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CREDIT RISK DATABASE: CREDIT SCORING MODELS FOR THAI SMES

by

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Abstract

This paper aims to provide an introduction to Credit Risk Database (CRD)), a collection of financial and non-financial data for SME credit risk analysis, for Thailand. Aligning with the Bank of Thailand (BOT)'s strategic plan to develop the data ecosystem to help reduce asymmetric information problem in the financial sector, CRD is an initiative to effectively utilize data already collected from financial institutions as a part of the BOT's supervisory mandate. Our first use case is intended to help improve financial access for SMEs, by building credit risk models that can work as a complementary tool to help financial institutions and Credit Guarantee Corporation assess SMEs financial prospects in parallel with internal credit score. Focusing on SMEs who are new borrowers, we use only SME's financial and non-financial data as our explanatory variables while disregarding past default-related data such as loan repayment behavior. Credit risk models of various methodologies are then built from CRD data to allow financial institutions to conduct effective riskbased pricing, offering different sets of interest rates and loan terms. Statistical methods (i.e. logit regression and credit scoring) and machine learning methods (i.e. decision tree and random forest) are used to build credit risk models that can help quantify the SME's one-year forward probability of default. Out-of-sample prediction results indicate that the statistical and machine learning models yield reasonably accurate probability of default predictions, with the maximum Area under the ROC Curve (AUC) at approximately 70-80%. The model with the best performance, as compared by the maximum AUC, is the random forest model. However, the credit scoring model that is developed from logistic regression of weighted-of-evidence variables is more user-friendly for credit loan providers to interpret and develop practical application, achieving the second-best AUC.

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Introduction

Small and medium enterprises (SMEs) have been the main engine driving the Thai economy, both in terms of economic growth and employment. In 2020, according to the Office of Small and Medium Enterprises Promotion (OSMEP), there were 3.14 million SMEs, which accounted for 99.5 percent of total number of enterprises, 34.3 percent of Thailand s Gross Domestic Product (GDP) and 70 percent of employment. However, SMEs still have limited access to credit from formal financial institutions, owing to information asymmetry, whereby the lenders such as financial institutions do not have adequate information to assess the risk of borrowers.

The problem of asymmetric information is generally more acute in the case where borrowers are SMEs as compared to large corporations, as SMEs often lack credit history and reliable financial statements. Lenders often attempt to solve such asymmetric information problem by classifying SMEs as high risk borrowers, setting high interest rates on SME loans. and requiring obligatory collateral. Such solutions, however, can have negative impacts on SME financial inclusion. In Thailand, substantial progress has been made to reduce the asymmetric information problem with the introduction of National Credit Bureau (NCB), and Credit Guarantee Corporation (CGC). Until recently, NCB, however, could only provide credit report and NCB score for SMEs who already have credit history in its system. CGC, on the other hand, can help guarantee SME loans and promote financial inclusion, but CGC historically does not have adequate information to make risk-based pricing on SME loan guarantees. As such, there still remains a vast gap for SMEs with no bank credit history, or those who are new applicants for bank credit.

Credit Risk Database (CRD) is an initiative to create a collection of financial and non-financial data to further help reduce the asymmetric information problem via effective utilization of financial data². Credit scoring and probability of default (PD) models built upon CRD data allow financial institutions and credit guarantee corporations to conduct risk-based pricing, offering different interest rates and loan terms to different consumers, based on scientifically accurate judgement about borrowers, creditworthiness. To illustrate, borrowers with lower credit risk will be able to access to finance at lower interest rates (and lower loan guarantee rates), while borrowers with higher credit risk have a higher chance to borrow if they pay higher interest rates (or higher guarantee rates).

The introduction of CRD in Thailand also fits into the Bank of Thailand (BOT)'s strategic plan to develop a data ecosystem that ensures that transactional data received by financial institutions will be effectively utilized for the benefit of the data's owners, the financial system and the economy. CRD credit scoring and PD models which are constructed from loan data collected through the BOTs' supervision function, along with data on financial ratios and firm profiles collected by Department of Business Development, the Ministry of Commerce, can serve as a complementary tool to help financial institutions and CGC comprehensively evaluate credit risk of SMEs in parallel with internal credit score. Refer to Appendix A for detailed notes on data, modelling methods and limitations. This could help improve access to funding for SMEs, especially those who are "new to bank" (i.e. new SME loan applicants who the financial institutions are not familiar with), to better access funding sources, and brings along economic improvement.

²An example of internationally known Credit Risk Database is the one in Japan, which started in mid 1990's.

2. Data Collection

Pseudonymization

As required by Financial Institutions Act, B.E. 2551 (2008), data has been submitted by financial institutions to Bank of Thailand with non-masking identification for both individual and juristic persons, for supervisory purposes. CRD applies data masking policy for data leak prevention and data privacy protection. CRD uses the tool encrypts ID by hashing algorithm with salt, creates a hash value that could uniquely identify entities. Pseudonymization process is completed by Bank of Thailand. As a result, the recipient of data (CRD) does not directly handle real identity, but is still capable of matching data of the same entity across databases.

Data Collection

CRD is built from three main databases and one complementary database:

- Loan Arrangement (LAR) database: This database provides information on all account-level loans of borrowers with aggregate credit line or outstanding of 20 million baht or higher granted by commercial banks³ specialized financial institutions and finance and credit foncier companies in Thailand on a monthly basis.
- SMEs Data (SMD) database: This database provides information on all account-level business loans of borrowers with aggregate credit line or outstanding of lower 20 million baht granted by Thai commercial banks and specialized financial institutions in Thailand on a monthly basis.
- Corporate Profile and Financial Statement (CPFS) database: This database provides information on financial statements of all registered businesses granted by Department of Business Development Ministry of Commerce (Thailand) on a yearly basis. There are three main components in this dataset, 1) company profiles 2) balance sheet statement and 3) income statement.
- SMEs Profile (SMP) database: This database provides information on profiles of SMD's borrowers for complementing CPFS's missing values as representative values on the most up-to-date basis when they get a new loan.

³ Commercial Banks consist of Thai commercial banks (commercial banks registered in Thailand), retail banks, subsidiary and foreign bank branches.

3. Dataset

3.1 Dataset Summary

The diagram below illustrates the datasets that are used to build database for CRD.





Firstly, when we combine the LAR and SMD database, we get a database that covers all loans for juristic and natural persons in the banking system (the largest circle on the left). In the combined LAR and SMD database, we filter for loans that are borrowed by the juristic entities only (smaller circle in the middle). Lastly, we map the filtered loan data with the CPFS database. The resulting dataset for CRD analysis is the intersection of LAR, SMD and CPFS database represented by the smallest circle in the middle area.

Table 1: Total number of observations from LAR, SMD and CPFS Database

Data Sources	# Observations								
Data Sources	2014	2015	2016	2017	2018				
Loan Data Ordinary & Juristic (LAR + SMD)	473K	473K	489K	1.25M	1.47M				
Loan data (Juristic-only)	127K	130K	132K	146K	150K				
Financial statement data (CPFS)	447K	458K	486K	505K	536K				
Juristic existed in both datasets	108K	109K	112K	122K	123K				

The table above indicates the total number of juristic observations from the combined LAR, SMD and CPFS database per annum from 2014 to 2018. Note that the observations from the CRD database only starts at year 2014 due to the shortage of the reported SMD data. Furthermore, we also make use of SMP database to fill up any incomplete CPFS database from the Department of Business Development Ministry of Commerce.

Once we get the total juristic observations from the combined database, we filter for loan data of micro SMEs, small SMEs and medium SMEs only. We classify SMEs in line with official definitions from the Ministry of Industry, as prescribed in the Ministerial regulation issued in 2020. Furthermore, we omit some specialized business sectors from ISIC BOT Rev. 4 categories out of our SME definition such as

- Category K : Financial and insurance activities
- Category O : Public administration and defense & compulsory social security

- Category S94: Activities of membership organizations

(For more details on the definition of SME and ISIC BOT Rev. 4 categories, see the section on "*SME Definition*")

Lastly, we exclude any other inconsistent observations with Not Applicable (N/A) information out. Overall, the remaining observations that we use in the CRD database from 2014-2018 have a total of 400,994 observations, including 17,628 default cases.

In addition to the database cleaning and filtering process above, other related issues exist for the remaining observations as follow:

• Financial Statement Consistency

The following corrections are made to ensure conformation with accounting principles and standards. We ensure that all observations have complete data from CPFS database (If not, fill in with the SMP data) and consistent value according to accounting formula below:

- Total Asset = Total Liability + Total Equity
- Total Current Asset = Cash + Short-term Investment + Account Receivable + short-term Loans + Inventory + Other Current Asset
- Total debt = Short-term debt + Long-term debt
- Total Sales = Income from Sales + Income from Service
- Total Cost of Goods Sold = Cost from Sales + Cost from Service
- Total Selling, General & Administrative Expense (SG&A) = SG&A from Sales + SG&A from Service

Imbalanced dataset of Default and Non-default data

Imbalanced dataset between Default and Non-default groups occurs when there is a large difference in the proportion of the two groups in the dataset. With 17,628 default cases from the total observations of 400,994, the proportion of default cases is only 4.4%. When the proportion of default groups is too low, it can lead to an underestimated PD estimation problem. In the case of machine learning application, this may cause the default group pattern to be ignored.

This effect of imbalanced dataset can be partially reduced by random oversampling of default group and random under-sampling of non-default group. Oversampling involves selecting default observations with replacement and adding them to the training dataset while under-sampling involves selecting non-default observations and deleting them from the training dataset. To ensure robustness of the machine learning models (decision tree and random forest), the proportion of non-default group and default group is selected from the simulation process on the training dataset, which leads to the maximum Area under the ROC Curve (AUC). We do not use under-sampling or oversampling for regression models.

3.2 Default information

The CRD database provides the probability of default (PD) based on models that are built on aggregated and pseudonymized SME data collected by the Bank of Thailand. The dependent variable is defined as the SME's default status on one of its accounts in the 1-year forward period and takes value of either 0 (non-default) or 1 (default). The explanatory variables are based on default-related financial and non-financial SME data.

Loan Classification

According to the CRD database collected prior to 2016, loans are still classified in accordance of their attributes to reflect the actual current risk under the categories of "Pass", "Special Mention", "Substandard", "Doubtful". "Doubtful of Loss" and "Loss". In our analysis, we re-categorized them into 3 categories: "Pass", "Special Mention" and "NPL" where NPLs are substandard loans and lower. Finally, we set

the dependent variable as 0 when the SME loan stays at Pass category and as 1 when the SME loan falls to Special Mention or NPL.

However, under the Bank of Thailand's current regulation on loan classification, loans are now classified in accordance with TFRS 9 to reflect the expected credit loss under the categories of "Performing", "Underperforming" and "Non-performing". The TFRS 9 has been effective since 1st January 2020. Therefore, once the new dataset in 2020 has been collected, the definition will need to be adjusted accordingly.

Default Definition

For data exploration purpose of this section, we use an end-of-year default in order to reflect the actual default with other indicators. The definition of default in this section will therefore be historical and actual default shown in the dataset. In this case, the number of actual defaults is 17,628 in total.

However, in the "Analytical Model Result" section, we use a forward-looking definition of default as the dependent variable. Therefore, an SME is defined as default if at least one of his/her loan accounts is fallen from Pass to other loan categories at any point of time within the next 12 months. In other words, an SME will be categorized as default when the loan classification default status of one of his/her loan accounts is shown as 1. In this case, the total number of default used for modelling purpose is 42,958 in total.

• <u>Actual Default Data Statistics</u>

We collected the actual default data between 2014-2018 and observed the trends by industry sector, regions and cities accordingly. However, these trends are only for interpretation and may not necessarily serve as the overall future trend as more data arrive in the future.

Actual Default Over Time

The chart below represents the default rate and the total number of defaults over time respectively. There has been a gradual increase in both the default rate and the number of defaults over the past 5 years. Both the rate and the number peaked in 2018.



Figure 2: Default rate and Number of defaults from 2014 - 2018

Average Default by Industry Sectors

The construction and utility sectors clearly have larger average default rates over the past 5 years compared other sectors. However, the trade and manufacturing sectors, being larger in population size, have overtaken them in terms of the number of defaults.



Figure 3: Average default rate and Average number of defaults by Industry sector

Average Default by Regions \succ

The southern, the western and the northern regions have the top three average default rates over the past 5 years. However, the central region, which has the highest number of firms, has overcome other regions in terms of the number of defaults.





\geq Actual Default by City

Cities in the southern region and the northern region have higher default rates on average than cities in other regions.

Figure 5: Average default rate of different cities in Thailand



Average Default by Ownership Structure \triangleright

The most prevalent type of ownership structure in the SME dataset is private limited company, which shows the most number of defaults on average. In terms of the average default rate for SMEs, partnerships have a higher default tendency than other ownership structures.

Figure 6: Average default rate and Number of defaults by SME's ownership structure



Average Number of Defaults

Average Default by Firm Size

The type of SMEs that occurs the most in the dataset is small SMEs, which shows the highest number of defaults on average. However, micro SMEs have average default rate that is far higher than those of medium and small SMEs. We define the type of SME according to the Thai Ministry of Industry. (See the section of "SME Definition" in the report for details on how we categorize SMEs into micro, small and medium SMEs.)

Figure 7: Average default rate and Number of defaults by SME's firm size



Default by Firm Age

According to the range of firm age in the dataset as shown below, both the default rate and the number of defaults are high among firms that have operated for approximately 5 to 20 years and get lower among firms that have operated for more than 20 years.

Figure 8: Default rate and Number of defaults by SME's firm age



Default by Authorized Shareholding Capital

In terms of the SME's total authorized shareholding capital in the dataset, the default rate peaks among those SMEs with authorized shareholding capital of above 100 million baht and remains quite constant below that. However, the number of defaults is the highest among SMEs with authorized shareholding capital of below 1 million and below 5 million.



Figure 9: Average default rate and Number of defaults by SME's authorized shareholding capital

3.3 SMEs definition

The Ministry of Industry classifies SMEs as below according to Ministerial regulation issued in 2020. Table 2: Definition of SMEs according to the Thai Ministry of Industry.

		Sr	Madium					
Business	Mi	cro	Sn	nall	wiedlum			
Туре	Employees	Income (Mil. THB)	Employees	Income (Mil. THB)	Employees	Income (Mil. THB)		
Manufacturing	Not more than 5	Not more than 1.8	Not more than 50	Not more than 100	Not more than 200	Not more than 500		
Wholesale & Service	Not more than 5	Not more than 1.8	Not more than 30	Not more than 50	Not more than 100	Not more than 300		

In this analysis, we define business type from the first digit number of International Standard Industrial Classification of All Economic Activities (ISIC) category (Revision 4) as details below:

 Table 3: ISIC category (Revision 4)

Group	ISIC Description	Business Type
А	Agriculture, forestry and fishing	
В	Mining and quarrying	
С	Manufacturing	Monufacturing
D	Electricity, gas, steam and air conditioning supply	Wanufacturing
Н	Transportation and storage	
E	Water supply; sewerage, waste management and remediation activities	
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	
F	Construction	
L	Real estate activities	
Ι	Accommodation and food service activities	
J	Information and communication	Wholegele or
Ν	Administrative and support service activities	Service
Μ	Professional, scientific and technical activities	Service
Q	Human health and social work activities	
R	Arts, entertainment and recreation	
Р	Education	
S	Other service activities	
Κ	Financial and insurance activities	
0	Public administration and defence; compulsory social security	
S94	Activities of membership organizations	Others (Null)
Т	Activities of households as employers; undifferentiated goods- and	Oulers (Inull)
	services-producing activities of households for own use	
U	Activities of extraterritorial organizations and bodies	

In addition, we prioritize ISIC code from CPFS as it refers to the firm's economic activity that generates the highest income for each financial year; however, if we do not have ISIC code from CPFS, we use from loan business ISIC, which is based the firm's activity with the highest loan credit.

Next step, we use income from CPFS database ("sale and service revenue" variable) as the first criteria to categorize SMEs, following by employment. If CPFS database does not have income item, we use income from SMP (SME profile) database instead. However, if both CPFS and SMP do not have income item, we use employee data.

3.4 Financial Indicators

Having created accounting variables from the dataset, CRD uses these variables to compute 34 financial ratios that will be used as the explanatory variables for analysis and modelling. The 34 financial ratios are as follow:

Table 4: Financial ratios

1. Pro	fitability ratios
1	Operating Profit to Total Asset = Operating Profit / Total assets $(avg^4) * 100$
2	Ordinary Profit to Total Asset = Ordinary Profit / Total assets * 100
3	ROA = (Net Income / Total Assets) * 100
4	ROE = (Net Income / Total Equity) * 100
5	Operating Margin Ratio = Operating profit / Sales * 100
6	Ordinary Income Margin Ratio = Ordinary Income / Sales * 100
7	Net Profit Margin Ratio = Net Income / Sales * 100
8	SGA Ratio = Selling and General Administrative Expenses / Sales * 100
2. Liq	uidity Ratio
9	Current Ratio = Total Current Assets / Total Current Liabilities * 100
10	Quick Ratio = (Total Current Assets – Inventory) / Total Current Liabilities * 100
11	Reserves Ratio = Cash and Cash equivalents / Total Current Liabilities * 100
12	Cash to Sales Ratio = Cash and Cash equivalents / Sales * 100
3. Gro	owth Ratio
13	Sales Growth Rate = $(Sales(t) / Sales(t-1) - 1) * 100$
14	Assets Growth Rate = (Total Assets(t) / Total Assets(t-1) - 1) * 100
4. Sta	bility Ratio
15	Equity Ratio = Total Equity / Total Assets * 100
16	Debt to Equity Ratio = Total Debt / Total Equity
17	Asset-to-Equity Ratio = Total Assets / Total Equity
5. Sol	vency Ratio
18	Debt Dependency Ratio = (Short-term Debts + Long-term Debts) / Total Assets * 100
19	Debt Capacity Ratio = (Short-term Debts + Long-term Debts) / (Cash and Cash Equivalents + Total Fixed Assets) * 100

- 20 Debt to Sales Ratio = (Short-term Debts + Long-term Debts) / (Sales / 12) [times]
- 21 Working capital to debt ratio = (Cash + Account Receivable + Inventory Account Payable) / Total Debt
- 22 Interest Expenses to Sales Ratio = Interest Expenses / Sales * 100

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⁴ Average value between period t and t-1

- 23 Years of Debt Redemption = (Long-term Debts + Short-term Debts Cash and Cash equivalents) /(Operating profit + Depreciation)[times]
- 24 Debt-to-EBITDA Ratio = Total Debt / Earnings Before Interest Taxes Depreciation & Amortization (EBITDA)

6. Efficiency/Activity Ratio

- 25 Total Assets Turnover Rate = Sales / Total Assets [times]
- 26 Fixed Assets Turnover Rate = Sales / Total Fixed Assets [times]
- 27 Account Receivable Turnover Days = Account Receivables / Sales * 365 [days]
- 28 Inventory Turnover Days = Total Inventory / Sales * 365 [days]
- 29 Account Payable Turnover Days = Account Payables / Sales * 365 [days]
- 30 Accounts Payable Turnover Ratio = supplier purchases / average accounts payable
- 31 Cash Conversion Cycle = (Account Receivables + Total Inventories Account Payable) / (Sales / 12) [Months]

7. Funding and Funding utilization

- 32 Fixed Assets to Fixed Liabilities and Total Equity = Fixed Assets / (Total Equity + Fixed Liabilities) * 100
- 33 Fixed Assets to Equity Ratio = Total Fixed Assets / Total Equity * 100

8. Assets Condition Ratio

34 Other Current Assets Ratio = Total Other Current Assets / Total Current Assets * 100

3.5 Non-Financial Indicators

Apart from the financial indicators that CRD uses above, CRD also uses 9 non-financial indicators as explanatory variables as follow:

Table 5 : Non-financial Indicators – Continuous and Categor

No	Variable	Туре	Available Values								
1	Firm Age	Continuous	From 0 to 100								
2	Authorized shareholding capital	Continuous	From 0 to 200M								
3	Loan size	Categorical	< 50K	50-350K	350K-1M	1M-5M	> 5M				
4 ISIC	Catagorical	Trade	Service	Manufacturing	Real estate	Utility					
	ISIC	Categorical	Construction	Mining	Agriculture						
5	SME size	Categorical	Micro	Micro Small Medium							
6	Registration Type	Categorical	Partnerships	nerships Company Public Company Limited Limited							
7	Year of financial statements	Categorical	2014	2015	2016	2017	2018				
8	Province	Categorical		All 77	provinces in Thailand						
9	Region	Categorical	Northern	Southern	Northeastern	Central					

3.6 Data distribution⁵

This section discusses the profile of financial and non-financial indicators for default and non-default groups⁶. It is noteworthy that the default group and the non-default group have distributions of financial indicators, as depicted in Figure 10 – 17. In each of the Figures, for density distribution, the blue line depicts that of the non-default group and the red dotted line depicts that of the default group. For the box graph, the left hand-side graph represents that of the non-default group.

3.6.1 Financial Indicators

1) Profitability ratio

The default group has distribution of profitability ratio that tends to the left side of that of the nondefault group. The box graphs also show that the default group has a lower 25th percentile, median, and 75th percentile compared to the non-default group. It is clear that, on average, the non-default group has higher ability to generate income than the default group.

Figure 10: Profitability ratio



⁵ Refer to Appendix B for details on Financial and Non-financial variables distribution

⁶ Data as of 2018

2) Liquidity ratio

For the liquidity ratio, the non-default group's distribution generally stays on the right side of the default group. The same results can be derived from the box graphs in which the non-default group has higher median than the default group. In brief, liquidity ratio determines a company's ability to cover short-term obligations, thus; the non-default group has higher ability to pay off current debt obligations without raising external capital.

Figure 11: Liquidity ratio



3) Growth ratio

Growth ratio is higher for the non-default group as expected, judging from the two groups[,] distributions and box graphs.



Figure 12: Growth ratio

4) Stability Ratio

For equity ratio, the higher the value, the less leveraged the company is. The non-default group has higher equity ratio for the positive-value area as expected, judging from the two groups distribution and box graphs. Debt to equity ratio reflects the ability of shareholder equity to cover all outstanding debts in the event of a business downturn. For the positive-value area, it is clear that the distribution of non-default group tends to be lower and to the left side of the default group. Conversely, for the negative-value area, the distribution of default group tends to be higher because its equity is already negative.

Figure 13: Stability ratio



5) Solvency Ratio

Solvency ratio is used to indicate whether a company's cash flow is sufficient to meet its long-term liabilities and thus is a measure of its financial health. The distribution of default group tends to be higher and to the right side of the non-default group. The box graphs also show that the default group has higher median compared to the non-default group. It is clear that the default group has higher risk to solvency.

Figure 14: Solvency Ratio



6) Efficiency ratio

Efficiency ratio are higher for the non-default group as predicted, judging from the two groups[,] distributions and box graphs.



3.6.2 Non-financial Indicators

1. Firm Age

The distribution of firm age for default group tends to be higher than the non-default group when the firm has operated for approximately 5 to 20 years and tends to be lower in other firm age range. The box graphs also show that the default group has similar median with the non-default group while having smaller range of age.



Figure 16: Firm age

2. Authorized Shareholding Capital

The distribution of firm age for the default group tends to be similar with the non-default group. Both distributions skew towards the left which is approximately 1 million to 5 million baht of authorized shareholding capital. The box graphs also show that the default group has similar median with the non-default group while having a larger range of authorized shareholding capital.



Figure 17: Authorized Shareholding Capital

4. Analytical Results

In this section, we apply statistical and machine learning methods to determine optimal sets of financial and non-financial variables that are highly correlated with loan defaults, and that the correlations have high potential to be explained rationally. For statistical models, we apply logit regression on the SME dataset to build probability of default and credit score models for SMEs. For machine learning models, we apply supervised learning methods, including decision tree and random forest models, to build probability of default models for SMEs. For both methods, we use the Area Under the estimated ROC Curve (AUC) as a criterion for our model selection. The optimal models should have a well-explained set of variables that produce a relative high percentage of AUC.

The explanatory variables for the models focus more on financial ratios and firm profiles rather than the commonly-used variables on repayment or loan usage behaviors. This is in line with CRD's mission to help assess risk of SMEs who might be new loan applicants to a financial institution, and might not have financial footprints with that particular financial institution. While other behavioral variables such as mobile or e-commerce usage behaviors, are becoming prevalent recently and might be useful as alternative data in loan applications, they do not necessarily reflect the behaviors of SMEs that are juristic persons, and currently, this type of dataset is still in the beginning process of data collection at the BOT.

For all models in this part, the data that we use is split into 2 datasets, 75% for the training dataset and 25% for the test dataset, for simple train-test split cross-validation. In total, there are 300,745 observations in the training dataset for model estimation and 100,249 observations in the test dataset for model evaluation. While we build the models using the training dataset, we calculate the AUC as the measure of the models performance based on the test dataset to avoid overfitting the models to the data.

4.1 Logit Regression Model

Logit regression model is a traditional credit risk model for predicting probability of default, with widespread use in the banking industry due to its simplicity. For our CRD database, we have the following sets of variables as potential explanatory variables of the logit model.

- **Financial variables**, such as key financial ratios.
- Non-Financial Continuous Variables such as firm age, authorized shareholding capital.
- **Non-Financial Categorical Variables** such as SME size, registration type, region, province, sector of business, year of financial statement and loan size.

To use these variables as inputs into logistic regression, first we consider the financial variables and non-financial continuous variables. A these variables are in continuous form, the models could be unjustly affected by the outliers, i.e. the extreme values of the variables. Therefore, we need to determine the appropriate left and right tail of each variables. The plots of all of the distributions of the continuous variables are shown in "data distribution" part.

Having addressed the outliers, we are aware that the effects of some of the variables could also be non-linear. We thus transform these variables into either level or natural logarithm format. For variables that have negative value, we apply Yeo-Johnson natural logarithm technique as negative logarithm transformation is undefined. Then, we select all financial variables and non-financial continuous variables, either in level or in natural logarithm format, using single logit regression model.

• Single Logit Regression Model

Single logit regression is the statistical model that uses a logit function to estimate the relationship between each explanatory variable (x) and the binary dependent variable (y). In this case we are trying to test each variable's ability to explain the SME default status in both format and select only the better form of each variable (i.e. either in level form or log form) only. The formula for single logit regression model is as follow:

$$\mathbf{y} = \frac{\mathbf{1}}{\mathbf{1} + e^{-(\alpha + \beta x)}}$$

where α is constant, β is the coefficient

The table below records the resulting coefficients that we pick for each variable, either in level form or in natural logarithm form

				Log-transformed				Vor				
No Variable	Coeff.	p-value	Corr.	R2	AUC	Coeff.	p-value	Corr.	R2	AUC	dict	
Prof	it Efficiency Ratio											
1	Operating Profit to Total Asset	-0.0089	***	-0.057	0.00458	0.562	-0.1063	***	-0.073	0.00739	0.562	Log
2	Ordinary Profit to Total Asset	-0.0073	***	-0.054	0.00433	0.567	-0.1048	***	-0.076	0.00825	0.567	Log
3	ROA	-0.0105	***	-0.068	0.00624	0.577	-0.1310	***	-0.090	0.01136	0.577	Log
4	ROE	-0.0030	***	-0.034	0.00163	0.540	-0.0656	***	-0.055	0.00420	0.540	Log
Prof	itability Ratio											
5	Operating Profit Margin	-0.0095	***	-0.054	0.00411	0.484	-0.0828	***	-0.057	0.00450	0.484	Log
6	Ordinary Income Margin	-0.0003	0.0821	-0.003	0.00001	0.506	-0.0811	***	-0.035	0.00169	0.506	Log
7	Net Profit Margin	-0.0101	***	-0.090	0.01039	0.552	-0.1195	***	-0.086	0.01023	0.552	Level
8	SGA Ratio	0.0036	***	0.052	0.00338	0.521	0.0565	***	0.021	0.00067	0.521	Level
Effic	ciency/Activity Ratio											
9	Total Assets Turnover	-0.1788	***	-0.071	0.00905	0.609	-0.7343	***	-0.101	0.01607	0.609	Log
10	Account Receivable Turnover Days	0.0016	***	0.043	0.00251	0.507	-0.0312	***	-0.016	0.00038	0.507	Level
11	Inventory Turnover Days	0.0006	***	0.017	0.00039	0.528	-0.0532	***	-0.034	0.00166	0.528	Level
12	Fixed Assets Turnover	-0.0013	***	-0.018	0.00048	0.583	-0.1733	***	-0.069	0.00736	0.583	Log
13	Account Payable Turnover Days	0.0026	***	0.073	0.00680	0.517	0.0347	***	0.015	0.00033	0.517	Level
14	Account Payable Turnover	0.0015	***	0.016	0.00035	0.519	-0.0361	***	-0.016	0.00039	0.519	Log
15	Cash Conversion Cycle	0.0145	***	0.045	0.00251	0.521	0.0168	0.00276	0.005	0.00003	0.521	Level
Liqı	udity Ratio											
16	Current Ratio	-0.0002	***	-0.018	0.00050	0.551	-0.1407	***	-0.059	0.00493	0.551	Log
17	Quick Ratio	-0.0001	***	-0.006	0.00005	0.544	-0.0967	***	-0.050	0.00358	0.544	Log
18	Reserves Ratio	-0.0004	***	-0.024	0.00092	0.601	-0.1827	***	-0.098	0.01461	0.601	Log
19	Cash to Sales	-0.0125	***	-0.040	0.00258	0.564	-0.2087	***	-0.065	0.00636	0.564	Log

Table 6: Single Logit Regression Model on each variable - Level vs Log Form

		Level					Log-transformed					Vor	
No	No Variable	Coeff.	p-value	Corr.	R2	AUC	Coeff.	p-value	Corr.	R2	AUC	dict	
Stab	ility Ratio												
20	Equity Ratio	-0.0038	***	-0.059	0.00477	0.539	-0.0776	***	-0.070	0.00639	0.539	Log	
21	Debt to Equity	-0.0351	***	-0.025	0.00094	0.527	-0.1295	***	-0.038	0.00202	0.527	Log	
22	Asset-to-Equity	-0.0062	***	-0.009	0.00011	0.527	-0.1033	***	-0.035	0.00170	0.527	Log	
Funding and Funding utilization													
23	Fixed Assets to Fixed Liabilities and Total Equity	0.0011	***	0.031	0.00135	0.524	-0.0251	***	-0.017	0.00042	0.524	Level	
24	Fixed Assets to Equity	0.0002	***	0.014	0.00027	0.496	-0.0419	***	-0.043	0.00253	0.496	Level	
Solv	ency Ratio - credit co	ndition											
25	Debt Dependency Ratio	0.0031	***	0.059	0.00459	0.535	0.0534	***	0.029	0.00125	0.535	Level	
26	Debt Capacity Ratio	0.0034	***	0.064	0.00531	0.538	0.0613	***	0.033	0.00162	0.538	Level	
27	Debt to Sales	0.0001	***	0.082	0.00822	0.559	0.0477	***	0.042	0.00265	0.559	Level	
28	Working Capital to Debt	-0.0392	***	-0.027	0.00118	0.597	-0.3577	***	-0.064	0.00653	0.597	Log	
29	Interest Expenses to Sales	0.0207	***	0.110	0.01229	0.583	0.3941	***	0.137	0.02382	0.583	Log	
Solv	ency Ratio - debt repa	ayment abili	ty										
30	Years of Debt Redemption	0.0182	***	0.072	0.00729	0.557	0.1528	***	0.067	0.00645	0.557	Level	
31	Debt-to-EBITDA	-0.0122	***	-0.036	0.00193	0.538	-0.0933	***	-0.054	0.00422	0.538	Log	
Asse	ts Condition Ratio												
32	Other Current Assets Ratio	0.0116	***	0.050	0.00341	0.512	0.0879	***	0.035	0.00175	0.512	Level	
Gro	wth Ratio												
33	Sales Growth	-0.0026	***	-0.046	0.00352	0.590	-0.0878	***	-0.085	0.01077	0.590	Log	
34	Assets Growth	-0.0027	***	-0.034	0.00193	0.552	-0.0649	***	-0.057	0.00467	0.552	Log	
Non	Financial Continuou	s Variables											
35	Firm Age	-0.0235	***	-0.066	0.00686	0.553	-0.2470	***	-0.052	0.00400	0.553	Level	
36	Authorized Shareholding Capital	-3.765E-10	0.0156	-0.004	0.00002	0.519	-0.0386	***	-0.017	0.00045	0.519	Log	

Significant codes: 0 **** 0.001 *** 0.01 ** 0.05 ** 0.1 ** 1

From the table above, it can be seen that there are a number of criterions available for us to assess significance of the coefficients before deciding to which form of the variables (i.e. level or log form) to use. The selection criterions are considered in order as follow:

1. <u>By p-value</u>

The dependent variable is considered "explainable" by the explanatory variables, if the coefficients of the explanatory variables are statistically significant and have low p-value. Therefore, if any coefficients in the table have p-value, we pick another form of those coefficients. For example, ordinary income margin has p-value of 0.0821, so we pick its natural log form.

2. By Expert Judgement

If the dependent variable is to be considered "explainable" by the explanatory variables, the coefficients of the explanatory variables should have economically explainable signs (positive of negative).

Therefore, if coefficients of both forms of variables (level and log) are statistically significant but show different signs, we pick the one that can economically explain default. For example, both coefficients of account receivable turnover (in days) show significant p-values but have different signs. This financial ratio indicates the number of days the it takes a customer to pay the SME for its sales on credit. The longer it takes, the less its liquidity and efficiency is and the more the probability of default. As such, we pick the level form of this variable since it shows positive coefficient.

3. By Absolute value of Correlation with Dependent Variable

For the remaining variables whose coefficients are statistically significant and have economically explainable signs, we then compare the magnitude of correlation with the dependent variable and pick the form of variable that has larger magnitude with the premise that it could explain the dependent variable more.

4. By MacFadden's Pseudo R² and AUC

Lastly, if the magnitude of correlation for both forms of the variable does not represent a clear cut for the choice of form to pick, we use the values of MacFadden's Pseudo R2 and AUC as complimentary criterions. The formula for MacFadden's Pseudo R2 is as follow:

$\label{eq:macFadden} \mbox{MacFadden Pseudo } R^2 = 1 \ - \ \frac{\mbox{LogLikelihood (Logit model)}}{\mbox{LogLikelihood (Intercept model)}}$

We pick the form of remaining variables according to their higher pseudo R2 and higher AUC as shown in the table.

After a decision is made on the form of each of the variables to use, we then consider the correlation between each of them using the correlation matrix. The correlation matrix for the coefficients in logit model is illustrated in the Appendix C1. To avoid multi-collinearity problem among each pair of explanatory variables, we use variance inflation factor (VIF) technique for removing the highly correlated explanatory variables. A large VIF on an explanatory variable indicates a highly collinear relationship to the other variables and, if occurred, a decision to adjust some explanatory variables in the model is necessary. The table below indicates the VIF values of each explanatory variable before and after the adjustments in the logit model.

Variable	VIF (Before)	VIF (After)
Debt Dependency Ratio	<u>154.919</u>	-
Debt Capacity Ratio	<u>151.080</u>	4.397
In(Operating Profit to Total Asset)	<u>40.608</u>	-
ln(ROA)	<u>36.382</u>	8.227
ln(Asset-to-Equity Ratio)	<u>26.771</u>	-
In(Debt-to-Equity Ratio)	24.255	5.045
In(Operating Margin Ratio)	<u>17.282</u>	-
ln(Equity Ratio)	7.964	7.454
ln(Current Ratio)	6.520	6.505
ln(Reserves Ratio)	5.828	5.741
Net Profit Margin Ratio	5.308	3.236
ln(Quick Ratio)	5.053	5.037
In(Ordinary Profit to Total Asset)	4.427	4.411
Fixed Assets to Equity Ratio	3.895	2.810
Years of Debt Redemption	3.760	3.612
In(Total Assets Turnover Rate)	3.575	3.079
ln(Cash-to-Sales Ratio)	3.393	3.306
In(Interest Expenses to Sales Ratio)	3.119	2.184
Inventory Turnover Days	3.079	3.064
Debt-to-Sales Ratio	3.075	3.038
ln(Working capital to debt ratio)	3.004	2.837
ln(Debt-to-EBITDA Ratio)	2.680	1.785
Cash Conversion Cycle	2.609	2.608
In(Fixed Assets Turnover Rate)	2.339	2.318
Account Payable Turnover Days	2.186	2.168
Account Receivable Turnover Days	2.098	2.089
SGA Ratio	2.093	2.055
In(Accounts Payable Turnover Ratio)	1.987	1.981
In(Ordinary Income Margin Ratio)	1.791	1.770
Fixed Assets to Fixed Liabilities and Total Equity	1.717	1.685
ln(ROE)	1.713	1.666
ln(Assets Growth Rate)	1.469	1.465
In(Sales Growth Rate)	1.257	1.253
Other Current Assets Ratio	1.118	1.115

 $Table \ 7: Variance \ Inflation \ Factor \ (VIF) \ for \ explanatory \ variables \ in \ Logit \ Regression \ Model$

For the CRD project, we choose the threshold cut-off VIF value of 10. Together with the correlation matrix, we adjust the model by removing the explanatory variables with high VIF and correlation until the VIF values of all explanatory variables are below 10. Finally, 4 explanatory variables have been removed off the model as shown in the table above.

After considering the VIF of the explanatory variables, we then take all the selected variables from the table as the explanatory variables for multiple logit regression model in the next stage.

• Multiple Logit Regression Model

Multiple logit regression is the statistical model that uses logit function to estimate the relationship between many explanatory variables (xi) and the binary dependent variable (y). The formula for single logit regression model is as follow:

$$\mathbf{y} = \frac{1}{1 + e^{-(\alpha + \sum_{i=1}^{n} \beta x_i)}}$$

where α is constant, β is the coefficient, n=no. of explanatory variables

The explanatory variables that we use in this stage are as follow:

- All 36 selected forms of financial and non-financial variables from single logit regression
- All non-financial categorical variables as dummy variables

Since there are a lot of variables to be selected into the multiple regression model, we decide to run the variables in two methods: Full Selection and Stepwise Selection.

For our analysis, we use Akaike Information Criteria (AIC) as the selector. AIC weights the ability of the model to predict the observed data against the number of parameters the model requires to reach that level of precision. A low AIC value indicates a better-fit model. The AIC formula in R is as follow:

AIC = -2LogLikelihood (model) + 2k

For full selection method, we run multiple logit regression using all variables. For stepwise selection method, we use bidirectional elimination procedure to choose the variables and measure the goodness of fit by AIC⁷. Stepwise selection procedure is used to determine which explanatory variables from above are to be included into the model. Stepwise selection procedures include forward selection, backward elimination and bidirectional elimination. The last method used for stepwise logistic regression first adds the variable with the most contributive predictor (i.e. smallest AIC) like forward selection. Then the model removes any variables that no longer provide an improvement in the model fit like backward selection. This procedure of adding and removing continues until there is no smaller AIC for the model.

We perform multiple logit regression in 3 cases as follow:

1. Full set of variables

This is a benchmark case used to assess predictive performance of other cases, where stepwise variable selection comes into play. For this benchmark case, we plug in all financial and non-financial, including all dummy variables, into the model and run multiple logit regression in R. The number of variables is 139 in total. As for the result in this case, most of the variables are not statistically significant. This likely is a result of multicollinearity problem, as are too many variables. This is when stepwise selection comes in to solve these problems. We decided to use this case as a benchmark for performance comparison with stepwise selection cases only.

⁷ This is done using the R programming language.

2. Stepwise Selection Procedure on all variables

In this case, we plug all financial and non-financial, including all dummy variables, into the model and run bidirectional stepwise selection in R in order to pick the variables that can explain the dependent variables the most, and achieve minimum AIC. The result of the coefficients, as well as their significance, is shown in the Appendix C2.



Figure 18: AUC of Stepwise Logit Regression on all variables

Overall, the value of AUC for this model is 73.71%, which is a little higher than the previous full selection model. However, the total variables used in this model are in total of only 82 variables, as opposed to 139 variables in full selection model. This stepwise selection model also achieves the minimum AIC, which is an unbiased estimator that measures the goodness-of-fit of this model.

3. Stepwise Selection on continuous variables, adding all dummy variables

In the last case, we plug in only financial and non-financial continuous variables into the model and run bidirectional stepwise selection in R in order to pick the variables that can mostly explain the dependent variables. Then, we take the variables selected from stepwise selection, along with all non-financial dummy variables, and re-run multiple logit regression model. The result of the variables coefficients, as well as their significance, is shown Appendix C3



Figure 19: AUC of Stepwise Logit Regression on continuous variables, adding all dummy variables

In this case, the value of AUC for this model is 73.69%. The total number of variables used in this model is 124. This model turns out to show a little worse AUC, compared to the previous stepwise selection model.

• SME Sectoral Analysis by Logit Regression Model

In addition to running a multiple logit regression model based on the full dataset, we hypothesize that idiosyncrasies from the SME data specific to each sector might also be helpful in default probability prediction. Therefore, we segregate the full dataset into 8 sectoral datasets according to the SME s business sector. The table below shows AUCs of logit models of the different business sectors, as well as the number of observations in each sector. The results of the variables, coefficients in all the models, as well as their statistical significance, for each business sector are separately shown in Appendix C4.

Model type / AUC (%)	Trade	Manu.	Service	Constr.	Utility	Real estate	Agri.	Mining	All sectors
Multiple Logit (Appendix C2)	75.23	74.61	71.33	70.23	70.77	72.36	65.71	75.62	73.71
Multiple Logit (Appendix C2 coefficients re-estimated by sectoral data)	75.52	75.09	72.38	70.95	72.37	77.89	66.18	77.66	73.71
Stepwise Selection using sectoral data	75.60	75.25	72.61	71.15	72.41	78.31	68.95	66.87	73.71
Stepwise Selection using sectoral data (Dropping some Variables)*	75.60	75.25	72.77	71.15	72.36	78.35	71.90	74.19	73.71
Number of observations in training set Number of observations in test set	122,841 40,948	70,709 23,570	48,671 16,224	29,282 9.761	17,083 5.695	9,360 3.121	1,650 550	1,146 383	300,745 100,249
Number of all observations	163,789	94,279	64,895	39,043	22,778	12,481	2,200	1,529	400,994

Table 8: AUC results by Industry Sectors using different variables of logit models

*For Trade/Manufacturing sectors, no variables have been dropped for sectoral model since no multi-collinearity issue exists.

To perform sectoral analysis, we first predict defaults in the sectoral test dataset using the coefficients from a stepwise selection procedure on all variables as mentioned in Appendix C2. The results show that the AUCs in a sector with a larger number of observations, such as trade and manufacturing sector, are higher than the all-sector AUC. However, models for certain sectors with a lower number of observations, such as

mining, also have a higher AUC value than the all-sector AUC. This could be because such sectors exhibit unique and different characteristics compared to other sectors.

Then, we re-estimate our logit coefficients using sectoral training datasets so that each sector has different coefficients. The result shows that the AUC in a sector with a larger number of observations is similar to the previous result, while those with a smaller number of observations have higher AUCs because of sector-specific behavior. However, multi-collinearity issue with extreme standard error exists in some of the business sectors. This could be because there are too many variables in the model while the number of each sectoral observations is rather low.

Lastly, we re-perform stepwise logit regression using each sectoral training dataset to come up with new sets of explanatory variables that could seize different characteristics specific to each sector. The result shows that the AUC in most sectors have higher values except the one in the mining sector. However, multi-collinearity problem with extreme standard error still exists in the sectors with low number of observations. Only the trade and manufacturing sector can avoid this issue. Therefore, we resolve the problem by removing those variables with extreme standard errors out. The end-result shows that the AUC is higher than 70% in all sectors.

• Application of Logit Model: Credit Scorecard

With the traditional logit model results in hand, the CRD extends its practices to the financial industry by constructing the Credit Scoring Model as a leading indicator, with the aim to provide financial institutions in Thailand a complimentary tool to analyze credit risk of SMEs, including those SMEs for which might be new to any particular financial institution.

In this Credit Scoring Model, we still use the forward-looking default within the next 12 months as the dependent variable. However, for the explanatory variables, we use all above variables in level form. Similar to the logit regression model above, we first need to consider the correlations and the VIF of the explanatory variables prior to constructing the credit scorecard model for avoiding multicollinearity. The correlation matrix for the coefficients in logit model is illustrated in the Appendix C5 The table below indicates the VIF values of each variable before and after the adjustments in the credit scoring model.

Variable	VIF (Before)	VIF (After)	
Debt Dependency Ratio	<u>150.108</u>	-	
Debt Capacity Ratio	<u>143.597</u>	5.190	
ROA	<u>42.190</u>	3.761	
Operating Profit to Total Asset	<u>39.298</u>	-	
Net Profit Margin Ratio	<u>11.681</u>	2.966	
Operating Margin Ratio	<u>11.105</u>	-	
Current Ratio	9.686	9.627	
Quick Ratio	9.503	9.484	
Equity Ratio	6.746	6.241	
Asset-to-Equity Ratio	6.537	6.534	
Debt-to-Equity Ratio	5.049	5.045	
Fixed Assets to Equity Ratio	3.924	3.913	

 Table 9: Variance Inflation Factor for variables in Credit Scoring Model

Variable	VIF (Before)	VIF (After)
Debt-to-Sales Ratio	3.426	3.242
Working capital to debt ratio	3.078	3.065
Ordinary Profit to Total Asset	3.071	3.058
Reserves Ratio	2.927	2.926
Inventory Turnover Days	2.710	2.704
Years of Debt Redemption	2.678	2.585
Cash Conversion Cycle	2.609	2.608
Interest Expenses to Sales Ratio	2.548	1.954
SGA Ratio	2.025	2.010
Account Payable Turnover Days	1.887	1.857
Account Receivable Turnover Days	1.861	1.861
Ordinary Income Margin Ratio	1.811	1.779
Cash-to-Sales Ratio	1.809	1.672
Total Assets Turnover Rate	1.767	1.695
Accounts Payable Turnover Ratio	1.601	1.595
Fixed Assets to Fixed Liabilities and Total Equity	1.551	1.548
Debt-to-EBITDA Ratio	1.364	1.313
Assets Growth Rate	1.333	1.330
Fixed Assets Turnover Rate	1.289	1.288
Sales Growth Rate	1.243	1.243
ROE	1.237	1.230
Other Current Assets Ratio	1.097	1.096

In this model, we still use the threshold cut-off VIF value of 10. Together with the correlation matrix, we adjust the model until the VIF values of all explanatory variables are below 10 indicating all explanatory variables are not highly correlated among one another. Finally, 3 explanatory variables have been removed off the model as shown in the table above.

Therefore, the process for credit scoring model breaks down into three stages as follow:

1. Weighted-of-Evidence (WOE) variables transformation

First of all, we have to take all variables, whether continuous or dummy, and categorized them into appropriate discrete WOE bins. In R Application, we can achieve this using 'woebin' function from scorecard package. The 'woebin' function automatically generates optimal binning for numerical, factor and categorical variables using methods including tree-like segmentation or chi-square merge. In this case, we use tree-like segmentation method to generate optimal binning.

For each binning, we then separate the data into "default" and "non-default" groups, according to the actual dependent variable, and consider separate "default" and "non-default" distributions. The new WOE explanatory variables can be formulated as follow:

$\mathsf{WOE}_{i} = \ln(\frac{\% \, \textit{Distn NonDefault}_{i}}{\% \, \textit{Distn Default}_{i}})$

This transformation from all binnings into WOE variables is said to have a monotonically increasing or decreasing linear relationship with the dependent variable. A positive WOE means the proportion of non-default is more than that of default and vice versa for a negative WOE.

2. Stepwise Logit Regression

After we have the WOE variables, we then perform multiple logit regression by stepwise selection on these WOE variables. The formula for multiple logit regression model on WOE variables is as follow:

$$\mathbf{y} = \frac{1}{1 + e^{-(\beta_0 + \beta_1 \text{WOE}_1 + \dots + \beta_n \text{WOE}_n)}}$$

From the equation, we can see that one other benefit of using the WOE-transformed variables, instead of using discrete binnings, to run the regression is that we can greatly reduce the number of coefficients to be estimated from the total number of bins to only the number of WOE variables used.

Figure 20: AUC of Stepwise Logit Regression on WOE variables



The result of the WOE coefficients by stepwise selection, as well as their significance, is shown in the Appendix C6 The value of AUC for this model is 74.50%. The total number of WOE-transformed variables used in this model is 33.

3. Credit Score Calculation & Distribution

After we have the list of WOE-transformed variables used in logit regression model, we transform the probability of default, our dependent variable, into credit score. The above multiple logit regression formula on WOE variables can be re-expressed linearly as below:

$$\ln\left(\frac{y}{1-y}\right) = \ln(\text{Odds}) = \beta_0 + \beta_1 \text{WOE}_1 + \dots + \beta_n \text{WOE}_n$$

Now, we can use our selected WOE-transformed variables to build a credit scoring model. Our WOEtransformed variables now have linear relationship with natural logarithm of odds of default, not the probability of default. Next, we can express the credit score linearly with natural logarithm of odds as follow:

And when we combine both equations together, we get:

Credit Score = offset + factor*(
$$\beta_0+\beta_1WOE_1+...+\beta_nWOE_n$$
)
= (offset + factor* β_0) + $\sum_{i=1}^{n} \beta_i WOE_i$
= Base Score + Contributions WOE-transformed Predictors

With this equation, it can be seen that our credit scoring model comprises of a base score and the contributions by the WOE-transformed predictors. The base score can be interpreted as the initial score that an SME receives having considered other environments implied in the intercept, and not covered by WOE specific values. The contributions by the WOE-transformed predictors can be interpreted as the SME's fundamental score. This has already been calculated from the logit regression process. The breakdown of each predictor's score contribution is illustrated in Appendix C7.

Table 10: Credit Score Calculation and Score Meaning

Total Score = Base Score + Contributions by Predictors

Base Score = Offset + factor * intercept from Logit

Offset = 500, pd0 = 50, factor = pd0 / ln(2)

Score	Odds	Non-default rate	Default rate
350	1:8	11.1%	88.9%
400	1:4	20%	80%
450	1:2	33%	67%
500 (Offset score)	1:1	50%	50%
550	2:1	67%	33%
600	4:1	80%	20%
650	8:1	88.9%	11.1%

Now, we need to make initial values of offset, factor and point to double the odds (pdo) in order to calculate a base score for our own credit scoring model. The above table illustrates the settings and interpretation of the score in our credit scoring model. First, we assume an unknown SME to have an offset score of 500 with a non-default to default odd of 1:1. Then, we set an incremental score (pdo) of 50 to doubly increase or decrease the odds. By comparing any two equations between score and odds, it can be shown that the credit score will be increasing or decreasing by a scaling factor of 50/ln(2). With these assumptions, we can lastly calculate the base score and the total credit score of any SMEs according to the above prescribed formulae.



Figure 21: Total Credit Score for Default and Non-default groups - Train and Test Dataset

In order to compare the performance of our model, we have to compare the credit score of the test data with the one of train data. The graphs above demonstrate this. Overall, the credit score of both the default and non-default groups in the test data exhibit similar distributions with those of the train data, suggesting the goodness-of-fit of the model.



Figure 22: Total Credit Score for Default and Non-default groups - Full Dataset

For completeness, the histogram above illustrates the credit score for all 400,994 observations of our SME data. In total, the median score for the distribution of the SME's default group is 621 while that of non-default group is 680.

From the separation of the two distributions of SME's default and non-default groups, it can be seen that there is a large overlapping area between the two distributions, although the peaks of the distributions are clearly distinct. As such, we cannot rely solely on the credit score to decide on a loan application. More analyses and considerations may need to be made by financial institutions before making a decision whether to grant a loan to the SMEs or not. Nonetheless, one of the indicators that could be useful is to consider the credit score threshold for granting a loan.

Figure 23: Minimum Thresholds of Credit Score using Logistic Classifier's Metrics



To derive the minimum threshold score that is appropriate for the financial institutions to grant an SME loan, we use concepts of accuracy, sensitivity, and specificity to assess the acceptable credit score. The formulae for accuracy, sensitivity, and specificity rate are as follow:

TP+TN	<u>True positive (TP)</u>	
$Accuracy = \frac{1}{TP+TN+FP+FN}$	No. of Correctly identified Defaulters	
	False positive (FP)	
Sensitivity = $\frac{TP}{TP+FN}$ where	No. of Incorrectly identified Defaulters	
	<u>True negative (TN)</u>	
Specificity = $\frac{\text{TN}}{\text{TN+FP}}$	No. of Correctly identified Non-defaulters	
	False negative (FN)	
	No. of Incorrectly identified Non-defaulters	

Accuracy rate measures the ability to differentiate both the defaulters and non-defaulters correctly, while sensitivity rate measures the ability to determine the defaulters, and specificity measures the ability to determine non-defaulters. With too low a threshold score, we will predict too high the number of non-defaulters. Accuracy and specificity rates will be high but sensitivity rate will be low. This is really not what we want because we want to identify as many defaulters as we can (i.e. minimum false negative cases). With too a high threshold score, we will predict too high the number of defaulters. Sensitivity rate will be high but accuracy and specificity rates will be low. This is also not favorable as there will be too high number of false positive cases, losing an opportunity to grant the loan.

From the graph above, we can see that the appropriate minimum threshold score is the area around where all the rates are intersected, which is the credit score of approximately 650, for flexibility to adjust the measurements being consistent with credit-risk management policy.

4.2 Decision Tree Model

Due to rapid increases in data availability and computing power, machine learning now contributes significantly to credit risk modeling applications of SMEs borrowers. Tree-based machine learning methods are among the most commonly used supervised learning methods. Starting with a decision tree which is a simply series of tree-based model. A decision tree is constructed from two components; branches and nodes which recursively split a training sample, using different features from a dataset at each node.

We use a total of 143 variables comprising of financial variables and non-financial variables in dummy and categorical forms. As our dataset consists of 10% of default group and 90% of non-default group, we are faced with the imbalanced data problem. To solve this problem, we apply over-sampling on the default group to make it 30% of the training set and under-sampling on the non-default group to make it 70% of the training set. Our decision tree was built using the following characteristics: (1) the complexity parameter (cp) = 0.001 (2) the maximum depth of the tree (maxdepth) = 8 (3) the building method using "rpart" package.

The decision tree starts with a root node, seeking the most important variable according to the impurity criterion. In our case, "interest expense to sales ratio" is found to be the most important variable. The algorithm then recursively seeks other important variables according to the impurity criterion, and output branches are selected until the leaf node is reached. Finally, the category stored by the leaf node is regards as the decision result ("probability of default") as seen in Figure 24.
To illustrate, the decision tree model starts with SME's interest expense to sales ratio. Based on that, it classifies the customer into two groups, i.e., customer with interest expense to sell ratio less than 3% (1st group) and customer with interest expense to sell ratio equal or more than 3% (2nd group). Then it checks loan size for the 1st group and checks sale growth ratio for the 2nd group and again recursive binary spilt until reaching the leaf node. Finally, it provides probability of default for each node that helping the lender decides whether the customer's loan should be approved or not. The decision tree model reaches AUC at 72.43%, marking a good performance to distinguish between the non-default and default group.







Figure 24: Decision Tree Model

Yes

obs = 4%

PD = 0.5 obs = 3%

PD = 0.64

PD = 0.53

PD = 0.58 obs = 4%

obs = 11%

4.3 Random Forest Model

A random forest is comprised of a large number of decision trees and merges them to obtain a more accurate and stable prediction. Random forests lead to less over-fit compared to a single decision tree, especially if there is a sufficient number of trees in the forest. Random forest belongs to supervised learning algorithm as a random subset of features are considered by the algorithm each time a node is being split.

We use a total of 147 variables comprising of financial variables in both level and logarithm formats as well as non-financial dummy variable in the model. To solve the imbalanced data problem, we apply oversampling on the default group to make it 30% of the training set and under-sampling on the non-default group to make it 70% of the default group, similar to the decision tree model. Our random forest is built using the number of trees equal to 500. To improve the model performance, we provide the tuneRanger package in R that tunes the hyperparameters with automated model-based optimization (MBO). This method suggests the number of randomly drawn candidate variables (mtry) to be 36. After training a random forest, it provides "variable importance" that have a significant impact on the probability of default. The table 11 below shows the importance of 20 variables when predicting an outcome (probability of default). It is noteworthy that the random forest model has AUC of 80.45%, the best performance among all our models.

Figure 24: AUC of Random Forest Model



Rank	Variable	(node purity)
1	Interest expense to sales	3087.14
2	Sales growth	2971.31
3	Firm age	2136.88
4	Cash to sales	2068.83
5	Reserves ratio	1856.36
6	Total assets turnover Rate	1771.39
7	Working capital to debt	1753.08
8	Asset growth	1584.89
9	Account payable turnover	1532.72
10	Fixed asset turnover	1417.06
11	Account receivable turnover	1337.75
12	Fixed assets to fixed liabilities and total equity	1295.51
13	SGA ratio	1284.38
14	Ordinary income Margin	1247.77
15	Net margin	1194.37
16	Quick ratio	1190.10
17	Equity ratio	1168.57
18	Current ratio	1165.05
19	Fixed assets to total equity	1158.13
20	Operating profit to total asset	1146.12

Table 11: Variable importance of the random forest model

As SMEs have different characteristics across sectors, we run Random Forest model on full training dataset and find that the prediction efficiency (AUC) is higher for all sectors as we can define the suitable cutoff threshold for each sector, leading to more flexible to classify between default and non-default groups. Next, we try to use sectoral data instead to develop the more sector specific models for each sector and find that the AUC is lower as the lower data being available for each sector; thus, lacks data to detect the varieties of default and non-default patterns. However, one of the most important drawback of sectoral results is we cannot compare probability of default (PD) across sectors as each sector use a different training dataset as well as a cut-off threshold to classify between default and non-default groups.

Table 12: Random Forest by Sector using Sectoral Models⁸

Model type / AUC (%)	Trade	Manu.	Service	Constr.	Utility	Real estate	Agri.	Mining	All sectors
Random forest	96.47	96.41	96.51	95.60	96.27	97.36	98.35	94.97	80.45
Sectoral random forest	81.36	83.05	79.18	74.08	79.17	84.95	85.44	84.41	80.45
Number of observations in training set	122,841	70,709	48,671	29,282	17,083	9,360	1,650	1,146	300,745
Number of observations in test set	40,948	23,570	16,224	9,761	5,695	3,121	550	383	100,249
Number of all observations	163,789	94,279	64,895	39,043	22,778	12,481	2,200	1,529	400,994

 $^{^{8}}$ Random forest was built from all observations in the training dataset, while sectoral random forest models were built from sectoral subsets of the training dataset.

In this paper, we built various credit risk models for Thai small and medium enterprises (SMEs) registered as juristic persons. This is done as a part of the study on the feasibility of introducing a credit risk database (CRD) to help improve financial inclusion in Thailand, through the promotion of information-based lending to SMEs.

The dataset used in this paper is derived from financial and non-financial profile data collected by the Department of Business Development (DBD), Ministry of Commerce, and loan data from financial institutions under the supervision of the Bank of Thailand. To build models that can accommodate lending to SMEs that are "new to bank", data on loan repayment behavior were not included as explanatory variables, only those on financial ratios and firm profiles.

Evaluating the models based on the test data, to avoid overfitting problems, we found that the econometric and machine learning models yielded reasonably accurate one-year forward probability of default predictions, with AUC at approximately 70-80%. Based on weight-of-evidence (WOE) methodology, we also built a credit scorecard model that can potentially be used to help financial institutions assess credit risk of new loan applicants. Given that the dataset used to build the model has industry-wide coverage, the resulting models could help financial institutions better assess risk of customer segments new to them, and thus improve financial access for SMEs in general.

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Appendix A: Detailed notes on data, modelling methods and limitations

About the data

- The loan data collected from LAR & SMD is the second-largest loan database in Thailand, second only to National Credit Bureau (NCB) database which also includes non-bank lending data. This coverage can help avoid the selective-default or cross-default problem when creating the loan status used as the dependent variable from borrowers who borrow more than one bank, because each financial institution has only loan data lending to the borrowers by itself and borrowers may default on a loan from the other banks. So, the more coverage the loan database, the better the selective-default can solve.
- CRD applies data masking policy for data leak prevention and data privacy protection using Pseudonymization process by hashing algorithm with salt.
- The datasets are much larger than maximum number of rows supporting in MS Excel spreadsheet. Therefore, we store the data to Hadoop Ecosystem instead and manage (union and merge join) it by Impala SQL. The connection between Hadoop server and our clients are connected by ODBC driver for data transfer. Then, creating and cleansing variables is done by R programming with the most popular R packages that everyone must know of (i.e. dplyr tidyr).
- We combine the LAR and SMD database and intersect with CPFS database and filter with multiple conditions for obtaining SMEs registered as juristic and received a loan granted by bank to use for this analysis.
- Data cleansing is inevitable even though it decreases the number of observation in the database due to improve data quality before feeding into models.
- The observations from the CRD database only starts at year 2014 due to the shortage of the reported SMD data. Besides that, we also make use of another complement SMP database to fill up any incomplete CPFS database from DBD.
- The data that we use (400,994 observations) is subdivided into 2 datasets, 75% into the training dataset and 25% into the test dataset, for simple cross-validation called train-test split. In total, there are 300,745 observations in the training dataset for model estimation and 100,249 observations in the test dataset for model evaluation.

About the analysis

- The explanatory variables in the models are financial ratios and firm profiles rather than the commonly-used variables on loan repayment or loan usage behaviors in order to accommodate the case where financial institutions need to assess riskiness of loan applicants who are not yet their own customers. Other groups of explanatory variables, such as variables on application or platform or mobile usage behaviors, are also prevalent recently and can be considered as alternative data. However, this type of dataset is still in the process of feasibility study to collect the data to BOT.
- By adding categorical variables as dummy variables to the combination of financial ratio data, we are able to increase the accuracy of the model.
- In machine learning, there is a trade-off between predictive power (performance) and descriptive power (interpretation). Generally, the better the model performance, the more complex and less

understandable. For instance, a decision tree can be interpreted simply by plotting the tree and seeing how splits are made. However, there's no specific way to do that with a random forest which are usually better at making a prediction. Because, each tree in a random forest is much more complex than a decision tree. So, that is why a random forest model is called a black box model.

Model	AUC (%)	Gini (%)
Econometric Model		
Logistic regression	74.69	49.38
• Logistic regression (weight of evidence)	74.57	49.14
Tree-based Model		
Decision tree	72.43	44.86
Random forest	80.45	60.90

Table 13: Out-of-sample performance comparison among different types of models

- The table 13 above shows the performance of all models measuring by AUC and Gini. The best model in terms of performance providing maximum AUC is a random forest. However, in terms of interpretation and application development, the logistic regression (weight of evidence) seeming like the second-best performance and providing scorecard application is more user-friendly to use and understand for credit officers.
- The appropriate minimum threshold score for granting a loan is the area around the optimal cut-off point as the point minimizing the Euclidean distance between the ROC curve and the (0,1) point for flexibility to adjust the measurements in the curve being consistent with credit-risk management policy.
- Building models for each category (i.e. business sector) will be appropriate if the data in that sector is sufficient to hold the law of large number for providing statistical significance to explanatory variables and an acceptable value of AUC. Moreover, we cannot compare a sectoral probability of default (PD) across sectors because of the differences in training datasets and cut-off thresholds for each of the sectors.
 - Econometric models: Multi-collinearity exists in some business sectors because of a small sample size. After solving this problem, the result shows that the AUCs in the sector with a large sample size, such as trade and manufacturing sector, are higher than the all-sector AUC. However, some sectors with low observations, such as mining and real estate, also indicate a higher AUC value because of sector-specific behaviors.
 - Machine learning models: The result shows that the AUC of the sector-specific model is lower than the multi-sector AUC as a smaller sample size available for each sector; thus, lack of data to detect the default and non-default pattern.
- Credit score model is a result from predictive analytics by learning historical data and predicting credit risk as a credit score. This type of data analytics can improve a user's ability to make a better decision as a data-driven decision and reduce human decision-making. However, the analytics still makes a decision depending on some human input (i.e. credit officer opinions) to finalize a decision. The levels of analytics is not the same as prescriptive analytics making a decision automatically without any human input.

• In this paper, we have studied the feasibility of building a qualified credit risk scoring model for Thai SMEs firms. From the results of the study, we positively access its feasibility and recommend the introduction of CRD in Thailand. Furthermore, larger and more variety of dataset contributing from participants could lead to more concise and robust models.

About the Limitations

- The credit risk model in this report is an A-score model which generally has smaller degree of accuracy than a B-score model. Financial institutions are encouraged to apply both types of credit score models for the credit risk assessment process.
- The database for credit risk models covers most financial institutions in Thailand, except non-banks and financial institutions that have not been supervised and examined by the Bank of Thailand. Therefore, this degree of coverage in the current stage of CRD is considered to be less than the National Credit Bureau (NCB).
- The data quality of financial statements submitted to the DBD can be questionable to a certain degree. This is due to the fact that some juristic entities might be motivated to submit falsified financial statements with small amount of net profit in order for themselves to be subject to less corporate income tax. So, the analytical results of CRD mainly based on financial factors may be inaccurate and could lead to overestimate of the SMEs[•] probability of default. However, promoting single-financial account scheme among SMEs nationwide to increase transparency and business governance should eventually reflect the real status of their businesses.
- Credit risk models in this report emphasize on the impact from quantitative factors (e.g., financial ratios on financial statements) while still lack of company-specific qualitative factors (e.g., management quality, innovation adoption) and any alternative data reflecting behaviors (e.g., application or platform-usage behavior, mobile-usage behavior). All factors that are indicated can be mutually indicative of the SMEs⁻ probability of default.

Appendix B: Financial and Non-financial variables distribution

















4. Stability Ratio





5. Solvency Ratio













7. Funding and Funding utilization



Financial variables	Outlier		
Financial variables		Max	
8. Assets Condition Ratio			



2. Non-Financial variables distribution





Appendix C: Logit Regression & Credit Scoring Model

C1: Correlation Matrix for coefficients in Logit Regression Model

Variable	Coefficient	Std. Error	z value	Pr(> z)
(Intercept)	-0.658	0.105	-6.250	<0.001***
Continuous variable				
In(Interest Expenses to Sales)	0.123	0.009	13.043	<0.001***
In(Sales Growth)	-0.059	0.002	-27.415	<0.001***
ln(Cash to Sales)	-0.372	0.011	-34.948	<0.001***
Firm Age	-0.028	0.001	-36.001	<0.001***
Account Payable Turnover Days	0.003	0.000	27.037	<0.001***
In(Total Assets Turnover)	-0.589	0.023	-25.595	<0.001***
ln(Debt to Equity)	-0.098	0.015	-6.461	<0.001***
ln(ROE)	-0.030	0.003	-10.593	<0.001***
In(Reserves Ratio)	0.014	0.008	1.814	0.070.
Other Current Assets Ratio	0.004	0.000	8.416	<0.001***
ln(Assets Growth)	-0.017	0.003	-6.451	<0.001***
In(Quick Ratio)	0.015	0.008	1.808	0.071.
Fixed Assets to Equity	0.000	0.000	7.110	<0.001***
Years of Debt Redemption	-0.015	0.001	-15.639	<0.001***
ln(ROA)	-0.045	0.008	-5.370	<0.001***
ln(Equity Ratio)	-0.031	0.006	-4.768	<0.001***
ln(Debt-to-EBITDA)	-0.033	0.004	-7.467	<0.001***
SGA Ratio	-0.001	0.000	-6.074	<0.001***
ln(Authorized Shareholding Capital)	-0.035	0.006	-6.214	<0.001***
In(Account Payable Turnover)	0.026	0.006	4.498	<0.001***
In(Current Ratio)	0.075	0.011	6.538	<0.001***
Inventory Turnover Days	-0.001	0.000	-10.046	<0.001***
Cash Conversion Cycle	0.011	0.001	10.231	<0.001***
Account Receivable Turnover Days	-0.001	0.000	-6.676	<0.001***
Debt to Sales	0.000	0.000	-7.342	<0.001***
Debt Capacity Ratio	0.001	0.000	5.920	<0.001***
In(Ordinary Income Margin)	-0.019	0.005	-3.578	<0.001***
In(Fixed Assets Turnover)	0.027	0.006	4.193	<0.001***
Net Profit Margin	-0.001	0.000	-2.489	0.013*
In(Working Capital to Debt)	-0.040	0.016	-2.502	0.012*
In(Ordinary Profit to Total Asset)	0.010	0.006	1.708	0.088.
Dummy variable				
Loan Size : <50K	-1.122	0.037	-30.158	<0.001 ***

$C2: Multiple \ Logit \ Regression \ Result \ (Stepwise \ Selection \ Procedure \ on \ all \ variables \)$

Variable	Coefficient	Std. Error	z value	Pr(> z)
Loan Size : 50K - 350K	-0.197	0.026	-7.574	< 0.001 ***
Loan Size : 1M - 5M	0.168	0.021	7.981	< 0.001 ***
Loan Size : > 5M	0.621	0.022	28.019	< 0.001 ***
SME Size : Micro	0.766	0.025	30.638	< 0.001 ***
SME Size : Medium	-0.517	0.020	-25.598	< 0.001 ***
ISIC : Manufacturing	0.036	0.016	2.205	0.027*
ISIC : Real Estate	-0.591	0.043	-13.766	< 0.001 ***
ISIC : Construction	0.579	0.019	29.966	< 0.001 ***
ISIC : Utility	0.170	0.026	6.556	< 0.001 ***
ISIC : Agriculture	-0.220	0.085	-2.583	0.010**
Registration Type : Partnerships	0.199	0.016	12.078	< 0.001 ***
Year of Financial Statement : 2558	-0.069	0.017	-4.128	< 0.001 ***
Year of Financial Statement : 2561	0.081	0.015	5.292	< 0.001 ***
Region : Central	0.073	0.032	2.312	0.021*
Region : Eastern	-0.222	0.026	-8.702	< 0.001 ***
Province Bangkok	-0.406	0.031	-13.150	< 0.001 ***
Province : SamutPrakarn	-0.334	0.036	-9.164	< 0.001 ***
Province : Phatthalung	0.582	0.110	5.280	< 0.001 ***
Province : NakhonPathom	-0.325	0.052	-6.243	< 0.001 ***
Province : Yala	-0.589	0.145	-4.070	< 0.001 ***
Province : SuratThani	0.184	0.048	3.812	< 0.001 ***
Province : Yasothon	0.573	0.136	4.210	< 0.001 ***
Province : PhangNga	0.248	0.089	2.788	0.005**
Province : SamutSakhon	-0.388	0.046	-8.445	< 0.001 ***
Province : Phetchabun	-0.558	0.140	-3.983	< 0.001 ***
Province : LopBuri	-0.447	0.108	-4.125	< 0.001 ***
Province : Kalasin	0.373	0.110	3.384	< 0.001 ***
Province : Chaiyaphum	-0.366	0.120	-3.062	0.002**
Province : Nonthaburi	-0.173	0.039	-4.435	< 0.001 ***
Province : Lamphun	-0.287	0.096	-2.996	0.003**
Province : Sukhothai	0.300	0.134	2.231	0.026*
Province : Trang	0.206	0.083	2.493	0.013*
Province : UdonThani	-0.199	0.081	-2.458	0.014*
Province : Loei	-0.331	0.141	-2.358	0.018*
Province : Kanchanaburi	0.170	0.081	2.094	0.036*
Province : Chanthaburi	-0.271	0.132	-2.050	0.040*

Variable	Coefficient	Std. Error	z value	Pr(> z)
Province : KamphaengPhet	-0.236	0.111	-2.128	0.033*
Province : Trat	-0.323	0.173	-1.872	0.061.
Province : Nan	0.269	0.138	1.957	0.050.
Province : BuriRam	-0.211	0.109	-1.934	0.053.
Province : PathumThani	-0.131	0.039	-3.361	< 0.001 ***
Province : NongKhai	-0.249	0.131	-1.903	0.057.
Province : Phetchaburi	-0.210	0.111	-1.884	0.060.
Province : Surin	-0.233	0.126	-1.844	0.065.
Province : SamutSongkhram	-0.376	0.169	-2.220	0.026*
Province : AmnatCharoen	0.312	0.181	1.721	0.085.
Province : Krabi	-0.135	0.085	-1.596	0.110
Province : Sakaeo	0.235	0.145	1.625	0.104
Province : ChaiNat	-0.252	0.174	-1.444	0.149
Province : Phichit	-0.210	0.148	-1.414	0.157

Signif. codes: 0 **** 0.001 *** 0.01 ** 0.05 * 0.1 * 1

C3: Multiple Logit Regression Result (Stepwise Selection on continuous variables with dummy variables separated)

Variable	Coefficient	Std. Error	z value	$\Pr(> z)$
(Intercept)	-1.710	0.249	-6.863	< 0.001 ***
Continuous Variable				
In(Interest Expenses to Sales)	0.129	0.009	13.690	< 0.001 ***
In(Sales Growth)	-0.060	0.002	-28.707	< 0.001 ***
ln(Cash to Sales)	-0.375	0.011	-35.224	< 0.001 ***
Firm Age	-0.028	0.001	-36.057	< 0.001 ***
In(Total Assets Turnover)	-0.581	0.023	-25.329	< 0.001 ***
In(Authorized Shareholding Capital)	-0.038	0.006	-6.572	< 0.001 ***
ln(Debt-to-EBITDA)	-0.029	0.004	-6.670	< 0.001 ***
Account Payable Turnover Days	0.003	0.000	28.452	< 0.001 ***
In(Account Payable Turnover)	0.022	0.006	3.831	< 0.001 ***
Other Current Assets Ratio	0.004	0.000	8.544	< 0.001 ***
In(Quick Ratio)	0.005	0.008	0.642	0.521
In(Debt to Equity)	-0.153	0.011	-14.505	<0.001 ***
ln(ROE)	-0.030	0.003	-10.641	<0.001 ***
Years of Debt Redemption	-0.015	0.001	-15.899	<0.001 ***
Debt Capacity Ratio	0.002	0.000	12.066	< 0.001 ***
ln(ROA)	-0.058	0.008	-6.982	<0.001 ***
Fixed Assets to Equity	0.000	0.000	9.058	< 0.001 ***
Debt to Sales	0.000	0.000	-7.998	< 0.001 ***
Cash Conversion Cycle	0.010	0.001	10.039	< 0.001 ***
Account Receivable Turnover Days	-0.001	0.000	-5.770	<0.001 ***
Inventory Turnover Days	-0.001	0.000	-9.747	< 0.001 ***
In(Ordinary Income Margin)	-0.020	0.005	-3.700	< 0.001 ***
In(Ordinary Profit to Total Asset)	0.008	0.006	1.382	0.167
In(Current Ratio)	0.076	0.011	6.684	<0.001 ***
Net Profit Margin	-0.001	0.000	-2.566	0.010*
SGA Ratio	-0.001	0.000	-6.224	<0.001 ***
In(Fixed Assets Turnover)	0.032	0.006	5.018	<0.001 ***
In(Working Capital to Debt)	-0.054	0.016	-3.437	<0.001 ***
In(Reserves Ratio)	0.018	0.008	2.288	0.022*
Dummy Variable				
Loan Size : > 5M	1.734	0.036	48.093	< 0.001 ***
Loan Size : 1M - 5M	1.279	0.036	35.808	< 0.001 ***

Variable	Coefficient	Std. Error	z value	Pr(> z)
Loan Size : 350K - 1M	1.114	0.037	29.942	< 0.001 **
Loan Size : 50K - 350K	0.923	0.039	23.902	< 0.001 **
Year of Financial Statement : 2558	-0.051	0.021	-2.464	0.014*
Year of Financial Statement : 2559	0.018	0.021	0.894	0.371
Year of Financial Statement : 2560	0.017	0.020	0.871	0.384
Year of Financial Statement : 2561	0.091	0.020	4.612	<0.001**
SME Size : Small	-0.758	0.025	-30.319	< 0.001 **
SME Size : Medium	-1.267	0.034	-37.478	<0.001**
Registration Type : Company Limited	0.086	0.201	0.426	0.670
Registration Type : Partnerships	0.273	0.202	1.352	0.176
ISIC : Construction	0.790	0.086	9.149	<0.001 **
ISIC : Manufacturing	0.257	0.086	2.996	0.003**
ISIC : Mining	0.131	0.132	0.993	0.321
ISIC : Real Estate	-0.349	0.094	-3.711	<0.001 **
ISIC : Service	0.236	0.086	2.738	0.006**
ISIC : Trade	0.212	0.085	2.479	0.013*
ISIC : Utility	0.403	0.088	4.583	<0.001 **
Province : AmnatCharoen	0.644	0.181	3.552	<0.001 **
Province : AngThong	0.397	0.175	2.275	0.023*
Province : BuengKan	0.274	0.173	1.579	0.114
Province : BuriRam	0.129	0.109	1.186	0.236
Province : Chachoengsao	0.096	0.063	1.528	0.127
Province : ChaiNat	0.155	0.173	0.897	0.370
Province : Chaiyaphum	-0.031	0.120	-0.260	0.795
Province : Chanthaburi	-0.161	0.131	-1.230	0.219
Province : ChiangMai	0.300	0.039	7.692	< 0.001 **
Province : ChiangRai	0.411	0.068	6.057	< 0.001 **
Province : ChonBuri	0.096	0.030	3.247	0.001 **
Province : Chumphon	0.340	0.111	3.046	0.002**
Province : Kalasin	0.712	0.110	6.456	<0.001 **
Province : KamphaengPhet	0.099	0.111	0.895	0.371
Province : Kanchanaburi	0.505	0.081	6.234	< 0.001 **
Province : KhonKaen	0.328	0.058	5.653	<0.001**
Province : Krabi	0.202	0.084	2.393	0.017*
Province : Lampang	0.382	0.073	5.210	<0.001**
Province : Lamphun	0.050	0.096	0.522	0.602

Variable	Coefficient	Std. Error	z value	Pr(> z)
Province : Loei	0.015	0.141	0.104	0.917
Province : LopBuri	-0.037	0.105	-0.352	0.725
Province : MaeHongSon	0.459	0.255	1.798	0.072.
Province : MahaSarakham	0.376	0.122	3.069	0.002**
Province : Mukdahan	0.506	0.159	3.179	0.001 **
Province : NakhonNayok	0.513	0.140	3.674	< 0.001 ***
Province : NakhonPathom	0.085	0.045	1.875	0.061.
Province : NakhonPhanom	0.493	0.144	3.430	< 0.001 ***
Province : NakhonRatchasima	0.360	0.051	7.106	< 0.001 ***
Province : NakhonSawan	0.249	0.079	3.145	0.002**
Province : NakhonSiThammarat	0.367	0.063	5.800	< 0.001 ***
Province : Nan	0.615	0.138	4.471	< 0.001 ***
Province : Narathiwat	0.471	0.127	3.695	< 0.001 ***
Province : NongBuaLamPhu	0.398	0.160	2.484	0.013*
Province : NongKhai	0.090	0.131	0.685	0.493
Province : Nonthaburi	0.232	0.028	8.166	< 0.001 ***
Province : PathumThani	0.275	0.029	9.548	< 0.001 ***
Province : Pattani	0.339	0.137	2.467	0.014*
Province : PhangNga	0.587	0.089	6.615	< 0.001 ***
Province : Phatthalung	0.921	0.110	8.358	< 0.001 ***
Province : Phayao	0.521	0.137	3.810	< 0.001 ***
Province : Phetchabun	-0.145	0.138	-1.051	0.293
Province : Phetchaburi	0.125	0.111	1.123	0.261
Province : Phichit	0.199	0.146	1.361	0.174
Province : Phitsanulok	0.436	0.084	5.208	< 0.001 ***
Province : Phrae	0.369	0.122	3.035	0.002**
Province : PhraNakhonSiAyutthaya	0.401	0.047	8.458	< 0.001 ***
Province : Phuket	0.280	0.045	6.243	< 0.001 ***
Province : PrachinBuri	0.164	0.088	1.861	0.063.
Province : PrachuapKhiriKhan	0.430	0.082	5.271	< 0.001 ***
Province : Ranong	0.475	0.157	3.014	0.003 **
Province : Ratchaburi	0.376	0.073	5.139	< 0.001 ***
Province : Rayong	0.134	0.043	3.106	0.002**
Province : RoiEt	0.406	0.115	3.540	< 0.001 ***
Province : Sakaeo	0.348	0.144	2.419	0.016*
Province : SakonNakhon	0.236	0.113	2.077	0.038*

Variable	Coefficient	Std. Error	z value	$\Pr(> z)$
Province : SamutPrakarn	0.072	0.025	2.849	0.004 **
Province : SamutSakhon	0.021	0.038	0.565	0.572
Province : SamutSongkhram	0.040	0.167	0.240	0.810
Province : Saraburi	0.346	0.057	6.084	< 0.001 ***
Province : Satun	0.535	0.152	3.525	< 0.001 ***
Province : SingBuri	0.604	0.163	3.714	< 0.001 ***
Province : SiSaKet	0.262	0.133	1.969	0.049*
Province : Songkhla	0.292	0.043	6.804	< 0.001 ***
Province : Sukhothai	0.710	0.132	5.377	< 0.001 ***
Province : SuphanBuri	0.450	0.075	6.019	< 0.001 ***
Province : SuratThani	0.521	0.048	10.904	< 0.001 ***
Province : Surin	0.109	0.126	0.863	0.388
Province : Tak	0.377	0.114	3.314	< 0.001 ***
Province : Trang	0.543	0.082	6.589	< 0.001 ***
Province : Trat	-0.208	0.172	-1.212	0.226
Province : UbonRatchathani	0.256	0.082	3.124	0.002 **
Province : UdonThani	0.138	0.081	1.712	0.087.
Province : UthaiThani	0.350	0.195	1.791	0.073.
Province : Uttaradit	0.472	0.129	3.660	< 0.001 ***
Province : Yala	-0.249	0.145	-1.716	0.086.
Province : Yasothon	0.915	0.136	6.719	< 0.001 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

C4: Sectoral Analysis by Logit Regression Model (8 Sectors)

1. Trade Sector

Variable	Multiple Logit (Appendix C2 coefficients re- estimated by sectoral obs)			Sectoral Stepwise Selection			Sectoral Stepwise Selection (Dropping some Variables)		
	Coeff.	Std. Err.	Pr (> z)	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	Pr (> z)
(Intercept)	-1.228	0.193	< 0.001 ***	-2.479	0.739	< 0.001 ***	-2.479	0.739	< 0.001 ***
Continuous variable									
In(Ordinary Profit to Total Asset)	0.029	0.009	0.001 **	0.028	0.009	0.001 **	0.028	0.009	0.001 **
ln(ROA)	-0.088	0.014	< 0.001 ***	-0.215	0.025	< 0.001 ***	-0.215	0.025	< 0.001 ***
ln(ROE)	-0.029	0.005	< 0.001 ***	-0.032	0.005	< 0.001 ***	-0.032	0.005	< 0.001 ***
ln(Ordinary Income Margin)	-0.041	0.010	<0.001 ***	-0.045	0.010	<0.001 ***	-0.045	0.010	<0.001 ***
Net Profit Margin	-0.001	0.001	0.375	-0.005	0.001	< 0.001 ***	-0.005	0.001	< 0.001 ***
SGA Ratio	-0.002	0.000	< 0.001 ***	-0.002	0.000	< 0.001 ***	-0.002	0.000	< 0.001 ***
In(Current Ratio)	0.083	0.019	< 0.001 ***	0.086	0.015	< 0.001 ***	0.086	0.015	< 0.001 ***
In(Quick Ratio)	0.012	0.012	0.322						
In(Reserves Ratio)	0.068	0.013	< 0.001 ***	0.067	0.013	< 0.001 ***	0.067	0.013	< 0.001 ***
ln(Cash to Sales)	-0.403	0.019	< 0.001 ***	-0.394	0.018	< 0.001 ***	-0.394	0.018	< 0.001 ***
In(Sales Growth)	-0.061	0.004	< 0.001 ***	-0.060	0.004	< 0.001 ***	-0.060	0.004	< 0.001 ***
ln(Assets Growth)	-0.022	0.004	< 0.001 ***	-0.023	0.004	< 0.001 ***	-0.023	0.004	< 0.001 ***
In(Equity Ratio)	-0.005	0.011	0.650						
ln(Debt to Equity)	-0.186	0.024	< 0.001 ***	-0.551	0.052	< 0.001 ***	-0.551	0.052	< 0.001 ***
Debt Capacity Ratio	0.001	0.000	0.002 **	0.001	0.000	0.019*	0.001	0.000	0.019*
Debt to Sales	0.000	0.000	0.978						
ln(Working Capital to Debt)	-0.048	0.028	0.081.	-0.120	0.027	<0.001 ***	-0.120	0.027	<0.001 ***
In(Interest Expenses to Sales)	0.170	0.017	< 0.001 ***	0.095	0.019	< 0.001 ***	0.095	0.019	< 0.001 ***
Years of Debt Redemption	-0.013	0.002	< 0.001 ***	-0.010	0.002	< 0.001 ***	-0.010	0.002	< 0.001 ***
ln(Debt-to-EBITDA)	-0.017	0.007	0.022*	-0.057	0.009	< 0.001 ***	-0.057	0.009	< 0.001 ***
In(Total Assets Turnover)	-0.665	0.037	< 0.001 ***	-0.594	0.034	< 0.001 ***	-0.594	0.034	< 0.001 ***
ln(Fixed Assets Turnover)	0.021	0.010	0.032*						
Account Receivable Turnover Days	-0.001	0.000	< 0.001 ***	-0.001	0.000	< 0.001 ***	-0.001	0.000	< 0.001 ***
Inventory Turnover Days	-0.002	0.000	<0.001 ***	-0.002	0.000	< 0.001 ***	-0.002	0.000	< 0.001 ***
Account Payable Turnover Days	0.003	0.000	< 0.001 ***	0.003	0.000	< 0.001 ***	0.003	0.000	< 0.001 ***
Turnover)	0.028	0.010	0.005 **	0.027	0.010	0.007 **	0.027	0.010	0.007 **
Cash Conversion Cycle	0.011	0.002	<0.001 ***	0.010	0.002	< 0.001 ***	0.010	0.002	< 0.001 ***
Fixed Assets to Equity	0.001	0.000	<0.001 ***	0.000	0.000	0.002**	0.000	0.000	0.002**
Other Current Assets Ratio	0.004	0.001	< 0.001 ***	0.004	0.001	< 0.001 ***	0.004	0.001	< 0.001 ***
Firm Age	-0.031	0.001	<0.001 ***	-0.032	0.001	<0.001 ***	-0.032	0.001	<0.001 ***
In(Authorized Shareholding Capital)	-0.003	0.011	0.755						
Dummy variable									
Loan Size : 1M - 5M	0.225	0.036	< 0.001 ***	0.241	0.036	< 0.001 ***	0.241	0.036	< 0.001 ***
Loan Size : 50K - 350K Loan Size : > 5M	-0.142 0.791	0.045 0.038	0.002 ** <0.001 ***	-0.151 0.818	0.045 0.038	<0.001 *** <0.001 ***	-0.151 0.818	0.045 0.038	<0.001 *** <0.001 ***

Variable	Multiple Logit (Appendix C2 coefficients re- estimated by sectoral obs)			Sectoral Stepwise Selection			Sectoral Stepwise Selection (Dropping some Variables)		
	Coeff.	Std. Err.	Pr(> z)	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	Pr(> z)
Loan Size : <50K	-1.191	0.064	< 0.001 ***	-1.185	0.064	< 0.001 ***	-1.185	0.064	< 0.001 ***
SME Size : Medium	-0.616	0.032	< 0.001 ***	-0.605	0.030	< 0.001 ***	-0.605	0.030	< 0.001 ***
SME Size : Micro	0.719	0.044	< 0.001 ***	0.707	0.043	< 0.001 ***	0.707	0.043	< 0.001 ***
Registration Type :				1.020	0.722	0.156	1.020	0.722	0.156
Company Limited				1.039	0.732	0.150	1.039	0.732	0.150
Registration Type :	0.245	0.027	< 0.001 ***	1.283	0.732	0.080.	1.283	0.732	0.080.
Partnerships									
Year of Financial Statement : 2557	-0.082	0.030	0.006**						
Year of Financial	0.000	0.020	0.002 **						
Statement : 2558	-0.090	0.029	0.002**						
Year of Financial Statement : 2559				0.081	0.029	0.006**	0.081	0.029	0.006**
Year of Financial				0.094	0.028	<0.001 ***	0.094	0.028	<0.001 ***
Statement : 2560				0.074	0.020	<0.001	0.074	0.020	<0.001
Year of Financial Statement : 2561	0.101	0.027	< 0.001 ***	0.186	0.028	< 0.001 ***	0.186	0.028	< 0.001 ***
Region : Central	0.068	0.057	0.227						
Region : Eastern	-0.140	0.045	0.002 **	-0.157	0.042	< 0.001 ***	-0.157	0.042	< 0.001 ***
Province : AmnatCharoen	0.243	0.273	0.372						
Province : Bangkok	-0.301	0.055	<0.001 ***	-0.243	0.026	< 0.001 ***	-0.243	0.026	<0.001 ***
Province : BuriRam	-0.703	0.216	0.001 **	-0.723	0.215	< 0.001 ***	-0.723	0.215	< 0.001 ***
Province : ChaiNat	-0.277	0.318	0.385						
Province : Chaiyaphum	-0.149	0.180	0.409						
Province : Chanthaburi	-0.159	0.185	0.392						
Province : Kalasin	0.212	0.168	0.209						
Province : KamphaengPhet	-0.274	0.173	0.113	-0.282	0.172	0.101	-0.282	0.172	0.101
Province : Kanchanaburi	-0.236	0.172	0.169	-0.244	0.171	0.152	-0.244	0.171	0.152
Province : KhonKaen				-0.201	0.095	0.034*	-0.201	0.095	0.034*
Province : Krabi	-0.046	0.149	0.758						
Province : Lamphun	0.127	0.131	0.333						
Province : Loei	0.032	0.192	0.869						
Province : LopBuri	-0.438	0.184	0.017 *	-0.405	0.177	0.023*	-0.405	0.177	0.023*
Province : NakhonPathom	-0.116	0.091	0.200						
Province : Nan	0.271	0.211	0.199	0.454		0.010			0.010
Province : Narathiwat			0.001	-0.676	0.273	0.013*	-0.676	0.273	0.013*
Province : NongKhai	-0.783	0.239	0.001 **	-0.809	0.240	<0.001 ***	-0.809	0.240	<0.001 ***
Province : Nonthaburi	-0.100	0.068	0.140						
Province : PathumThani	-0.026	0.069	0.709		0.004	0.007	0.550	0.004	0.007
Province : Pattani	0154	0.1.67	0.250	-0.//8	0.284	0.006**	-0.778	0.284	0.006**
Province : PhangNga	0.154	0.167	0.358	0.570	0.154	-0.001	0.570	0.154	.0.001
Province : Phatthalung	0.586	0.155	<0.001 ***	0.572	0.154	<0.001 ***	0.572	0.154	<0.001 ***
Province Phetchabun	-0.680	0.219	0.002**	-0.639	0.213	0.003 **	-0.639	0.213	0.003 **
Province : Phetchaburi	-0.580	0.224	0.010**	-0.606	0.223	0.00/**	-0.606	0.223	0.007**
Province : Phichit	-0.112	0.223	0.616	0.244	0.110	0.002	0.244	0.110	0.002
Province : Philsanulok				0.344	0.118	0.003 **	0.344	0.118	0.003 **
PhraNakhonSiAvutthava				0.161	0.089	0.069.	0.161	0.089	0.069.
Province : PrachinBuri				-0.334	0.185	0.072.	-0.334	0.185	0.072.
Province : Sakaeo	0.602	0.207	0.004 **	0.584	0.207	0.005 **	0.584	0.207	0.005 **
Province : SamutPrakarn	-0.285	0.066	< 0.001 ***	-0.227	0.045	< 0.001 ***	-0.227	0.045	< 0.001 ***
Province : SamutSakhon	-0.251	0.084	0.003 **	-0.191	0.069	0.005 **	-0.191	0.069	0.005 **

Variable	Multiple Logit (Appendix C2 coefficients re- estimated by sectoral obs)			Sectora	ıl Stepwise	Selection	Sectoral Stepwise Selection (Dropping some Variables)		
	Coeff.	Std. Err.	$\Pr(> z)$	Coeff.	Std. Err	$\Pr(> z)$	Coeff.	Std. Err.	$\Pr(> z)$
Province :	-0.522	0.332	0.116	-0.445	0.328	0.174	-0.445	0.328	0.174
Province : Saraburi				-0.276	0.116	0.017*	-0.276	0.116	0.017*
Province : Satun				0.439	0.204	0.032*	0.439	0.204	0.032*
Province : Sukhothai	0.122	0.232	0.598						
Province : SuratThani	0.268	0.083	0.001 **	0.247	0.081	0.002 **	0.247	0.081	0.002 **
Province : Surin	-0.833	0.244	< 0.001 ***	-0.856	0.243	< 0.001 ***	-0.856	0.243	< 0.001 ***
Province : Trang	0.092	0.140	0.511						
Province : Trat	-0.213	0.300	0.478						
Province : UdonThani	-0.310	0.130	0.017 *	-0.316	0.129	0.014*	-0.316	0.129	0.014*
Province : Uttaradit				0.400	0.182	0.028*	0.400	0.182	0.028*
Province : Yala	-1.216	0.330	< 0.001 ***	-1.256	0.330	< 0.001 ***	-1.256	0.330	< 0.001 ***
Province : Yasothon	0.645	0.194	< 0.001 ***	0.583	0.194	0.003 **	0.583	0.194	0.003 **

Signif. codes: 0 **** 0.001 *** 0.01 ** 0.05 ** 0.1 ** 1

2. Service Sector

Variable	Multiple Logit (Appendix C2 coefficients reestimated by sectoral observations)			Sectoral Stepwise Selection			Sectoral Stepwise Selection (Dropping some Variables)		
	Coeff.	Std. Err.	$\Pr(> z)$	Coeff.	Std. Err	Pr(> z)	Coeff.	Std. Err.	Pr(> z)
(Intercept)	-1.116	0.248	< 0.001 ***	-1.167	0.123	< 0.001 ***	-1.171	0.123	< 0.001 ***
Continuous variable ln(Ordinary Profit to Total Asset)	-0.032	0.014	0.024*	-0.028	0.014	0.044*	-0.028	0.014	0.043*
ln(ROA)	0.017	0.020	0.372	-0.112	0.036	0.002 **	-0.112	0.036	0.002 **
ln(ROE)	-0.041	0.007	< 0.001 ***	-0.055	0.007	< 0.001 ***	-0.055	0.007	< 0.001 ***
ln(Ordinary Income Margin)	-0.016	0.012	0.208	-0.019	0.012	0.111	-0.019	0.012	0.105
Net Profit Margin	-0.002	0.001	0.006 **	-0.006	0.001	< 0.001 ***	-0.006	0.001	< 0.001 ***
SGA Ratio	-0.001	0.000	0.030*	-0.001	0.000	0.081.	-0.001	0.000	0.075.
In(Current Ratio)	0.034	0.040	0.388	0.028	0.017	0.096.	0.028	0.017	0.095.
In(Quick Ratio)	0.021	0.036	0.569						
In(Reserves Ratio)	-0.084	0.020	< 0.001 ***	-0.069	0.018	< 0.001 ***	-0.069	0.018	< 0.001 ***
ln(Cash to Sales)	-0.340	0.025	< 0.001 ***	-0.323	0.025	< 0.001 ***	-0.323	0.025	< 0.001 ***
In(Sales Growth)	-0.069	0.005	< 0.001 ***	-0.066	0.005	< 0.001 ***	-0.066	0.005	< 0.001 ***
ln(Assets Growth)	-0.012	0.007	0.064.	-0.013	0.007	0.053.	-0.013	0.007	0.054.
In(Equity Ratio)	-0.011	0.015	0.466	-0.030	0.015	0.047 *	-0.030	0.015	0.048*
ln(Debt to Equity)	-0.038	0.043	0.376	-0.447	0.080	< 0.001 ***	-0.448	0.080	< 0.001 ***
Debt Capacity Ratio	0.002	0.000	< 0.001 ***	0.010	0.004	0.014 *	0.009	0.004	0.014*
Debt to Sales	0.000	0.000	0.006 **	0.000	0.000	0.005 **	0.000	0.000	0.005 **
ln(Working Capital to Debt)	0.095	0.040	0.016*						
ln(Interest Expenses to Sales)	0.047	0.021	0.025*						
Years of Debt Redemption	-0.016	0.002	< 0.001 ***	-0.013	0.002	<0.001 ***	-0.013	0.002	< 0.001 ***
ln(Debt-to-EBITDA)	-0.028	0.011	0.012*	-0.084	0.015	< 0.001 ***	-0.084	0.015	< 0.001 ***
In(Total Assets Turnover)	-0.372	0.058	< 0.001 ***	-0.302	0.057	< 0.001 ***	-0.302	0.057	< 0.001 ***

Variable	Multiple Logit (Appendix C2 coefficients reestimated by sectoral observations)			Sectoral Stepwise Selection			Sectoral Stepwise Selection (Dropping some Variables)		
	Coeff.	Std. Err.	Pr(> z)	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	Pr (> z)
In(Fixed Assets	0149	0.018	<0.001 ***	0.127	0.019	<0.001 ***	0.127	0.018	<0.001.***
Turnover)	0.140	0.018	<0.001 ***	0.137	0.018	<0.001 ***	0.137	0.018	<0.001***
Account Receivable Turnover Days	-0.001	0.000	0.022*						
Inventory Turnover Days	0.000	0.000	0.962	0.000	0.000	0.106	0.000	0.000	0.105
Account Payable Turnover Days	0.002	0.000	< 0.001 ***	0.002	0.000	< 0.001 ***	0.002	0.000	< 0.001 ***
ln(Account Payable Turnover)	-0.012	0.014	0.386						
Cash Conversion Cycle	0.004	0.003	0.155						
Fixed Assets to Equity	0.000	0.000	0.853	0.000	0.000	< 0.001 ***	0.000	0.000	< 0.001 ***
Other Current Assets	0.005	0.001	<0.001 ***	0.005	0.001	< 0.001 ***	0.005	0.001	<0.001 ***
Firm Age	-0.018	0.002	< 0.001 ***	-0.018	0.002	< 0.001 ***	-0.018	0.002	< 0.001 ***
In Authorized									
Shareholding Capital)	0.001	0.014	0.946						
Dummy variable									
Loan Size : 1M - 5M	0.141	0.048	0.003**	0.161	0.048	< 0.001 ***	0.161	0.048	< 0.001 ***
Loan Size : 50K - 350K	-0.151	0.056	0.007**	-0.149	0.056	0.007**	-0.149	0.056	0.007**
Loan Size > 5M	0.546	0.054	<0.001 ***	0.578	0.053	<0.001 ***	0.579	0.053	<0.001 ***
Loan Size . < 50K	0.240	0.034	<0.001***	0.576	0.055	<0.001***	0.856	0.035	<0.001***
SME Size Medium	-0.600	0.054	<0.001 ***	-0.630	0.080	<0.001 ***	-0.630	0.050	<0.001***
SME Size Mieno	-0.025	0.054	<0.001 ***	-0.010	0.050	< 0.001 ***	-0.010	0.030	< 0.001 ***
SME SIZE : MICIO	0.840	0.031	<0.001 ***	0.828	0.049	<0.001 ***	0.828	0.049	<0.001 ***
Partnerships	0.022	0.046	0.627						
Year of Financial Statement : 2557	0.005	0.044	0.905						
Year of Financial Statement : 2558	-0.009	0.043	0.826						
Year of Financial Statement : 2561	0.062	0.040	0.119						
Region : Central	0.205	0.088	0.020*						
Region : Eastern	-0.325	0.066	< 0.001 ***	-0.175	0.091	0.053.	-0.170	0.091	0.060.
Province :	2.022	1160	0.001	2041	1165	0.001	2015	114	0.001
AmnatCharoen	3.923	1.168	<0.001 ***	3.941	1.165	<0.001 ***	3.947	1.165	<0.001***
Province : AngThong				-11.399	106.579	0.915			
Province : Bangkok	-0.640	0.085	< 0.001 ***	-0.474	0.038	< 0.001 ***	-0.470	0.038	< 0.001 ***
Province : BuriRam	-0.349	0.443	0.430						
Province : ChaiNat	-0.118	0.549	0.830						
Province : Chaiyaphum	0.684	0.342	0.046*	0.631	0.342	0.065.	0.635	0.342	0.063.
Province : Chanthaburi	-0.719	0.399	0.072.	-0.889	0.406	0.028*	-0.888	0.406	0.029*
Province : ChonBuri				-0.262	0.110	0.017*	-0.262	0.110	0.017*
Province : Chumphon				-0.670	0.473	0.157	-0.666	0.473	0.159
Province : Kalasin	0.496	0.560	0.376						
Province :	0.000	0.505	0.0.07	1.000	0.55 /	0.055	0.007	0.55.	0.050
KamphaengPhet	-0.980	0.525	0.062.	-1.000	0.524	0.056.	-0.995	0.524	0.058.
Province Kanchanaburi	0.797	0.220	< 0.001 ***	0.794	0.219	< 0.001 ***	0.799	0.219	< 0.001 ***
Province : Krabi	-0.046	0.140	0.744						
Province : Lampang				-0.517	0.307	0.092.	-0.513	0.307	0.094.
Province : Lamphun	0.178	0.341	0.601						
Province Loei	0.075	0.395	0.849						
Province : LopBuri	-0.239	0.269	0.374						

Variable	Multip coeffic sect	le Logit (A cients rees toral obse	ppendix C2 timated by rvations)	Sector	ral Stepwise	Selection	Sectoral Stepwise Selection (Dropping some Variables)		
	Coeff.	Std. Err.	$\Pr(> z)$	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	Pr (> z)
Province : Mukdahan				0.612	0.356	0.086.	0.616	0.357	0.084.
Province :				1.012	0 304	<0.001 ***	1016	0 304	<0.001 ***
NakhonNayok				1.012	0.504	<0.001	1.010	0.504	<0.001
Province :	-0.391	0.167	0.019*	-0.220	0.149	0.139	-0.215	0.149	0.148
NakhonPathom					0.4.44			0.4.44	0.00
Province : Nan	0.974	0.463	0.035 *	0.970	0.464	0.037*	0.975	0.464	0.036*
Province :				1.697	0.597	0.004 **	1.702	0.597	0.004 **
NongBuaLamPhu	0.007	0.552	0.000						
Province : NongKnai	0.007	0.553	0.990	0.100	0.077	0.002	0.105	0.077	0.004
Province : Nonthaburi	-0.359	0.101	<0.001 ***	-0.199	0.067	0.003 **	-0.195	0.067	0.004 **
Province : Pathum I hani	-0.103	0.108	0.341	0.0(1	0.150	0.000	0.044	0.150	0.002
Province : PhangNga	0.285	0.160	0.074.	0.261	0.159	0.099.	0.266	0.159	0.093.
Province Phatthalung	0.582	0.407	0.153						
Province : Phetchabun	-0.490	0.549	0.372						
Province : Phetchaburi	0.156	0.218	0.473	1 - 1 -	1.020	0.105	1.640	1.000	0.100
Province : Phichit	-1.800	1.022	0.078.	-1.645	1.020	0.107	-1.640	1.020	0.108
Province : Phrae				-1.331	0.734	$0.0^{\prime}/0.$	-1.327	0.734	0.071.
Province : Sakaeo	0.368	0.468	0.431						
Province : SakonNakhon									
Province : SamutPrakarn	-0.325	0.107	0.002 **	-0.152	0.076	0.046*	-0.147	0.076	0.053.
Province : SamutSakhon	-0.142	0.161	0.379						
Province :	-11.510	84.676	0.892	-11.297	84.436	0.894			
SamutSongkhram				0.004	0.150	0.024	0.220	0.150	0.022
Province : Saraburi	1 1 0 0	0.7.0	0.122	0.334	0.158	0.034*	0.339	0.158	0.032*
Province : Sukhothai	-1.189	0.769	0.122	-0.995	0.769	0.196	-0.992	0.769	0.197
Province : SupnanBuri	0.101	0.000	0.066	0.1.65	0.000	0.007	0.1.00	0.007	0.070
Province : Surat I hani	0.181	0.098	0.066.	0.165	0.096	0.087.	0.169	0.096	0.079.
Province : Surin	0.530	0.424	0.212						
Province Trang	-0.386	0.354	0.275						
Province : Trat	0.315	0.281	0.263						
Province Udon Thani	-0.104	0.208	0.619						
Province : Yala	-0.496	0.409	0.224	0.014	0.515	0.115	0.017	0 515	0.114
Province : Yasothon	0.782	0.515	0.129	0.814	0.517	0.115	0.817	0.517	0.114

Signif.codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' 1

3. Manufacturing Sector

Variable	Multiple Logit (Appendix C2 coefficients reestimated by sectoral observations)			Sectora	l Stepwise	Selection	Sectoral Stepwise Selection (Dropping some Variables)		
	Coeff.	Std. Err.	$\Pr(> z)$	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	Pr(> z)
(Intercept)	0.485	0.237	< 0.001 ***	-0.284	0.472	0.548	-0.284	0.472	0.548
Continuous variable									
In(Ordinary Profit to Total Asset)	0.004	0.013	0.751						
ln(ROA)	-0.055	0.019	0.004 **	-0.183	0.031	< 0.001 ***	-0.183	0.031	< 0.001 ***
ln(ROE)	-0.037	0.006	< 0.001 ***	-0.045	0.006	< 0.001 ***	-0.045	0.006	< 0.001 ***
ln(Ordinary Income Margin)	-0.032	0.011	0.004 **	-0.041	0.011	< 0.001 ***	-0.041	0.011	< 0.001 ***
Net Profit Margin	0.002	0.001	0.091.	-0.003	0.001	0.006**	-0.003	0.001	0.006**
Variable	Multipl coeffic sect	e Logit (A ients rees oral obse	Appendix C2 Stimated by rvations)	Sectora	ıl Stepwise	Selection	Sectoral Stepwise Selection (Dropping some Variables)		
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	Coeff.	Std. Err.	Pr (> z)	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	Pr (> z)
SGA Ratio	-0.002	0.000	0.002 **	-0.001	0.000	0.003 **	-0.001	0.000	0.003**
In(Current Ratio)	0.148	0.026	< 0.001 ***	0.136	0.026	< 0.001 ***	0.136	0.026	< 0.001 ***
In(Quick Ratio)	-0.039	0.018	0.031*	-0.051	0.017	0.003 **	-0.051	0.017	0.003**
In(Reserves Ratio)	0.056	0.018	0.002 **	0.069	0.018	< 0.001 ***	0.069	0.018	< 0.001 ***
In(Cash to Sales)	-0.431	0.024	< 0.001 ***	-0.422	0.025	< 0.001 ***	-0.422	0.025	< 0.001 ***
In(Sales Growth)	-0.056	0.005	< 0.001 ***	-0.054	0.005	< 0.001 ***	-0.054	0.005	< 0.001 ***
In(Assets Growth)	-0.031	0.006	< 0.001 ***	-0.032	0.006	< 0.001 ***	-0.032	0.006	< 0.001 ***
In(Equity Ratio)	-0.070	0.014	< 0.001 ***	-0.084	0.014	< 0.001 ***	-0.084	0.014	< 0.001 ***
In(Debt to Equity)	-0.024	0.033	0.465	-0.376	0.069	< 0.001 ***	-0.376	0.069	< 0.001 ***
Debt Capacity Ratio	0.000	0.001	0.433	0.010	0.005	0.034*	0.010	0.005	0.034*
Debt to Sales	0.000	0.000	0.154						
ln(Working Capital to Debt)	-0.066	0.039	0.094.	-0.152	0.039	< 0.001 ***	-0.152	0.039	<0.001 ***
In(Interest Expenses to Sales)	0.210	0.021	< 0.001 ***	0.137	0.024	< 0.001 ***	0.137	0.024	<0.001 ***
Years of Debt Redemption	-0.014	0.002	< 0.001 ***	-0.009	0.002	< 0.001 ***	-0.009	0.002	<0.001 ***
ln(Debt-to-EBITDA)	-0.031	0.009	< 0.001 ***	-0.081	0.012	< 0.001 ***	-0.081	0.012	< 0.001 ***
In(Total Assets Turnover)	-0.941	0.060	< 0.001 ***	-0.890	0.061	< 0.001 ***	-0.890	0.061	< 0.001 ***
In(Fixed Assets Turnover)	0.091	0.016	< 0.001 ***	0.080	0.016	< 0.001 ***	0.080	0.016	< 0.001 ***
Account Receivable Turnover Days	0.000	0.000	0.152						
Inventory Turnover Days	-0.001	0.000	< 0.001 ***	-0.001	0.000	< 0.001 ***	-0.001	0.000	< 0.001 ***
Account Payable Turnover Days	0.003	0.000	<0.001 ***	0.003	0.000	<0.001 ***	0.003	0.000	<0.001 ***
In(Account Payable Turnover)	0.058	0.014	< 0.001 ***	0.057	0.014	< 0.001 ***	0.057	0.014	< 0.001 ***
Cash Conversion Cycle	0.008	0.002	0.002 **	0.008	0.002	< 0.001 ***	0.008	0.002	< 0.001 ***
Fixed Assets to Equity	0.000	0.000	0.289	0.000	0.000	0.004 **	0.000	0.000	0.004 **
Other Current Assets Ratio	0.006	0.001	<0.001 ***	0.006	0.001	< 0.001 ***	0.006	0.001	<0.001 ***
Firm Age ln(Authorized	-0.028	0.002	<0.001 ***	-0.030	0.002	< 0.001 ***	-0.030	0.002	< 0.001 ***
Shareholding Capital)	-0.100	0.012	<0.001 ***	-0.094	0.012	<0.001 ***	-0.094	0.012	<0.001 ***
Loan Size : 1M - 5M	0.037	0.049	0.448						
Loan Size : 50K - 350K	-0.351	0.062	< 0.001 ***	-0.382	0.054	< 0.001 ***	-0.382	0.054	< 0.001 ***
Loan Size : $> 5M$	0.497	0.049	< 0.001 ***	0.503	0.035	< 0.001 ***	0.503	0.035	< 0.001 ***
Loan Size : <50K	-1.346	0.085	< 0.001 ***	-1.362	0.080	< 0.001 ***	-1.362	0.080	< 0.001 ***
SME Size Medium	-0.232	0.045	<0.001 ***	-0.236	0.045	< 0.001 ***	-0.236	0.045	< 0.001 ***
SME Size : Micro	0.736	0.060	< 0.001 ***	0.742	0.060	< 0.001 ***	0.742	0.060	< 0.001 ***
Registration Type : Company Limited				0.667	0.400	0.095.	0.667	0.400	0.095.
Registration Type - Partnerships	0.178	0.037	<0.001 ***	0.851	0.402	0.034*	0.851	0.402	0.034*
Year of Financial Statement : 2557	-0.019	0.036	0.594						
Year of Financial Statement : 2558	-0.143	0.037	< 0.001 ***	-0.144	0.034	< 0.001 ***	-0.144	0.034	<0.001***
Year of Financial Statement : 2561	0.022	0.035	0.534						

Mu co Variable		Multiple Logit (Appendix C2 coefficients reestimated by sectoral observations)			ıl Stepwise	Selection	Sectoral Stepwise Selection (Dropping some Variables)			
	Coeff.	Std. Err.	Pr(> z)	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	Pr(> z)	
Region : Central	0.112	0.066	0.089.							
Region : Eastern	-0.216	0.055	< 0.001 ***	-0.170	0.048	< 0.001 ***	-0.170	0.048	< 0.001 ***	
Region : Southern				0.269	0.081	< 0.001 ***	0.269	0.081	< 0.001 ***	
Province :	0.600	0.260	0.000	0.655	0.269	0.075	0.655	0.269	0.075	
AmnatCharoen	0.009	0.309	0.099.	0.035	0.508	0.075.	0.055	0.508	0.075.	
Province : Bangkok	-0.421	0.061	< 0.001 ***	-0.256	0.038	<0.001 ***	-0.256	0.038	< 0.001 ***	
Province : BuriRam	-0.260	0.274	0.343							
Province : ChaiNat	-0.097	0.321	0.762							
Province : Chaiyaphum	0.357	0.344	0.299							
Province : Chanthaburi	0.024	0.356	0.947							
Province : ChiangMai				0.172	0.097	0.077.	0.172	0.097	0.077.	
Province : Kalasin	0.382	0.368	0.299							
Province :	0.442	0.242	0.068.	0.486	0.243	0.045 *	0.486	0.243	0.045*	
KamphaengPhet	0.029	0.160	0.822							
Province : Kanchanaburi	-0.038	0.109	0.822							
Province : Krabi	0.055	0.303	0.801	0.224	0.202	0.000	0.224	0.202	0.000	
Province : Lamphun Drovince : Loci	-0.570	0.204	0.070.	-0.554	0.205	0.099.	-0.334	0.205	0.099.	
Province : Loei	0.337	0.414	0.416							
Province : LopBuri	-0.300	0.247	0.225							
Province :				0.853	0.260	0.001 **	0.853	0.260	0.001 **	
NaknonNayok Province										
NakhonPathom	-0.424	0.089	< 0.001 ***	-0.258	0.076	< 0.001 ***	-0.258	0.076	< 0.001 ***	
Province :				0.440		0.0.40	0.640		0.0.40	
NakhonPhanom				0.648	0.355	0.069.	0.648	0.355	0.069.	
Province :				0 272	0.210	0.080	0.272	0.210	0.080	
NakhonSawan				-0.372	0.219	0.089.	-0.372	0.219	0.089.	
Province : Nan	-0.291	0.564	0.606							
Province : NongKhai	-0.188	0.363	0.605							
Province : Nonthaburi	-0.218	0.082	0.008 **							
Province : PathumThani	-0.180	0.074	0.016*							
Province : PhangNga	-0.381	0.302	0.207	-0.635	0.311	0.041 *	-0.635	0.311	0.041*	
Province : Phatthalung	1.276	0.276	< 0.001 ***	1.063	0.285	< 0.001 ***	1.063	0.285	< 0.001 ***	
Province : Phetchabun	0.118	0.293	0.686							
Province : Phetchaburi	-0.340	0.269	0.206							
Province : Phichit	0.140	0.282	0.621							
Province :				0120	0.084	0151	0.120	0.084	0151	
PhraNakhonSiAyutthaya	0.444			0.120	0.001	0.101	0.120	0.001	0.101	
Province : Sakaeo	0.611	0.448	0.172							
Province : SakonNakhon				-0.697	0.355	0.049*	-0.697	0.355	0.049*	
Province : SamutPrakarn	-0.404	0.066	<0.001 ***	-0.243	0.046	<0.001 ***	-0.243	0.046	<0.001 ***	
Province : SamutSakhon	-0.416	0.073	<0.001 ***	-0.249	0.056	<0.001 ***	-0.249	0.056	<0.001 ***	
Province :	-0.323	0.269	0.230							
SamutSongkhram				20.00	1.000	0.042	20.00	1.000	0.042	
Province : Satun				-2.068	1.022	0.043*	-2.068	1.022	0.043*	
Province : SiSaKet				-0.823	0.443	0.063.	-0.823	0.443	0.063.	
Province Songkhla	0.005	0.014	0.550	-0.188	0.129	0.145	-0.188	0.129	0.145	
Province Sukhothai	0.205	0.346	0.552	c 1=-	0.1.1-	0.001	o 1 - -	0.1.15	0.001	
Province SuphanBuri	0.5	0		0.479	0.143	<0.001 ***	0.479	0.143	<0.001 ***	
Province SuratThani	0.168	0.150	0.263							
Province : Surin	0.198	0.254	0.435		0.1-1	0	a	o ·	0	
Province : Trang	0.575	0.182	0.002 **	0.375	0.194	0.053.	0.375	0.194	0.053.	
Province : Trat	-0.719	0.546	0.188							

Variable	Multipl coeffic sect	e Logit (A ients reest oral obser	ppendix C2 timated by vations)	Sectora	l Stepwise	Selection	Sectoral Stepwise Selection (Dropping some Variables)			
	Coeff.	Std. Err.	Pr (> z)	Coeff.	Std. Err	Pr(> z)	Coeff.	Std. Err.	Pr (> z)	
Province : UdonThani	0.027	0.238	0.909							
Province : UthaiThani				-1.352	1.051	0.198	-1.352	1.051	0.198	
Province : Yala	-0.603	0.522	0.248	-0.826	0.526	0.117	-0.826	0.526	0.117	
Province : Yasothon	0.260	0.365	0.476							

Signif. codes: 0 **** 0.001 *** 0.01 ** 0.05 *. 0.1 ** 1

4. Real Estate Sector

Variable	(Appe estin	Multiple Lo endix C2 coeff mated by sect	ogit ficients re- oral obs)	Secto	ral Stepwise	Selection	Sectoral Stepwise Selection (Dropping some Variables)		
	Coeff.	Std. Err.	Pr(> z)	Coeff.	Std. Err.	$\Pr(> z)$	Coeff.	Std. Err.	Pr (> z)
(Intercept)	-4.195	0.572	< 0.001 ***	-3.702	0.482	< 0.001 ***	-3.677	0.481	< 0.001 ***
Continuous variable In(Ordinary Profit to Total Asset)	-0.089	0.046	0.054.	-0.075	0.043	0.084.	-0.073	0.043	0.088.
ln(ROA)	-0.111	0.063	0.078.	-0.412	0.081	< 0.001 ***	-0.417	0.080	< 0.001 ***
ln(ROE)	-0.010	0.016	0.542						
ln(Ordinary Income Margin)	0.037	0.026	0.165						
Net Profit Margin	-0.005	0.002	0.020*	-0.005	0.002	0.010**	-0.005	0.002	0.011*
SGA Ratio	-0.004	0.001	< 0.001 ***	-0.003	0.001	0.002**	-0.003	0.001	0.003 **
In(Current Ratio)	0.293	0.047	< 0.001 ***	0.183	0.028	< 0.001 ***	0.190	0.028	< 0.001 ***
In(Quick Ratio)	-0.058	0.035	0.105						
In(Reserves Ratio)	-0.074	0.042	0.076.						
In(Cash to Sales)	-0.383	0.053	< 0.001 ***	-0.445	0.042	< 0.001 ***	-0.447	0.042	< 0.001 ***
In(Sales Growth)	-0.036	0.013	0.004 **	-0.037	0.012	0.003 **	-0.038	0.012	0.002**
ln(Assets Growth)	-0.003	0.019	0.861						
In(Equity Ratio)	-0.073	0.038	0.056.	-0.064	0.023	0.005 **	-0.064	0.023	0.005 **
In(Debt to Equity)	-0.028	0.077	0.718						
Debt Capacity Ratio	0.003	0.001	0.061.	0.003	0.001	0.005 **	0.003	0.001	0.005 **
Debt to Sales	0.000	0.000	0.221						
ln(Working Capital to Debt)	0.120	0.134	0.370						
ln(Interest Expenses to Sales)	0.007	0.041	0.856	-0.074	0.042	0.081.	-0.069	0.042	0.098.
Years of Debt Redemption	-0.033	0.007	< 0.001 ***	-0.031	0.006	< 0.001 ***	-0.031	0.006	< 0.001 ***
ln(Debt-to-EBITDA)	0.073	0.023	0.002 **						
In(Total Assets Turnover)	0.334	0.186	0.072.						
ln(Fixed Assets Turnover)	-0.019	0.044	0.672						
Account Receivable Turnover Days	0.002	0.000	< 0.001 ***	0.002	0.000	< 0.001 ***	0.002	0.000	< 0.001 ***
Inventory Turnover Days	-0.001	0.001	0.037*						
Account Payable Turnover Days	0.002	0.000	<0.001 ***	0.002	0.000	< 0.001 ***	0.002	0.000	<0.001***
In(Account Payable Turnover)	0.036	0.032	0.270						

Variable	(Appe esti	Multiple Logit (Appendix C2 coefficients re- estimated by sectoral obs)				Selection	Sector (Drop	al Stepwi ping some	se Selection e Variables)
	Coeff.	Std. Err.	Pr (> z)	Coeff.	Std. Err.	$\Pr(> z)$	Coeff.	Std. Err.	$\Pr(> z)$
Cash Conversion Cycle	0.009	0.004	0.018*	0.009	0.003	< 0.001 ***	0.008	0.003	0.001 **
Fixed Assets to Equity	0.000	0.000	0.737						
Other Current Assets	0.007	0.003	0.008 **	0.007	0.002	0.005 **	0.006	0.002	0.007**
Ratio	-0.013	0.005	0.013*	-0.011	0.005	0.023*	-0.011	0.005	0.026*
In Authorized	-0.015	0.005	0.015 *	-0.011	0.005	0.025 *	-0.011	0.005	0.020*
Shareholding Capital)	0.079	0.032	0.012*	0.079	0.030	0.009 **	0.075	0.030	0.013*
Dummy variable									
Loan Size : 1M - 5M	0.173	0.215	0.420						
Loan Size : 50K - 350K	0.148	0.253	0.558						
Loan Size : $> 5M$	0.777	0.200	< 0.001 ***	0.596	0.111	< 0.001 ***	0.600	0.110	< 0.001 ***
Loan Size : <50K	-0.736	0.275	0.007 **	-0.950	0.222	< 0.001 ***	-0.958	0.222	< 0.001 ***
SME Size : Medium	-0.345	0.128	0.007 **	-0.331	0.121	0.006**	-0.336	0.120	0.005 **
SME Size : Micro	0.871	0.135	< 0.001 ***	0.935	0.132	< 0.001 ***	0.916	0.132	< 0.001 ***
Registration Type :									
Partnerships	0.106	0.163	0.515						
Year of Financial Statement : 2557	0.191	0.114	0.095.						
Year of Financial Statement : 2558	0.156	0.109	0.152						
Year of Financial Statement : 2561	0.075	0.107	0.486						
Region : Central	-0.329	0.257	0.200	-0.487	0.093	< 0.001 ***	-0.503	0.092	< 0.001 ***
Region : Eastern	-0.238	0.137	0.082.						
Province : Bangkok	-0.286	0.252	0.255						
Province : BuriRam	-14.182	604.897	0.981	-14.003	608.562	0.982			
Province : ChaiNat	-14.402	1070.028	0.989						
Province : Chaiyaphum	1.488	1.188	0.210						
Province : Chanthaburi	1.596	0.775	0.039*	1.492	0.744	0.045*	1.504	0.744	0.043*
Province : ChiangRai				0.896	0.373	0.016*	0.900	0.373	0.016*
Province :	14015	1100 754	0.000						
KamphaengPhet	-14.013	1190.734	0.990						
Province : Kanchanaburi	-0.215	1.071	0.841						
Province : Krabi	-0.389	0.756	0.607						
Province : Lampang				-14.457	737.556	0.984			
Province : Lamphun	-0.511	1.078	0.636						
Province : Loei	-14.950	1035.180	0.988						
Province : LopBuri	-14.001	469.918	0.976	-13.671	470.825	0.977			
Province :	-0.008	0.400	0.984						
NakhonPathom									
Province :				2.129	0.600	< 0.001 ***	2.126	0.600	< 0.001 ***
Province									
NakhonSiThammarat Province Nan	-11 579	2399 545	0.996	-1.204	0.739	0.104	-1.216	0.739	0.100
Province : Narathiwat	-1.017	-077.040	0.220	2.630	1.503	0.080.	2.607	1.500	0.082.
Province				1.000	2399.54		2.007		
NongBuaLamPhu				19.812	5	0.993			
Province : NongKhai	-13.640	794.026	0.986		J				
Province Nonthaburi	0.080	0.298	0.789	0.391	0.183	0.032*	0.403	0.183	0.028*
Province PathumThani	-0.407	0.340	0.232						
Province : Pattani			-	3.243	1.170	0.006**	3.244	1.169	0.006**
Province : PhangNga	2.108	0.517	< 0.001 ***	2.140	0.512	< 0.001 ***	2.133	0.512	< 0.001 ***

Variable	Multiple Logit (Appendix C2 coefficients re- estimated by sectoral obs)			Sector	ral Stepwise	Selection	Sectoral Stepwise Selection (Dropping some Variables)			
	Coeff.	Std. Err.	$\Pr(> z)$	Coeff.	Std. Err.	$\Pr(> z)$	Coeff.	Std. Err.	Pr(> z)	
Province : Phayao				17.743	976.368	0.986	•			
Province : Phetchabun	-14.585	914.567	0.987							
Province : Phetchaburi	1.313	0.470	0.005 **	1.504	0.461	0.001 **	1.501	0.461	0.001 **	
Province : Phichit	NA	NA	NA							
Province :				0.563	0.310	0.069.	0.575	0.310	0.064.	
PhraNakhonSiAyutthaya Province : PrachinBuri				-0.922	0.616	0.135	-0.925	0.617	0.134	
Province : Sakaeo	-15.453	1612.363	0.992							
Province : SamutPrakarn	-0.216	0.325	0.507							
Province : SamutSakhon	-0.686	0.491	0.162							
Province :	-14 071	1026344	0 989							
SamutSongkhram Province : Saraburi	1	1020.011	0.507	-13.827	374.755	0.971				
Province : Songkhla				-0.523	0.313	0.095.	-0.532	0.313	0.090.	
Province : Sukhothai	-14.100	1665.696	0.993							
Province : SuratThani	-0.446	0.380	0.241							
Province : Surin	-0.497	1.078	0.645							
Province : Trang	-0.567	0.761	0.456							
Province : Trat	-14.501	1381.418	0.992							
Province : UdonThani	0.004	0.523	0.993							
Province : Uttaradit				-14.591	832.253	0.986				
Province : Yala	1.023	1.107	0.355							
Province : Yasothon	-12.807	1381.068	0.993							

Signif. codes: 0 **** 0.001 *** 0.01 ** 0.05 *. 0.1 * 1

5. Construction Sector

Variable	Multiple Logit (Appendix C2 coefficients re- estimated by sectoral obs)			Secto	ral Stepwise	Selection	Sectoral Stepwise Selection (Dropping some Variables)			
	Coeff.	Std. Err.	Pr (> z)	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	Pr (> z)	
(Intercept)	0.576	0.292	< 0.001 ***	-9.489	80.083	0.906	0.867	0.261	<0.001 ***	
Continuous variable In(Ordinary Profit to Total Asset)	-0.005	0.018	0.796							
ln(ROA)	-0.017	0.025	0.482							
ln(ROE)	-0.023	0.010	0.016*	-0.034	0.009	< 0.001 ***	-0.034	0.009	< 0.001 ***	
ln(Ordinary Income Margin)	-0.030	0.016	0.063.	-0.040	0.013	0.002**	-0.040	0.013	0.002**	
Net Profit Margin	0.002	0.001	0.136							
SGA Ratio	-0.001	0.001	0.328							
In(Current Ratio)	0.035	0.032	0.284							
In(Quick Ratio)	-0.014	0.024	0.576							
In(Reserves Ratio)	-0.039	0.018	0.034*	-0.044	0.017	0.009 **	-0.043	0.017	0.010**	
ln(Cash to Sales)	-0.239	0.026	< 0.001 ***	-0.234	0.025	< 0.001 ***	-0.235	0.025	< 0.001 ***	
In(Sales Growth)	-0.022	0.005	< 0.001 ***	-0.021	0.005	< 0.001 ***	-0.021	0.005	< 0.001 ***	
ln(Assets Growth)	-0.023	0.007	0.002 **	-0.022	0.007	0.002**	-0.022	0.007	0.002**	
In(Equity Ratio)	-0.075	0.019	< 0.001 ***	-0.086	0.013	< 0.001 ***	-0.086	0.013	< 0.001 ***	
ln(Debt to Equity)	-0.039	0.047	0.414	-0.370	0.099	< 0.001 ***	-0.369	0.099	< 0.001 ***	
Debt Capacity Ratio	0.000	0.001	0.733							

Variable	(Appe estin	Multiple Lo endix C2 coeff mated by sect	ogit ficients re- oral obs)	Secto	ral Stepwise	Selection	Sectoral Stepwise Selection (Dropping some Variables)			
	Coeff.	Std. Err.	$\Pr(> z)$	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	$\Pr(> z)$	
Debt to Sales	0.000	0.000	< 0.001 ***	0.000	0.000	< 0.001 ***	0.000	0.000	< 0.001 ***	
ln(Working Capital to Debt)	0.063	0.035	0.072.	0.052	0.033	0.111	0.052	0.033	0.116	
In(Interest Expenses to Sales)	0.035	0.027	0.207							
Years of Debt Redemption	-0.012	0.003	<0.001 ***	-0.009	0.003	< 0.001 ***	-0.009	0.003	<0.001 ***	
ln(Debt-to-EBITDA)	-0.035	0.014	0.014*	-0.043	0.016	0.006**	-0.043	0.016	0.007 **	
In(Total Assets Turnover)	-0.640	0.062	< 0.001 ***	-0.604	0.059	< 0.001 ***	-0.604	0.059	< 0.001 ***	
In(Fixed Assets										
Turnover)	0.005	0.016	0.769							
Account Receivable Turnover Days	-0.001	0.000	<0.001 ***	-0.001	0.000	< 0.001 ***	-0.001	0.000	< 0.001 ***	
Inventory Turnover Days	0.000	0.000	0.528							
Account Payable Turnover Days	0.002	0.000	< 0.001 ***	0.002	0.000	< 0.001 ***	0.002	0.000	< 0.001 ***	
ln(Account Payable Turnover)	0.015	0.014	0.299							
Cash Conversion Cycle	0.003	0.003	0.355							
Fixed Assets to Equity	0.000	0.000	0.036*							
Other Current Assets Ratio	0.002	0.001	0.090.	0.002	0.001	0.091.	0.002	0.001	0.092.	
Firm Age	-0.032	0.002	< 0.001 ***	-0.033	0.002	< 0.001 ***	-0.033	0.002	< 0.001 ***	
In(Authorized	-0.023	0.016	0.160	-0.027	0.016	0.091.	-0.028	0.016	0.075.	
Dummy variable										
Loan Size · 1M - 5M	0.242	0.048	<0.001 ***	0257	0.048	<0.001 ***	0257	0.048	<0.001 ***	
Loan Size : 50K - 350K	-0.209	0.060	< 0.001 ***	-0.210	0.060	< 0.001 ***	-0.210	0.060	< 0.001 ***	
Loan Size $> 5M$	0.620	0.055	<0.001 ***	0.653	0.054	< 0.001 ***	0.654	0.054	<0.001 ***	
Loan Size : <50K	-1.015	0.090	< 0.001 ***	-1.011	0.089	< 0.001 ***	-1.016	0.089	< 0.001 ***	
SME Size Medium	-0.464	0.055	< 0.001 ***	-0.452	0.055	< 0.001 ***	-0.453	0.055	< 0.001 ***	
SME Size : Micro	0.680	0.068	< 0.001 ***	0.654	0.067	< 0.001 ***	0.655	0.067	< 0.001 ***	
Registration Type : Company Limited				10.122	80.083	0.899	-0.210	0.040	< 0.001 ***	
Registration Type : Partnerships	0.226	0.041	< 0.001 ***	10.335	80.083	0.897				
Year of Financial Statement : 2557	-0.118	0.049	0.016*	-0.097	0.047	0.037*	-0.097	0.047	0.037*	
Year of Financial Statement : 2558	-0.061	0.046	0.184							
Year of Financial Statement : 2561	0.085	0.041	0.038*	0.101	0.039	0.009**	0.102	0.039	0.008**	
Region : Central	-0.125	0.077	0.104	-0.277	0.048	< 0.001 ***	-0.278	0.048	< 0.001 ***	
Region : Eastern	-0.430	0.067	< 0.001 ***	-0.423	0.063	< 0.001 ***	-0.424	0.063	< 0.001 ***	
Province : AmnatCharoen	-0.163	0.325	0.616							
Province : Bangkok	-0.413	0.080	< 0.001 ***	-0.236	0.048	< 0.001 ***	-0.237	0.048	< 0.001 ***	
Province BuriRam	-0.339	0.213	0.111	-0.296	0.213	0.164	-0.296	0.213	0.164	
Province ChaiNat	0.322	0.294	0.273	0.513	0.288	0.075.	0.514	0.288	0.074.	
Province Chaivaphum	-0.782	0.217	< 0.001 ***	-0.759	0.217	< 0.001 ***	-0.759	0.217	< 0.001 ***	
Province Chanthaburi	-0.050	0.307	0.869			-				
Province : Kalasin	0.598	0.179	< 0.001 ***	0.610	0.178	< 0.001 ***	0.611	0.178	< 0.001 ***	

Variable	(Appe estin	Multiple Logit (Appendix C2 coefficients re- estimated by sectoral obs)			ral Stepwise	Selection	Sectoral Stepwise Selection (Dropping some Variables)		
	Coeff.	Std. Err.	Pr (> z)	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	$\Pr(> z)$
Province :	-0.251	0.234	0.283						
KamphaengPhet	0.025	0.188	0.895						
Province Krabi	-0.025	0.188	0.580						
Province Lampang	-0.150	0.230	0.560	0192	0123	0118	0 1 9 3	0123	0117
Province Lamphun	-0.618	0.241	0011*	-0 594	0.241	0.014*	-0 594	0.123	0.014*
Province : Loei	-0.659	0.269	0.015*	-0.633	0.269	0.019*	-0.633	0.269	0.019*
Province : LopBuri	-0.169	0.237	0.476	0.000	0.207	0.017	0.000	0.207	0.017
Province :	0.4.60	0.1.00	0.005	0.000	0.154	0.055	0.004	0156	0.057
NakhonPathom	-0.468	0.168	0.005 **	-0.296	0.156	0.057.	-0.296	0.156	0.057
Province :									
NakhonPhanom									
Province :				0.203	0.123	0.098.	0.203	0.123	0.098.
NakhonRatchasima	0.120	0.202	0.554						
Province : Nan Dravince NangKhai	0.120	0.203	0.554						
Province : NongKhai	-0.135	0.274	0.377						
Province : Nonulabuli Province DathumThani	-0.213	0.090	0.027*						
Province · PhangNga	-0.147	0.090	0.127						
Province Phatthalung	-0.025	0.24)	0.216						
Province Phetchabun	-0.041	0.235	0.863						
Province Phetchaburi	-0.585	0.235	0.019*	-0 538	0.248	0.030*	-0.538	0.248	0.030*
Province Phichit	-0454	0.249	0.199	0.550	0.240	0.050	0.550	0.240	0.050
Province :	0.151	0.551	0.177						0.050
PhraNakhonSiAyutthaya				0.241	0.128	0.059.	0.242	0.128	0.058.
Province : Ranong				1.142	0.397	0.004 **	1.143	0.397	0.004 **
Province : RoiEt				0.400	0.209	0.056.	0.401	0.209	0.055.
Province : Sakaeo	-0.368	0.337	0.275						
Province : SamutPrakarn	-0.150	0.102	0.140						
Province : SamutSakhon	-0.645	0.186	< 0.001 ***	-0.472	0.175	0.007 **	-0.471	0.175	0.007 **
Province :	0.024	0417	0954						
SamutSongkhram	0.021	0.117	0.251						
Province : SingBuri				0.711	0.363	0.050.	0.712	0.363	0.050*
Province : Sukhothai	0.830	0.234	<0.001 ***	1.006	0.227	< 0.001 ***	1.007	0.227	< 0.001 ***
Province : SuphanBuri				0.389	0.156	0.013*	0.391	0.156	0.012*
Province : Surat Thani	0.041	0.117	0.724						
Province : Surin	0.034	0.238	0.887						
Province Trang	0.076	0.182	0.676						
Province : Trat	-0.375	0.456	0.410						
Province : Udon I hani	-0.054	0.164	0.741	0.465	0.210	0.027	0 464	0.210	0.027
Province : 1 ala	-0.4/8	0.211	0.023*	-0.465	0.210	0.027*	-0.464	0.210	0.027*
Province : Y asothon	-0.088	0.258	0.735						

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 '' 1

6. Utility Sector

Variable	Multiple Logit (Appendix C2 coefficients re- estimated by sectoral obs)			Secto	ral Stepwise	Selection	Sectoral Stepwise Selection (Dropping some Variables)		
	Coeff.	Std. Err.	$\Pr(> z)$	Coeff.	Std. Err	$\Pr(> z)$	Coeff.	Std. Err.	Pr (> z)
(Intercept)	1.196	0.401	< 0.001 ***	1.434	0.367	< 0.001 ***	1.435	0.367	< 0.001 ***

Variable	Multiple Logit (Appendix C2 coefficients re- estimated by sectoral obs)					Selection	Sector (Drop)	ectoral Stepwise Selection Dropping some Variables)		
	Coeff.	Std. Err.	Pr (> z)	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	Pr (> z)	
Continuous variable										
In(Ordinary Profit to	0.010	0.022	0.285							
Total Asset)	-0.019	0.022	0.385							
ln(ROA)	0.039	0.034	0.260	-0.192	0.052	< 0.001 ***	-0.193	0.052	< 0.001 ***	
ln(ROE)	-0.023	0.012	0.062.	-0.022	0.013	0.079.	-0.022	0.013	0.078.	
In(Ordinary Income	0.020	0.021	0.058	0.060	0.010	0.002**	0.060	0.010	0.002 **	
Margin)	-0.039	0.021	0.038.	-0.000	0.019	0.002**	-0.000	0.019	0.002**	
Net Profit Margin	-0.008	0.002	< 0.001 ***	-0.012	0.002	< 0.001 ***	-0.012	0.002	< 0.001 ***	
SGA Ratio	-0.002	0.001	0.080.							
In(Current Ratio)	0.079	0.077	0.303	0.093	0.024	< 0.001 ***	0.094	0.024	< 0.001 ***	
In(Quick Ratio)	0.025	0.072	0.733							
In(Reserves Ratio)	-0.007	0.032	0.835							
In(Cash to Sales)	-0.438	0.043	< 0.001 ***	-0.436	0.030	< 0.001 ***	-0.436	0.030	< 0.001 ***	
In(Sales Growth)	-0.057	0.009	< 0.001 ***	-0.058	0.008	< 0.001 ***	-0.058	0.008	< 0.001 ***	
In(Assets Growth)	-0.008	0.010	0.410							
In(Equity Ratio)	-0.098	0.026	< 0.001 ***	-0.105	0.024	< 0.001 ***	-0.105	0.024	< 0.001 ***	
In(Debt to Equity)	0.039	0.071	0.583	0.062	0.040	0.121	0.061	0.040	0.124	
Debt Capacity Ratio	-0.002	0.001	0.035 *							
Debt to Sales	0.000	0.000	< 0.001 ***	0.000	0.000	< 0.001 ***	0.000	0.000	< 0.001 ***	
ln(Working Capital to	0.009	0.065	0.885							
Debt)	0.007	0.005	0.005							
In(Interest Expenses to Sales)	0.109	0.038	0.004 **							
Years of Debt Redemption	-0.012	0.004	0.003 **	-0.013	0.004	0.002**	-0.013	0.004	0.002**	
ln(Debt-to-EBITDA)	-0.044	0.020	0.026*	-0.108	0.023	< 0.001 ***	-0.108	0.023	< 0.001 ***	
In(Total Assets Turnover)	-1.044	0.097	< 0.001 ***	-1.041	0.100	< 0.001 ***	-1.040	0.100	< 0.001 ***	
ln(Fixed Assets Turnover)	0.056	0.031	0.068.	0.050	0.029	0.090.	0.050	0.029	0.093.	
Account Receivable Turnover Days	-0.003	0.000	< 0.001 ***	-0.003	0.000	< 0.001 ***	-0.003	0.000	< 0.001 ***	
Inventory Turnover	-0.001	0.001	0.240							
Days Account Payable Turnover Days	0.002	0.000	<0.001 ***	0.002	0.000	< 0.001 ***	0.002	0.000	< 0.001 ***	
In(Account Payable	-0.027	0.020	0.181	-0.031	0.019	0.107	-0.031	0.019	0.104	
Turnover)	0.024	0.007	0.001	0.017	0.005	0.001	0.015	0.005	0.001	
Cash Conversion Cycle	0.024	0.006	<0.001 ***	0.017	0.005	<0.001 ***	0.017	0.005	<0.001 ***	
Fixed Assets to Equity	0.000	0.000	0.901							
Other Current Assets	-0.002	0.002	0.317							
Firm Age	-0.027	0.003	< 0.001 ***	-0.027	0.003	< 0.001 ***	-0.027	0.003	< 0.001 ***	
ln(Authorized	0.000	0.000	0.001	0.000	0.001	0.001	0.000	0.001	0.001	
Shareholding Capital)	-0.083	0.022	<0.001 ***	-0.082	0.021	<0.001 ***	-0.083	0.021	<0.001 ***	
Dummy variable										
Loan Size : 1M - 5M	0.154	0.078	0.049*	0.154	0.078	0.048*	0.155	0.078	0.046*	
Loan Size : 350K - 1M										
Loan Size : 50K - 350K	-0.205	0.101	0.044 *	-0.207	0.101	0.041*	-0.206	0.101	0.041*	
Loan Size :> 5M	0.444	0.083	< 0.001 ***	0.435	0.082	< 0.001 ***	0.437	0.082	< 0.001 ***	
Loan Size : <50K	-0.797	0.144	< 0.001 ***	-0.827	0.143	< 0.001 ***	-0.826	0.143	< 0.001 ***	
SME Size : Medium	-0.488	0.086	< 0.001 ***	-0.479	0.086	< 0.001 ***	-0.478	0.086	< 0.001 ***	
SME Size : Micro	0.772	0.110	< 0.001 ***	0.761	0.108	< 0.001 ***	0.762	0.108	< 0.001 ***	

Variable	Multiple Logit (Appendix C2 coefficients re- estimated by sectoral obs)			Sectoral Stepwise Selection			Sectoral Stepwise Selection (Dropping some Variables)		
	Coeff.	Std. Err.	Pr (> z)	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	Pr (> z)
Registration Type :				0.212	0.060	<0.001	0.210	0.060	<0.001
Company Limited				-0.212	0.000	<0.001***	-0.210	0.000	<0.001 ***
Registration Type :	0216	0.061	<0.001 ***						
Partnerships	0.210	0.001							
Year of Financial Statement : 2557	0.046	0.070	0.512						
Year of Financial Statement : 2558	0.030	0.066	0.650						
Year of Financial Statement : 2561	0.083	0.065	0.201						
Region : Central	0.148	0.108	0.171						
Region : Eastern	-0.133	0.087	0.126						
Province : AmnatCharoen	-11.675	362.104	0.974						
Province : Bangkok	-0.330	0.104	0.002 **	-0.130	0.059	0.028*	-0.128	0.059	0.031*
Province : BuriRam	0.002	0.394	0.995						
Province : ChaiNat	-1.110	1.047	0.289						
Province : Chaiyaphum	-0.196	0.466	0.674						
Province : Chanthaburi	-0.382	0.660	0.563						
Province : ChonBuri				-0.155	0.093	0.096.	-0.153	0.093	0.100.
Province : Kalasin	-0.009	0.688	0.989						
Province :	0 1 2 2	0.400	0740						
KamphaengPhet	0.133	0.400	0.740						
Province : Kanchanaburi	1.185	0.230	< 0.001 ***	1.230	0.226	< 0.001 ***	1.231	0.226	< 0.001 ***
Province : Krabi	0.031	0.374	0.934						
Province : Lamphun	-0.392	0.354	0.268						
Province : Loei	-0.149	0.578	0.796						
Province : LopBuri	0.086	0.330	0.793						
Province :				0.000	0.512	0.054	0.003	0514	0.053
MahaSarakham				0.990	0.515	0.034.	0.993	0.314	0.055.
Province : NakhonPathom	-0.287	0.206	0.164						
Province :				-0.297	0.215	0166	-0.295	0.215	0169
NakhonRatchasima				0.297	0.210	01100	0.270	0.210	0.107
Province : Nan	NA	NA	NA						
Province :				2.716	0.899	0.003 **	2.718	0.899	0.003 **
NongBuaLamPhu	0.440	0.209	0.260						
Province : NongKilai	0.440	0.598	0.209						
Province : Nonulabuli Drovince DathumThani	-0.021	0.103	0.090						
Province PhangNga	-0.200	0.142	0.148	1 405	0351	<0.001	1 408	0351	<0.001 ***
Province Phatthalung	0.700	0.333	0.130	0.720	0.331	0.123	0.732	0.551	0.122
Province : Fliatulaiung	10.657	152.086	0.139	0.729	0.475	0.125	0.732	0.475	0.122
Province : Phetchaburi	-10.037	0.812	0.944						
Province : I licicitation	-1.024	1 1 1 1	0.208						
Province : I literit	-1.403	1.111	0.188	0.607	0.297	0.072	0.700	0.287	0.070
Province Phrae				1017	0.507	0.072.	1 020	0.507	0.070.
Province Salvago	0172	0833	0.837	1.017	0.054	0.100	1.020	0.034	0.107
Drovince Sakaeu	0.172	0.000	0.0 <i>31</i>	0.227	0.001	0.000 **	0.225	0.001	0.010**
Drovince : SamutPlakam	-0.437	0.124	< 0.001 ***	-0.237	0.091	0.009**	-0.233	0.091	0.010**
Province : SamutSaknon	-0.392	0.192	0.040*						
FIOVINCE : SamutSonalthrom	-1.793	1.030	0.082.	-1.602	1.028	0.119	-1.599	1.028	0.120
Province : Saraburi				0.403	0.148	0.006**	0.405	0.148	0.006**
Province : SiSaKet	10.000	004510	0.050	0.968	0.628	0.123	0.971	0.628	0.122
Province : Sukhothai	-12.209	236.549	0.959						

Multiple Logit (Appendix C2 coefficients re- estimated by sectoral obs)		ogit ficients re- oral obs)	Sector	ral Stepwise	Selection	Sectoral Stepwise Selection (Dropping some Variables)			
	Coeff.	Std. Err.	Pr (> z)	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	Pr (> z)
Province : SuratThani	0.307	0.199	0.122	0.380	0.194	0.050*	0.382	0.194	0.049*
Province : Surin	-0.134	0.629	0.831						
Province : Trang	1.203	0.256	< 0.001 ***	1.235	0.254	< 0.001 ***	1.238	0.254	< 0.001 ***
Province : Trat	0.809	0.414	0.051.	0.719	0.408	0.078.	0.720	0.408	0.077.
Province :				0.843	0324	0.000 **	0.845	0324	0.000**
UbonRatchathani Province : UdonThani	-0.429	0.396	0.279	0.845	0.524	0.009**	0.843	0.324	0.009**
Province : UthaiThani				-11.776	163.054	0.942			
Province : Yala	0.672	0.490	0.170						
Province : Yasothon	-11.275	306.000	0.971						

Signif. codes: 0 **** 0.001 *** 0.01 ** 0.05 *. 0.1 * 1

7. Agriculture Sector

Variable	Multiple Logit (Appendix C2 coefficients re- estimated by sectoral obs)			Sectoral Stepwise Selection			Sectoral Stepwise Selection (Dropping some Variables)		
	Coeff.	Std. Err.	Pr(> z)	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	Pr (> z)
(Intercept)	1.087	1.586	< 0.001 ***	1.827	0.995	0.066.	1.962	0.983	0.046*
Continuous variable In(Ordinary Profit to Total Asset)	0.031	0.094	0.745						
ln(ROA)	-0.121	0.134	0.368						
ln(ROE)	-0.041	0.039	0.290	-0.075	0.033	0.024*	-0.081	0.033	0.014*
ln(Ordinary Income Margin)	-0.009	0.065	0.889						
Net Profit Margin	-0.005	0.005	0.349						
SGA Ratio	0.001	0.003	0.819						
In(Current Ratio)	0.067	0.139	0.629						
In(Quick Ratio)	0.060	0.101	0.556						
In(Reserves Ratio)	-0.132	0.107	0.220						
ln(Cash to Sales)	-0.355	0.165	0.032*	-0.557	0.114	<0.00 1***	-0.560	0.111	< 0.001 ***
In(Sales Growth)	-0.082	0.030	0.006**	-0.086	0.028	0.002 **	-0.093	0.028	< 0.001 ***
In(Assets Growth)	-0.026	0.037	0.488						
In(Equity Ratio)	-0.110	0.094	0.244						
In(Debt to Equity)	-0.023	0.241	0.923	-1.034	0.340	0.002 **	-1.105	0.337	0.001 **
Debt Capacity Ratio	-0.012	0.005	0.008 **	-0.042	0.016	0.011*	-0.042	0.016	0.011*
Debt to Sales	0.000	0.000	0.993						
ln(Working Capital to Debt)	0.386	0.271	0.155						
In(Interest Expenses to Sales)	0.293	0.144	0.043*	0.447	0.105	<0.00 1***	0.423	0.103	< 0.001 ***
Years of Debt Redemption	-0.011	0.014	0.442						
In(Debt-to-EBITDA)	0.070	0.057	0.218						
In(Total Assets Turnover)	-0.134	0.330	0.683						
ln(Fixed Assets Turnover)	0.113	0.143	0.430						
Account Receivable Turnover Days	0.003	0.002	0.045 *	0.003	0.001	0.005 **	0.003	0.001	0.003**

Variable	Multiple Logit (Appendix C2 coefficients re- estimated by sectoral obs)		git icients re- oral obs)	Sector	al Stepwise S	Selection	Sector (Drop)	Sectoral Stepwise Selection (Dropping some Variables)		
	Coeff.	Std. Err.	$\Pr(> z)$	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	Pr (> z)	
Inventory Turnover	0.001	0.001	0514							
Days	0.001	0.001	0.011							
Account Payable Turnover Days	0.002	0.002	0.257	0.002	0.001	0.042*	0.003	0.001	0.028*	
ln(Account Payable	0.1.20	0.000	0.101							
Turnover)	0.120	0.092	0.191							
Cash Conversion Cycle	-0.008	0.014	0.553							
Fixed Assets to Fixed										
Liabilities and Total				-0.002	0.001	0.058.	-0.002	0.001	0.037*	
Equity Fixed Assets to Equity	0.000	0.001	0.635							
Other Current Assets	0.000	0.001	0.055							
Ratio	0.001	0.006	0.912							
Firm Age	-0.036	0.012	0.002 **	-0.033	0.011	0.002**	-0.029	0.010	0.005 **	
ln(Authorized	0160	0.082	0.030*	0.215	0.063	< 0.00	0.220	0.062	~0.001***	
Shareholding Capital)	-0.109	0.082	0.039*	-0.215	0.005	1	-0.229	0.002	<0.001 ***	
Dummy variable										
Loan Size : 1M - 5M	0.012	0.382	0.975							
Loan Size : 50K - 350K	-0.019	0.456	0.967							
Loan Size $:> 5M$	0.392	0.356	0.271	0.420	0.220	0.057.	0.398	0.216	0.066.	
Loan Size : <50K	-0.838	0.554	0.130	-0.640	0.470	0.174	-0.686	0.469	0.144	
SME Size : Medium	-0.295	0.268	0.271							
SME Size : Micro	0.141	0.484	0.771							
Registration Type	0.119	0.262	0.648							
Partnerships Vear of Financial										
Statement : 2557	0.222	0.253	0.380							
Year of Financial	0.029	0.251	0.011							
Statement : 2558	0.028	0.231	0.911							
Year of Financial	0.375	0.226	0.097.	0.365	0.197	0.063.	0.309	0.195	0.112	
Statement : 2561	0.252	0.201	0.402							
Region : Central	0.252	0.301	0.403							
Region Western	-0.740	0.539	0.038*	0.805	0.277	0.022+	0.506	0.260	0.161	
Drovince				0.805	0.377	0.033*	0.500	0.300	0.101	
AmnatCharoen	NA	NA	NA							
Province : Bangkok	-0.447	0.345	0.195							
Province BuriRam	-0.609	0.571	0.286							
Province : ChaiNat	-17.978	3734.928	0.996							
Province : Chaiyaphum	-16.841	1152.606	0.988	-16.392	1176.407	0.989				
Province : Chanthaburi	0.395	1.257	0.753							
Province : ChiangRai				1.762	0.765	0.021*	1.883	0.768	0.014*	
Province : ChonBuri				-1.442	0.744	0.053.	-1.370	0.746	0.066.	
Province : Kalasin	NA	NA	NA							
Province :	-17 679	2325710	0 994	-17483	2363 322	0 994				
KamphaengPhet	-17.077	2323.117	0.774	-17.405	2303.322	0.774				
Province Kanchanaburi	-16.482	1265.087	0.990	-16.909	1273.340	0.989				
Province : Krabi	1.325	0.675	0.050*	1.691	0.649	0.009 **	1.772	0.645	0.006**	
Province Lamphun	-0.864	0.840	0.303							
Province : Loei	-14.734	3236.546	0.996							
Province : LopBuri	-0.844	0.610	0.167							
Province :				-16.430	1696.866	0.992				
NakhonNayok										

Multiple Logit(Appendix C2 coefficients re- estimated by sectoral obs)	Sector	al Stepwise S	Selection	Sector (Drop)	al Stepwis ping some	e Selection Variables)			
	Coeff.	Std. Err.	$\Pr(> z)$	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	Pr (> z)
Province :	-2.792	1.051	0.008 **	-2.177	1.025	0.034*	-2.143	1.027	0.037*
NakhonPathom Province									
NakhonSiThammarat				-1.347	1.040	0.195	-1.239	1.039	0.233
Province : Nan	-12.225	4607.343	0.998						
Province : NongKhai	-16.172	4601.026	0.997						
Province : Nonthaburi	-1.792	1.088	0.100.						
Province : PathumThani	0.115	0.598	0.847						
Province : PhangNga	-16.182	2266.160	0.994						
Province : Phatthalung	-16.455	3517.665	0.996						
Province : Phetchabun	-16.053	1649.079	0.992						
Province : Phetchaburi	-16.759	4417.370	0.997						
Province : Phichit	-0.464	1.207	0.701						
Province : Ranong				20.158	6522.639	0.998			
Province : Rayong				1.624	0.680	0.017*	1.738	0.677	0.010*
Province : Sakaeo	1.710	1.023	0.094.						
Province : SamutPrakarn	-16.915	2584.358	0.995						
Province : SamutSakhon	-1.296	1.088	0.234						
Province :	NΔ	NA	NΔ						
SamutSongkhram	1171	na -							
Province : Saraburi				0.731	0.455	0.108	0.815	0.455	0.073.
Province : Songkhla				0.599	0.367	0.102	0.646	0.367	0.078.
Province : Sukhothai	-1.093	1.316	0.406						
Province : SuphanBuri				1.067	0.366	0.004 **	1.148	0.367	0.002**
Province : SuratThani	0.673	0.459	0.143	0.834	0.437	0.056.	0.938	0.437	0.032*
Province : Surin	-16.197	1666.607	0.992	-16.084	1632.573	0.992			
Province : Trang	-16.073	1370.979	0.991	-15.630	1387.111	0.991			
Province : Trat	-16.018	3719.314	0.997						
Province : UdonThani	-15.585	2621.630	0.995						
Province : UthaiThani				19.496	6522.639	0.998			
Province : Yala	NA	NA	NA						
Province : Yasothon	-17.022	3116.860	0.996						

Signif. codes: 0 **** 0.001 *** 0.01 ** 0.05 ** 0.1 ** 1

8. Mining Sector

Variable	Multiple Logit (Appendix C2 coefficients re- estimated by sectoral obs)			Sectoral Stepwise Selection			Sectoral Stepwise Selection (Dropping some Variables)		
-	Coeff.	Std. Err.	Pr (> z)	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	Pr (> z)
(Intercept)	0.910	2.007	< 0.001 ***	3.319	1.664	0.046*	2.557	1.611	0.112
Continuous variable In(Ordinary Profit to Total Asset) In(ROA)	0.065	0.109	0.551						
ln(ROE) ln(Ordinary Income Margin)	-0.059 0.055	0.056	0.294 0.622	-0.090	0.047	0.058.	-0.033	0.046	0.480
Net Profit Margin SGA Ratio	-0.021 -0.011	0.011 0.006	0.050* 0.070.	-0.022	0.006	<0.001 ***	-0.017	0.006	0.002**

Variable	Multiple Logit (Appendix C2 coefficients re- estimated by sectoral obs)		Sector	Sectoral Stepwise Selection			Sectoral Stepwise Selection (Dropping some Variables)		
-	Coeff.	Std. Err.	Pr (> z)	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	Pr (> z)
In(Current Ratio)	-0.001	0.264	0.996	•			•		
In(Quick Ratio)	0.122	0.207	0.553						
In(Reserves Ratio)	0.029	0.146	0.845						
In(Cash to Sales)	-0.502	0.210	0.017*	-0.474	0.148	0.001 **	-0.471	0.138	< 0.001 ***
In(Sales Growth)	-0.039	0.039	0.327						
In(Assets Growth	-0.063	0.046	0.172	-0.088	0.042	0.033*	-0.070	0.040	0.078.
In(Equity Ratio)	-0.060	0.132	0.648	0.106	0.056	0.058.	0.119	0.054	0.029*
In(Debt to Equity)	0.810	0.329	0.014*						
Debt Capacity Ratio	-0.001	0.005	0.765						
Debt to Sales	0.000	0.000	0.546						
ln(Working Capital to	1566	0.423	~0.001***	1 966	0.403	~0.001***	1 560	0350	<0.001***
Debt)	-1.500	0.423	<0.001 ***	-1.700	0.405	<0.001	-1.500	0.550	<0.001 ***
ln(Interest Expenses to Sales)	-0.063	0.186	0.732						
Years of Debt	-0.028	0.017	0.108	-0.034	0.014	0.017*	-0.023	0.013	0.082.
Redemption ln(Debt-to-EBITDA)	-0.042	0.090	0.636						
ln(Total Assets Turnover)	-1.116	0.504	0.027*	-1.379	0.432	0.001 **	-1.298	0.390	< 0.001 ***
ln(Fixed Assets Turnover)	0.447	0.188	0.018*	0.630	0.162	< 0.001 ***	0.621	0.155	< 0.001 ***
Account Receivable	-0.001	0.003	0.752						
Inventory Turnover Days	-0.007	0.003	0.016*	-0.004	0.002	0.030*	-0.004	0.002	0.027*
Account Payable Turnover Days	0.003	0.002	0.170						
ln(Account Payable Turnover)	0.091	0.108	0.402						
Cash Conversion Cycle	0.054	0.032	0.096.						
Fixed Assets to Equity	-0.002	0.001	0.019*						
Other Current Assets Ratio	-0.014	0.009	0.117	-0.023	0.009	0.009**	-0.023	0.008	0.007**
Firm Age	0.007	0.012	0.562						
In(Authorized	-0.114	0.110	0.298	-0.210	0.097	0.030*	-0.195	0.095	0.040*
Shareholding Capital)									
Dummy variable Loan Size : 1M - 5M	0.214	0.448	0.632						
Loan Size : 50K - 350K	-0.238	0.613	0.698						
Loan Size :> 5M	-0.036	0.448	0.936						
Loan Size : <50K	-1.098	0.661	0.097.	-1.150	0.516	0.026*	-1.087	0.508	0.033*
SME Size : Medium	-0.815	0.376	0.030*	-0.570	0.356	0.109	-0.619	0.348	0.075.
SME Size : Micro	2.102	0.761	0.006**	1.222	0.609	0.045*	1.515	0.573	0.008 **
Registration Type : Partnerships	0.388	0.290	0.181						
Year of Financial Statement : 2557	0.053	0.326	0.871						
Year of Financial Statement : 2558	0.193	0.317	0.542						
Year of Financial Statement : 2561	0.476	0.302	0.115	0.620	0.269	0.021 *	0.449	0.255	0.078.

Variable	Multiple Logit (Appendix C2 coefficients re- estimated by sectoral obs)		it cients re- ral obs)	Sector	al Stepwise S	Selection	Sectoral Stepwise Selection (Dropping some Variables)		
	Coeff.	Std. Err.	Pr (> z)	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	Pr (> z)
Region : Central	-0.256	0.430	0.551	-0.684	0.264	0.010**	-0.434	0.249	0.081.
Region : Eastern	0.036	0.433	0.934						
Province :	NA	NIA	ΝA						
AmnatCharoen	NA	INA	NA						
Province : Bangkok	-0.523	0.526	0.320						
Province : BuengKan				-17.869	2824.401	0.995			
Province : BuriRam	-15.835	1675.255	0.992	-15.991	1626.029	0.992			
Province : ChaiNat	NA	NA	NA						
Province :	-17.187	6522.639	0.998						
Chaiyaphum Drouin ao									
Chanthaburi	NA	NA	NA						
Province ChiangMai				0794	0.477	0.096	0.933	0473	0.048*
Province Kalasin	NA	NA	NΔ	0.794	0.477	0.070.	0.755	0.475	0.040
Province :	11A	na -	INA						
KamphaengPhet	-0.633	0.936	0.499						
Province :	0742	0.002	0.292						
Kanchanaburi	0.743	0.692	0.283						
Province : KhonKaen				-16.809	2085.175	0.994			
Province : Krabi	1.298	0.686	0.058.	1.588	0.640	0.013*	1.734	0.630	0.006**
Province : Lamphun	1.457	1.038	0.160						
Province : Loei	0.404	1.115	0.717						
Province : LopBuri	-0.178	0.953	0.851						
Province : Mukdahan				1.447	0.804	0.072.	1.580	0.793	0.046*
Province :	0270	0769	0725						
NakhonPathom	0.270	0.707	0.720						
Province :				-17.802	2087.716	0.993			
NakhonPhanom	2076	1642	0.206						
Province : Nan Province NongKhai	-2.070	1.043	0.206						
Province Nonthaburi	-10.234	2087.930	0.994						
Province : Nonulabuli	-1.515	1.162	0.201						
PathumThani	0.959	1.274	0.452						
Province · PhangNga	-16.266	1332.468	0.990	-16.896	1287.847	0.990			
Province : Phatthalung	NA	NA	NA	10.070	1207.017	0.570			
Province Phavao	1421	1171	1011	-17.169	2244.851	0.994			
Province : Phetchabun	-15.985	1986.857	0.994						
Province : Phetchaburi	-0.306	1.403	0.827						
Province : Phichit	NA	NA	NA						
Province :				1 5 9 4	0.720	0.020	1017	0710	0.011
PrachuapKhiriKhan				1.584	0.729	0.030*	1.817	0./18	0.011*
Province : Ranong				23.389	6522.639	0.997			
Province : Ratchaburi				-15.670	1315.998	0.991			
Province : Sakaeo	NA	NA	NA						
Province :	0467	1 100	0.671						
SamutPrakarn	0.107	1.100	0.071						
Province	-15.414	2337.755	0.995						
SamutSakhon Province									
SamutSongkhrom	-12.540	6522.639	0.998						
Province Satun				20.382	2900.971	0.994			
Province Songkhla				-17.001	1027.686	0.987			
Province Sukhothai	-15.582	2813.988	0.996						

Variable	Multiple Logit (Appendix C2 coefficients re- estimated by sectoral obs)			Sectoral Stepwise Selection			Sectoral Stepwise Selection (Dropping some Variables)		
-	Coeff.	Std. Err.	Pr(> z)	Coeff.	Std. Err	Pr (> z)	Coeff.	Std. Err.	Pr (> z)
Province : SuratThani	0.461	0.617	0.456	•			•		
Province : Surin	-16.078	2339.167	0.995	-17.368	2105.466	0.993			
Province : Trang	-1.278	1.128	0.257						
Province : Trat	-15.989	3676.051	0.997						
Province : UdonThani	-14.242	1734.953	0.993						
Province : Yala	0.116	1.312	0.930						
Province : Yasothon	-14.970	4594.075	0.997						

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

C5: Correlation Matrix for coefficients in the Credit Scoring Model



Variable	Coefficient	Std. Error	z value	$\Pr(> z)$
(Intercept)	-2.140	0.007	-321.614	< 0.001 ***
Continuous variable				
ROA (WOE)	0.348	0.039	8.899	< 0.001 ***
ROE (WOE)	0.238	0.036	6.548	<0.001 ***
Net Profit Margin (WOE)	0.146	0.028	5.182	< 0.001 ***
SGA Ratio (WOE)	-0.434	0.044	-9.824	< 0.001 ***
Quick Ratio (WOE)	-0.287	0.031	-9.287	< 0.001 ***
Reserves Ratio (WOE)	0.204	0.024	8.586	< 0.001 ***
Cash to Sales (WOE)	1.242	0.034	36.415	<0.001 ***
Sales Growth (WOE)	0.634	0.016	38.762	< 0.001 ***
Assets Growth (WOE)	0.340	0.035	9.675	< 0.001 ***
Equity Ratio (WOE)	0.555	0.044	12.758	< 0.001 ***
Debt to Equity (WOE)	0.157	0.056	2.807	0.005 **
Debt Capacity Ratio (WOE)	-0.332	0.058	-5.742	< 0.001 ***
Debt to Sales (WOE)	-0.216	0.041	-5.287	< 0.001 ***
Working Capital to Debt (WOE)	0.371	0.021	17.909	< 0.001 ***
Interest Expenses to Sales (WOE)	0.340	0.020	16.830	< 0.001 ***
Years of Debt Redemption (WOE)	-0.681	0.050	-13.679	< 0.001 ***
Total Assets Turnover (WOE)	0.472	0.029	16.287	< 0.001 ***
Fixed Assets Turnover (WOE)	-0.119	0.030	-3.911	< 0.001 ***
Account Receivable Turnover Days (WOE)	0.212	0.027	7.836	< 0.001 ***
Inventory Turnover Days (WOE)	0.116	0.033	3.492	< 0.001 ***
Account Payable Turnover Days (WOE)	0.269	0.030	9.062	< 0.001 ***
Account Payable Turnover (WOE)	0.157	0.037	4.235	< 0.001 ***
Cash Conversion Cycle (WOE)	0.194	0.030	6.480	< 0.001 ***
Fixed Assets to Equity (WOE)	0.054	0.033	1.634	0.102
Other Current Assets Ratio (WOE)	0.071	0.043	1.646	0.100.
Firm Age (WOE)	0.808	0.026	31.672	< 0.001 ***
Authorized Shareholding Capital (WOE)	0.967	0.071	13.635	< 0.001 ***
Categorical variable				
SME Size (WOE)	0.678	0.021	31.857	< 0.001 ***
Registration Type (WOE)	0.624	0.050	12.478	< 0.001 ***
Loan Size (WOE)	0.931	0.018	50.340	< 0.001 ***
Group ISIC (WOE)	0.692	0.026	26.220	< 0.001 ***
Province (WOE)	0.472	0.034	13.743	< 0.001 ***
Region (WOE)	0.188	0.037	5.086	< 0.001 ***

C6: Multiple Logit Regression Result (Stepwise Selection on WOE-transformed variables)

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

C7: Score Contribution Metric

Predictor	Group	WOE	Scorecard	Bin IV	Total IV
ROA	From -Inf to -6	0.488	-12	0.044	0.083
ROA	From -6 to 1	0.213	-5	0.009	0.083
ROA	From 1 to Inf	-0.222	6	0.03	0.083
ROE	From -Inf to -20	0.379	-7	0.017	0.045
ROE	From -20 to 0	0.21	-4	0.006	0.045
ROE	From 0 to 5	0.081	-1	0.001	0.045
ROE	From 5 to 75	-0.188	3	0.019	0.045
ROE	From 75 to Inf	0.221	-4	0.003	0.045
Net Profit Margin	From -Inf to -9	0.618	-7	0.071	0.094
Net Profit Margin	From -9 to 8	-0.202	2	0.023	0.094
Net Profit Margin	From 8 to Inf	0.005	0	0	0.094
SGA Ratio	From -Inf to 6	0.021	1	0	0.026
SGA Ratio	From 6 to 40	-0.092	-3	0.005	0.026
SGA Ratio	From 40 to 74	0.118	4	0.002	0.026
SGA Ratio	From 74 to Inf	0.533	17	0.019	0.026
Quick Ratio	From -Inf to 20	0.411	9	0.027	0.055
Quick Ratio	From 20 to 40	0.187	4	0.003	0.055
Quick Ratio	From 40 to 80	-0.009	0	0	0.055
Quick Ratio	From 80 to 1000	-0.213	-4	0.022	0.055
Quick Ratio	From 1000 to Inf	0.171	4	0.003	0.055
Reserves Ratio	From -Inf to 5	0.4	-6	0.064	0.13
Reserves Ratio	From 5 to 20	-0.05	1	0.001	0.13
Reserves Ratio	From 20 to 235	-0.475	7	0.062	0.13
Reserves Ratio	From 235 to Inf	-0.202	3	0.004	0.13
Cash to Sales	From -Inf to 2	0.251	-23	0.026	0.059
Cash to Sales	From 2 to 4	0.029	-3	0	0.059
Cash to Sales	From 4 to 6.5	-0.147	13	0.002	0.059
Cash to Sales	From 6.5 to Inf	-0.321	29	0.03	0.059
Sales Growth	From -Inf to -50	0.97	-44	0.093	0.163
Sales Growth	From -50 to -25	0.5	-23	0.034	0.163
Sales Growth	From -25 to Inf	-0.218	10	0.036	0.163
Assets Growth	From -Inf to -25	0.458	-11	0.02	0.039
Assets Growth	From -25 to -15	0.183	-4	0.002	0.039
Assets Growth	From -15 to 5	0.064	-2	0.002	0.039
Assets Growth	From 5 to Inf	-0.184	5	0.015	0.039
Equity Ratio	From -Inf to -25	0.567	-23	0.029	0.069
Equity Ratio	From -25 to 5	0.266	-11	0.006	0.069
Equity Ratio	From 5 to 35	0.027	-1	0	0.069
Equity Ratio	From 35 to 95	-0.221	9	0.024	0.069
Equity Ratio	From 95 to Inf	0.327	-13	0.01	0.069
Debt to Equity	From -Inf to -3	0.342	-4	0.009	0.052
Debt to Equity	From -3 to 0	0.612	-7	0.025	0.052
Debt to Equity	From 0 to 0.2	0.022	0	0	0.052

Predictor	Group	WOE	Scorecard	Bin IV	Total IV
Debt to Equity	From 0.2 to 3	-0.187	2	0.017	0.052
Debt to Equity	From 3 to Inf	0.097	-1	0.002	0.052
Debt Capacity Ratio	From -Inf to 35	-0.138	-3	0.011	0.043
Debt Capacity Ratio	From 35 to 55	0.006	0	0	0.043
Debt Capacity Ratio	From 55 to 110	0.223	5	0.009	0.043
Debt Capacity Ratio	From 110 to Inf	0.56	13	0.022	0.043
Debt to Sales	From -Inf to 450	-0.206	-3	0.027	0.083
Debt to Sales	From 450 to 700	0.061	1	0	0.083
Debt to Sales	From 700 to Inf	0.448	7	0.056	0.083
Working Capital to Debt	From -Inf to 0.3	0.389	-10	0.066	0.126
Working Capital to Debt	From 0.3 to 5.1	-0.359	10	0.061	0.126
Working Capital to Debt	From 5.1 to Inf	0.003	0	0	0.126
Interest Expenses to Sales	From -Inf to 2.6	-0.258	6	0.047	0.176
Interest Expenses to Sales	From 2.6 to 5	0.362	-9	0.015	0.176
Interest Expenses to Sales	From 5 to Inf	0.814	-20	0.114	0.176
Years of Debt Redemption	From -Inf to 2.5	-0.185	-9	0.017	0.053
Years of Debt Redemption	From 2.5 to 7	-0.092	-5	0.001	0.053
Years of Debt Redemption	From 7 to 29.5	0.059	3	0.001	0.053
Years of Debt Redemption	From 29.5 to Inf	0.38	19	0.035	0.053
Total Assets Turnover	From -Inf to 0.5	0.571	-19	0.075	0.142
Total Assets Turnover	From 0.5 to 0.9	0.205	-7	0.008	0.142
Total Assets Turnover	From 0.9 to 1.6	-0.173	6	0.007	0.142
Total Assets Turnover	From 1.6 to Inf	-0.402	14	0.051	0.142
Fixed Assets Turnover	From -Inf to 1	0.494	4	0.054	0.096
Fixed Assets Turnover	From 1 to 2	0.175	1	0.005	0.096
Fixed Assets Turnover	From 2 to 5	-0.072	-1	0.001	0.096
Fixed Assets Turnover	From 5 to Inf	-0.297	-3	0.036	0.096
Account Receivable Turnover Days	From -Inf to 20	0.145	-2	0.008	0.066
Account Receivable Turnover Days	From 20 to 40	-0.1	2	0.002	0.066
Account Receivable Turnover Days	From 40 to 120	-0.275	4	0.025	0.066
Account Receivable Turnover Days	From 120 to 225	0.116	-2	0.001	0.066
Account Receivable Turnover Days	From 225 to Inf	0.677	-10	0.031	0.066
Inventory Turnover Days	From -Inf to 5	0.168	-1	0.013	0.046
Inventory Turnover Days	From 5 to 125	-0.248	2	0.025	0.046
Inventory Turnover Days	From 125 to 230	-0.057	0	0	0.046

Predictor	Group	WOE	Scorecard	Bin IV	Total IV
Inventory Turnover Days	From 230 to Inf	0.328	-3	0.009	0.046
Account Payable Turnover Days	From -Inf to 10	0.093	-2	0.003	0.074
Account Payable Turnover Days	From 10 to 20	-0.116	2	0.002	0.074
Account Payable Turnover Days	From 20 to 80	-0.25	5	0.023	0.074
Account Payable Turnover Days	From 80 to 145	0.091	-2	0.001	0.074
Account Payable Turnover Days	From 145 to Inf	0.67	-13	0.046	0.074
Account Payable Turnover	From -Inf to 2	0.318	-4	0.022	0.048
Account Payable Turnover	From 2 to 4	-0.012	0	0	0.048
Account Payable Turnover	From 4 to 26	-0.235	3	0.022	0.048
Account Payable Turnover	From 26 to 60	-0.009	0	0	0.048
Account Payable Turnover	From 60 to Inf	0.151	-2	0.004	0.048
Cash Conversion Cycle	From -Inf to 0.2	0.257	-4	0.021	0.065
Cash Conversion Cycle	From 0.2 to 4.2	-0.239	3	0.027	0.065
Cash Conversion Cycle	From 4.2 to 9	-0.058	1	0	0.065
Cash Conversion Cycle	From 9 to Inf	0.418	-6	0.017	0.065
Fixed Assets to Equity	From -Inf to 0	0.464	-2	0.031	0.086
Fixed Assets to Equity	From 0 to 20	-0.096	0	0.002	0.086
Fixed Assets to Equity	From 20 to 80	-0.437	2	0.043	0.086
Fixed Assets to Equity	From 80 to 220	0.054	0	0.001	0.086
Fixed Assets to Equity	From 220 to Inf	0.255	-1	0.009	0.086
Other Current Assets Ratio	From -Inf to 6.5	-0.068	0	0.003	0.021
Other Current Assets Ratio	From 6.5 to 21.5	0.048	0	0	0.021
Other Current Assets Ratio	From 21.5 to Inf	0.38	-2	0.017	0.021
SME Size	Medium	-0.568	28	0.065	0.128
SME Size	Micro	0.828	-41	0.06	0.128
SME Size	Small	0.062	-3	0.003	0.128
Registration Type	Company limited	-0.075	3	0.004	0.018
Registration Type	Partnerships or Public company limited	0.235	-11	0.013	0.018
Firm Age	From -Inf to 3	-0.175	10	0.002	0.071
Firm Age	From 3 to 14	0.207	-12	0.023	0.071
Firm Age	From 14 to 22	-0.065	4	0.001	0.071
Firm Age	From 22 to 26	-0.328	19	0.009	0.071
Firm Age	From 26 to Inf	-0.579	34	0.036	0.071
Authorized Shareholding Capital	From -Inf to 1000000	-0.04	3	0	0.009
Authorized Shareholding Capital	From 1000000 to 2000000	0.115	-8	0.004	0.009

Predictor	Group	WOE	Scorecard	Bin IV	Total IV
Authorized Shareholding Capital	From 2000000 to 2500000	0	0	0	0.009
Authorized Shareholding Capital	From 2500000 to 3500000	0.017	-1	0	0.009
Authorized Shareholding Capital	From 3500000 to 5500000	-0.022	2	0	0.009
Authorized Shareholding Capital	From 5500000 to 19500000	-0.192	13	0.004	0.009
Authorized Shareholding Capital	From 19500000 to Inf	-0.072	5	0.001	0.009
Loan Size	From 350K to 1M or 1M to 5M	0.032	-2	0	0.256
Loan Size	From 50K to 350K	-0.317	21	0.011	0.256
Loan Size	Greater than 5M	0.353	-24	0.051	0.256
Loan Size	Less than 50K	-1.594	107	0.195	0.256
ISIC	Agriculture or Construction	0.556	-28	0.039	0.055
ISIC	Manufacturing, Mining, Real estate or Service	-0.047	2	0.001	0.055
ISIC	Trade	-0.17	8	0.011	0.055
ISIC	Utility	0.232	-12	0.003	0.055
Province	AmnatCharoen, AngThong or Bangkok	-0.275	9	0.028	0.05
Province	BuengKan, BuriRam, Chachoengsao, ChaiNat, Chaiyaphum, Chanthaburi, ChiangMai, ChiangRai, ChonBuri, Chumphon, Kalasin, KamphaengPhet, Kanchanaburi, KhonKaen, Krabi, Lampang, Lamphun, Loei, LopBuri, MaeHongSon, MahaSarakham, Mukdahan, NakhonNayok, NakhonPathom, NakhonPhanom, NakhonPathom, NakhonPhanom, NakhonRatchasima, NakhonSawan, NakhonRatchasima, NakhonSawan, NakhonSiThammarat, Nan, Narathiwat, NongBuaLamPhu, NongKhai, Nonthaburi, PathumThani, Pattani, PhangNga, Phatthalung, Phayao, Phetchabun, Phetchaburi, Phichit, Phitsanulok, Phrae, PhraNakhonSiAyutthaya, Phuket, PrachinBuri, PrachuapKhiriKhan, Ranong, Ratchaburi, Rayong, RoiEt, Sakaeo, SakonNakhon, SamutPrakarn, SamutSakhon or SamutSongkhram	0.133	-5	0.009	0.05
Province	Saraburi, Satun, SingBuri, SiSaKet, Songkhla, Sukhothai, SuphanBuri, SuratThani, Surin, Tak, Trang, Trat, UbonRatchathani, UdonThani, UthaiThani, Uttaradit, Yala or Yasothon	0.371	-13	0.012	0.05
Region	Central	-0.135	2	0.012	0.041
Region	Eastern	0.069	-1	0	0.041
Region	Northeastern, Northern, Southern or Western	0.343	-5	0.029	0.041