

BANKRUPTCY PREDICTION USING CAMEL RATIOS: THE CASE OF THE STOCK EXCHANGE OF THAILAND

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Abstract

The objective of this paper is to find a model to predict bankruptcy of firms listed on the Stock Exchange of Thailand (SET) by using a secondary data approach. Using five ratios and applying logistic regression approach, the CAMEL model was then created. The results show the model could be used as a predictor; however, the degree of accuracy may vary with different time, situations and environments.

INTRODUCTION

Business bankruptcy is defined as the inability of a firm to pay its debts. Bankruptcy is widely perceived to be damaging to the economy (Kaufman 1996). Many researchers and rating companies have investigated the causes of business failures and identified them into four factors; financial, economic, natural disasters and others (Brigham et al. 1999). More importantly, researchers have searched for techniques to analyze possible business failures and one of the techniques is by using financial ratios that are referred to as **CAMEL** ratios. CAMEL stands for Capital, Assets quality, Management, Earnings and Liquidity (Bennett & Loucks 1996, Kane et al. 1998, Luther 1998, Gunther 1999, Estrella 2000, McKee 2000, Mongid 2000 and Shah & Murtaza 2000).

Researchers have argued that ratios attempt to predict a going concern's condition and the overall performance of business. It is claimed that the ratios can be used as an effective tool to identify business problems. Therefore it is important to investigate whether the CAMEL ratios could be used as a predicting tool in emerging capital markets such as Thailand. The objective of this research is to identify whether CAMEL ratios are an accurate predictor of business failure in Thailand. This paper seeks to investigate and answer this question.

This paper applies the secondary data technique. Therefore, all publicly listed firms in the SET (Stock Exchange of Thailand) were selected from year 2000 to 2003, except firms from the banking and finance sectors due to incomplete information. Listed firms are classified depending on their business status in time

t (current year) in order to predict their performances in $t+1$ (one year in advance), $t+2$ (two years in advance) and $t+3$ (three years in advance). In discussing CAMEL ratios, descriptive statistics and logistic regression techniques are applied.

This paper is organized as follows: (1) literature review and selected methodology (2) analysis and discussion (3) conclusion and implications.

LITERATURE REVIEW AND SELECTED METHODOLOGY

Beaver started investigating business failures in 1966 by using financial ratios known as univariate analysis. The ratios are grouped into "best predictors", "second best predictors" and "worst predictor". Beaver suggested that financial ratios are useful for bankruptcy predictions (Beaver, 1966). Altman (1968) advanced the theory by using a multiple discriminant analysis (MDA) prediction model. The accuracy of the model is 95% for data one year before bankruptcy and 70% for two years before bankruptcy. Other researchers who followed Altman by using MDA are Deakin (1972) and McKee (2000). However, Ohlson (1980) applied a logistic regression model to increase the accuracy of prediction to 96.3%. Other researchers who followed were Zmijewski (1984) and Zavgren (1985).

Although there is a range of research into bankruptcy applying different methodologies and models (Santoso, 1996), the three studies above are considered as foundations and are referred to the most in recent bankruptcy studies.

Before discussing the CAMEL ratios, it is useful to understand the nature of financial statements. Financial statements help managers and owners:

- to understand the relationship between revenue, expenses and financial position of the business;
- to understand and explain the level of business performance;
- to identify a firm’s position in an industry;
- to gain insight and look at a firm’s strengths, weaknesses, opportunities and threats;
- to understand past performance and ability to predict future performance (Meredith 1995).

Financial ratios are the main exploratory or independent variables used in this study to predict possible bankruptcy. The motivations of using financial ratios in this study are:

- to act as a summary (or descriptive statistic);
- to identify industry benchmarks;
- to input formal decision models;
- to standardize for different scales (Ree 1995).

Researchers and academics have listed financial ratios into five groups namely: liquidity, assets management, financial leverage, profitability and market value ratios (Brigham et al. 1998). Therefore it is easy to see why the CAMEL model is commonly used among researchers, academics and analysts as the CAMEL ratio model includes all the major ratios categories in its analysis.

In this paper, the researcher used only one ratio as a representative of each ratio category following previous studies (Sinkey 1975, Henebry 1997, Gilbert et al. 1999, Demirguc-Kung & Huizinga 2000, Mongid 2000). Each category and its ratio representative are listed below:

- a. Equity Capital to Total Assets (**EC/TA**) represents Capital adequacy
- b. Return on Assets (**EBIT/TA**) represents Assets quality
- c. Return on Assets (**Y/TA**) represents Management
- d. Earnings before Interest and Taxes on Interest Expenses (**EBIT/INT**) represents Earnings
- e. Total Loans to Total Asset (**TL/TA**) represents Liquidity

This study used financial statements to find five financial ratios as mentioned above, then applied logistic regression analysis to predict the bankruptcy of listed firms in the Stock Exchange of Thailand from 2000 to 2003. The logistic regression was chosen over other models because there are no underlying assumptions about the distribution of the predictors making it the best and most accurate predictor.

Analysis and Discussion

All listed firms which provided full financial statements excluding banks and finance sectors in the calendar year 2000 to 2003 and which were listed before 2000, were selected. Useful information from financial statements was obtained from the CD-ROM from the Stock Exchange of Thailand (SET). The five ratios were then found. Table 1 below shows the number of sampled firms, industries included and number of businesses that failed during 2000-2003 as reported by the Stock Exchange of Thailand.

Table 1: Number of samples, industries and businesses that failed

Year	2000	2001	2002	2003
Number of Sampled Firms	280	280	280	280
Number of Industries	31	31	31	31
Number of Delist due to Failure in Business Operation	N/A	3	7	2

Source: Developed for this research

After the ratios were calculated, the logistic regression was used to find the coefficient for each variable using SPSS program. Then the coefficient was multiplied with each ratio in 2000, 2001 and 2002 to find the best base year to be used as a model. See table 2 for details.

From table 2, it is clear that logistic regression suggests only EC/TA(X1), Y/TA(X3) and EBIT/INT (X4) as significant variables to be used in the prediction model. Also the significant model is obtained from the sample from year 2000. Again, in table 3 below, average coefficient from each ratio and a beta (constant) are shown in separate table.

Therefore, only three ratios are maintained in the appropriate equation or model below:

$$Z = -3.3903 ((-3.118 \times X1) + (7.870 \times X3) + (-0.408 \times X4))$$

Moreover, logistic regression allowed the prediction of two outcomes; “0” is when the firm will survive and “1” is when the firm will become bankrupt. The same equation will be used as a predictor of bankruptcy one year in advance, two years in advance and three years in advance when applying year 2000 data, only one year in advance and two years in advance for year 2001 data, then only one year in advance for year 2002 data. The accuracy of the bankruptcy prediction is shown below:

Table 2: Coefficient values for 2000, 2001 and 2002

2000 Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	X1	-3.11826	1.68122	3.4401	1	0.063630774	0.044234
	X3	7.870557	3.521145	4.9962	1	0.025402471	2619.025
	X4	-0.4082	0.949845	0.1847	1	0.067377333	0.664849
	Constant	-3.3903	0.7455	20.681	1	5.42384E-06	0.033699
a Variable(s) entered on step 1: X1, X3, X4.							
2001 Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	X1	-0.84195	1.434964	0.3443	1	0.557379416	0.43087
	X3	1.417877	2.937834	0.2329	1	0.629360901	4.128345
	X4	-0.55953	0.665515	0.7069	1	0.400491175	0.571479
	Constant	-2.86368	0.594849	23.176	1	1.47837E-06	0.057058
a Variable(s) entered on step 1: X1, X3, X4.							
2002 Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	X1	0.260667	2.699183	0.0093	1	0.923065761	1.297796
	X3	3.305624	3.286408	1.0117	1	0.314489115	27.26556
	X4	-0.06784	0.428264	0.0251	1	0.874132228	0.934408
	Constant	-6.04282	1.529469	15.61	1	7.7849E-05	0.002375
a Variable(s) entered on step 1: X1, X23 X4.							

Source: Developed for this research

Table 3: Average Coefficient for the base year

	Average Coefficient			
	Constant	X1	X3	X4
2000 as base year for forecasting	-3.3903	-3.118257303	7.870557308	-0.408196017

Source: Developed for this research

Table 4: Crosstab forecast using base year to predict bankruptcy one year in advance

		BK01 * FORE1 Crosstabulation			
			FORE1		Total
			0	1	
BK01	0	Count	230	47	277
		Expected Count	228.53	48.48	277
		% within BK01	83.03	16.97	100
		% within FORE1	99.57	95.92	98.93
		% of Total	82.14	16.79	98.93
	1	Count	1	2	3
		Expected Count	2.48	0.53	3
		% within BK01	33.33	66.67	100
		% within FORE1	0.43	4.08	1.07
		% of Total	0.36	0.71	1.07
Total		Count	231	49	280
		Expected Count	231	49	280
		% within BK01	82.5	17.5	100
		% within FORE1	100	100	100
		% of Total	82.50	17.50	100

Source: Developed for this research

Table 5: Crosstab forecast using base year to predict bankruptcy two years in advance

		BK02 * FORE2 Crosstabulation			
			FORE2		Total
			0	1	
BK02	0	Count	227	46	273
		Expected Count	225.23	47.78	273
		% within BK02	83.15	16.85	100
		% within FORE2	98.27	93.88	97.50
		% of Total	81.07	16.43	97.50
	1	Count	4	3	7
		Expected Count	5.775	1.225	7
		% within BK02	57.14	42.86	100
		% within FORE2	1.73	6.12	2.50
		% of Total	1.43	1.07	2.50
Total		Count	231	49	280
		Expected Count	231	49	280
		% within BK02	82.50	17.50	100
		% within FORE2	100	100	100
		% of Total	82.50	17.50	100

Source: Developed for this research

Table 6: Crosstab forecast using base year to predict bankruptcy three years in advance

		BK03 * FORE3 Crosstabulation		
		FORE3		Total
		0	1	
BK03 0	Count	231	48	279
	Expected Count	230.18	48.83	279
	% within BK03	82.80	17.20	100
	% within FORE3	100.00	97.96	99.64
	% of Total	82.50	17.14	99.64
1	Count	0	1	1
	Expected Count	0.83	0.18	1
	% within BK03	0	100	100
	% within FORE3	0.00	2.04	0.36
	% of Total	0.00	0.36	0.36
Total	Count	231	49	280
	Expected Count	231	49	280
	% within BK03	82.50	17.50	100
	% within FORE3	100	100	100
	% of Total	82.50	17.50	100

Source: Developed for this research

From table 4, 5 and 6, it is clear that from base year of 2000, the formula above would be able to predict the bankruptcy of listed firms on the Stock Exchange of Thailand in year 2001, 2002 and 2003 with accuracy rates of 66.67%, 42.86% and 100%, respectively. It is important to notice that the degree of accuracy of prediction using the model varies. Previous studies suggest that the degree of accuracy and the number of years in advance before a bankruptcy occurred have negative relationship. In Thailand, the results only support the previous studies in year 2001 and 2002, not in 2003 or three years in advance. This could be due to stronger economic growth in Thailand after the crisis in 1997-1998 resulting in lower number of listed firms going bankrupt, thus, lowering the level of predictability.

Conclusion and Implication

The performances of listed firms in emerging capital market such as Thailand facilitate the development of public and private sectors. Since the economic crisis in 1997 that hit East Asia including Thailand, investors and business firms have focused more on their performance to avoid the

problems they faced in the past. Financial statement analysis has become popular among investors, regulators and financial institutions. Specifically, CAMEL ratios are well-known models used in rating the quality of business, risk, financial conditions and over all performance. In this study, CAMEL ratios are used as a technique for failure prediction. The results suggest that capital adequacy, good management of assets/liabilities and earning power are significant ratios to be used in predicting bankruptcy in the Thai capital market. The study also suggests that logistic model built from base year 2000 is a significant model and could be used, to some degree, to predict bankruptcy in most industries listed on the Stock Exchange of Thailand. Although research has tried to make a consistent and successful model based on logistic regression, researchers, practitioners, and investors have yet to understand that a perfect model cannot be found. It can be concluded that each model developed can be useful in different conditions, environments and countries with different assumptions.

Although only CAMEL ratios were used in this study and factors outside financial ratios such as politics, economics growth, inflation and unemployment rates were not considered, this research paper is a very useful one for building a strong

forecasting models in emerging markets like Thailand. As there has been little bankruptcy research in emerging markets, there are still plenty of opportunities for other researchers to investigate bankruptcy cases in Thailand.

This research could be used as an early warning signal for investors, business and government about failure. It also could be used as a tool for predicting business failure for investment institutions. For the regulators, it is a foundation to a more developed technique to supervise and monitor the quality of a business's assets, liabilities and owner's equities. The benefits mentioned are aimed to provide safe and sound business environment in the emerging and competitive Thai capital markets.

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