Credit Risk Analysis of West Fraser Timber Co.Ltd.(WFG)

(The presentation is a horizontal layout.)

This one-page presentation describes the calculation of the default probability of West Fraser Timber via using the Merton and Credit Metrics model

* Choose the time horizon to be 5 years.

$$r(T) = -\frac{\log(P/N)}{T}$$

r(T) is the yield, P is the bond price, N is the notional($100), T is the time to maturity

Using the spot rate in A1 and applying the formula above, the bond's price for 1-5 years can be obtained.

$$P = \sum_i p_i e^{-r(t_i)\,t_i}.$$

From Table1, the first bond will mature in June 2022, which is 2 months from now. So t1 is 2/12 years. Similar for the remaining 4 years. Then, applying the formula above, the corresponding risk-free rate ri for each year can be computed, which is shown in Table2.

Table1. Bonds

Bond Name
CAN 1.75 Jun 22
CAN 1.5 Jun 23
CAN 2.5 Jun 24
CAN 2.25 Jun 25
CAN 1.5 Jun 26

Table2. Risk-free rate over 5 years

Year	Risk-free rate
1	r1 = 1.977%
2	r2 = 2.344%
3	r3 = 2.439%
4	r4 = 2.458%
5	r5 = 2.636%

1. Merton Model Assumption:

- The risk-free rate and the volatility are known and constant within one year.
- The returns on the underlying asset are log-normally distributed.
- Only consider the European option which can only be exercised at the expiration date.
- No dividend is involved and no transaction costs.

2. Data:

The historical stock prices of WFT over the last year, market cap, total assets, liability and equity values are all from Yahoo Finance.

Based on the second point of assumption, we can get the historical volatility of returns by:

1. Using ln[P(t+1)/p(t)] to compute the daily log returns.
2. Squaring each log return, summing it and dividing the sum by 251 to get the daily variance since there are approximately 252 trading days annually.
3. Taking the square root of the daily variance and multiplying it by the square root of 252, we obtain the annualized historical volatility as 35.6%

Table 3. West Fraser Timber Stock Info

σ_S	**35.6%**
V (Mkt Cap)	9.18B
K(Total debt)	5.28B
D/E Ratio (Leverage)	0.36

3. Black-Scholes Merton Model Formula:

$$S = VN(d_1) - Ke^{-rt}N(d_2)$$

$$d_1 = \frac{-\ln(Ke^{-e\tau}/V)}{\sigma\sqrt{\tau}} + \frac{\sigma\sqrt{\tau}}{2}, \quad d_2 = d_1 - \sigma\sqrt{\tau}$$

$$\sigma_V = \sigma_S \frac{S\partial V}{V\partial S} \qquad \textit{Equation *}$$

S: market value of the firm's equity
V: market capitalization of the firm
K: total debt of the firm r: risk-free rate
T: time to maturity N: normal distribution
σ*: Volatility of returns of the underlying assets*

Since σ_S, V, r1 and K are known, we can use the RMFI software to obtain the market value of the firm's equity S which is 4.059 and delta = 0.963. Then, applying Equation *, we can obtain σ_V as 0.152. Next, applying the formula of d1 and d2, and since t1 = 2/12, we get d1= 3.746591, d2= 3.595018, which implies the probability of default for the first year is 0.0001621848.

Employing the same approach, we can obtain the probability of default of WFG for five years. They are shown in Table 4.

Table 4. PD of WFG over 5 years

	PD(Merton)	PD(Credit Metric)
Year 1	0.00016218	0.01482
Year 2	0.00011502	0.02942
Year 3	0.00006239	0.04381
Year 4	0.00003060	0.05799
Year 5	0.00001102	0.07195

4. Credit Metrics Model Assumption

- There are only 2 possible credit states: solvency and default
- The probability of solvency in a period, conditional on solvency at the beginning of the period is a fixed value, q.
- The recovery rate is 50%.
- The credit spread is fixed.

Thus, we can define a two-state Markov chain with a transition probability matrix.

Since the qi is the half-year solvent probability, the first transition probability matrix is A^(0.5). So,

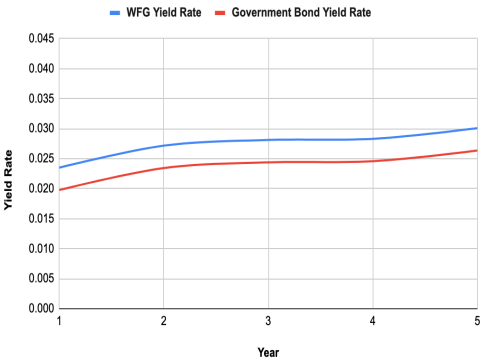
$$A^{0.5} = \begin{pmatrix} 0.99256 & 0.00744 \\ 0 & 1 \end{pmatrix}$$

Then, the 1st year Markov model is shown by taking the square power of A^0.5:

	Solvency	Default
Solvency	0.98518	0.01482
Default	0	1

Similarly, we can obtain the Markov model for the 2nd to 5th year by the matrix multiplication. And the corresponding PDs are shown in Table 4.

Figure1. ***Yield between WFG and the Canadian Government***



From Figure1, it is observed that WFG's yields on long-term bonds move together with the government. It implies a stable economic condition. Since the yield rate and the risk-free rate for the first year are known, we get h1 = 0.373%. Applying the formula:

$$q = \frac{e^{-h} - R}{1 - R}$$, q = 0.99256, 1- q = 0.00744

Figure2. ***PD of Merton model V.S PD of CreditMetrics Model***

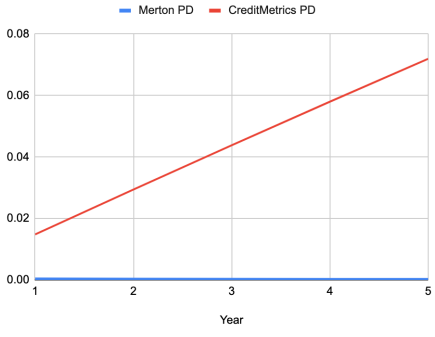


Table 5. West Fraser Timber Balance Sheet in 2021

Total Asset	$ 10,433,000
Total Liability	$ 2,777,000
Total Equity	$ 7,656,000

we choose R = 50% since this value is approximately equal to the mean value of the general R-value before and after the 2008 financial crisis. From Figure2, we found the PD generated by the Credit metrics model is increasing, whereas the PD by Merton is steadily decreasing and approaching zero since the former is more practical and the latter is more theoretical. AS WFG has a relatively low liability compared to its equity in Table 5, it makes sense that it has a low PD value over time. Overall, the Merton model is sometimes restrictive to its assumption, whereas CreditMetrics is more flexible when applied to different types of assets and is an easier way of calculation.