MINISTRY OF ECONOMY
DEPARTMENT OF STATISTICS MALAYSIA

ANALYSING THE DEFAULT RISK PROFILES OF FIRMS' BUSINESS SECTORS USING SELECTED RISK INDICATORS AND KMV-MERTON MODEL

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INTRODUCTION

Definition

The probability that a borrower fails to make full and timely payments of principal and interest.

Causes

High costs, fund misappropriation, poor judgment, fraud.

Effects

Harder to obtain credit, higher required returns, increased interest rates

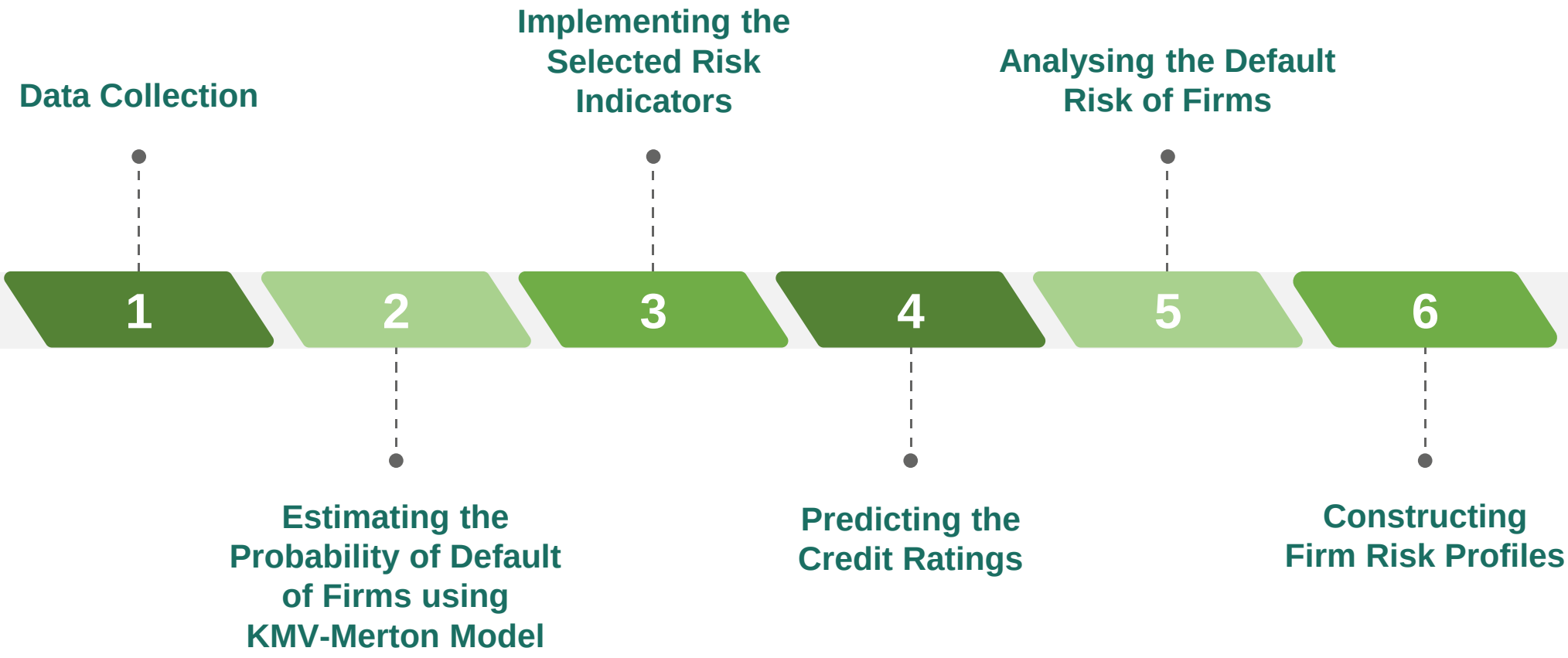
Methods

KMV-Merton probability, with other indicators, is best for assessing default risk.

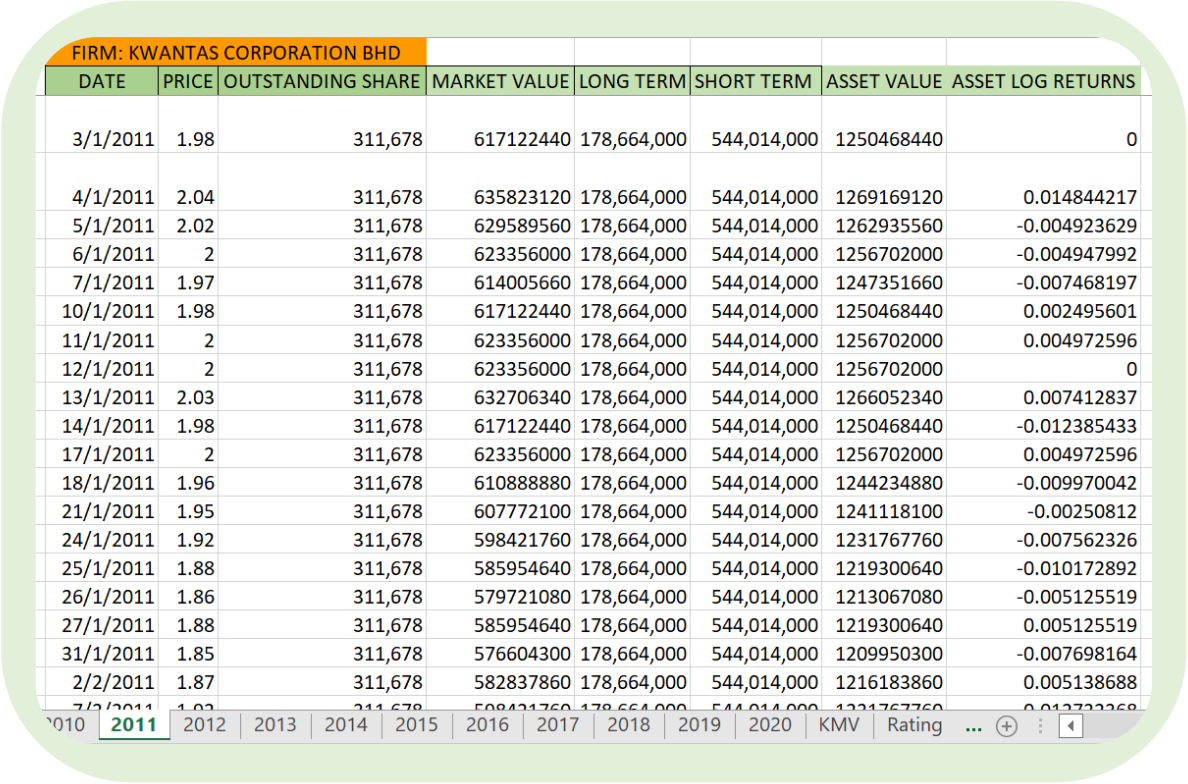
Objectives

i. To analyse the level of default risk of firms using KMV-Merton model, credit ratings, and the selected risk indicators.
ii. To provide the risk profile of certain firm sector based on the analysis objective (i).

METHODOLOGY



1) DATA COLLECTION



FIRM: KWANTAS CORPORATION BHD

DATE	PRICE	OUTSTANDING SHARE	MARKET VALUE	LONG TERM	SHORT TERM	ASSET VALUE	ASSET LOG RETURNS
3/1/2011	1.98	311,678	617122440	178,664,000	544,014,000	1250468440	0
4/1/2011	2.04	311,678	635823120	178,664,000	544,014,000	1269169120	0.014844217
5/1/2011	2.02	311,678	629589560	178,664,000	544,014,000	1262935560	-0.004923629
6/1/2011	2	311,678	623356000	178,664,000	544,014,000	1256702000	-0.004947992
7/1/2011	1.97	311,678	614005660	178,664,000	544,014,000	1247351660	-0.007468197
10/1/2011	1.98	311,678	617122440	178,664,000	544,014,000	1250468440	0.002495601
11/1/2011	2	311,678	623356000	178,664,000	544,014,000	1256702000	0.004972596
12/1/2011	2	311,678	623356000	178,664,000	544,014,000	1256702000	0
13/1/2011	2.03	311,678	632706340	178,664,000	544,014,000	1266052340	0.007412837
14/1/2011	1.98	311,678	617122440	178,664,000	544,014,000	1250468440	-0.012385433
17/1/2011	2	311,678	623356000	178,664,000	544,014,000	1256702000	0.004972596
18/1/2011	1.96	311,678	610888880	178,664,000	544,014,000	1244234880	-0.009970042
21/1/2011	1.95	311,678	607772100	178,664,000	544,014,000	1241118100	-0.00250812
24/1/2011	1.92	311,678	598421760	178,664,000	544,014,000	1231767760	-0.007562326
25/1/2011	1.88	311,678	585954640	178,664,000	544,014,000	1219300640	-0.010172892
26/1/2011	1.86	311,678	579721080	178,664,000	544,014,000	1213067080	-0.005125519
27/1/2011	1.88	311,678	585954640	178,664,000	544,014,000	1219300640	0.005125519
31/1/2011	1.85	311,678	576604300	178,664,000	544,014,000	1209950300	-0.007698164
2/2/2011	1.87	311,678	582837860	178,664,000	544,014,000	1216183860	0.005138688

2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | KMV | Rating | ...

Gathered data from non-financial sectors between 2010 and 2020

Data obtained included share prices, market value of equity, outstanding shares, short-term and long-term borrowing of firms.

Data gathered from Thomson Reuters Data Stream and Refinitive Eikon databases, and firms' annual reports

2) ESTIMATING THE PROBABILITY OF DEFAULT OF FIRMS USING KMV-MERTON MODEL

Step 1

Multiplying each of the daily stock prices with the outstanding share to get the daily market value of a firm's equity.

Step 2

Calculate the daily book value of liabilities, by defining it as a total borrowing of the short term plus half of the long-term borrowings.

Step 3

The daily asset's market value is calculated based on the sum of the firms' book value of liabilities and market value of equity.

Step 4

Generates the daily natural log of the assets' market values returns to get the average return and the standard deviation.

Step 5

Calculating the distance to default, *d*, followed by estimating the annual default probability of the firms using the equation:

$$d = \frac{ln(\frac{V}{X_t}) + (\mu - \frac{1}{2}\sigma_{v^2})t}{\sigma_v\sqrt{t}}$$

3) IMPLEMENTING THE SELECTED RISK INDICATORS

Leverage ratio

$$\frac{\text{total debt}}{\text{total assets} - \text{total liabilities}}$$

Liquidity ratio

Acquired from firm's annual financial summary

Firm size

$\ln$ Total Assets

Return on assets (ROA)

$$\frac{\text{net income}}{\text{total assets}}$$

Cash

$$\frac{(\text{annual cash + cash equivalents})}{\text{total assets}}$$

Volatility

$$\sigma\sqrt{252}$$

4) PREDICTING THE CREDIT RATINGS

MARC Default Rate

Rating	MARC Default Rate
AAA	< 0.0278
AA	0.0278-0.5886
A	1.1328-2.7092
BBB	3.7413-12.2848
BB	19.7963-34.8192
B	42.3306-57.3535
C	> 64.8650

5) ESTIMATING THE LEVEL OF DEFAULT RISK OF FIRMS

Level of Default Risk

Credit Ratings	Level Of Default Risk
AAA/AA/A	Low
BBB/BB	Medium
B/C	High

6) CONSTRUCTING FIRM RISK PROFILES

Risk Profile for Construction & Engineering

CONSTRUCTION & ENGINEERING

	Low	Medium	High
Actual Credit Rating	AAA/AA/A	BBB/BB	B/C
MARC Probability of Default Rate	PD ≤ 2.7092	3.7413 ≤ PD ≤ 34.8192	PD ≥ 42.3306
Predicted Probability of Default Rate	PD ≤ 3.2	4.05 ≤ PD ≤ 37.53	PD ≥ 43.13
Leverage Ratio	LEV ≤ 5.1616	0.3423 ≤ LEV ≤ 12.6269	LEV ≥ -4.5101
Liquidity Ratio	LIQ ≤ 79.72	0.31 ≤ LIQ ≤ 2.09	LIQ ≥ 0.78
Firm Size	FS ≤ 10.2974	7.9847 ≤ FS ≤ 9.9385	FS ≥ 7.8559
ROA	ROA ≤ 0.1635	-0.5194 ≤ ROA ≤ 0.0520	ROA ≥ -0.3196
Cash	CASH ≤ 0.2274	0.0030 ≤ CASH ≤ 0.2526	CASH ≥ 0.0047
Volatility	VOL ≤ 1.0901	0.0009 ≤ VOL ≤ 0.2497	VOL ≥ 0.5946

Low level consist of firms that have predicted rating of AAA, AA and A. Medium consist of firms that have predicted rating of BBB and BB. High level consist of firms with predicted credit rating of B and C.

Value of risk indicators for each category depends on which firm is in each category.

MARC probability of default rate and available actual credit rating of firms is also attached, as comparison

Risk profile is constructed

RESULT

Descriptive Statistic of DD & PD for Each Rating Category

Ratings	Distance To Default (DD)				Probability Of Default (PD)			
	Mean	Minimum	Maximum	Count	Mean	Minimum	Maximum	Count
AAA	7.862118	0.00209	28.4	165	0.000881	2.80E-177	0.000288	165
AA	7.9446232	1.44	34.5	33	0.003343	0.000456	0.007984	33
A	2.20396	-15.5971	5.18	20	0.021259	0.0101	0.031944	20
BBB	3.005	2.27	3.74	18	0.088385	0.040537	0.145304	18
BB	1.520799	0.386	2.29	12	0.243733	0.171398	0.375307	12
B	-0.1046	-0.24516	-0.0119	14	0.545604	0.431311	0.609291	14
C	-0.50245	-0.51587	-0.48902	5	0.676974	0.631699	0.733145	5

Higher PD Values Indicate Higher Default Risk

i. Larger PD values imply a higher likelihood of a firm defaulting.
ii. This is evident from the maximum and minimum PD values for each rating category.
iii. Higher PD values suggest that these companies might have to pay more to borrow money and might find it harder to get loans or investments.

Inverse Relationship Between Credit Rating and Default Risk

i. As the credit rating declines from ‘AAA’ to ‘B’, the average PD increases.
ii. Firms with higher credit ratings are less likely to default compared to those with lower ratings.
iii. Crucial for investors, lenders, and credit rating agencies to assess the risk associated with different firms based on their credit ratings.

RESULT

The Risk Profile of Firms for All Sectors

Firm Risk Indicators	LEVEL OF RISK		
	Low	Medium	High
Predicted Rating	AAA/AA/A	BBB/BB	B/C
MARC Probability Of Default Rate (%)	PD ≤ 2.7092	3.7413 ≤ PD ≤ 34.8192	PD ≥ 42.3306
Estimated Probability Of Default Rate (%)	9.6234E-260 ≤ PD ≤ 2.66	4.05 ≤ PD ≤ 37.53	50.47 ≤ PD ≤ 73.31
Leverage Ratio	0.0019 ≤ LEV ≤ 316.389	-29.1769 ≤ LEV ≤ 12.6269	-4.5101 ≤ LEV ≤ 106.223
Liquidity Ratio	-6.12 ≤ LIQ ≤ 79.72	0.18 ≤ LIQ ≤ 2.63	0.15 ≤ LIQ ≤ 2.25
Firm Size	7.3954 ≤ FS ≤ 11.2587	7.9847 ≤ FS ≤ 10.8305	7.8559 ≤ FS ≤ 11.0687
ROA	-3.8134 ≤ ROA ≤ 0.1788	-0.5194 ≤ ROA ≤ 0.0654	-0.3196 ≤ ROA ≤ 0.0731
Cash	0.0453≤ CASH ≤ 0.2350	0.0005 ≤ CASH ≤ 0.2526	0.0031 ≤ CASH ≤ 0.1673
Volatility	0.00026≤ VOL ≤ 1.0901	0.0009 ≤ VOL ≤ 1.0565	0.0456 ≤ VOL ≤ 2.6321

Low

i. Financially stable and powerful.
ii. Strong credit ratings, indicating low likelihood of default.
iii. Lower borrowing costs and higher investor confidence.

Medium

i. Balanced financial position with moderate risks.
ii. Somewhat stable but vulnerable to economic fluctuations and market changes.
iii. Investors and creditors approach with caution, demanding higher returns for seen risk.

High

i. Greater risk of default and financial distress.
ii. Poor credit ratings, indicating instability.
iii. Higher borrowing costs and reduced access to capital.

DISCUSSION & CONCLUSION

Findings

i. Predicted ratings closely match actual ratings, indicating high accuracy in calculations.

ii. Some firms have high leverage and volatility but low probability of default (PD), and vice versa.

iii. Due to inconsistent values, it is challenging to determine the exact impact on default risk.

iv. Leverage ratio and volatility do not always indicate a firm's default risk.

Conclusion

i. To provide early warnings to selected firms about their financial status.

ii. To help future investors choose the best firms to invest in.

iii. Focus is not only on Malaysian non-financial firms but also on a broader scope.

Thank you