Bankruptcy Prediction Model Using Multiple Discriminant Analysis: Case of Real Estate Companies in Thailand*

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Abstract

A negative view on the residential property industry in Thailand due to the global trade war and the appreciation of the baht affected rising non-performing loans (NPLs). Also business implications that has a huge impact on this business. The economic slowdown in Thailand mostly affected residential real estate, indicating a negative 10 percent growth rate. Therefore, this study attempts to construct the bankruptcy prediction model of real estate companies in Thailand and to investigate the correlation between financial and corporate governance towards bankruptcy. The names of bankrupt companies that filed at the bankruptcy court were derived from the Department of Business Development (DBD) business data warehouse. The sample included 102 companies registered with the Department of Business Development. 25 companies went bankrupt, and 77 companies were non-bankrupt. Financial ratios included Return on Assets (ROA), Return on Equity (ROE), Gross Profit Margin (GPM), Current Ratio (CR), Total Assets Turnover (AT), Operation Expense to Total Revenue Ratio (OPE), Debt to Asset Ratio (DA), and Debt to Equity Ratio (DE). Corporate governance factors included Size, Percentage of Thai's shareholder (TSH), Holding Share of Major Shareholder (MSH), Number of Shareholders (NSH), Number of directors (ODT). The study period covered 2016-2019. Multiple discriminant analysis was used to construct model and to examine the correlation.

The results showed that the bankruptcy prediction model was specified as D= -0.382 + 0.235(ROE) + 0.466(DA) + 0.707(TSH) – 0.693(MSH) + 0.348(ODT). Return on Equity, Debt to Asset, Percentage of Thai's shareholder, Number of Director were statistically significantly positively correlated to bankruptcy while Holding Share of Major Shareholder was statistically significantly negatively correlated to bankruptcy. Since the accuracy rate is 82.7%, the practical application is suggested.

Keywords: Bankruptcy Prediction; Discriminant Analysis; Financial Ratios; Corporate Governance

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Introduction

The economy is inversely over time. Nothing can confirm that our business will be able to survive? Thailand's growth is slow down due to the trade war economic slowdown, which make negatively affected Thai exports. Also have the impact of falling exports spread to domestic demand.

Bank of Thailand (BOT) explained "In 2019, affected industries can be divided into 3 groups: Expansion, Deceleration, and Contraction. Real Estate is in the Contraction group. Transferred housing units were expected to reduce by 10%, from 197 thousand units in 2018 to 176 thousand units in 2019 due to Loan to Value (LTV) measure and decline of the Chinese customers. From restraining forces make a direct and indirect effects on the purchase demand. Direct effect was lower ability to purchase depend on pricing level and type of residential real estate. Indirect effects were lower willingness to purchase due to price expectation and market confidence in part of investment and foreign demand."

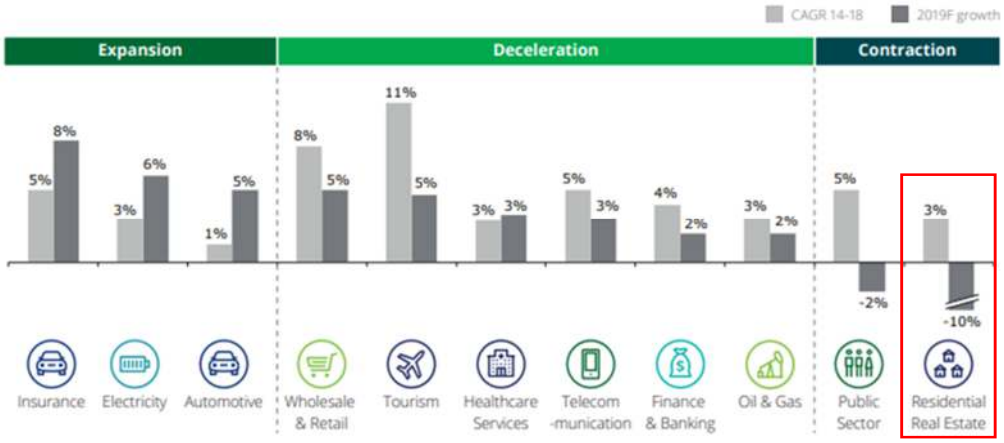

Figure 1. Growth in each sector which divided into 3 groups.

Deloitte Thailand reported: "**Implication to businesses**, Large developers: Income for large developers will continue to grow, as these players are able better to adjust themselves to changing circumstances. What's more, they also have lower financing costs. Small - sized developers and medium - sized developers: They will face greater levels of difficulty and will see their market share shrink because, relative to large players, smaller operators lack the flexibility to adjust their business activities and this in turn reduces their competitiveness."

A negative view on the residential property industry in Thailand due to the global trade war and the appreciation of the baht affected rising non-performing loans (NPLs) may cause banks to maintain stringent lending policies. The NPLs of commercial banks has been increased from 2.19% of credit outstanding in 2014 to 3.49% in September 2019. A further slowdown in the domestic economy could drive NPLs higher still.

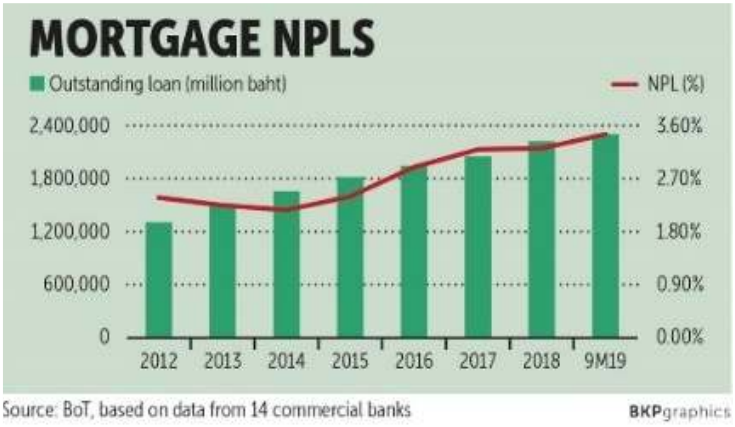

Figure 2. Rising of mortgage NPLS during 2012-9M2019.

Bankruptcy Definition in Thailand

Bankruptcy is the legal status of a natural person or juristic person (business, company) that cannot repay outstanding debts to creditors. Generally, it is initiated by the debtor and imposed by a court. In Thailand's legal, BANKRUPTCY ACT, B.E. 2483 (1940) section 9 is provided bankruptcy action as below, "Section 9. The creditor may initiate a bankruptcy action against the debtor only if:

(1) The debtor becomes insolvent.

(2) The debtor who is a natural person is indebted to one or more plaintiff creditors in an amount of not less than one million Baht or the debtor who is a juristic person is indebted to one or more plaintiff creditors in an amount of not less than two million Baht; and

(3) The definite amount of such debt is determinable, whether it becomes due forthwith or at a future date."

Bankruptcy Prediction Model

From the study of the number of companies that went bankrupt in the past, Europe has the most bankrupt companies, which may be caused by the economy, competition, and deciding executive. So, Bankruptcy Prediction Model was invented in 1932 by Seán FitzPatrick, Former Anglo Irish Bank chairman.

" Since 1968, the primary methods that have been used for model development are multivariate discriminant analysis (MDA), logit analysis, Probit analysis, and neural networks. The early multivariable models were primarily developed using MDA. MDA classifies firms (bankrupt or non-bankrupt) based on each firm's characteristics (ratios/factors). Based on sample observations, coefficients are calculated for each characteristic (ratio). The products of the ratios and their coefficients are summed to give a discriminant score, allowing classification of the firm. Logit analysis and Probit analysis began to appear in the late 1970's but did not overtake MDA in popularity until the late 1980's. Logit analysis and Probit analysis take into account the probability that the firm will go bankrupt. In the late 1980's, neural networks began to appear, and, in the 1990's, there are several different types of neural network methods." (Jodi, 2007).

In addition to financial ratios, corporate governance indicators (CGIs) are another important input variable. Some combinations of specific categories of " FRs and CGIs would be more representative (have more discriminatory power) that would allow the prediction model to provide higher prediction accuracy. However, only some selected CGIs and FRs have been used in related studies, and the chosen features may differ from study to study." (Deron, 2016).

Multiple Discriminant Analysis

Widely method of predicting bankruptcy. Multiple discriminant analysis (MDA) is a statistician technique that reduces the differences between some variables to classify a group. MDA is related to a discriminant analysis by setting a rule or selecting a value that will provide the most meaningful separation. MDA based on three restrictive assumptions:

(1) the independent variables are multivariate normally distributed, (2) the group dispersion matrices or 'variance-covariance matrices' are equal across group and (3) the prior probability of failure and the misclassification costs are specified. The data set for MDA is dichotomous, which means that the groups are discrete, non-overlapping and identifiable.

The linear discriminant function is adopted from Altman (1968) and Altman and Hotchkiss (2006).

The discriminant equation:

$$\square = \square_0 + \square_1\square_1 + \square_2\square_2 + .. + \square_\square\square_\square + \square. \quad (1)$$

Where:

D is discriminant score

$\square_\square$ is discriminant coefficients

X_i is the independent variables, i is number of independent variable

$\square$ is the error term

Thus, this research is conducted with financial ratios and corporate governance indicators of more discriminatory power and using MDA for bankruptcy prediction. To gather the advantages of previous studies and the most accurate forecast to be genuinely utilized in the real estate sector.

Objectives of the Research

To predict bankruptcy of real estate companies in Thailand using financial ratios and corporate governance as predictors.

Research Methodology

1st step: This research used 102 real estate companies in Thailand, divided into 77 non- bankrupt companies and 25 bankrupt companies. Financial Ratios and Corporate Governance factors were taken from the DBD Data warehouse with a cumulative three-year data set. Variable divided into 5 groups as follows.

Profitability: Return on Assets (ROA), Return on Equity (ROE), Gross Profit Margin (GPM)

Liquidity: Current Ratio (CR)

Efficiency: Total Assets Turnover (AT), Operation Expense to Total Revenue Ratio (OPE)

Leverage: Debt to Asset Ratio (DA), Debt to Equity Ratio (DE)

Corporate Governance: Size of company (set total assets less than or equal 50 MB = 1 total asset more than 50 MB = 0), Percent of Thai's shareholder (TSH), Percent of Holding Share of Major Shareholder (MSH), Number of Shareholder (NSH) and One Director Flag (ODT) by set one director = 1, more than one director = 0.

2nd step: This research tested of Multicollinearity test using Collinearity by Tolerance/VIF analysis-the MDA used in this study based on a stepwise approach in selecting significant variables.

3rd step: Using Wilk' s Lambda for testing, independent variables can explain the differences between non- bankrupt and bankrupt companies or not? And Interpret group centroids (mean) of both groups.

4th step: Create the discriminant function to see the relationship. Financial ratios and corporate governance factors as independent variables affect the status of companies in the following equation below:

The discriminant functions

$$\square = \square_0 + \square_1\square_1 + \square_2\square_2 + .. + \square_\square\square_\square + \square. \quad (2)$$

where:

D is a discriminant score

$\square_\square$ is are the discriminant coefficients

X_i is significant variables, i is number of significant variables

$\square$ is the error term

Finally, Conclude and analysis classification results by interpret accuracy rate.

5th step: Test the hypothesis that Independent variables can explain the differences between non-bankrupt and bankrupt companies or not which hypothesis as below:

Hypothesis

$H_0: \mu_1 = \mu_2$

(Independent variables cannot explain the differences between non-bankrupt companies and bankrupt companies)

$H_1: \mu_1 \neq \mu_2$

(Independent variables can explain the differences between non-bankrupt companies and bankrupt companies)

Results

The objective of this research is to predict bankruptcy of real estate companies in Thailand using financial ratios and corporate governance as predictors. The research result from Multiple Discriminant Analysis, it was found that financial ratios and corporate governance factors that have significant predictive ability for detecting bankrupt as 82.7% of original grouped cases correctly classified with details in the process of finding an results as follows:

Multicollinearity

Table 1. Tolerance and VIF value.

Collinearity Statistics		
Variables	**Tolerance**	**VIF**
Size	0.826	1.211
ROA	0.294	3.406
ROE	0.941	1.062
GPM	0.029	35.078
CR	0.914	1.095
AT	0.945	1.058
OPE	0.029	34.38
DA	0.506	1.975
DE	0.971	1.03
TSH	0.802	1.247
MSH	0.786	1.272
NSH	0.868	1.152
ODT	0.76	1.316

Normally, Tolerance value should be higher than 0.10 or VIF is lower than 10. Results show that 2 variables, including GPM and OPE demonstrate problems with multicollinearity. Therefore, it should remove the mentioned variables from the model and test assumption again with the remaining 11 variables.

Table 2. Tolerance and VIF value after removed GPM and OPE.

Collinearity Statistics		
Variables	**Tolerance**	**VIF**
Size	0.832	1.201
ROA	0.69	1.448
ROE	0.95	1.052
CR	0.914	1.094
AT	0.946	1.057
DA	0.674	1.484

Table 2. Tolerance and VIF value after removed GPM and OPE (cont).

Collinearity Statistics		
Variables	**Tolerance**	**VIF**
DE	0.971	1.03
TSH	0.802	1.246
MSH	0.795	1.258
NSH	0.868	1.152
ODT	0.765	1.308

After removing GPM and OPE for amending problems with multicollinearity, it is obvious that none of the variables demonstrates multicollinearity problems. Therefore, it can be concluded that the model satisfies the assumption of non-multicollinearity.

Wilk's Lamda Test

Table 3. Results of Wilk's Lamda test.

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	0.656	126.993	6	.000

From hypothesis:

H_0: $\mu_1 = \mu_2$

(Independent variables cannot explain the differences between non-bankrupt companies and bankrupt companies)

H_1: $\mu_1 \neq \mu_2$

(Independent variables can explain the differences between non-bankrupt companies and bankrupt companies)

Results show Sig. = 0.000 < α = 0.05, Rejected null hypothesis. Independent variables can explain the differences between Non-bankrupt and bankrupt companies.

Discriminant Function

Table 4. Function at Group Centroid.

Status of company	Group Centroids
Non-bankrupt	-0.411
Bankrupt	1.267

From the results, non-bankrupt companies have a centroid (mean) -0.411, while bankrupt companies have a centroid (mean) 1.267. Companies with scores near to a centroid were predicted as belonging to that group.

Discriminant functions:

D = -0.382 + 0.235(ROE) + 0.466(DA) + 0.707(TSH) -0.693(MSH) + 0.348(ODT) (3)

Table 5. Classification Results.

Important Variable	Accuracy Rate		
	Overall	Non-bankrupt Company	Bankrupt Company
- Return on Equity (ROE) - Debt to Assets (DA) - Thai's shareholder (%) (TSH) - Holding Share of major shareholder (%) (MSH) - Number of director (ODT)	82.7%	92.6%	52%

Results show overall as 82.7% of original grouped cases correctly classified. Non-bankrupt companies were classified with better accuracy as 92.6% than bankrupt companies at 52%.

The new body of knowledge

The results of this research showed financial ratios and corporate governance factors helped predict the status of company in the future with conceptual framework as figures 3.

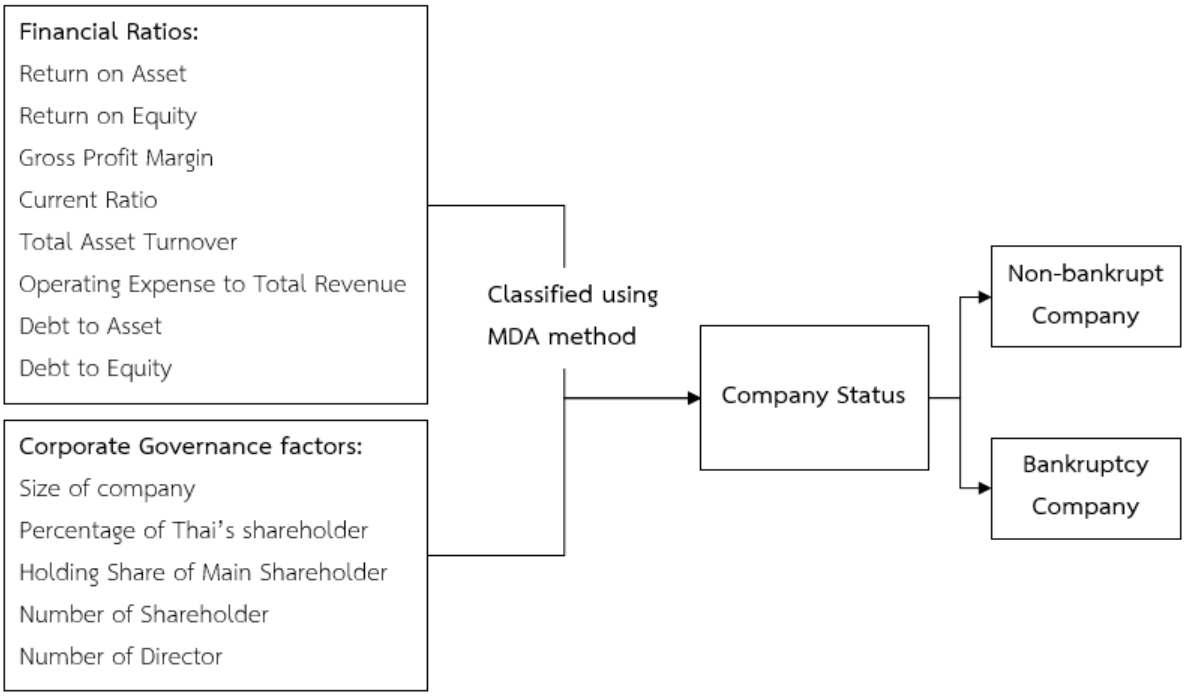

Figure 3. Conceptual framework.

Most of previous research studied only financial ratio or corporate governance which has different results depending on the variables. In this research was combined between financial ratio and corporate governance as predictor. To expect greater prediction accuracy

when focus on more perspective, not only numerical or management but still use the MDA method, which is the most prevalent method of predicting the model.

Discussions

From the research result of the objective, it was found that the overall predictive accuracy is lower than the predictive accuracy of Altman's original work which produced 95% (Altman's, 1968). On the other hand, the result higher than proceedings of Ciampi and Gordini that use some of the same variables in term of financial ratios and reported 80 % accuracy for the overall prediction (Ciampi, and Gordini, 2008).

Non- bankrupt companies correctly classified as 92. 6% whereas only 52% of the bankruptcy companies were correctly classified because the sample size of the bankruptcy companies was too small. Predicting the behavior of company's status requires an appropriate level of population, but the real estate industry has few companies that go bankrupt. So, most of the predicted outcomes will not be bankruptcy.

The number of significant variables was corporate governance more than financial ratios. It indicated that owners of business groups might actively get involved in managerial decision-making that enhances firm value. Alternatively, the risk-sharing and the utilization of internal markets within a business group might help the member firms to avoid financial distress consist with (Piruna, and Kingkarn, 2009).

In Thailand, most companies are family businesses. Weaknesses in governance systems of family businesses are most evident in internal controls, internal audit, and risk management. Since many family businesses are managed by the founders or their children, the control environment is largely tailored to their needs. The problem: the controls do not grow along with the company, as the business becomes more complex (Organisation for Economic Co-operation and Development, 2019). That is why the percent of Thai's shareholder increases and the chances of the company's bankruptcy is also increased.

In terms of decisions, if the company has a major shareholder holding a large number of shares which means has a lot of power. When decision- making power from a few people will make better decisions sell faster if unexpected situations occur. That's why Holding Share of Major Shareholder (%) (MSH) increases one unit, the score decreases by 0.693, which means the score indicating that the company is going bankrupt is lower. Although this result not consisted with Yan- Leung and team' s research that recommended to give minority shareholders easier ways to make their voices heard, improved disclosure, transparency, and communication. These ways of management may be different at the time of impact analysis for the company. Accepting comments or waiting for the decision from many people at the time of the bankruptcy may cause more delays or conflicts in opinions making decisions unable to proceed and the management of the company in various unexpected events (Yan-Leung et al. 2014).

On the other hand, if there is only one director, it will increase the chance that the company will go bankrupt. In terms of directors who responsible for the management of the company's business. If the number of directors is too small, the company will not get a variety of opinions, suggestions and many aspects are beneficial to consider and decide the various problem. When directors have expired or resigned, there may not be anyone left who can continue to work, and finally, the company becoming bankrupt.

Conclusion

The results also showed that it is possible to generate warning signals for real estate companies in Thailand with high accuracy as 82.7% when using the appropriate prediction model with Profitability (ROE), Leverage ratios (DA), and concentrated ownership structure (Shareholder, Director). Shareholders and directors have two completely different roles in a company. The shareholders (also called members) own the company by owning its shares, and the directors manage it.

Many financial ratios were not significant because financial ratios may not have enough impact on the status of the company. Therefore, it may have other additional factors to be studied, such as Macroeconomic factors.

From group centroid, when the discriminant scores close to 1.267, the company is more likely to go bankrupt. If the discriminant scores close to -0.411, it means the company is less likely to go bankrupt. The discriminant coefficient showed the relation between independent variables and the company's status, including Return on Equity (ROE) increases one unit, the score increases by 0.235. Debt to Assets (DA) increases one unit; the score increases by 0.466. Percent of Thai's shareholder (TSH) increases one unit, the score increases by 0.707. Holding Share of Major Shareholder (%) (MSH) increases one unit, the score decreases by 0.693. Number of director (ODT) equals 1, the score increases by 0.348.

Recommendation

The suggestions from the research pointed out that the company should strengthen corporate governance mechanisms to reduce the incidence of financial distress and improve uniform mechanisms of control, for the company can operate and survive regardless of any crisis.

The suggestions for future research should conduct comparative research in companies that are not listed in DBD data warehouse (Department of Business Development) or not in Thailand but publish their financial statements. It will help develop a robust model that can be used in the country when making investment decisions. Also, increase Economics factors such as Dynamics of GDP per capita, Dynamics of investments in fixed assets, Dynamics of domestic demand per capita, Unemployment rate, Exchange rate into independent variables

to improve the analysis aspect and may be able to describe the status of the company more accurately (Tomasz, 2017).

Another variable that might be interesting is the risk management variable, such as Credit Rating. A rating can refer to an entity's specific financial obligation or its general creditworthiness and showed how risky it is to invest money in a certain country or security by providing independent, objective assessments of the creditworthiness of companies and countries. Therefore, Credit Risk is considered a variable that indicates the status of the company is another aspect which is quite interesting.

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