatively affects the probability of the firm falling in the Unhealthy group.

Equation 3.8 shows the probability of the firm in the Healthy group being affected by X.

If the result is positive, the interpretation is that x positively affects the probability of the firm falling in the Healthy group.

If the result is negative, the interpretation is that x negatively affects the probability of the firm falling in the Healthy group.

CHAPTER 4
DATA ANALYLSIS AND RESULTS

Since a mixed method reduces the variance of error and improves the whole performance (Kim et al 2002), this study combined MDA and MLRA as a mixed tool to identify the factors that determined long-term financial health stability and to develop a financial health model for logistics companies in Thailand. The scenario of the real world situation affecting financial health is represented by Case 1 (all variables used at the same time) and Case 2 (most of the previous studies concentrated on financial variable). This scenario used financial and non-financial variables separately.

This chapter describes the results of both cases from part I (using MDA to screen significant variables) and part 2 (using MLRA) to find the factors and financial health model for logistics companies in Thailand. The marginal effect analysis results showed the probability of the unhealthiness and healthiness of a firm that is affected by the significant variables. To be easy to understand, this study also used marginal effect to explain the results of each case in this chapter.

4.1 Case I using all variables (financial variables and non-financial variables)

4.1.1 Part I (multiple discriminant analysis)

In the first part of Case 1, MDA was used as the tool to run the data on SPSS 20 with a total of 23 variables at the same time. The results were as follows:

Table 4.1 : Group Statistics - Case 1

Variables	Mean			
	Unhealthy group	Normal group	Healthy group	Total
Current Ratio	1.597245	2.47573	2.728856	2.343365
WCTA	-0.395508	0.291404	0.326933	0.15353

Variables	Mean			
	Unhealthy group	Normal group	Healthy group	Total
CFD	-0.105337	0.206069	0.605212	0.224639
Return on Assets	-25.696224	4.425955	12.087169	-0.328202
EBITTA	-0.221092	0.071663	0.16646	0.029762
RETA	-1.201384	0.327101	0.41653	0.022506
Debt Ratio	1.288469	0.512697	0.470064	0.667875
NITL	-0.137332	0.135674	0.462947	0.147161
BVETL	0.448112	1.579967	2.407402	1.515533
Total Asset Turnover	3.392449	2.437341	2.321317	2.614944
Sales Growth	71.497275	12.906779	33.088043	29.579851
Net Profit Growth	-162.000827	40.872547	92.078811	8.770221
Total Assets Growth	9.095751	14.716292	18.077678	14.238113
Total Liability Growth	106.753682	97.435589	34.799728	86.150187
Variation of total sale growth	124.113337	83.425193	92.132302	93.880344
Variation of Net Profit Growth	632.88001	226.596437	204.15205	307.841016
Variation of Total Assets Growth	58.4082	31.767418	47.352175	40.705005
Variation of Total Liability Growth	151.46315	219.70202	323.015222	227.125961
Size	8.020408	10.104869	126.642857	34.330454
Age (years)	13.651985	17.87448	19.37519	17.298379
Nationality of shareholders (Thai	-	-	-	-

Variables	Mean			
	Unhealthy group	Normal group	Healthy group	Total
(1)/Non Thai (0))				
Type of Network (Logistics Network (1) / Non Logistics Network (0))	-	-	-	-
No. of Shareholders	5.734694	6.490637	5.234694	6.064795

The statistical mean came from adding all the data and dividing the total by the number of data. The resulting number is known as the mean. This is used to explain the central tendency of the data.

The differences of mean values for all variables between the three groups illustrated the variables are different in each group which shows the variables are identifying the group.

As can be seen in Table 4.1, for the mean of the Current Ratio, a company with a higher Current Ratio seems to be in the healthier group as the trend of the mean for the Current Ratio was low in Unhealthy group (1.597245), higher in the Normal group (2.47573) and the highest in the Healthy group (2.728856).

For the mean of WCTA, a company with a higher WCTA (Working Capital to Total Asset Ratio) seems to be in the healthier group as the trend of the mean for WCTA was low in the Unhealthy group (-0.395508), higher in the Normal group (0.291404) and the highest in the Healthy group (0.326933).

For the mean of CFD, a company with a higher CFD (Cash Flow to Debt Ratio) seems to be in the healthier group as the trend of the mean for CFD was low in the Unhealthy group (-0.105337), higher in the Normal group (0.206069) and the highest in the Healthy group(0.605212).

Concerning the mean of the Return on Asset Ratio, a company with a higher ratio seems to belong to the healthier group as the trend of the mean for the ratio was low in the Unhealthy group (-25.696224), higher in the Normal group (4.425955) and highest in the Healthy group (12.087169).

Regarding the mean of EBITTA, a company with a higher EBITTA (Earnings Before Interest and Tax to Total Asset Ratio) seems to be in the healthier group as the trend of the mean for the EBITTA ratio was low in the Unhealthy group (-0.221092), higher in the Normal group (0.071663) and highest in the Healthy group (0.16646).

For the mean of RETA, a company with a higher RETA (Retained Earnings to Total Asset Ratio) seems to be in the healthier group as the trend of the mean for the RETA ratio was low in the Unhealthy group (-1.201384), higher in the Normal group (0.327101) and highest in the Healthy group (0.41653).

Concerning the mean of the Debt Ratio, a company with a lower Debt Ratio seems to be in the healthier group as the trend of the mean for the Debt Ratio was high in the Unhealthy group (1.288469), lower in the Normal group (0.512697) and lowest in the Healthy group (0.470064).

For the mean of NITL, a company with higher NITL (Net Income to Total Liability Ratio) seems to be in the healthier group as the trend of the mean for the NITL ratio was low in the Unhealthy group (-0.137332), higher in the Normal group (0.135674) and highest in the Healthy group (0.462947).

Regarding the mean of BVETL, a company with a higher BVETL (Book Value Equity to Total Liability Ratio) seems to be in the healthier group as the trend of the mean for the BVETL ratio was low in the Unhealthy group (0.448112), higher in the Normal group (1.579967) and highest in the Healthy group (2.407402).

For the mean of Total Asset Turnover Ratio, a company with a lower Total Asset Turnover Ratio seems to be in the healthier group as the trend of the mean for the ratio was high in the Unhealthy group (3.392449), lower in the Normal group (2.437341) and lowest in the Healthy group (2.321317).

The Sales Growth variable had no trend in the mean.

For the mean of Net Profit Growth, a company with a higher growth seems to be the healthier group as the trend of the mean for Net Profit Growth was low in the Unhealthy group (-162.000827), higher in the Normal group (40.872547) and highest in the Healthy group (93.078811).

As concerns the mean of Total Asset Growth, a company with a higher growth seems to be in the healthier group as the trend of the mean for Total Asset Growth was low in the Unhealthy group (9.095751), higher in the Normal group (14.716292) and highest in the Healthy group (18.077678).

Concerning the mean of Total Liability Growth, a company with a lower growth seems to be the healthier group as the trend of the mean for Total Liability Growth was the highest in the Unhealthy group (106.753682), lower in the Normal group (97.435589) and lowest in the Healthy group (34.799728).

Regarding the mean of variation in growth, the variation in growth in terms of the Sales Growth, Net Profit Growth, Total Asset Growth and Total Liability Growth variables had no trend in the mean.

For the mean of Company Size, a larger sized company seems to be in the Healthy group as the trend of the mean for size was low in the Unhealthy group (8.020408 million), higher in the Normal group (10.104869 million) and highest in the Healthy group (126.642 million).

Concerning the mean of Company Age, an older company seems to be in the Healthy group as the trend of the mean for company age was low in the Unhealthy group (13.651985), higher in the Normal group (17.87448) and highest in the Healthy group (19.37519).

Regarding the mean of Nationality of Shareholders, since the nationality is a dichotomous nominal scale (0= non-Thai (international company) 1= Thai (local company) with no quantitative value, the mean could not be considered.

For the mean of the type of network, similarly to Nationality of Shareholder, Type of Network is a dichotomous nominal scale (0 =.non-logistics network company, 1 =

company having logistics network) with no qualitative value. Therefore, the mean could not be considered.

Number of Shareholders showed no trend in its mean.

The means show that each group is different. According to there being 3 groups, the discriminant functions to separate these groups are 2 functions as shown below.

Table 4.2 : Standardized Canonical Discriminant Function Coefficients – Case 1

	Function	
	1	2
CFD	2.633	-2.139
RETA	.683	.568
NITL	-1.797	1.597
BVETL	-.588	.536
Sales Growth	.388	.007
Variation of Net Profit Growth	-.227	-.194
Size	.318	-.462
Age (years)	.310	-.036
Nationality of shareholders (Thai/non Thai)	-.245	.340
No. of Shareholders	-.136	.430

As can be seen in Table 4.2, there are 2 discriminant functions as follows:

Function 1

* D_{1case1} = 2.633(CFD) + 0.683(RETA) – 1.797(NITL) - 0.588(BVETL) + 0.388(Sale Growth) - 0.227 (Variation of Net Profit Growth) + 0.318(Size) + 0.31(Age) – 0.245(Nationality of Shareholders) - 0.136(No. of Shareholders) ---------- (4.1)

Function 2

* D_{2case1} = -2.139(CFD) + 0.568(RETA) + 1.597(NITL) + 0.536(BVETL) - 0.007(Sale Growth) - 0.194 (Variation of Net Profit Growth) - 0.462(Size) – 0.036(Age) + 0.34(Nationality of Shareholders) + 0.431(No. of Shareholders)---------- (4.2)

The magnitudes of standardized coefficients from discriminant function (a) indicate how strongly the variables affect the score.

From Function 1 (equation 4.1), the standardized coefficient for CFD was greater in magnitude than the coefficients for the other seven variables. Thus, CFD had the greatest impact of the ten variables in the first discriminant score. No. of Shareholders had the least impact in the first discriminant score.

For Function 2 (equation 4.2), the standardized coefficient for CFD was also greater in magnitude than the coefficients for the other seven variables. Thus, CFD had the greatest impact among the ten variables on the second discriminant score. Meanwhile, the least impact on the first discriminant score was Sales Growth.

Of these two discriminant functions, there were 10 significant variables that allowed the study to discriminate between the different groups which consisted of CFD, RETA, NITL, BVETL, Sales Growth, Variation of Net Profit Growth, Size, Age, Nationality of Shareholders and No. of Shareholders.

The study identified the centroid of each group as shown below.

Table 4.3 : Wilks' Lambda – Case 1

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 2	.502	313.873	20	.000
2	.827	86.741	9	.000

As can be seen in Table 4.3, Wilks' lambda of function 1 through 2 was 0.502 and function 2 was 0.827 and significance was 0.000.

H0: The centroid of each group from both functions is equal

H1: The centroid of each group from both functions is not equal

From the above table, H0 was rejected as the centroids of each group from both functions were not equal. Therefore, both functions can be implied in this study.

Table 4.4 : Functions at Group Centroids

Distressed/Normal/Non-distressed	Function	
	1	2
0	-1.308	-.471
1	.059	.390
2	1.147	-.591

Table 4.4 group centroids of canonical functions 1 and 2 show each group has different centroids and the longer distance shows the greater difference of each group as shown in the graph below.

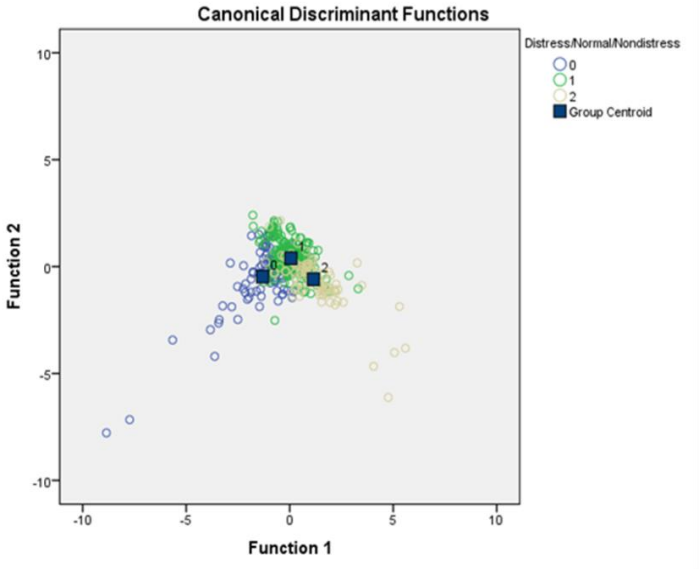

Figure 4.1 : Canonical Discriminant Functions of Case 1

Table 4.5 presents the classification functions used to predict each company that falls into each group.

Table 4.5 : Classification Function Coefficients for a Total of 23 Variables – Case 1

	Distressed/Normal/Non-distressed		
	0	1	2
CFD	2.269	5.526	14.725
RETA	-1.088	.184	.350
NITL	-2.854	-5.117	-12.483
BVETL	.043	-.079	-.496
Sales Growth	.000	.001	.003
Variation of Net Profit Growth	.001	.001	.001
Size	.000	.000	.003
Age (years)	.176	.223	.267
Nationality of shareholders (Thai/non Thai)	2.817	2.725	1.436
No. of Shareholders	.939	1.018	.774
(Constant)	-7.145	-7.600	-7.330

Fisher's linear discriminant functions

The multiple discriminant classification function for Case 1 is as follows:

Distressed group (Unhealthy)

D_{LT0} = -7.145 + 2.269(CFD) - 1.088(RETA) – 2.854(NITL) + 0.043(BVETL) + 0.00(Sale Growth) + 0.001(Variation of Net Profit Growth) + 0.00(Size) + 0.176(Age) + 2.817(Nationality of Shareholders) + 0.939(No. of Shareholders) ---------- (4.3)

Where D_{LT0} = discriminant score (financial health level) of logistics companies in Thailand falling in group 0

Normal Group

D_{LT1} = -7.6 + 5.526(CFD) + 0.184(RETA) –5.117(NITL) - 0.079(BVETL) + 0.001(Sales Growth) + 0.001(Variation of Net Profit Growth) - 0.00 (Size) + 0.223(Age)+ 2.725(Nationality of Shareholders) + 1.018(No. of Shareholders) ---------- (4.4)

Where D_{LT1} = discriminant score (financial health level) of logistics companies in Thailand falling in group 1.

Non Distress Group (Healthy)

D_{LT2} = -7.330 + 14.725(CFD) + 0.35(RETA) – 12.483(NITL) – 0.496(BVETL) + 0.003(Sales Growth) + 0.003(Size) + 0.267(Age) + 1.436(Nationality of Shareholders) + 0.774(No. of Shareholders) ---------- (4.5)

Where D_{LT2} = discriminant score (financial health level) of logistics companies in Thailand falling in group 2.

The discriminant function score is obtained by multiplying each variable (x) by its classification coefficient (b_i) plus constant (b_0). The maximum score among 3 functions could be justified financial health of the firm into one and only Unhealthy, Normal or Healthy group. However, the purpose of this study at this stage is to screen the significant variables that affect the financial health of the logistics company. Only the significant variables were picked up for further investigation. Therefore, the discriminant function score was not raised in the study.

In this part, of the 23 variables 10 variables comprising CFD, RETA, NITL, BVETL, Variation of Net Profit Growth, Sales Growth, Size, Age, Nationality of Shareholders and No. of Shareholders were significant at the 0.05 level for all groups as shown in Figure 4.2. These significant variables affected financial health in this part and will be applied in part II.

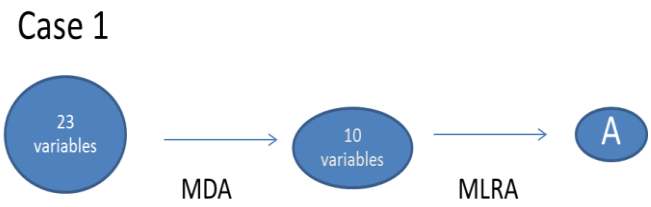

Figure 4.2 : Frame work - case 1

4.1.2. Part II (multinomial logistics regression analysis)

After using multi discriminant analysis to identify the significant variables of CFD, RETA, NITL, BVETL, Sale Growth, Variation of Net Profit Growth, Size, Age, Nationality of Shareholders and No. of Shareholders, all these variables comprised the data in part II to identify the factors that determine long-term financial stability.

Multinomial logistics regression analysis was the tool utilized at this stage. The output from SPSS on applying the 10 variables at the same time is shown as follows.

Table 4.6 : Parameter Estimates from MLRA for 10 significant variables from part I – Case 1

Distress/Normal/Nondistress[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
0	Intercept	0.17	0.735	0.054	1	0.817			
	CFD	-18.011	9.533	3.569	1	0.059	1.51E-08	1.16E-16	1.963
	RETA	-8.107	1.22	44.132	1	0	0	2.76E-05	0.003
	NITL	11.222	10.454	1.152	1	0.283	74761.266	9.45E-05	5.91317E+13
	BVETL	0.481	0.239	4.047	1	0.044	1.618	1.012	2.586
	SalesGrowth	0	0.001	0.028	1	0.868	1	0.998	1.003
	VariationofNetProfitGrowth	0	0	0	1	0.985	1	0.999	1.001
	Size	-0.006	0.01	0.418	1	0.518	0.994	0.974	1.013
	Ageyears	0.013	0.034	0.157	1	0.692	1.014	0.948	1.083
	No.ofShareholders	-0.121	0.1	1.467	1	0.226	0.886	0.728	1.078
	[NationalityofshareholdersThainonThai=0]	0.221	0.511	0.187	1	0.665	1.247	0.458	3.393
	[NationalityofshareholdersThainonThai=1]	0[b]	.	.	0	.	.	.	.
2	Intercept	-1.821	0.638	8.136	1	0.004			
	CFD	4.369	4.268	1.048	1	0.306	78.98	0.018	339180.196
	RETA	3.451	1.148	9.032	1	0.003	31.546	3.322	299.573
	NITL	1.749	5.441	0.103	1	0.748	5.75	0	246010.396
	BVETL	-1.417	0.299	22.468	1	0	0.242	0.135	0.436
	SalesGrowth	0.001	0.001	0.707	1	0.401	1.001	0.999	1.002
	VariationofNetProfitGrowth	0	0	0.06	1	0.807	1	0.999	1.001
	Size	0.026	0.006	17.18	1	0	1.027	1.014	1.04
	Ageyears	0.02	0.021	0.899	1	0.343	1.02	0.979	1.064
	No.ofShareholders	-0.224	0.074	9.177	1	0.002	0.8	0.692	0.924
	[NationalityofshareholdersThainonThai=0]	0.722	0.317	5.192	1	0.023	2.059	1.106	3.832
	[NationalityofshareholdersThainonThai=1]	0[b]	.	.	0	.	.	.	.

a. The reference category is: 1.

b. This parameter is set to zero because it is redundant.

According to Table 4.6, **the multinomial logistic regression analysis model which is the logistics model of long-term financial health for logistics companies in Thailand is as follows:**

Logit Response Function:

$g0 = \ln(P_0/P_1) = -8.107(RETA)+0.481(BVETL)$ ---------(4.6)

$g2 = \ln(P_2/P_1) = -1.821 + 3.451(RETA) - 1.417(BVETL) + 0.026(Size)$

$-0.224(No.\ of\ Shareholder) + 0.722\ (Nationality\ of\ Shareholders)$ ------- (4.7)

Where g0, g2 = log odd or logit

$Pr\ (Y=j/x) =$ ----------(4.8)

Where j = 0, 2

Pr = Probability to the outcome of the interest

$\sum^{2}_{j=0} Pr\ (Y=j|x) = 1$ ---------- (4.9)

These are the estimated multinomial logistic regression coefficients for the models. This study treated the Normal group as the reference. Therefore, the estimated model was a model for Distressed (Unhealthy) relative to Normal and a model for Non-Distressed (Healthy) relative to Normal. The parameter estimates were relative to the Normal group.

For Distressed (Unhealthy) relative to Normal.

1) The Wald test statistic for the variables RETA and BVETL were 44.132 and 4.047 with an associated p-value of 0. The study set the alpha level to 0.05. That means we reject the null hypothesis and this could imply that the regression coefficient for RETA and BVETL were statistically different from zero for Distressed (Unhealthy) to Normal given that other variables were in the model. In other words, RETA and BVETL were significant variables in this group.

The other variables failed to reject the null hypothesis. It could be concluded that for the Unhealthy relative to Normal, the regression coefficient for the other variables were found statistically different from zero given that other variables were in the model. In other words, other variables were not significant in this group.

2) For B,

RETA – if the company were to increase in RETA score by one point, the multinomial log-odds of Unhealthy to Normal would be expected to decrease by 8.107 units while holding all other variables in the model constant.

BVETL – if the company were to increase in BVETL score by one point, the multinomial log-odds of Unhealthy to Normal would be expected to increase by 0.481 units while holding all other variables in the model constant.

3) According to Table 4.6, Exp(B),

Exp(B) is the odds ratio for the predictors. The odds ratio of a coefficient indicates the risk of the outcome falling in the comparison group compared to the risk of the outcome falling in the reference group changes with the variable in question.

RETA – The odds or "relative risk" ratio was 0 which was less than 1. This result indicates that the risk of the company in the Unhealthy group to Normal group decreases as the RETA increases. That means if the company has a higher Retained Earning Total Asset Ratio, it is less likely that the firm will be in the Unhealthy group.

BVETL – The odds or "relative risk" ratio was 1.618 which was higher than 1. This result indicates that the risk of the company in the Unhealthy group to Normal group increases as the BVETL increases. That means if the company has a higher Book Value Equity to Total Liability Ratio, it is more likely that the firm will be in the Unhealthy group.

<u>For the Non Distressed group (Healthy) relative to Normal.</u>

1) The Wald test statistics for the variables RETA, BVETL, Size, Nationality of Shareholders and No. of Shareholders were 9.032, 22.468, 17.180, 5.192 and 9.177 respectively with an associated p-value of 0.003, 0, 0, 0.023 and 0.002. The study set the alpha level to 0.05, that means we reject the null hypothesis and conclude that the regression coefficients for RETA, BVETL, Size, Nationality of Shareholders and No. of Shareholders were statistically different from zero for Non Distressed (Healthy) to Normal given that other variables were in the model. In other words, RETA, BVETL, Size, Nationality of Shareholders and No. of Shareholders were significant variables in this group.

The other variables failed to reject the null hypothesis. It can be concluded that for the Healthy relative to Normal, the regression coefficient for the other variables were

found to be statistically different from zero given that other variables were in the model. In other words, other variables were not significant variables in this group.

2) For B,

RETA – if the company were to increase in RETA score by one point, the multinomial log-odds of Healthy to Normal would be expected to increase by 3.451 units while holding all other variables in the model constant.

BVETL – if the company were to increase in BVETL score by one point, the multinomial log-odds of Healthy to Normal would be expected to decrease by 1. 417 units while holding all other variables in the model constant.

Size – if the company were to increase in Size score by one point, the multinomial log-odds of Healthy to Normal would be expected to increase by 0.026 units while holding all other variables in the model constant.

Nationality of Shareholders – if the company were to increase in Nationality of Shareholders as International Company, the multinomial log-odds of Healthy to Normal would be expected to increase by 0.722 units while holding all other variables in the model constant.

No. of Shareholders – if the company were to increase the No. of Shareholders score by one unit, the multinomial log-odds of Healthy to Normal would be expected to decrease by 0.224 units while holding all other variables in the model constant.

3) For Exp (B).

RETA - The odds or "relative risk" ratio was 31.546 which was more than 1. The results indicate that the risk of the company in the Non Distressed (healthy) group to Normal group increases as the RETA increases. That means if the company has a higher Retained Earnings to Total Assets, the firm is increased by the factor to the Healthy group, or more likely to be in the Healthy group. RETA was the strongest drive for the company to be Healthy as the highest Exp (B).

BVETL - The odds or "relative risk" ratio was 0.242 which was less than 1. The results indicate that the risk of the company in the Non Distressed (healthy) group to

Normal group increases as the BVETL decreases. That means if the company has higher Book Value of Equity to Total Liability, the firm is less likely to be in the Healthy group.

Size - The odds or "relative risk" ratio was 1.027 which was higher than 1. This result indicates that the risk of the company in the Non Distressed (healthy) group to Normal group increases as Size increases. That means if the company is of bigger size, the firm is more likely to be in the Healthy group.

Nationality of Shareholders - The odds or "relative risk" ratio was 2.059 which was higher than 1. This result indicates that the risk of the company in the Non Distressed (Healthy) group to Normal group increases as the company is an international company increases. That means if the company is an international company, the firm is more likely be in the Healthy group.

No. of Shareholders - The odds or "relative risk" ratio was 0.80 which was less than 1. This result indicates that the risk of the company in the Non Distressed (Healthy) group to Normal group increases as the No. of Shareholders decreases. That means if the company has more shareholders, the firm is less likely to be in the Healthy group.

The results of Case 1 from part 2 showing 5 significant variables affecting Unhealthy relative to Normal and Healthy relative to Normal are shown in Figure 4.3.

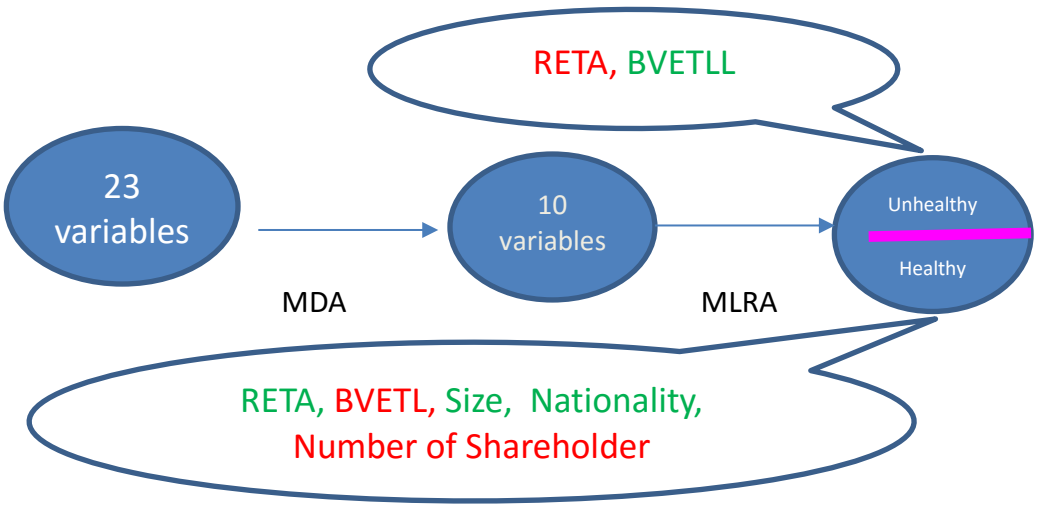

Figure 4.3 : frame work with results – case 1

4.1.3 Analysis of the marginal effect of significant variables.

The results of the marginal effect of x were calculated as shown by the following equation:

$(\partial P_0)/\partial x = P_0(1- P_0)_{\beta 0} - P_0 P_{2\beta 2}$ ----------(4.10)

$(\partial P_2)/\partial x = P_2(1- P_2)_{\beta 2} - P_0 P_{2\beta 0}$ ----------(4.11)

Where X = significant variable

X = RETA, the results of marginal effect are as follows:

$(\partial P_0)/\partial x = P_0(1- P_0) * -8.107 - P_0 P_2 * 3.451$ ----------(4.12)

$(\partial P_2)/\partial x = P_2(1- P_2) * 3.451 - P_0 P_2 * -8.107$ ----------(4.13)

Equation 4.12 shows the probability of the firm falling in the Unhealthy group as affected by X.

The average result from substituting x into equation 4.12 was -0.812. The interpretation is that the probability of the firm falling in the Unhealthy group decreases 0.812 if RETA increases 1 unit.

Equation 4.13 shows the probability of the firm falling in the Healthy group as affected by X.

The average result from substituting x into equation 4.14 was 0.215. The interpretation is that the probability of the firm falling in the Healthy group increases 0.215 if RETA increases 1 unit.

X = BVETL, the results of the marginal effect are as follows:

$(\partial P_0)/\partial x = P_0(1- P_0) * 0.481 - P_0 P_2 * -1.417$ ----------(4.14)

$(\partial P_2)/\partial x = P_2(1- P_2) * -1.417 - P_0 P_2 * 0.481$ ----------(4.15)

Equation 4.14 shows the probability of the firm falling in the Unhealthy group as affected by X.

The average result from substituting x into equation 4.13 was 0.058. The interpretation is that the probability of the firm falling in the Unhealthy group increases 0.058 if RETA increases 1 unit.

Equation 4.15 shows the probability of the firm in the Healthy group as affected by X.

The average result from substituting x into equation 4.15 was -0.067. The interpretation is that the probability of the firm falling in the Healthy group decreases 0.067 if BVETL increases 1 unit.

For X = Size. The results of the marginal effect are as follows:

$(\partial P_0)/\partial x = P_0(1- P_0) *0 - P_0P_2*0.026$ ----------(4.16)

$(\partial P_2)/\partial x = P_2(1- P_2) *0.026- P_0P_2*0$ ----------(4.17)

Equation 4.16 shows the probability of the firm falling in the Unhealthy group as affected by X.

Size was not a significant variable in the Unhealthy group.

Equation 4.17 shows the probability of the firm falling in the Healthy group as affected by X.

The average result from substituting x into equation 4.17 was 0.0012. The interpretation is that the probability of the firm falling in the Healthy group increases 0.0012 if Size increases 1 unit.

For X = Nationality of Shareholders, the results of marginal effect are as follows:

$(\partial P_0)/\partial x = P_0(1- P_0) *0 - P_0P_2*0.722$ ----------(4.18)

$(\partial P_2)/\partial x = P_2(1- P_2) *0.722- P_0P_2*0$ ----------(4.19)

Equation 4.18 shows the probability of the firm falling in the Unhealthy group as affected by X.

Nationality of Shareholders was not a significant variable in the Unhealthy group.

Equation 4.19 shows the probability of the firm falling in the Healthy group as affected by X.

The average result from substituting x into equation 4.19 was 0.032. The interpretation is that the probability of the firm to falling in the Healthy group increases 0.032 if the company is an international company.

For X = No. of Shareholders, the results of the marginal effect are as follows:

$(\partial P_0)/\partial x = P_0(1- P_0) *0 - P_0P_2*-0.224$ ----------(4.20)

$(\partial P_2)/\partial x = P_2(1- P_2) *-0.224 - P_0P_2*0$ ----------(4.21)

Equation 4.20 shows the probability of the firm falling in the Unhealthy group as affected by X.

No. of Shareholders was not a significant variable in the Unhealthy group.

Equation 4.21 shows the probability of the firm falling in the Healthy group as affected by X.

The average result from substituting x into equation 4.21 was -0.01. The interpretation is that the probability of the firm falling in the Healthy group decreases 0.01 if No. of Shareholders increases 1 unit.

4.2 Case 2: Split Variables into Financial Variables and Non-Financial Variables

According to most of the obtained financial variables in previous studies, this study splits variables into the 2 sections of Financial Variable and Non-Financial Variables.

1) The Financial Variables

Financial Variables consist of 10 Financial Ratios, 4 Growth Rate and 4 Variation in Growths (a total of 18 Financial Variables).

2) Non-Financial Variables

Non-Financial Variables consisted of Company Size, Age, Nationality of Shareholders, Type of Network and No. of Shareholders.

Similar to Case 1, this study carried out multiple discriminant analysis on SPSS for 18 Financial Variables from part I and part II using significant variables from part I as the data for part II. The tool for part II was the multinomial logistics regression analysis. Also, the same was done with 5 Non Financial Variables.

4.2.1 Financial Variables

4.2.1.1 Part I (Multiple discriminant Analysis)

The results from SPSS by obtaining Multiple Discriminant Analysis Method for Financial Variables is shown as follows:

Table 4.7 : Group Statistics - Case 2 (Financial Variables)

Variables	Mean			
	Unhealthy group	Normal group	Healthy group	Total
Current Ratio	1.597245	2.47573	2.728856	2.343365
WCTA	-0.395508	0.291404	0.326933	0.15353
CFD	-0.105337	0.206069	0.605212	0.224639
Return on Assets	-25.696224	4.425955	12.087169	-0.328202
EBITTA	-0.221092	0.071663	0.16646	0.029762
RETA	-1.201384	0.327101	0.41653	0.022506
Debt Ratio	1.288469	0.512697	0.470064	0.667875
NITL	-0.137332	0.135674	0.462947	0.147161
BVETL	0.448112	1.579967	2.407402	1.515533
Total Asset Turnover	3.392449	2.437341	2.321317	2.614944
Sales Growth	71.497275	12.906779	33.088043	29.579851
Net Profit Growth	-162.000827	40.872547	92.078811	8.770221
Total Assets Growth	9.095751	14.716292	18.077678	14.238113

Total Liability Growth	106.753682	97.435589	34.799728	86.150187
Variation of total sale growth	124.113337	83.425193	92.132302	93.880344
Variation of Net Profit Growth	632.88001	226.596437	204.15205	307.841016
Variation of Total Assets Growth	58.4082	31.767418	47.352175	40.705005
Variation of Total Liability Growth	151.46315	219.70202	323.015222	227.125961

According to Table 4.7, the group statistics result is similar to Case 1 (Table 4.1) due to same financial variable data.

The mean of the Current Ratio, a company with a higher Current Ratio seems to be in the healthier group as the trend of the mean for the Current Ratio was low in Unhealthy group (1.597245), higher in the Normal group (2.47573) and the highest in the Healthy group (2.728856).

For the mean of WCTA, a company with a higher WCTA (Working Capital to Total Asset Ratio) seems to be in the healthier group as the trend of the mean for WCTA was low in the Unhealthy group (-0.395508), higher in the Normal group (0.291404) and the highest in the Healthy group (0.326933).

For the mean of CFD, a company with a higher CFD (Cash Flow to Debt Ratio) seems to be in the healthier group as the trend of the mean for CFD was low in the Unhealthy group (-0.105337), higher in the Normal group (0.206069) and the highest in the Healthy group(0.605212).

Concerning the mean of the Return on Asset Ratio, a company with a higher ratio seems to belong to the healthier group as the trend of the mean for the ratio was low in the Unhealthy group (-25.696224), higher in the Normal group (4.425955) and highest in the Healthy group (12.087169).

Regarding the mean of EBITTA, a company with a higher EBITTA (Earnings Before Interest and Tax to Total Asset Ratio) seems to be in the healthier group as the trend of the mean for the EBITTA ratio was low in the Unhealthy group (-0.221092), higher in the Normal group (0.071663) and highest in the Healthy group (0.16646).

For the mean of RETA, a company with a higher RETA (Retained Earnings to Total Asset Ratio) seems to be in the healthier group as the trend of the mean for the RETA ratio was low in the Unhealthy group (-1.201384), higher in the Normal group (0.327101) and highest in the Healthy group (0.41653).

Concerning the mean of the Debt Ratio, a company with a lower Debt Ratio seems to be in the healthier group as the trend of the mean for the Debt Ratio was high in the Unhealthy group (1.288469), lower in the Normal group (0.512697) and lowest in the Healthy group (0.470064).

For the mean of NITL, a company with higher NITL (Net Income to Total Liability Ratio) seems to be in the healthier group as the trend of the mean for the NITL ratio was low in the Unhealthy group (-0.137332), higher in the Normal group (0.135674) and highest in the Healthy group (0.462947).

Regarding the mean of BVETL, a company with a higher BVETL (Book Value Equity to Total Liability Ratio) seems to be in the healthier group as the trend of the mean for the BVETL ratio was low in the Unhealthy group (0.448112), higher in the Normal group (1.579967) and highest in the Healthy group (2.407402).

For the mean of Total Asset Turnover Ratio, a company with a lower Total Asset Turnover Ratio seems to be in the healthier group as the trend of the mean for the ratio was high in the Unhealthy group (3.392449), lower in the Normal group (2.437341) and lowest in the Healthy group (2.321317).

The Sales Growth variable had no trend in the mean.

For the mean of Net Profit Growth, a company with a higher growth seems to be the healthier group as the trend of the mean for Net Profit Growth was low in the Unhealthy group (-162.000827), higher in the Normal group (40.872547) and highest in the Healthy group (93.078811).

As concerns the mean of Total Asset Growth, a company with a higher growth seems to be in the healthier group as the trend of the mean for Total Asset Growth was low in the Unhealthy group (9.095751), higher in the Normal group (14.716292) and highest in the Healthy group (18.077678).

Concerning the mean of Total Liability Growth, a company with a lower growth seems to be the healthier group as the trend of the mean for Total Liability Growth was the highest in the Unhealthy group (106.753682), lower in the Normal group (97.435589) and lowest in the Healthy group (34.799728).

Regarding the mean of variation in growth, the variation in growth in terms of the Sales Growth, Net Profit Growth, Total Asset Growth and Total Liability Growth variables had no trend in the mean.

Table 4.8 : Standardized Canonical Discriminant Function Coefficients – Case 2 (Financial Variable)

	Function	
	1	2
CFD	.713	1.193
RETA	.823	-.519
BVETL	-.271	-.545
Sales Growth	.433	.318
Variation of Net Profit Growth	-.283	.188

As can be seen in Table 4.8, there are 2 discriminant functions as follows:

Function 1

* D1case2FV = 0.713(CFD) + 0.823(RETA) - 0.271(BVETL) + 0.433(Sale Growth) - 0.283(Variation of Net Profit Growth) ----------(4.22)

Function 2

* D2case2FV = 1.193(CFD) - 0.519(RETA) - 0 .545(BVETL) + 0.318(Sale Growth) + 0.188(Variation of Net Profit Growth) ----------(4.23)

From Function 1 (equation 4.22), the standardized coefficient for RETA was greater in magnitude than the coefficients for the other five variables. Thus, RETA had the greatest impact on the first discriminant score. BVETL had the least impact on the same.

For Function 2 (equation 4.23), the standardized coefficient for CFD was greater in magnitude than the coefficients for the other five variables. Thus, CFD had the greatest impact of the five on the first discriminant score. But the least impact on the first discriminant score was Variation of Net Profit Growth.

Of these two discriminant functions, there are 5 significant variables that allowed the study to discriminate between the different groups that are CFD, RETA, BVETL, Sales Growth, and Variation of Net Profit Growth.

The study identified the centroid of each group as shown below.

Table 4.9 : Wilks'Lambda - Case 2 (Financial variables)

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 2	.616	221.886	10	.000
2	.923	36.829	4	.000

As can be seen in Table 4.9, Wilks' Lambda of function 1 through 2 is .616 and function 2 is .923 and significant is .000.

H0: The centroid of each group from both functions is equal

H1: The centroid of each group from both functions is not equal

From the above table, H0 was rejected as the centroids of each group from both functions are not equal and both functions to be implied in this study.

Table 4.10 : Functions at Group Centroids - Case2 (Financial Variables)

Distressed/Normal/ Non-distressed	Function	
	1	2
0	-1.291	.172
1	.198	-.233
2	.751	.464

Table 4.10 group centroids of canonical functions 1 and 2 show each group has different centroids and the longer distance shows the greater difference of each group as shown in the graph below.

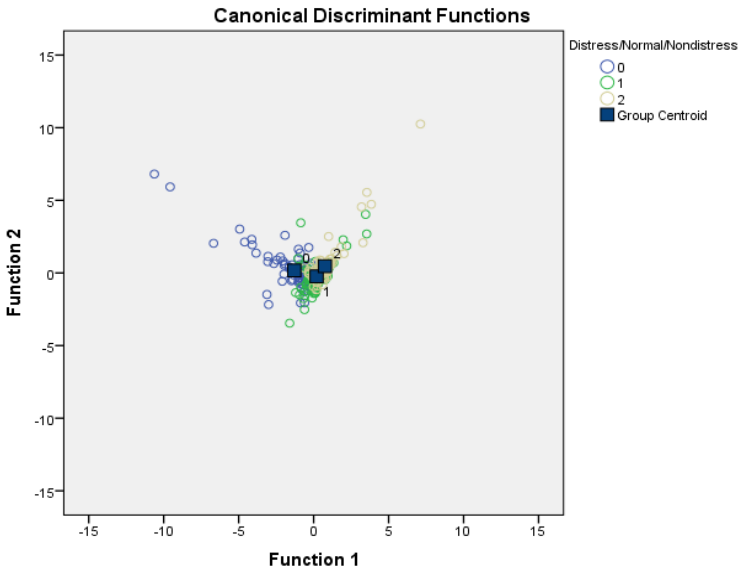

Figure 4.4 : Canonical Discriminant Functions - Case 2 (Financial Variables)

The below table 4.11 implies discriminant equation uses for prediction of each company that fall into each group.

Table 4.11: Classification Function Coefficients - Case2 (Financial Variables)

	Distressed/Normal/Non-distressed		
	0	1	2
CFD	-.986	.087	2.359
RETA	-1.040	.244	.327
BVETL	.252	.187	-.002
Sales Growth	-.001	.000	.002
Variation of Net Profit Growth	.001	.000	.000
(Constant)	-2.122	-1.345	-1.951

Fisher's linear discriminant functions

The multiple discriminant equations for Case 2 (Financial Variables) are as follows:

Distressed group (Unhealthy)

DLT0 FVi = -2.122 - 0.986(CFD) - 1.040(RETA) + .252(BVETL) - 0.001 (Sales Growth) + 0.001(Variation of Net Profit Growth) ----------(4.24)

Where DLT0 FVi = discriminant score (Financial health level) of Logistics companies in Thailand fall in group 0 for case 2 Financial Variable

Normal Group

DLT1 FVi = -1.345 + 0.087(CFD) + 0.244(RETA) + 0.187(BVETL)----------(4.25)

Where DLT1 FVi = discriminant score (Financial health level) of Logistics companies in Thailand fall in group 1 for case 2 Financial Variable

Non Distressed Group (Healthy)

DLT2 FVi = -1.951 + 2.853(CFD) + .327(RETA) - 0.002(BVETL) + 0.002 (Sales Growth)-(4.26)

Where DLT2 FVi = discriminant function score (Financial health level) of Logistics companies in Thailand fall in group 2 for case 2 Financial Variable.

The discriminant function score is obtained by multiplying each variable (x) by its classification coefficient (bi) plus constant (b0). The maximum score among 3 functions could be justified financial health of the firm into one and only Unhealthy, Normal or Healthy group. However, the purpose of this study at this stage is to screen the significant variables that affect the financial health of the logistics company. Only the significant variables were picked up for further investigation. Therefore, the discriminant function score was not raised in the study.

In this part of the 18 Variables, 5 variables comprising CFD, RETA, BVETL, Sales Growth and Variation of Net Profit Growth were significant at the 0.05 level for all groups as shown in figure 4.5.

These significant variables affected financial health in this part and will be applied in part II.

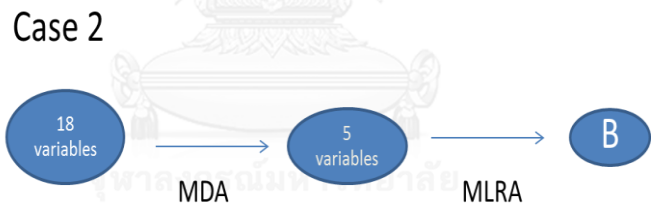

Figure 4.5 : Frame work – case 2 (Financial variables)

4.2.1.2 Part II (multinomial logistics regression analysis)

After using multiple Discriminant Analysis to identify the significant variables of CFD, RETA, BVETL, Sale Growth and Variation of Net Profit Growth, all these variables comprised the data in part II to identify the factors that determine long-term financial stability.

Multinomial logistics regression analysis was the tools utilized at this stage. The output from SPSS on applying the 5 variables at the same time is shown as follows:

Table 4.12 : Parameter Estimates From MLRA for 5 significant variables from part II - Case2 (Financial Variables)

Distress/Normal/Nondistress[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
0	Intercept	-0.724	0.298	5.918	1	0.015			
	CFD	-7.674	1.367	31.513	1	0	0	3.19E-05	0.007
	RETA	-8.083	1.115	52.549	1	0	0	3.47E-05	0.003
	BVETL	0.48	0.208	5.337	1	0.021	1.616	1.075	2.429
	SalesGrowth	0	0.001	0.068	1	0.794	1	0.998	1.003
	VariationofNetProfitGrowth	0	0	0.022	1	0.883	1	0.999	1.001
2	Intercept	-1.989	0.299	44.333	1	0			
	CFD	4.091	0.715	32.699	1	0	59.824	14.718	243.169
	RETA	1.143	0.64	3.186	1	0.074	3.137	0.894	11.006
	BVETL	-0.417	0.087	23.16	1	0	0.659	0.556	0.781
	SalesGrowth	0.001	0.001	1.327	1	0.249	1.001	0.999	1.002
	VariationofNetProfitGrowth	0	0	0.041	1	0.84	1	0.999	1.001

a. The reference category is: 1.

According to Table 4.12, the multinomial logistic Regression Analysis model which is the Logistics model of long term financial health for logistics companies in Thailand are as follow.

Logit Response Function:

g0 = ln (P0/P1)= -0.724-7.674(CFD)-8.083(RETA)+0.48(BVETL) ----------(4.27)

g2 = ln (P2/P1)= -1.989+4.091(CFD)-0.417(BVETL) ----------(4.28)

Where g0, g2 = log odd or logit

Pr (Y=j/x) = ----------(4.29)

Where j = 0, 2

Pr = Probability to the outcome of the interest

$\Sigma 2j=0$ Pr (Y=j|x) = 1 ---------- (4.30)

These are the estimated multinomial logistic regression coefficients for the models. This study treated the Normal group as the reference. Therefore, the estimated model was a model for Distressed (Unhealthy) relative to Normal and a model for Non-Distress (Healthy) relative to Normal. The parameter estimates were relative to the Normal group.

For Distressed (Unhealthy) relative to Normal.

1) The Wald test statistic for the variable CFD, RETA and BVETL were 31.513, 52.549 and 5.337 with an associated p-value of 0. The study set the alpha level to 0.05, that means we reject the null hypothesis and this could imply that the regression coefficient for CFD, RETA and BVETL were statistically different from zero for Distressed (unhealthy) to Normal given that other variables were in the model. In other words, CFD, RETA and BVETL were significant variables in this group.

The other variables failed to reject the null hypothesis. It can be concluded that for the Unhealthy relative to Normal, the regression coefficients for the other variables were found statistically different from zero given that other variables were in the model. In other words, other variables were not a significant variable in this group.

2) For B,

CFD – if the company were to increase in CFD score by one point, the multinomial log-odds of Unhealthy to Normal would be expected to decrease by 7.674 units while holding all other variables in the model constant.

RETA – if the company were to increase in RETA score by one point, the multinomial log-odds of Unhealthy to Normal would be expected to decrease by 8.083 units while holding all other variables in the model constant.

BVETL – if the company were to increase in RETA score by one point, the multinomial log-odds of Unhealthy to Normal would be expected to increase by 0.48 units while holding all other variables in the model constant.

3) According to Table 4.12, Exp (B)

CFD – The odds or “relative risk” ratio was 0 which less than 1. This result indicates that the risk of the company in Distressed (Unhealthy) group to Normal group increase as the CFD decreases. That means if the company has a higher Cash Flow to Debt, it is less likely that the firm will be in the Unhealthy group.

RETA – The odds or “relative risk” ratio was 0 which less than 1. This result indicates that the risk of the company in the Distressed (Unhealthy) group to Normal group increase as the CFD decreases. That means if the company has a higher Retained earnings to total asset ratio, it is less likely that the firm will be in the Unhealthy group.

BVETL – The odds or “relative risk” ratio was 1.616 which higher than 1. This result indicates that the risk of the company in the Distressed (Unhealthy) group to Normal group increase as the BVETL increases. That means if the company has a higher Book Value Equity to Total Liability ratio, it is more likely that the firm will be in the Unhealthy group.

For the Non Distress group (Healthy) relative to Normal.

1) The Wald test statistics for the variables CFD and BVETL were 32.70 and 23.16 with an associated p-value of 0. The study sets the alpha level to 0.05, that means we reject the null hypothesis and conclude that the regression coefficient for CFD and BVETL were statistically different from zero for Non-Distressed (Healthy) to Normal given that other variables were in the model. In other words, CFD and BVETL were significant variables in this group.

The other variables failed to reject the null hypothesis. It can be concluded that for the Healthy relative to Normal, the regression coefficient for the other variables were not found to be statistically different from zero given that other variables were in the model. In other word, other variables were not a significant variable in this group

2) For B,

CFD – if the company were to increase in CFD score by one point, the multinomial log-odds of Healthy to Normal group would be expected to increase by 4.091 units while holding all other variables in the model constant.

BVETL – if the company were to increase in BVETL score by one point, the multinomial log-odds of Healthy would be expected to decrease by 0.417 units while holding all other variables in the model constant.

3) For Exp (B

CFD - The odds or "relative risk" ratio was 59.824 which more than 1. This result indicates that the risk of the company in the Non-Distressed (Healthy) group to Normal group increase as the CFD increases. That means if the company has higher Cash flow to debt ratio, it is more likely that the firm will be in the Healthy group. CFD was the strongest drive for the company to be Healthy as the highest Exp (B).

BVETL - The odds or "relative risk" ratio was 0.659 which less than 1. This result indicates that the risk of the company in Non-Distressed (Healthy) group to Normal group increases as the BVETL decreases. That means if the company has a higher Book Value Equity to Total Liability ratio, it is less likely that the firm will be in Healthy group.

The results of case 2 from part 2 showed 3 significant variables affecting Unhealthy relative to Normal and 2 significant variables affecting Healthy relative to Normal as per figure 4.6.

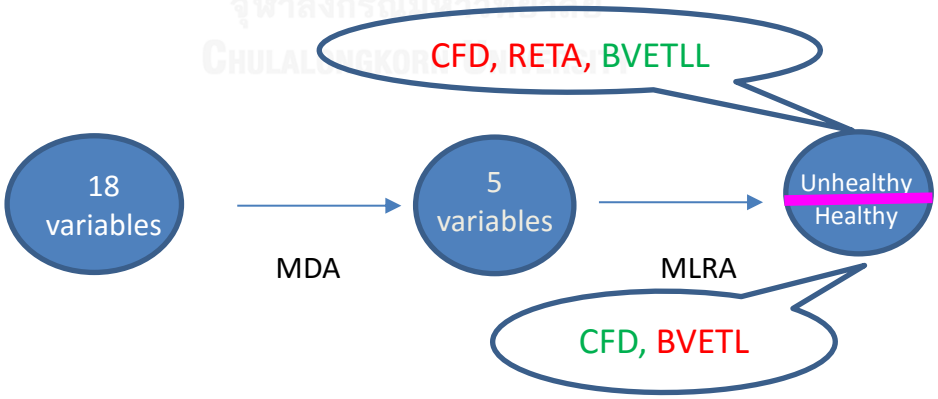

Figure 4.6 : frame work with results – case 2 (Financial variables)

4.2.1.3 Analysis of the Marginal effect of significant variables.

The results of the marginal effect of x were calculated as shown below.

X = CFD, the results of the marginal effect are as follows:

$(\partial P0)/\partial x = P0(1- P0) *-7.674 - P0P2*4.091$ ----------(4.31)

$(\partial P2)/\partial x = P2(1- P2) *4.091- P0P2*-7.674$ ----------(4.32)

Equation 4.31 shows the probability of the firm falling in the Unhealthy group as affected by X.

The average result from substituting x into equation 4.31 was -0.380. The interpretation is that the probability of the firm falling in the Unhealthy group decreases 0.318 if Cash Flow to Debt ratio increases 1 unit.

Equation 4.32 shows the probability of the firm falling in the Healthy group as affected by X.

The average result from substituting x into equation 4.32 was 0.479. The interpretation is that the probability of the firm falling in the Healthy group increases 0.479 if CFD increases 1 unit.

X = RETA, the results of the marginal effect are as follows:

$(\partial P0)/\partial x = P0(1- P0) *-8.766- P0P2*0$ ----------(4.33)

$(\partial P2)/\partial x = P2(1- P2) *0- P0P2*-8.766$ ----------(4.34)

Equation 4.33 shows the probability of the firm falling in the Unhealthy group as affected by X.

The average results from substiting x into the equation 4.33 was -0.377. The interpretation is that the probability of the firm falling in the Healthy group decreases 0.377 if RETA increases 1 unit.

Equation 4.34 shows the probability of the firm falling in the Healthy group as affected by X.

RETA was not a significant variable in the Healthy group.

X = BVETL, the results of the marginal effect are as follows:

$(\partial P0)/\partial x = P0(1- P0) *0.48 - P0P2*-0.417$ ----------(4.35)

$(\partial P2)/\partial x = P2(1- P2) *-0.417 - P0P2*0.48$ ----------(4.36)

Equation 4.35 shows the probability of the firm falling in the Unhealthy group as affected by X.

The average result from substituting x into the equation 4.35 was 0.025. The interpretation is that the probability of the firm falling in the Healthy group increases 0.025 if Book Value Equity to Total Liability increases 1 unit.

Equation 4.36 shows the probability of the firm falling in the Healthy group as affected by X.

The average result from substituting x into the equation 4.36 was -0.047. The interpretation is that the probability of the firm falling in the Healthy group decreases 0.047 if BVETL increases 1 unit.

4.2.2 Non Financial Variables

The Non-Financial Variables consisted of Size, Nationality of Shareholders, Type of Network and Number of Shareholders (in total 5 Variables). The results after applied Multiple Discriminant Analysis and Multinomial Logistics Regression Analysis method on SPSS were as follows:

4.2.2.1 Part I (Multiple discriminant Analysis)

Table 4.13 : Group Statistics - Case 2 (Non-Financial Variables)

Variables	Mean			
	Unhealthy group	Normal group	Healthy group	Total
Size	8.020408	10.104869	126.642857	34.330454
Age (years)	13.651985	17.87448	19.37519	17.298379

Variables	Mean			
	Unhealthy group	Normal group	Healthy group	Total
Nationality of shareholders (Thai (1) / Non Thai (0))	-	-	-	-
Type of Network (Logistics Network 1)/ Non Logistics Network (0))	-	-	-	-
No. of Shareholders	5.734694	6.490637	5.234694	6.064795

From table 4.13, For the mean of Company Size, a larger sized company seems to be in the Healthy group as the trend of the mean for size was low in the Unhealthy group (8.020408 million), higher in the Normal group (10.104869 million) and highest in the Healthy group (126.642 million).

Concerning the mean of Company Age, an older company seems to be in the Healthy group as the trend of the mean for company age was low in the Unhealthy group (13.651985), higher in the Normal group (17.87448) and highest in the Healthy group (19.37519).

Regarding the mean of Nationality of Shareholders, since the nationality is a dichotomous nominal scale (0= non-Thai (international company) 1= Thai (local company) with no quantitative value, the mean could not be considered.

For the mean of the type of network, similarly to Nationality of Shareholder, Type of Network is a dichotomous nominal scale (0 =.non-logistics network company, 1 = company having logistics network) with no qualitative value. Therefore, the mean could not be considered.

Number of Shareholders showed no trend in its mean.

Table 4.14 : Standardized Canonical Discriminant Function Coefficients - Case 2 (Non-Financial Variables)

	Function	
	1	2
Size	-.366	-.259
Age (years)	-.401	.611
Nationality of shareholders (Thai/non Thai)	.636	.075
Type of Network (Logistics / Non Logistics)	-.194	.479
No. of Shareholders	.431	.411

As can be seen in Table 4.14, there are 2 discriminant functions as follows:

Function 1

* D1case2NFV = - 0.366(Size) - 0.401(Age) + 0.636(Nationality of Shareholders) – 0.194(Type of Network) + 0.431(No. of Shareholders) ---------- (4.37)

Function 2

* D2case2NFV = - 0.259(Size) + 0.611(Age) + 0.075(Nationality of Shareholders) + 0.479(Type of Network) + 0.411(No. of Shareholders) ---------- (4.38)

The magnitudes of standardized coefficients from discriminant function (a) indicate how strongly the variables affect the score.

From Function 1 (equation 4.37), the standardized coefficient for Nationality of Shareholders was greater in magnitude than the coefficients for the other five variables. Thus, Nationality of Shareholders had the greatest impact of the five

variables in the first discriminant score. Type of Network had the least impact in the first discriminant score.

For Function 2 (equation 4.38), the standardized coefficient for Age was also greater in magnitude than the coefficients for the other five variables. Thus, Age had the greatest impact among the five variables in the second discriminant score. Meanwhile, the least impact on the first discriminant score was Size.

Of these two discriminant functions, there were 5 significant variables that allowed the study to discriminate between the different groups which consisted of Size, Age, Nationality of shareholders, Type of Network and No. of Shareholders.

The study identified the centroid of each group as shown below.

Table 4.15 : Wilks' Lambda - Case 2 (Non-Financial Variables)

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 2	.805	99.440	10	.000
2	.939	29.015	4	.000

As can be seen in Table 4.15, Wilks' Lambda of function 1 through 2 is 0.805 and function 2 is 0.939 and significant is 0.000.

H0: The centroid of each group from both functions is equal

H1: The centroid of each group from both functions is not equal

From the above table, H0 was rejected as the centroids of each group from both functions were not equal. Therefore, both functions can be implied in this study.

Table 4.16 : Functions at Group Centroids - Case 2 (Non-Financial Variables)

Distressed/Normal/ Non-distressed	Function	
	1	2
0	.353	-.439
1	.153	.196
2	-.769	-.096

Unstandardized canonical discriminant functions evaluated at group mean

Table 4.16 group centroids of canonical functions 1 and 2 show each group has different centroids and the longer distance shows the greater difference of each group as shown in the graph below.

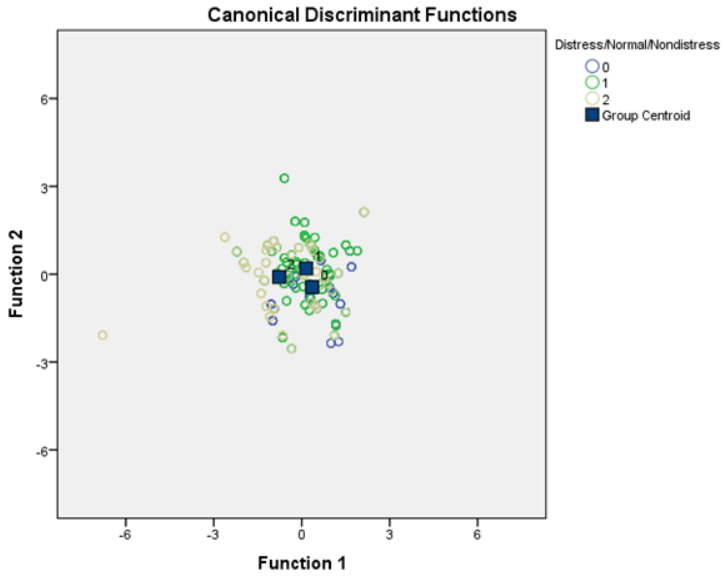

Figure 4.7 : Canonical Discriminant Functions - Case 2 (Non-Financial Variables)

Table 4.17 below presents the classification functions uses for prediction of each company that fall into each group.

Table 4.17 : Classification Function Coefficients for Total 5Variables - Case 2 (Non-Financial Variables)

	Distressed/Normal/Non-distressed		
	0	1	2
Size	.000	-.001	.001
Age (years)	.150	.206	.229
Nationality of shareholders (Thai/non Thai)	3.214	3.042	1.737
Type of Network (Logistics / Non Logistics)	3.571	4.460	4.561
No. of Shareholders	.777	.852	.629
(Constant)	-6.734	-8.632	-7.274

Fisher's linear discriminant functions

The multiple discriminant equations for Case 2(non-financial variables) are as follows:

Distressed group (Unhealthy)

DLT0NFV = -6.734 + 0.15(Age) + 3.214(Nationality of shareholders) + 3.571(Type of Network) + 0.777(No. Of Shareholders) ---------- (4.39)

Where DLT0NFV = discriminant score (Financial health level) of Logistics companies in Thailand falling in group 0

Normal Group

DLT1NFV = -8.632 - 0.001(Size) + 0.206(Age) + 3.042(Nationality of shareholders) + 4.460(Type of Network) + 0.852(No. of Shareholders) ---------- (4.40)

Where DLT1NFV = discriminant score (Financial health level) of Logistics companies in Thailand falling in group 1.

Non Distressed Group (Healthy)

DLT2NFV = -7.274 + 0.001(Size) +0.229(Age) + 1.737(Nationality of shareholders) + 4.561(Type of Network) + 0.629(No. of Shareholders) ---------- (4.41)

Where DLT2NFV = discriminant function score (Financial health level) of Logistics companies in Thailand falling in group 2.

The discriminant function score is obtained by multiplying each variable (x) by its classification coefficient (bi) plus constant (b0). The maximum score among 3 functions could be justified financial health of the firm into one and only Unhealthy, Normal or Healthy group. However, the purpose of this study at this stage is to screen the significant variables that affect the financial health of the logistics company. Only the significant variables were picked up for further investigation. Therefore, the discriminant function score was not raised in the study.

In this part, of the 5 variables comprising Size, Age, Nationality of shareholders, Type of Network and No. of Shareholders are significant at the 0.05 level for all groups as shown in figure 4.8. These significant variables affected financial health in this part and will be applied in part II.

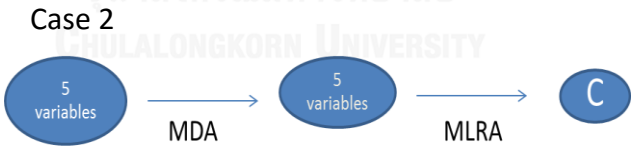

Figure 4.8 : Frame work – case 2 (Non-Financial variables)

4.2.2.2 Part II (multinomial logistics regression analysis)

After using Multi Discriminant Analysis to identify the significant variables of Size, Age, Nationality of shareholders, Type of Network and No. of Shareholders, all these variables comprised the data in part II to identify the factors that determine long-term financial stability.

Multinomial logistics regression analysis was the tool utilized at this stage. The output from SPSS on applying the 5 variables at the same time is shown as follows.

Table 4.18 : Parameter Estimates From MLRA for 5 significant variables from part II - Case 2 (Non-Financial Variables)

Distress/Normal/Nondistress[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
0	Intercept	0.315	0.437	0.519	1	0.471			
	Size	-0.003	0.009	0.085	1	0.77	0.997	0.981	1.015
	Ageyears	-0.069	0.018	14.444	1	0	0.934	0.901	0.967
	No.ofShareholders	-0.058	0.056	1.058	1	0.304	0.944	0.845	1.054
	[TypeofNetworkLogisticsNonLogistics=0]	0.764	0.297	6.638	1	0.01	2.147	1.201	3.838
	[TypeofNetworkLogisticsNonLogistics=1]	0[b]	.	.	0	.	.	.	.
	[NationalityofshareholdersThainonThai=0]	-0.149	0.273	0.298	1	0.585	0.862	0.505	1.471
	[NationalityofshareholdersThainonThai=1]	0[b]	.	.	0	.	.	.	.
2	Intercept	-0.723	0.496	2.128	1	0.145			
	Size	0.022	0.005	19.883	1	0	1.022	1.012	1.032
	Ageyears	0.015	0.016	0.828	1	0.363	1.015	0.983	1.047
	No.ofShareholders	-0.256	0.064	15.779	1	0	0.774	0.682	0.878
	[TypeofNetworkLogisticsNonLogistics=0]	0.112	0.367	0.094	1	0.76	1.119	0.545	2.299
	[TypeofNetworkLogisticsNonLogistics=1]	0[b]	.	.	0	.	.	.	.
	[NationalityofshareholdersThainonThai=0]	1.08	0.271	15.854	1	0	2.945	1.73	5.011
	[NationalityofshareholdersThainonThai=1]	0[b]	.	.	0	.	.	.	.

a. The reference category is: 1.

b. This parameter is set to zero because it is redundant.

According to Table 4.18, the multinomial logistic regression analysis model which is the logistics model of long-term financial health for logistics companies in Thailand is as follows.

Logit Response Function:

g0 = ln (P0/P1) = -0.069(Age)+0.764(Type of Network) ----------(4.42)

g2 = ln(P2/P1) = 0.022(Size) - 0.256(No. of Shareholders) + 1.08(Nationality of Shareholders) ---------- (4.43)

Where g0, g2 = log odd or logit

Pr (Y=j/x) = ----------(4.44)

Where j = 0, 2

Pr = Probability to the outcome of the interest

∑2j=0 Pr (Y=j|x) = 1 ---------- (4.45)

These are the estimated multinomial logistic regression coefficients for the models. This study treated the Normal group as the reference. Therefore, the estimated model was a model for Distressed (Unhealthy) relative to Normal and a model for Non-Distressed (Healthy) relative to Normal. The parameter estimates were relative to the Normal group.

<u>For Distressed (Unhealthy) relative to Normal.</u>

1) The Wald test statistic for the variables Age and Type of Network were 14.444 and 6.638 with an associated p-value of 0 and .01. The study set the alpha level to 0.05, means we reject the null hypothesis and this could imply that the regression coefficient for Age and Type of Network were statistically different from zero for distressed(unhealthy) to Normal given that other variables were in the model. In other words, Age and Type of Network were significant variables in this group.

The other variables failed to reject the null hypothesis. It could be concluded that for the Unhealthy relative to Normal, the regression coefficient for the other variables were not found statistically different from zero given that other variables were in the model. In the other words, other variables were not significant in this group.

2) For B,

Age – if the company were to increase in Age by one point, the multinomial log-odds of Unhealthy would be expected to decrease by 0.069 units while holding all other variables in the model constant.

Type of Network – If the company with no logistics network were to increase by one point, the multinomial log-odds of Unhealthy would be expected to increase by 0.764 while holding all other variables in the model constant.

3) According to table 4.18, From Exp (B).

Age – The odds or "relative risk" ratio was 0.934 which was lower than 1. This result indicates that the risk of the company in the Unhealthy group to Normal group increases as the age decreases. That means if the Age of company decreases, it is less likely that the firm will be in the Unhealthy group.

Type of Network – The odds or "relative risk" ratio was 2.147 which was higher than 1. This result indicates that the risk of the company in the Unhealthy group to Normal group increases as the company with no logistics Network increases. That means if the company with no logistics Network increases, it is more likely that the firm will be in the Unhealthy group.

For the Non Distressed group (Healthy) relative to Normal.

1)The Wald test statistics for the variables Size, No. of Shareholders and Nationality of Shareholders were 19.883, 15.779 and 15.854 respectively with an associated p-value of 0. The study set the alpha level to 0.05, that means we reject the null hypothesis and conclude that the regression coefficient for Size, No. of Shareholders and Nationality of Shareholders were found statistically different from zero for Non Distressed (Healthy) to Normal given that other variables were in the model. In other words, Size, No. of Shareholders and Nationality of Shareholders were significant variables in this group.

The other variables failed to reject the null hypothesis. It can be concluded that for the Unhealthy relative to Normal, the regression coefficient for the other variables

were not found to be statistically different from zero given that other variables were in the model. In other words, other variables were not a significant variable in this group.

2) For B,

Size – If the company were to increase in Size score by one point, the multinomial log-odds of Healthy to Normal would be expected to increase by 0.022 units while holding all other variables in the model constant.

No. of Shareholders – if the company were to increase the No. of Shareholders score by one unit, the multinomial log-odds of Healthy to normal would be expected to decrease by 0.256 units while holding all other variables in the model constant.

Nationality of Shareholders – If the company were to increase in Nationality of Shareholders as International Company, the multinomial log-odds of Healthy to Normal would be expected to increase by 1.08 while holding all other variables in the model constant.

3) From Exp (B).

Size - The odds or "relative risk" ratio was 1.022 which was higher than 1. This result indicates that the risk of the company in the Healthy group to Normal group increases as Size increases. That means if the company is of bigger size, the firm is more likely to be in the Healthy group.

No. of Shareholders - The odds or "relative risk" ratio was 0.774 which was less than 1. This result indicates that the risk of the company in the Healthy group to Normal group decreases as the No. of Shareholders increases. That means if the company has more Shareholders, the firm is less likely to be in the Healthy group.

Nationality of Shareholder - The odds or "relative risk" ratio was 2.945 which was higher than 1. This result indicates that the risk of the company in the Healthy group to Normal group increase as the company is International Company. That means if the company is an International company, the firm is more likely be in the Healthy group.

The results of Case 2 (Non-financial variables) from part 2 showing 3 significant variables affecting Unhealthy relative to Normal and 3 significant variables affecting Healthy relative to Normal are shown in figure 4.9.

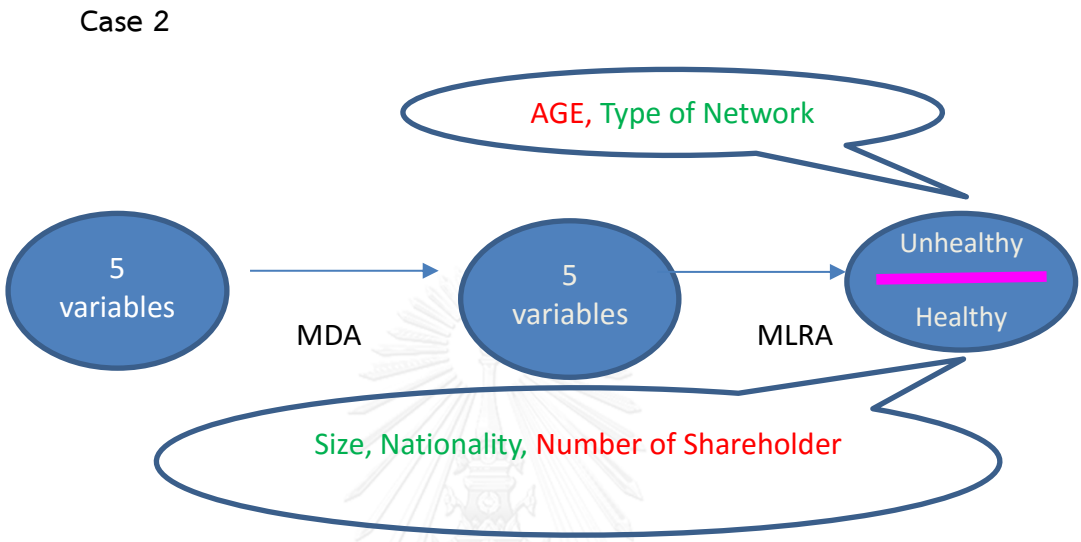

Figure 4.9 : Frame work with results – case 2 (Non-Financial variables)

4.2.2.3 Analysis of the marginal effect of significant variables.

The results of the marginal effect of x were calculated as shown below.

X = Size, the results of the marginal effect are as follows:

$(\partial P0)/\partial x = P0(1- P0) *0 - P0P2*0.022$ ----------(4.46)

$(\partial P2)/\partial x = P2(1- P2) *0.022 - P0P2*0$ ----------(4.47)

Equation 4.46 shows the probability of the firm falling in the Unhealthy group as affected by X.

Size was not a significant variable in the Unhealthy group.

Equation 4.47 shows the probability of the firm falling in the Healthy group as affected by X.

The average result from substituting x into equation 4.47 was 0.004. The interpretation is that the probability of the firm falling in the Healthy group increases 0.004 if Size increases 1 unit.

X = Age, the results of the marginal effect are as follows:

$(\partial P0)/\partial x = P0(1- P0) *-0.069 - P0P2*0$ ----------(4.48)

$(\partial P2)/\partial x = P2(1- P2) *0 - P0P2*-0.069$ ----------(4.49)

Equation 4.48 shows the probability of the firm falling in the Unhealthy group as affected by X.

The average result from substituting x into equation 4.46 was -0.012. The interpretation is that the probability of the firm falling in the Unhealthy group decreases 0.012 if Age increases 1 unit.

Equation 4.49 shows the probability of the firm falling in the Healthy group as affected by X.

Age was not a significant variable in the Healthy group.

X = Nationality of Shareholders, the results of the marginal effect are as follows:

$(\partial P0)/\partial x = P0(1- P0) *0 - P0P2*1.08$ ----------(4.50)

$(\partial P2)/\partial x = P2(1- P2) *1.08 - P0P2*0$ ----------(4.51)

Equation 4.50 shows the probability of the firm falling in the Unhealthy group as affected by X.

Nationality of shareholders was not a significant variable in the Unhealthy group.

Equation 4.51 shows the probability of the firm falling in the Healthy group as affected by X.

The average results from substitute x into the equation 4.49 was 0.188, the interpretation would be the probability of the firm to be in Healthy group increases 0.188 if Size increases 1 unit.

X = Type of Network, the results of the marginal effect are as follows:

$(\partial P0)/\partial x = P0(1- P0) *0.764 - P0P2*0$ ----------(4.52)

$(\partial P2)/\partial x = P2(1- P2) *0 - P0P2*0.764$ ----------(4.53)

Equation 4.52 shows the probability of the firm falling in the Unhealthy group as affected by X.

The average result from substituting x into the equation 4.50 was 0.138. The interpretation is that the probability of the firm falling in the Unhealthy group increases 0.138 if no logistics network.

Equation 4.53 shows the probability of the firm falling in the Healthy group as affected by X.

Type of network was not a significant variable in the Healthy group.

X = No. of Shareholders, the results of the marginal effect are as follows:

$(\partial P0)/\partial x = P0(1- P0) *0 - P0P2*-0.256$ ----------(4.54)

$(\partial P2)/\partial x = P2(1- P2) *-0.256 - P0P2*0$ ----------(4.55)

Equation 4.54 shows the probability of the firm falling in the Unhealthy group as affected by X.

No. of Shareholders was not a significant variable in the Unhealthy group.

Equation 4.55 shows the probability of the firm falling in the Healthy group as affected by X.

The average result from substituting x into equation 4.53 was -0.045. The interpretation is that the probability of the firm falling in the Healthy group decreases 0.045 if No. of Shareholders increases 1 unit.

CHAPTER 5
DISCUSSION AND CONCLUSION

This study aims to identify the factors that determine the long-term financial stability and financial health model for logistics companies in Thailand. The study adopted multiple discriminant analysis to screen the significant variables affecting financial health and then applied multinomial logistics regression analysis to identify the significant variables and model to keep Thai logistics companies strong and stable financial health. The results are given in Chapter 4 for each step in Case 1 and Case 2. This chapter comprises: 1) results form Case 1, 2) results from Case 2, 3) comparisons of results from Case 1 and Case 2, 4) marginal effect analysis of Case 1 and Case 2, 5) robustness and marginal effect, 6) radar chart of marginal effect for Unhealthiness and Healthiness, 7) comparison of the results from this study and previous studies, 8) research limitations and future studies, and 9) implications and conclusions.

5.1 Results from Case 1

The initial 23 variables consisted of 10 financial ratios, 4 growth rate, 4 variations of growth rate and 5 non-financial variables, while the final results of significant variables from part II were only 2 variables from the financial ratios and 3 variables from the non-financial ratios. Two groups out of four of the financial ratios, namely, the profitability and leverage ratios dominated the other financial variables. There were no significant variables from the growth rate group, variation of growth rate, liquidity and efficiency ratios. For the non-financial group, size, nationality of shareholder and number of shareholders were significant variables, but the rest of the non-financial variables were not significant (basis alpha level to 0.05) as reported in Table 26.

Table 5.1 : Summary of results – Case 1

Case/variables				Financial Ratios Variables									
				Liquidity			Profitability				Leverage		Efficency
				CACL	WCTA	CFD	NITA	EBITTA	RETA	NITL	TLTA	BVETL	STA
Case 1	All variables	MLRA	Unhealthy						-			+	
			Healthy						+			-	

Case/variables				Other Financial Variables							
				Growth Rate				Variation of growth rate			
				Sales Growth	Net Profit Growth	Total Asset Growth	Total Liability Growth	Variation of sales growth	Variation of net profit growth	variation of total asset growth	variation of total liability growth
Case 1	All variables	MLRA	Unhealthy								
			Healthy								

Case/variables				Non Financial Variables				
				Size	Age	Nationality of Shareholders	Type of Network	No. of shareholders
Case 1	All variables	MLRA	Unhealthy					
			Healthy	+		+		-

Green colour = possitive coefficient

Red colour = negative coefficient

The green color shows a positive beta, which means that if the variable increases, the probability of the company falling in that group increases; on the other hand, red shows a negative beta which means that if the variable increases, the chance of the company falling in that group decreases. It could be interpreted that when the significant variable is green, the company is more likely to be in that group compared to the reference group. Conversely, for red, the company is less likely to be in that group compared to the reference group.

For the Unhealthy group compared to Normal.

The results show RETA (retained earnings to total assets) had a negative beta (red) and this implied that if the retained earnings to total asset ratio increases, the chance of the company being Unhealthy decreases. The retained earnings is the accumulation of profit of the company over the time. This ratio measures how the asset reflects the company's cumulative profitability. A high ratio means the

company is able to manage its assets to achieve high profits over time. Therefore, the higher the RETA, the chance of becoming an Unhealthy company is less.

BVETL (book value equity to total liability) had a positive beta (green) implying that if the BVETL ratio increases, the chance of the company being Unhealthy increases. The book value equity is the amount of funds coming from shareholders' equity. Total liability is the amount of funds derived from outsiders, such as bank loan. This ratio measures how the company manages its source of funds. If the book value equity is higher than total liability (this ratio is high), the chance of the company being Unhealthy increases. Therefore, the company should consider management of the source of funds more from outside than from shareholders.

For the Healthy group compared to Normal.

RETA (retained earnings to total assets) has positive a beta (green) suggesting that if the RETA ratio increases, the chance of the company being Healthy increases. As previously mentioned, retained earnings is the accumulated profit of the company over the time. This ratio measures how the assets reflect the company's cumulative profitability. A high ratio means the company is able to manage the assets to achieve high profits over time. Therefore, the higher the RETA, the higher the chance of becoming a Healthy company.

BVETL (book value equity to total liability) has a negative beta (red) indicating that if the book value equity ratio increases, the chance of the company being Healthy decreases. This ratio measures how much the total assets can decline in value before total liabilities exceed book value of equity. If the total liability is higher than book value (this ratio is low), the chance of the company being Healthy increases. This means the logistics company should consider funding from debt more than using funds from shareholders.

Size has a positive beta (green). This implies that if the size increases, the chance of the company being Healthy increases. Size in this study is considered by registered capital. The high number means the company has more registered capital. Therefore,

the higher the registered capital, the higher the chance of becoming a Healthy company.

Nationality of shareholders has a positive beta (green) implying that if the nationality of the shareholders is not Thai, the chance of the company being Healthy increases. The nationality of shareholders might relate to know-how or the connections carried over from their country. An international company might utilize their technology and know-how more than a local company. Therefore, an international company has a higher chance of becoming a Healthy company.

The number of shareholders has a negative beta (red) implying that if the number of shareholders increases, the chance of the company being Healthy decreases. This means a logistics company should consider having fewer shareholders. The reasons for this could be that more shareholders might have different ideas and attitudes which might cause conflict among them. Also, the more the parties involved the more complicated it is in doing the business.

In conclusion, in Case 1 RETA (retained earnings to total asset) could have a negative impact for the Unhealthy group but a positive impact for the Healthy group. The size and nationality of the shareholders also had a positive effect for the Healthy group. On the other hand, BVETL (book value equity to total liability) showed a positive impact for the Unhealthy group but a negative impact for the Healthy group and the number of shareholders also had a negative impact for the Healthy group.

5.2 Results from Case 2

The results from running the financial variables and non-financial variables separately comprised 3 significant variables from financial variables and 5 significant variables from non-financial variables as shown in the table below.

Table 5.2 : Summary of results – Case 2

Case/variables				Financial Ratios Variables									
				Liquidity			Profitability				Leverage		Efficency
				CACL	WCTA	CFD	NITA	EBITTA	RETA	NITL	TLTA	BVETL	STA
Case 2	Financial Variables	MLRA	Unhealthy			-			-			+	
			Healthy			+						-	

Case/variables				Other Financial Variables							
				Growth Rate				Variation of growth rate			
				Sales Growth	Net Profit Growth	Total Asset Growth	Total Liability Growth	Variation of sales growth	Variation of net profit growth	variation of total asset growth	variation of total liability growth
Case 2	Non Financial Variables	MLRA	Unhealthy								
			Healthy								

Case/variables				Non Financial Variables				
				Size	Age	Nationality of Shareholders	Type of Network	No. of shareholders
Case 2	Non Financial Variables	MLRA	Unhealthy		-		+	
			Healthy	+		+		-

Green colour = possitive coefficient

Red colour = negative coefficient

For the Unhealthy group compared to Normal.

According to Table 5.2, CFD (cash flow to debt) had a negative beta (red) implying that if cash flow to debt ratio increases, the chance of the company being Unhealthy decreases. Cash flow ratio measures a firm's ability to pay short-term debt. A high ratio means the company has greater ability to pay short-term debt as it has better cash flow than liabilities. Therefore, the higher the CFD, the chance of becoming an Unhealthy company is less likely.

RETA (retained earnings to total assets) has a negative beta (red) implying that if the RETA ratio increases, the chance of the company being Unhealthy decreases. The retained earnings is the accumulated profit of the company over time. This ratio measures how the assets reflect the company's cumulative profitability. The high ratio means the company is able to manage its assets to achieve high profits over time. Therefore, the higher the RETA, the lower the chance of becoming an Unhealthy company.

BVETL (book value equity to total liability) had a positive beta (green). This suggests that if the BVETL ratio increases, the chance of the company being Unhealthy increases. The book value equity is the amount of funds coming from shareholders' equity. Total liability is the amount of funds derived from outsiders, such as bank loans. This ratio measures how the company manages its source of funds. If the book value equity is higher than total liability (this ratio is high), the chance of the company being Unhealthy increases. Therefore, the company should give greater consideration to managing the source of funds from outside than funds from shareholders.

Age has a negative beta (red), which implies that if the age of the firm increases, the chance of the company being Unhealthy decreases. An old firm might have more experience, and benefit from their reputation. Therefore, the older the company, the chance of becoming an Unhealthy company is less.

The type of network has a positive beta (green) implying that if a company without a logistics network increases, the chance of the company being Unhealthy increases. Logistics network is very important nowadays as diversification reduces the risk of bankruptcy. A company with a partner or network in the same sector might reduce the costs and risks of the business and the company without a logistics network. Therefore, a firm without a logistics network has a higher chance of becoming an Unhealthy company.

<u>For the Healthy group compared to Normal.</u>

CFD (cash flow to debt) has a positive beta (green). This suggests that if CFD ratio increases, the chance of the company being Healthy increases. Cash flow ratio measures a firm's ability to pay short-term debt. The high ratio means the company is more able to pay short-term debts as it has a better cash flow than liabilities. Therefore, the higher the CFD, the higher the chance of becoming a Healthy company.

BVETL (book value equity to total liability) has a negative beta (red) implying that if the book value equity ratio increases, the chance of the company being Healthy

decreases. This ratio measures how much the total asset can decline in value before total liabilities exceeds book value of equity. If the total liability is higher than book value (this ratio is low), the chance of the company being Healthy increases. This means the logistics company should consider funding from debt more than using funds from shareholders.

Size has a positive beta (green implies that if the size of the company increases, the chance of the company being Healthy increases. This could suggest that the logistics company should consider investing more funds to increase the size of the company. Since most logistics companies in Thailand are small and medium entrepreneurs, they should increase their registered capital to make the company have stronger financial health.

The nationality of the shareholders has a positive beta (green) implying that if the nationality is not Thai, the chance of the company being Healthy increases. The nationality of the shareholders might relate to know-how or the connections from their country. An international company might better utilize their technology and know-how than a local company. Therefore, for an international company, the chance of becoming a Healthy company is higher.

The number of shareholders has a negative beta (red). This implies that if the number of shareholders increases, the chance of the company being Healthy decreases. This suggests that a logistics company should consider having fewer shareholders. The reasons for this could be that more shareholders might have different ideas and attitudes which might cause conflict among shareholders. Also, the more parties involved, the more complicated it becomes to do business.

In conclusion, for Case 2, CFD (cash flow to debt) had a negative impact on the Unhealthy group but a positive impact on the Healthy group. RETA (retained earnings to total assets) and age had negative impacts on the Unhealthy group. A company without a logistics network had a positive impact on the Unhealthy group. BVETL (book value equity to total liability) had a positive impact on the Unhealthy group. The nationality of shareholders had a positive impact on the Healthy group, which

means international companies have a greater chance of being Healthy. In the same way the size of the company had a positive impact on the Healthy group. The greater the registered capital of the company, the healthier the firm. In contrast, the number of shareholders had a negative impact on the Healthy group. The more the shareholders the less healthy the company.

5.3 Comparison of results from Case 1 and Case 2

The results from Case 1 differ from Case 2 in terms of the number of significant variables with some variables differing.

From Case 1, there were five significant variables: RETA, BVETL, Size, Nationality of Shareholders and No. of Shareholders.

The variables affecting Unhealthiness were RETA and BVETL.

The variables affecting Healthiness were RETA, BVETL, Size, Nationality of Shareholders and No. of Shareholders.

While for Case 2, there were eight significant variables: CFD, RETA, BVETL, Size, Age, Nationality of Shareholders, Type of Network and No. of Shareholders.

The variables affecting Unhealthiness were CFD, RETA and BVETL.

The variables affecting Healthiness were CFD, BVETL, Age, Size, Nationality of Shareholders, Type of Network and No. of Shareholders.

Robust is a characteristic describing a model that performs effectively while its variables or assumptions are altered. Being robust means the results are still the same despite having its assumptions altered or violated. Robustness can relate to economic and statistical concepts. If the significant variable from the model is still significant even though some assumptions are altered, it can be said to be robust. From this study, Case 1 and Case 2 differ in terms of the variables used. In Case 1, all variables were used at the same time. For Case 2, the variables were split into 2 groups and statistics tools used separately in each group. The study considers robustness when making comparisons between Case 1 and Case 2.

5.3 Comparison between Case 1 and Case 2

The comparison between Case 1 and Case 2 reveals the following:

- RETA affects the Unhealthy group compared to the Normal group in both cases. This could mean that RETA is a robust variable. In both cases a red beta for the Unhealthy group means the RETA is also robust in terms of the direction of the coefficient. For a company with a high RETA ratio, the probability of being Unhealthy is less.

- BVETL affects both Unhealthy and Healthy groups compared to the Normal group in both cases. This could be interpreted as meaning that BVETL is a robust variable. In both cases, green beta was shown in the Unhealthy group and red beta in the Healthy group, which indicates BVETL is also robust in terms of the direction of the coefficient. A company with a high BVETL has a higher probability of being Unhealthy with a lower probability of being Healthy.

- Size affects the Healthy group compared to the Normal group in both cases. This could suggest that the bigger the firm in terms of registered funds, the stronger the financial health of the company.

- Nationality of Shareholders affects the Healthy group compared to the Normal group in both cases. This could mean that Nationality of Shareholders is a robust variable. In both cases it showed green beta, which means Nationality of Shareholders is also robust in terms of the direction of the coefficient. If the company is an international company, the probability of being Healthy is greater.

- No. of Shareholders affects the Healthy group compared to the Normal group in both cases. This could mean that No. of Shareholders is a robust variable. In both cases, it showed red beta, which means No. of Shareholders is also robust in terms of the direction of the coefficient. If the company has more shareholders, the probability of it being Healthy is less.

The robust variables with major impact on the financial health of logistics companies in Thailand consist of RETA, BVETL, Size, Nationality of Shareholders and No. of Shareholders.

The other significant variables that are not robust which could have a minor impact on the financial health of logistics companies are CFD, Age and Type of Network.

5.4 Marginal effect analysis from Case 1 and Case 2

Comparison of the results between Case I and Case II in terms of the coefficient or direction of affecting factors was mentioned in the previous section. This section discusses the marginal effect of significant factors in both cases. The green color indicates a significantly favorable factor for the firm and red color a significantly unfavorable factor for the firm. Both green and red in 5.1-5.3 reveal the magnitude of beta and the direction of the coefficients affecting the group, but this section is green and red showing favorable and unfavorable factors upon the firm. Favorable means the factor enhances the better health of the firm.

Table 5.3 : Summary of marginal effect - Case 1

Case I	RETA		BVETL		Size	
	Unhealthy	Healthy	Unhealthy	Healthy	Unhealthy	Healthy
	$\frac{\partial P_0}{dx} = P_0(1-P_0)\beta_0 - P_0P_2\beta_2$	$\frac{\partial P_2}{dx} = P_2(1-P_2)\beta_2 - P_2P_0\beta_0$	$\frac{\partial P_0}{dx} = P_0(1-P_0)\beta_0 - P_0P_2\beta_2$	$\frac{\partial P_2}{dx} = P_2(1-P_2)\beta_2 - P_2P_0\beta_0$	$\frac{\partial P_0}{dx} = P_0(1-P_0)\beta_0 - P_0P_2\beta_2$	$\frac{\partial P_2}{dx} = P_2(1-P_2)\beta_2 - P_2P_0\beta_0$
All	**-0.812**	**0.215**	**0.057**	**-0.067**	-0.0002	**0.0012**
Unhealthy	-0.621	0.070	0.042	-0.016	-0.0001	0.0003
Normal	-0.929	0.221	0.064	-0.069	-0.0002	0.0012
Healthy	-0.685	0.347	0.054	-0.112	-0.0003	0.0020
	Nationality of shareholders		No. of shareholders			
All	-0.006	**0.032**	0.002	**-0.010**		
Unhealthy	-0.003	0.007	0.001	-0.002		
Normal	-0.006	0.033	0.002	-0.010		
Healthy	-0.008	0.054	0.002	-0.017		
(green)	significant favorable to firm					
(red)	significant unfavorable to firm					

According to the results in Chapter 4, marginal effect is used to analyze the probability of the firm being affected by variable X in each group.

- RETA has a negative effect on the probability of Unhealthiness. The average probability of a firm becoming Unhealthy decreases 81.20% if the RETA ratio increases 0.01. To be Healthy, the marginal effects were consistently positive. The average probability of Healthiness increases 21.50% if the RETA ratio increases 0.01 (the number of 0.01 refers to that from the real data). The retained earnings to total assets ratio is a favorable factor for firms.

- Concerning BVETL, the marginal effects on the probability of Unhealthiness are significantly positive, while those for the probability of Healthiness are significantly negative. The average probability of Unhealthiness increases 5.70 percent if the BVETL ratio increases 1 (the number of 1 refers to that from the real data). The average probability of Healthiness decreases 6.7% if the BVETL ratio increases 1. The book value equity to total liability ratio is an unfavorable factor for the firm.

- Regarding Size, the marginal effects on probability of Unhealthiness are insignificantly negative while those on the probability of Healthiness are significantly positive. The average probability of Healthiness increases 0.12% if Size increases 1 million baht. Since measurement of size is the amount of registered capital (million baht), the average probability of Healthiness increases 0.12% if registered capital increases 1 million baht (the number of 1 million baht refers to that from real data). Size is a favorable factor behind the Healthiness of the firm.

- As regards Nationality of Shareholders, the marginal effects on the probability of Unhealthiness are not significantly negative while those on the probability of Healthiness are significantly positive. The average probability of Healthiness increases 3.20% if the firm is an international company. Nationality of Shareholders is a favorable factor for the Healthiness of a firm.

- Concerning No. of Shareholders, the marginal effects on the probability of Unhealthiness are not significantly positive while those on the probability of Healthiness are significantly negative. The average probability of Healthiness decreases 1% if the company increases by 1 shareholder. No. of Shareholders is an unfavorable factor for the Healthiness of a firm.

Table 5.4 : Summary of Marginal Effects - Case 2

Case 2	CFD		RETA		BVETL	
	Unhealthy	Healthy	Unhealthy	Healthy	Unhealthy	Healthy
	$\frac{\partial P_0}{\partial x} = P_0(1-P_0)\beta_0 - P_0P_2\beta_2$	$\frac{\partial P_2}{\partial x} = P_2(1-P_2)\beta_2 - P_2P_0\beta_0$	$\frac{\partial P_0}{\partial x} = P_0(1-P_0)\beta_0 - P_0P_2\beta_2$	$\frac{\partial P_2}{\partial x} = P_2(1-P_2)\beta_2 - P_2P_0\beta_0$	$\frac{\partial P_0}{\partial x} = P_0(1-P_0)\beta_0 - P_0P_2\beta_2$	$\frac{\partial P_2}{\partial x} = P_2(1-P_2)\beta_2 - P_2P_0\beta_0$
All	-0.380	0.479	-0.377	0.045	0.025	-0.047
Unhealthy	-0.645	0.132	-0.647	0.061	0.042	-0.011
Normal	-0.372	0.522	-0.366	0.047	0.024	-0.051
Healthy	-0.139	0.710	-0.135	0.022	0.009	-0.072
	Size		Age		Nationality of shareholders	
All	-0.0014	0.00383	-0.0125	0.004	-0.068	0.188
Unhealthy	-0.0016	0.00401	-0.0132	0.005	-0.078	0.197
Normal	-0.0013	0.00371	-0.0129	0.004	-0.065	0.182
Healthy	-0.0014	0.00398	-0.0108	0.004	-0.068	0.195
	Type of Net work		No. of shareholders			
All	0.138	-0.048	0.016	-0.045		
Unhealthy	0.146	-0.055	0.018	-0.047		
Normal	0.142	-0.046	0.015	-0.043		
Healthy	0.119	-0.048	0.016	-0.046		
(green)	significant favorable to firm					
(red)	significant unfavorable to firm					

Table 5.4 shows the summary of marginal effects on Case 2 from the results in Chapter 4.

- CFD has a consistently negative effect on the probability of Unhealthiness. The average probability for a firm to be Unhealthy decreases 38% if the RETA ratio increases 0.1 (the number of 0.1 refers to that from real data). For Healthiness, the marginal effects were consistently positive. The average probability of Healthiness increases 47.90% if the RETA ratio increases 0.1. The CFD ratio is a favorable factor for the firm.

- RETA has a negative effect on the probability of Unhealthiness. The average probability of a firm being Unhealthy decreases 37.70% if the RETA ratio increases 0.01. The marginal effects on the probability of Healthiness were not significantly positive. The retained earnings to total assets ratio is a favorable factor for the Unhealthiness of a firm.

- As concerns BVETL, the marginal effects on the probability of Unhealthiness are significantly positive while those on the probability of Healthiness are significantly

negative. The average probability of Unhealthiness increases 2.50% if the BVETL ratio increases 1. The average probability of Healthiness decreases 4.7% if the BVETL ratio increases 1. The BVETL ratio is an unfavorable factor for a firm.

- As for Size, the marginal effects on the probability of Unhealthiness are insignificantly negative while those on the probability of Healthiness are significantly positive. The average probability of Healthiness increases 0.38% if the registered capital increases 1 million baht. Size is a favorable factor for the Healthiness of the firm.

- Regarding Age, the marginal effects on the probability of Healthiness are not significantly negative while those on the probability of Unhealthiness are significantly positive. The average probability of Unhealthiness decreases 1.25% if Age increases 1 year. Age is an unfavorable factor in the Unhealthiness of the firm, which is to say that Age is a favorable factor in the Healthiness of the firm.

- Concerning Nationality of Shareholders, the marginal effects on the probability of Unhealthiness are insignificantly negative while those on the probability of Healthiness are significantly positive. The average probability of Healthiness increases 18.80% if the firm is an international company. Nationality of Shareholders is a favorable factor in the Healthiness of the firm.

- For the Type of Network, the marginal effects on probability of healthiness are not significantly negative while those on the probability of Unhealthiness are significantly positive. The average probability of Unhealthiness increases 13.80% if the firm has no logistic network. This supports the assertion that a firm with no logistic network is a favorable factor for Unhealthiness. In other words, a firm with a logistic network is a favorable factor in the Healthiness of the firm.

- As regards No. of Shareholders, the marginal effects on the probability of Unhealthiness are not significantly positive while those on the probability of Healthiness are significantly negative. The average probability of Healthiness decreases 4.50% if the company increases by 1 shareholder. No. of Shareholders is an unfavorable factor in the Healthiness of the firm.

Table 5.5 : Summary of Marginal Effects - Case 1 and Case 2

	CFD		RETA		BVETL		Size		Age		ionality of shareholc		Type of Net work		No. of shareholders	
	Unhealthy	Healthy	Unhealthy	Healthy	Unhealthy	Healthy	Unhealthy	Healthy	Unhealthy	Healthy	Unhealthy	Healthy	Unhealthy	Healthy	Unhealthy	Healthy
Case I																
All			**-0.812**	**0.215**	**0.057**	**-0.067**	-0.0002	**0.0012**			-0.006	**0.032**			0.002	**-0.010**
Unhealthy			-0.621	0.070	0.042	-0.016	-0.0001	0.0003			-0.003	0.007			0.001	-0.002
Normal			-0.929	0.221	0.064	-0.069	-0.0002	0.0012			-0.006	0.033			0.002	-0.010
Healthy			-0.685	0.347	0.054	-0.112	-0.0003	0.0020			-0.008	0.054			0.002	-0.017
Case II																
All	**-0.380**	**0.479**	**-0.377**	0.045	0.025	**-0.047**	-0.0014	**0.00383**	**-0.0125**	0.004	-0.068	**0.188**	**0.138**	-0.048	0.016	**-0.045**
Unhealthy	-0.645	0.132	-0.647	0.061	0.042	-0.011	-0.0016	0.00401	-0.0132	0.005	-0.078	0.197	0.146	-0.055	0.018	-0.047
Normal	-0.372	0.522	-0.366	0.047	0.024	-0.051	-0.0013	0.00371	-0.0129	0.004	-0.065	0.182	0.142	-0.046	0.015	-0.043
Healthy	-0.139	0.710	-0.135	0.022	0.009	-0.072	-0.0014	0.00398	-0.0108	0.004	-0.068	0.195	0.119	-0.048	0.016	-0.046
	significant favorable to firm															
	significant unfavorable to firm															

From Table 5.5 and section 5.3, there are five robust variables (major impact variables) that demonstrated the Unhealthiness and Healthiness of a firm: RETA, BVETL, Size, Nationality of Shareholders and No. of Shareholders. RETA, Size and Nationality of Shareholders are significantly favorable factors for the firm. The higher the RETA, the less probability of Unhealthiness and the greater the probability of the Healthiness of the firm. The larger the firm, the greater the probability of the Healthiness of firm while there is no significance for Unhealthiness. Being an international company increases the probability of the healthiness of firm. BVETL and No. of Shareholders are significantly unfavorable for the firm in terms of Healthiness. The higher the BVETL, the greater the probability of Unhealthiness and the lower the probability of Healthiness of the firm. The higher the No. of Shareholders, the lower the probability of the Healthiness of the firm while there is no significance for Unhealthiness.

The non-robust variables shown to be significant favorable factors for the firm are: CFD, Age and Type of Network. The higher the CFD, the less probability of Unhealthiness and the more probable the Healthiness of the firm. The older the firm, the less probable the Unhealthiness of the firm while there was no significance for Healthiness. A firm with a logistics network proves favorable to the firm. For a company without a logistics network, the more likely the Unhealthiness of the firm while there was no significance for Healthiness.

5.5 Robustness and marginal effect

Once again, a favorable factor is a factor or variable with a high ratio or high measurement driving the firm to better financial health. In order to make it easy to understand the results of this study, a summary of robustness and marginal effect for favorable factors for a firm are shown in Table 5.6.

Table 5.6 : Favorable factors with robustness and marginal effect

Robustness	Favorable Factors	Marginal Effect
No	CFD	Negative to Unhealthiness Positive to Healthiness
Yes	RETA	Negative to Unhealthiness (robust) Positive to Healthiness(non robust as only in case1)
No	Age	Negative to Unhealthiness
Yes	Size	Positive to Healthiness
Yes	Nationality of Shareholders	Positive to Healthiness
No	Type of Network	Negative to Unhealthiness

According to Table 5.6, the three favorable factors that have the major impacts as identified by Robustness consist of RETA, Size and Nationality of Shareholders.

RETA is the ratio of retained earnings to total assets. A firm with more accumulated profit to spend on assets will increase the financial health of the firm.

Concerning Size, if the firm has more registered capital, the better the chance of increase financial health.

An international company has higher probability of increasing financial health.

Furthermore, three favorable factors for the firm that do not have major impacts compromise CFD, Age and Type of Network.

CFD ratio refers to the cash flow of the company and its ability to cover debt. A higher cash flow reflects a better financial health.

As for Age, the older the company the higher financial health.

Concerning Logistic Network, if the firm has a logistic network to support their business, the better the financial health of the company.

Unfavorable factors for the firm are those factors or variables with high ratios or high measurements that will worsen financial health. There are two major impacts on financial health: BVETL and No. of Shareholders.

As concerns BVETL, raising funds more from outside debts (total liability) than funding from shareholders will increase the financial health of the firm.

Regarding No. of Shareholders, a lower number of shareholders has a positive impact on the financial health of the company.

A summary of the robustness and marginal effects for unfavorable factors on the firm are shown in Table 5.7.

Table 5.7 : Robustness and marginal effect on unfavorable factors

Robustness	Unfavorable Factors	Marginal Effect
Yes	BVETL	Positive to Unhealthiness Negative to Healthiness
Yes	No. of Shareholders	Negative to Healthiness

5.6 Radar chart of marginal effect for Unhealthiness and Healthiness

To show the marginal effects of the significant variables from Case 1 and Case 2, a radar graph consisting of 5 axes representing the different measurements of RETA ratio, BVETL ratio, Size, Nationality of Shareholders and No. of Shareholders for the Unhealthiness and Healthiness groups is presented. Figure 5.1 shows the radar chart for Case 1. The outstanding axis was RETA, which demonstrated a large gap between the marginal effect on RETA ratio axis (-81.22 percent) on the Unhealthiness group, while showing positive result (21.54 percent) on the Healthiness group. The BVETL ratio axis revealed there to be a small gap between Unhealthiness and Healthiness of a minus marginal effect 5.746% and -6.668% respectively. The rest of the significant variables were: Size, Nationality of Shareholders and No. of Shareholders. The marginal effect did not differ much on the financial health of the firm.

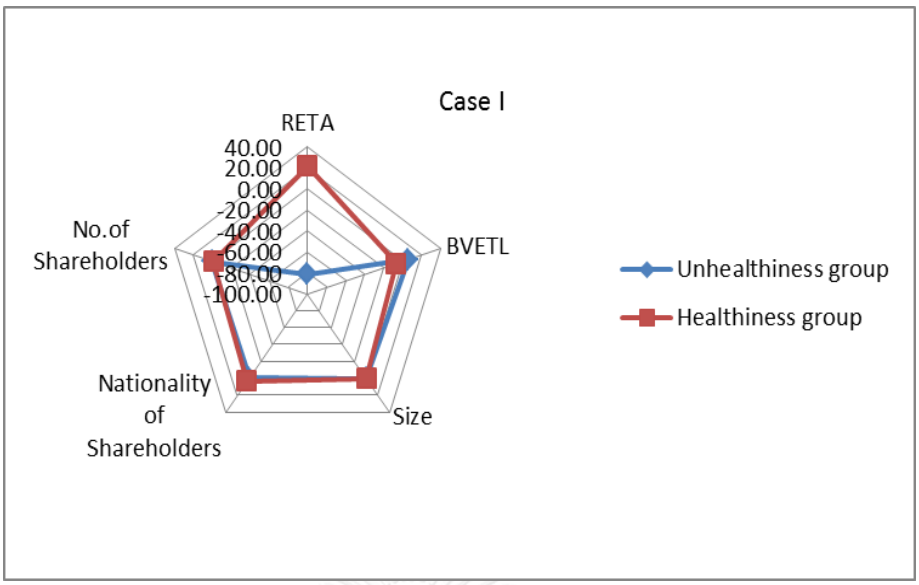

Figure 5.1 : Radar chart for Case 1

As can be seen from Figure 5.2, the CFD ratio and RETA ratio axes showed large differences between the Unhealthiness and Healthiness group. The CFD ratio axis had the largest difference. The cash flow to debt of Unhealthiness showed a minus marginal effect on the Unhealthiness group (-38%), and positive results on the Healthiness group (47.90%). The second largest gap was that of RETA ratio (minus marginal effect on RETA ratio axis of -37.70%, on the Unhealthiness group, while positive result of -4.7 percent on the Healthiness group even though there was no statistical significance on the Healthiness group). The Nationality of Shareholders and Type of Network axes also revealed some gaps that can be interpreted as being international companies that impact the Healthiness group more than that of the Unhealthiness group (18.80% versus -6.80% respectively). Having a logistics network axis effects Unhealthiness more than Healthiness (13.80% versus -4.80% respectively). The marginal effects on BVETL ratio, Size, Age and No. of Shareholders axes were not been much different between the Unhealthiness and Healthiness groups.

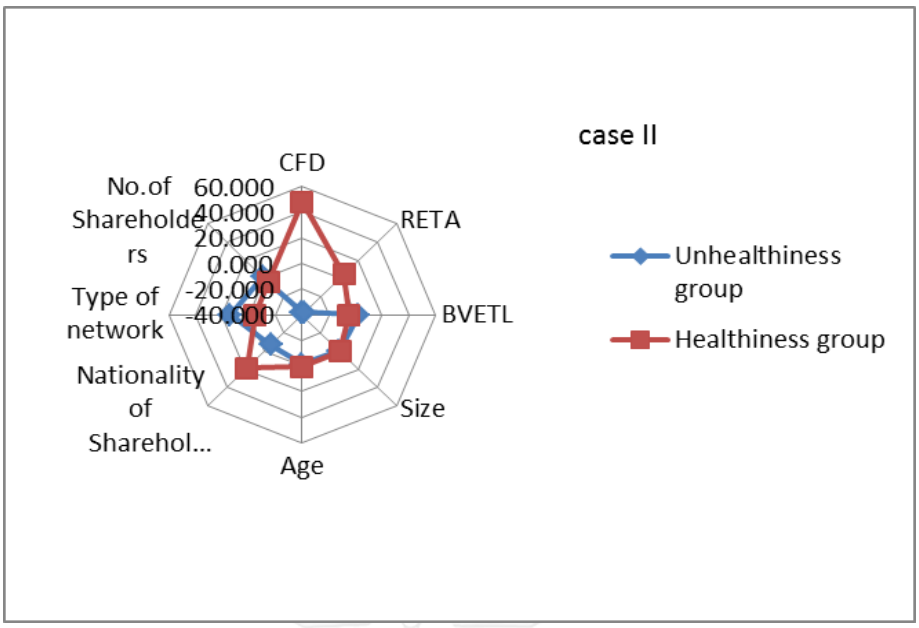

Figure 5.2 : Radar chart for Case 2

5.7 Comparison results for this study and previous studies

The results from the two cases in this study were the major and minor impacts on the financial health of logistics companies. The table below shows the comparison of results from this study and previous studies.

Table 5.8 : Comparison of results from this study and previous studies.

	Factors	Same	Different	Previous studies
Major factors	RETA (Retained earnings to total asset)	√		Altman (1968, 1977), Gibson & Frishkoff (1986).
	BVETL (Book Value equity to total liabilities)	√		Altman (1995).

	Factors	Same	Different	Previous studies
	Size	√		Ohlson (1980), Betts and Belhoul (1987), Keasey and Watson (1987), Altman et al (1997), Altman, Halderman and Narayanan (1997), Shumway (2001), Turetsky and Mc Ewen (2001), Reynolds et al (2002), Sauvage (2003), Laitinen (2005), Beaver et al. (2005), Laitinen (2005), Mine (2006) and Han Donker et al (2009).
	Nationality of Shareholders		√	Steen & Pedersen and Torben (1996), Nieves Lidia Díaz-Díaz1 el at (2008)
	No. of Shareholders			So far no evident on this factor
Minor factor	CFD (Cash flow to total debt)	√		Beaver (1968), Laitinen & Erkki (2005) and Shuk-Wern Ong (2011).
	Age	√		Altman (2000), Laitinen (1992), Keasey & Watson (1987), Shumway (2001), Argenti (1976), Laitinen (1992, 2005) and Arindam Bandyopadhyay (2006)

	Factors	Same	Different	Previous studies
			√	Baum (1989), Barron et al. (1994), Moore (1997), Liargovas and Skandalis (2008).
	Type of Network	√		Rose (1992), Beaver et al.(2005)

According to the above table, the major impact factors are as follows:

- RETA (retained earnings to total assets)

For a company with a high RETA ratio, the probability of being Unhealthy is less. This result is entirely consistent with the results for financial health in the previous studies of Altman (1968, 1977) and Gibson & Frishkoff (1986).

- BVETL (book value equity to total liabilities)

For a company with a high BVETL, the probability of being Healthy is greater. These results are also consistent with the results for financial health from the Altman Z-score (1995).

-Size

For a larger size company, the probability of being Healthy is greater, These results are consistent with the results from Ohlson (1980), Betts and Belhoul (1987), Keasey and Watson (1987), Altman et al (1997), Altman, Halderman and Narayanan (1997), Shumway (2001), Turetsky and Mc Ewen(2001), Reynolds et al (2002), Sauvage (2003), Laitinen (2005), Beaver et al. (2005), Laitinen (2005), Mine U ggurlu (2006) and Han Donker et al (2009).

-Nationality of Shareholders

For an international company, the chance of becoming a Healthy company is higher. An international firm might have advantages in innovation or know-how from other

countries. However, the results of this study are contrary to those from Nieves Lidia Díaz-Díaz1 et al (2008) who found there to be no significance between international companies and local firms as regards innovation. This also differs from Thomsen, Steen/Pedersen, Torben (1996) in that there was no indication that ownership affects company performance in terms of growth and profitability. It is possible that previous studies were conducted in developed countries (in Europe) where the technology and know-how do not differ much among themselves; however, Thailand is a developing country in which technology and know-how are needed from overseas.

- No. of Shareholders

If the company has more shareholders, the probability of being Healthy is less. To the best of the researcher's knowledge, there have been no research studies conducted to discover the effect of shareholders upon the financial health of the firm. This study could be the first on the number. of shareholders as relates to financial health.

The minor impacts on the financial health of logistics companies are as follows:

- CFD (cash flow to total debt)

For a company with a high CFD, the chance of becoming a Healthy company is greater. This result is consistent with the results for financial health in the previous studies of Beaver (1968), Laitinen & Erkki (2005) and Shuk-Wern Ong (2011).

- Age

The older the company, the chance of becoming an Unhealthy company is less. This is the same as Altman (2000) – a young firm probably has no time to build up its cumulative profits. Also, a young firm lacks capital and cash flow generation (Laitinen, 1992). There is also other literature that presents the same results such as Keasey & Watson (1987), Shumway (2001), Argenti (1976), Laitinen (1992), Laitinen (2005) and Arindam Bandyopadhyay (2006). The failure of the firm is higher in a young firm – 40-50% of the companies fail in the first 5 years of the business (Dun and Bradstreet, annual statistics).

Meanwhile, on the other side of the coin, some literature presents the opposite idea. The older the firm, the higher the chance of failure (Baum, 1989; Barron et al., 1994; Ranger-Moore, 1997). An older firm might be inert and follows a routine which result in less profitability (Liargovas and Skandalis (2008).

- Type of Network

Since network impacts the probability of an Unhealthy logistics firm in Thailand, the researcher collected more information on their networks by considering the sample company as the focal company and finding the number of networks for both suppliers and customer's tiers. The network is considered by looking at the relationships of the company with the directors of a sample company being the directors of other companies. If the director of company A is also the director of company B, where company B is a logistics company, this study considers both companies to have a relationship to each other. The study counted the number of companies with such relationships and plotted the results in a graph. The relationship of the number of logistics network companies and the probability of being Unhealthy is shown in Figure 26.

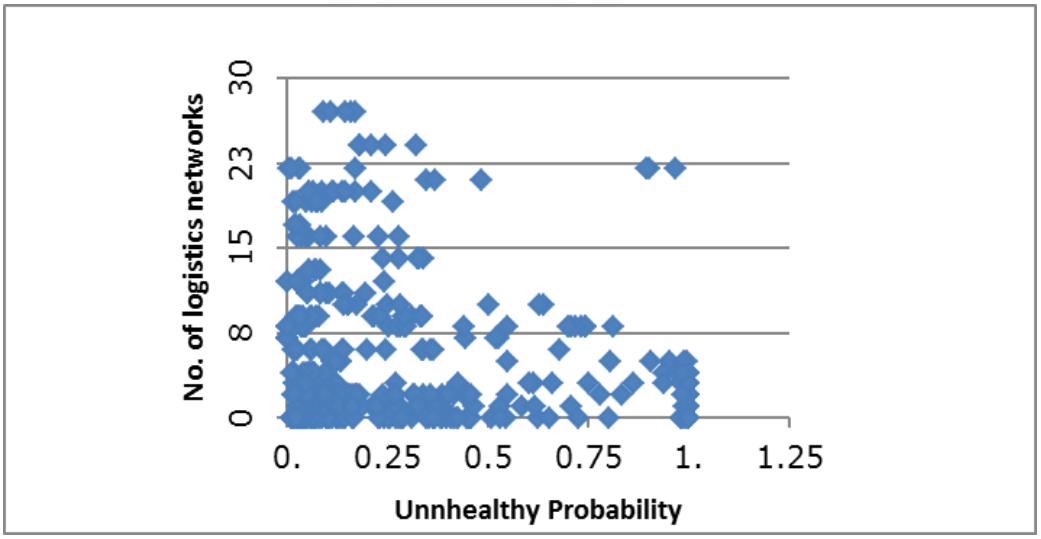

Figure 5.3 : Scatter graph between No. of companies with Logistics Network and Unhealthy probability

Many previous studies have shown the network and diversification to reduce bankruptcy (Rose, 1992) and diversification relating to the smaller probability of bankruptcy (Beaver et al., 2005). However, from the literature review, no study can be found that focuses on the logistics network of the firm. This study might be the first study on the type of network as relates to financial health.

According to Drucker, P. F. (1998) Christopher, M. G.(1998) and Bowersox, D. J (1997), in the new era of emerging competition the success of a single business depends on the management‘s ability to integrate the company’s network of business relationships. Supply chain management refers to the management of multiple relationships across the supply chain, which is not a one to one or business to business relationship, but a network of multiple businesses and relationships (Lambert M.D. and Cooper M.C., 2000). According to the above scatter graph for Unhealthiness, the highest number of logistics networks in the sample was 27 companies. The trend of the number of networks explains the higher probability of Unhealthiness and the lower number of logistics networks. However, in order to see the clearer trends, 3 outliers were omitted in the graph.

5.8 Research limitations and future studies

Although the research achieved its aim, there are some unavoidable limitations as shown below:

- The sample covered all the lists of companies registered as logistics companies in the Department of International Trade Promotion under the Ministry of Commerce. However, the sample covered almost every group of logistics companies except for the postal business while one of the networks of the sample companies was a postal company. The results for this group might not represent the whole industry.
- The results from this study show the significant variables in general. There might be an expansion of further studies on the significant variables affecting the financial health of logistics companies, such as the following:

Network: This study only considered the logistics network. It might be worth finding out more about the different types of relationships of network which might affect the financial health of a logistics company.

No. of Shareholders: This could be related to its stakeholders and the corporate governance mechanism of the firm. Further study on the structure of shareholders or management structure might be worth considering.

5.9 Implications and conclusions

The implications from this study are discussed in terms of their academic contributions and business implications.

Academic contributions

The most important academic contribution from this paper is the mixed model consisting of MDA and MLRA with the advantage of each model being fully utilized such as MDA being good for short-term prediction and MLRA outstanding for long-term prediction. Also, there have been 2 cases consisting of the real world situation in which every factor affects the firm at the same time (Case 1) and reference to previous studies to separate financial variables and non-financial variables (Case 2). The results are slightly different as mentioned in Chapter 5.

Another academic contribution of this study is the new idea of the three data categories (Unhealthy, Normal and Healthy groups). This is because some factors only impact Unhealthiness, Healthiness or both. The results showed that the factors that impact Unhealthiness are in only Case 2, consisting of Age, RETA and Type of Network. While Size, Nationality of Shareholders and Number of Shareholders impact Healthiness, CFD, RETA (only Case 1) and BVETL impact both Unhealthiness and Healthiness. This study is an empirical study of the financial health of logistics companies in Thailand where financial ratios, other financial factors and non-financial factors are included in this study.

Business implications

The results from this study could predict the financial health status of a firm in which management needs to detect firm unhealthiness before it occurs, and a new strategy could be created in relation to the results from this study.

Conclusions

The study found that the major factors that determine the long-term financial stability for logistics companies in Thailand are Retained Earnings to Total Assets (RETA), Book Value Equity to Total Liability (BVETL), Size, Nationality of Shareholders, and No. of Shareholders. The minor factors impacting financial health are Cash Flow to Debt (CFD), Age, and Type of Network. From Case 1, applying all 23 variables (Financial Variables and Nonfinancial Variables) at the same time, the following characteristics will increase the company's chance of being a healthy company: higher retained earnings than total assets, using funds from liability instead of funds from shareholders' equity, high registered capital, and being an international company that could also involve a joint venture with a foreign company and have less shareholders. A retained earnings to total assets has the strongest impact on the long-term stability of financial health. From Case 2, applying the Financial Variables separately from the Non-Financial Variables, in addition to the same results from Case 1, the cash flow being higher than debt will increase the chance of the company being a Healthy company. By far, in Case 2, the Cash Flow to Debt ratio has the strongest impact on the long-term stability of financial health. On the other hand, a young company and company without a logistics network have a higher chance of being an unhealthy company. RETA and CFD are positive drivers for improving both "from Distressed (Unhealthy) to Normal" and "from Normal to Non-distressed (Healthy)" but they seem to be more effective for "from Unhealthy to Normal". Therefore, the company should keep this ratio high. Size is a positive driver as bigger size raises the company from Normal to Non-distressed (Healthy) while a younger company will drive company for "from Normal to Distressed (Unhealthy)". BVETL is a negative driver for both "from Distressed (Unhealthy) to Normal" and "from Normal to Non-distressed (Healthy)". This implies that "debt financing" is not bad for financial health. Number of shareholders is also a negative driver for "from

Normal to Non-distressed (Healthy)" while foreign participation is a positive driver for "from Normal to Non-distressed (Healthy)". Logistics network is also a positive driver "from Unhealthy to Normal". A company should have a logistics network to enable a company to improve its financial situation. With reference to the results, management of the firm may consider the above factors when improving the financial health of the firm. However, not only is it up to the firm itself to drive financial health but also supporting policies are needed from the government such as providing financial loans with low interest rates to SMEs from logistics companies when using debt from outside, having appropriate benefits for foreign investment in logistics companies in Thailand and having a program for a logistics network for SMEs both in Thailand and globally. The findings and sample policies could focus the government's close attention upon supporting the potential factors affecting the financial health of the logistics business which might reinforce the competitive advantage of the logistics sector in Thailand.

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APPENDIX

VITA

After graduating from Tram Udom Suksa School in 1987, Miss Jaruwan Songsang attended Chulalongkorn University where she received her bachelor degree of Business administration major Merchant Marine in 1991. She began her career in Unithai Line Publics Company limited and IMC Shipping Pte Ltd in Singapore and received a certificate of The basic principle of Ship brokering and chartering from Singapore National Shipping Association in 1993. After that, she went back to Thailand and earned her Master' degree in Business administration from Chulalongkorn University in 1997. She had years' experience in logistics fields including a chartering executive in Precious Shipping (Public) Co. Ltd, a supply chain planner supervisor in Sara lee (Thailand) Limited, a chartering&broker/operation assistant manager in Nordana Project & Chartering (Thailand) Limited, a marketing and operation manager in Intergroup Agencies (Thailand) Co. Ltd, a chartering manager in Asian Independent Shipbrokers (Thailand) Co. Ltd and a marketing manager in JSS (Thailand) co. Ltd. She also had experience in Academics as a guest speaker at Chulalongkorn University and Schenker (Thai) –Oil&Gas department work shop, and a special lecturer at Pranakorn Rachapat University. With a variety of experiences, she stretched her work as a freelance logistics consultant giving advice in Feasibility study, Market Plan, Business Plan for Integrated Distribution Center Project, Researched for Logistics in Southern of Thailand, Strategy for Laem Chabang Port (Identify co. Ltd for Thai National Shippers' Council). She is a Ph.D. candidate (Logistics Management) at Chulalongkorn University.