Illinois Institute of Technology

MSF 504 Valuation and Portfolio Management

Project Report

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I. Valuation

A. Market Risk Premium computation for each stock

1. RiskFree Rate (r_f)

US-T Bill Rates 30 Yrs Source: US Department of Treasury

Date	1 Mo	3 Mo	6 Mo	1 Yr	2 Yr	3 Yr	5 Yr	7 Yr	10 Yr	20 Yr	30 Yr
12/31/2015	0.14	0.16	0.49	0.65	1.06	1.31	1.76	2.09	**2.27**	2.67	3.01

r_f

- The 10 Yr US T Bill Yield as on 12/31/2015 (the bold column) is considered as RiskFree Rate (r_f)

2. Expected Market Return (r_m)

Year	S&P 500
1928-2015	11.41%
1966-2015	**10.75%**
2006-2015	9.03%

- The S&P 500 Arithmetic Average for 1966-2015 (the bold row) is considered as Expected Market Rate of Return (rm)

3. CAPM computations

Companies	LyondellBasell Industries	P H Glatfelter Co	Franco-Nevada Corp
Ticker	LYB	GLT	FNV
Beta (β)	1.825	1.135	0.528
RiskFree Rate(r_f)	2.27%	2.27%	2.27%

Expected Market Return (r_m)	10.75%	10.75%	10.75%
Stock's Market Risk Premium [β*(rm - rf)]	**0.154809**	**0.096279**	**0.044789**
k or $r_e = r_f + \beta*(r_m - r_f)$	**17.75%**	**11.90%**	**6.75%**

- β for each stock as on 12/31/2015 is directly taken from online website (https://ycharts.com/)
- Market Risk Premium for each stock can be computed as the risk premium on individual securities is a function of the individual security's contribution to the risk of the market portfolio. [$\beta (r_m - r_f)$]

B. Sustainable Growth Rate (SGR) computation for each stock

The sustainable growth rate is a measure of how much a firm can grow without borrowing more money. After the firm has passed this rate, it must borrow funds from another source to facilitate growth.

- Formulae used
  - **ROE = Net Income / Average Shareholder's Equity**
  - **Dividend Payout Ratio = Dividends / Net Income**
  - **SGR = ROE x (1 – Dividend Payout Ratio)**

USD in Millions

	LYB	**GLT**	**FNV**
Net Income	4,476.00	64.75	24.60
Dividends Paid	1,410.00	20.44	94.10
Dividend Payout Ratio	0.32	0.32	3.83
Stockholder's Equity - 2015	8,314.00	663.25	3.14
Stockholder's Equity - 2014	6,550.00	649.11	3,405.50
Average Stockholder's Equity	7,432.00	656.18	1,704.32
Return on Equity	0.60	0.10	0.01
SGR	**0.41**	**0.07**	**-0.04**

- The financial data for each stock is taken from Annual Report for 2015 published on each Stock's company website and / or http://morningstar.com
- The SGR for Franco-Nevada Corp is negative because the company has paid $ 94.1 Million as total Dividend to their shareholders while their Net Income is just $ 24.60 Million. The same can be confirmed by company's Annual Report for Financial Year 2015

C. Discounted Cash Flow Analysis

1. Constant Growth DDM Model

The Dividend Discount Model (DDM) is a procedure for valuing the price of a stock by using predicted dividends and discounting them back to present value. The idea is that if the value obtained from the DDM is higher than what the shares are currently trading at, then the stock is undervalued.

- Formulae used
  - $\boldsymbol{P_0 = \frac{D_0(1+g)}{k-g} = \frac{D_1}{k-g}}$

	LYB	GLT	FNV
Dividend Paid per share - 2015	3.04	0.48	0.83
Dividend Paid per share - 2014	2.7	0.44	0.79
Dividend Growth Rate (g)	0.130112	0.090909	0.050633
Cost of Equity (k)	17.75%	11.90%	6.75%
Price (P_0)	**72.48**	**18.66**	**51.73**
As On Date (12/31/2015) Price	**86.09**	**18.44**	**45.75**

- The financial data for each stock is taken from Annual Report for 2015 published on each Stock's company website
- Cost of Equity (k) is already calculated in CAPM computations

2. Constant Growth (one stage) Free Cash Flow to the Firm (FCFF) model

Free cash flow for the firm (FCFF) is a measure of financial performance that expresses the net amount of cash that is generated for the firm, consisting of expenses, taxes and changes in net working capital and investments.

- Formulae used
  - **FCFF = CF from operations + Interest (1-T) - Capital Expenditure**
  - $\boldsymbol{WACC = \left[\left(\frac{MV\ (Debt)}{MV\ (Equity)+MV\ (debt)}\right) \times k_d \times (1 - Tax\ Rate)\right] + \left[\left(\frac{MV\ (Equity)}{MV\ (Equity)+MV\ (debt)}\right) \times k\right]}$

- FCFF computations

USD in Millions

	LYB	GLP	FNV
Cash flow from Operation	5,842	134	254
Interest expense	310	17.000	3.000
Tax Rate	0.281	0.350	0.260
Capital expenditures	-1,440	-100	-4
Increase in Net Working Capital	204.89	5.55	2.22
FCFF	**4,420.00**	**39.50**	**250.00**

USD in Millions

	LYB	GLP	FNV
Current FCFF	4,420.000	39.500	250.000
Market Value of debt (D)	8,195.000	363.870	457.000
Shares outstanding	430.450	43.395	156.000
Long Term growth in FCFF(g)	0.050	0.055	0.036
Tax rate (t)	0.281	0.350	0.260
Current Stock price	88.250	22.640	65.320
Cost of Debt (k_d)	0.038	0.047	0.007
Debt to Firm value (D/V)	0.177	0.270	0.043
Market value of Equity E	37,987,213	982.463	10,189.920
E/V	0.823	0.730	0.957
E+D =V	46,182.213	1,346.333	10,646.920
Cost of Equity (K_e)	0.178	0.119	0.064

WACC	**0.151**	**0.095**	**0.061**
Forecasted Value of the firm	**46,023.430**	**1,041.032**	**10,327.544**
Value of equity	**37,828.43**	**677.16**	**9,870.54**
Per share value	**87.88112**	**15.60460**	**63.27272**

- Current FCFF is already calculated in earlier table
- The financial data (Market Value of debt, Shares outstanding, Cost of Debt, Tax rate) for each stock is taken from Annual Report (Balance Sheet, Cash flow Statement, and Income Statement) for 2015 published on each Stock's company website
- As On Date Stock Prices are taken from Yahoo! Finance
- Cost of Equity (k) is already calculated in CAPM computations

3. Weights to Models

- For LYB, we did the Trend Analysis for both Dividends and Cash flows considering last 5 years' data. It is observed that Dividend Payments are volatile. Hence, we will rely more on FCFF. In addition, FCFF is more accurate and realistic. We will like to assign 70% weight to FCFF and 30% to DDM
- For GLT, out Trend Analysis for both Dividends and Cash flows considering last 5 years' data shows that the dividends seem to be constant whereas the cash flows are highly volatile like a roller coaster ride. Hence, we will like to assign 75% weight to DDM and remaining 25% to FCFF
- For FNV, during our Trend Analysis for both Dividends and Cash flows considering last 5 years' data, we observed that cash flows are really volatile. In addition, company has paid Dividend more than Net Income. Hence, we will like to assign 50% weight to each model

	LYB	**GLT**	**FNV**
Current Stock Price	88.25	22.64	47.75
DDM Price	72.48	18.66	51.74
FCFF Price	87.88	15.60	63.27
DDM Weight	30%	75%	50%
FCFF Weight	70%	25%	50%
Intrinsic Price	83.26	17.89	57.50

4. Intrinsic Value comparison

	LYB	GLP	FNV
Intrinsic Price	83.26	17.89	57.50
As On Date (12/31/2015) Price	86.09	18.44	45.75

The above table confirms that

- Stocks LYB and GLP are overvalued
- Stock FNV is undervalued

5. P/E Ratio computation

The price-earnings ratio (P/E ratio) is a valuation measure that compares the level of stock prices to the level of corporate profits, providing investors with a sense of a stock's value.

- Formulae used
  - **P/E Ratio = current Stock Price / Earnings Per Share (EPS)**
    where EPS = (Net income - Dividend on preferred stocks) / total shares outstanding)

	LYB	GLT	FNV
Current Stock price	88.25	22.64	47.75
Net Income	4,476.00	64.75	24.60
Dividend paid	1,410.00	20.44	94.10
Earnings	3,066.00	44.31	69.50
Avg. Shares outstanding	430.45	43.395	156
EPS	7.123	1.021	0.446
P/E	**12.39**	**22.17**	**107.18**

- The financial data (Net Income, Dividend Paid, and average Shares outstanding) for each stock is taken from Annual Report (Balance Sheet, Cash flow Statement, and Income Statement) for 2015 published on each Stock's company website
- As On Date Stock Prices are taken from Yahoo! Finance

II. Performance Measurement

a. Sharpe Ratio computations

$S_{Miranda} = (r_p – r_f)/ \sigma_p$

$= (0.102 – 0.02) / (0.37)$

$= 0.2216$

$S_{s\&p} = (r_p – r_f)/ \sigma_p$

$= (-0.225 – 0.02) / (0.44)$

$= -0.5568$

b. M^2 measures

M^2 measure can be calculated by blending the Miranda Fund with a position in T-Bills in way that the adjusted portfolio has the same volatility as the market index.

From the given data, the position in the Miranda Fund should be

(0.44) / (0.37) = 1.1892

The position in T-Bills should be

(1 – 1.1892) = -0.1892. (Assuming borrowing at the risk free rate)

The adjusted return r_p = (1.1892) x (10.2%) – (0.1892) x 2% = 11.75 %

The difference in the adjusted Miranda Fund return and the benchmark:

$M_2 = r_P – r_M$

= 11.75 % - (22.50%)

= 34.25%

c. Treynor measures

$T_{Miranda} = (r_p – r_f)/ \beta_p$

$= (0.102 –0 .02)/(1.10)$

$= 0.0745$

$T_{S \& P 500} = (r_p – r_f)/ \beta_p$

$= (-0.225 – 0.02)/(1.00)$

$= -0.245$

d. Jensen measures

$\alpha p = r_P – (r_f – \beta_p(r_M – r_f))$

= (0.102) - (0.02 – 1.10(0.225 – 0.02))

= 0.3515

III. Index Models

a. Expected excess returns, alpha values, and residual variances computations

$$Alpha\ (\alpha) = E(r) - \left[r_f + \beta\left(r_m - r_f\right)\right]$$

$$\begin{aligned} Alpha\ (\alpha_A) &= E(r_A) - \left[r_f + \beta_A\left(r_m - r_f\right)\right] \\ &= 20\% - [8\% + 1.3\ (16\% - 8\%)] \\ &= 20\% - [8\% + 1.3\ (8\%)] \\ &= 20\% - [8\% + 10.4\%] \\ &= 20\% - 18.4\% \\ &= 1.6\% \end{aligned}$$

$$\begin{aligned} Alpha\ (\alpha_B) &= E(r_B) - \left[r_f + \beta_B\left(r_m - r_f\right)\right] \\ &= 18\% - [8\% + 1.8\ (16\% - 8\%)] \\ &= 18\% - [8\% + 1.8\ (8\%)] \\ &= 18\% - [8\% + 14.4\%] \\ &= 18\% - 22.4\% \\ &= -4.4\% \end{aligned}$$

$$\begin{aligned} Alpha\ (\alpha_C) &= E(r_C) - \left[r_f + \beta_C\left(r_m - r_f\right)\right] \\ &= 17\% - [8\% + 0.7\ (16\% - 8\%)] \\ &= 17\% - [8\% + 0.7\ (8\%)] \\ &= 17\% - [8\% + 5.6\%] \\ &= 17\% - 13.6\% \\ &= 3.4\% \end{aligned}$$

$$\begin{aligned} Alpha\ (\alpha_D) &= E(r_D) - \left[r_f + \beta_D\left(r_m - r_f\right)\right] \\ &= 12\% - [8\% + 1.0\ (16\% - 8\%)] \end{aligned}$$

$$= 12\% - [8\% + 1.0\ (8\%)]$$
$$= 12\% - [8\% + 8\%]$$
$$= 12\% - 16\%$$
$$= -4\%$$

$$Expected\ Excess\ Return = E(r) - r_f$$

$$Expected\ Excess\ Return\ for\ Stock\ A = E(r_A) - r_f$$
$$= 20\% - 8\%$$
$$= 12\%$$

$$Expected\ Excess\ Return\ for\ Stock\ B = E(r_B) - r_f$$
$$= 18\% - 8\%$$
$$= 10\%$$

$$Expected\ Excess\ Return\ for\ Stock\ C = E(r_C) - r_f$$
$$= 17\% - 8\%$$
$$= 9\%$$

$$Expected\ Excess\ Return\ for\ Stock\ D = E(r_D) - r_f$$
$$= 12\% - 8\%$$
$$= 4\%$$

$$Residual\ Variance = \sigma^2(e)$$

$$Residual\ Variance\ for\ Stock\ A = \sigma^2(e_A)$$
$$= 58^2$$
$$= 3{,}364$$

$$Residual\ Variance\ for\ Stock\ B = \sigma^2(e_B)$$
$$= 71^2$$
$$= 5{,}041$$

$$Residual\ Variance\ for\ Stock\ C = \sigma^2(e_C)$$
$$= 60^2$$
$$= 3{,}600$$

$$Residual\ Variance\ for\ Stock\ D = \sigma^2(e_D)$$
$$= 55^2$$
$$= 3{,}025$$

	Stock A	Stock B	Stock C	Stock D
Excess Returns	1.6%	-4.4%	3.4%	-4.0%
Alpha Values	12%	10%	9%	4%
Residual Variances	3,364	5,041	3,600	3,025

b. Optimal Risky Portfolio construction

Using Treynor-Black method we construct an optimum active portfolio.

We first calculate the weights associated with each stock and the calculations are as follows

	$\frac{\alpha}{\sigma^2(e)}$	$\frac{\frac{\alpha}{\sigma^2(e)}}{\sum\frac{\alpha}{\sigma^2(e)}}$
Stock A	0.000476	-0.6142
Stock B	-0.000873	1.1265
Stock C	0.000944	-1.2181
Stock D	-0.001322	1.7058
Total	-0.000775	1.0000

With these weights, we calculate the forecast of the active portfolio

α = (–0.6142 × 1.6) + (1.1265 × (– 4.4)) – (1.2181 × 3.4) + (1.7058 × (– 4.0))

= -16.90 %

β = (–0.6142 × 1.3) + (1.1265 × 1.8) – (1.2181 × 0.70) + (1.7058 × 1)

= 2.08

$\sigma^2(e)$ = ((–0.6142)2 × 3364) + ((1.1265)2 × 5041) + ((–1.2181)2 × 3600) + ((1.7058)2× 3025)

= 21,809.6

σ(e) = 147.68 %

Points to notice form the forecast:

- Beta is higher than any single individual stock, which in turn indicates for long position relatively high beta stocks and short positions in relatively low beta stocks
- Higher residual standard deviation in the active portfolio is due to the high residual standard deviation of stock B when compared to others

Calculating W_0

$$W_0 = \frac{a}{\sigma^2(e)} \times \frac{\sigma_M^2}{E(r_m) - r_f}$$

$$W_0 = \frac{-16.90}{21{,}809.6} \times \frac{232}{8}$$

$$W_0 = -0.05124$$

We know that optimum risky portfolio has W^* proportion in optimum active portfolio.

$W^* = (W_0) / (1 + (1-\beta) W_0)$

= (-0.05124) / (1 + (1 – 2.08) (-0.05124))

= -0.0486

The position index of the stock is 1- (-0.0486) = 1.0486

With W*negative the result of the position is negative for stocks with negative alpha and positive for positive alpha stocks.

c. Sharpe's measure for the Optimal Portfolio

We start by calculating information ratio for the active portfolio.

$$A = \frac{a}{\sigma(e)}$$

$$= \frac{-16.90}{147.68}$$

$$= -0.1144$$

$$A^2 = 0.0131$$

Now we know

$$S^2 = S_M^2 + A^2$$

$= \left(\frac{8}{23}\right)^2 + 0.0131$

$S = 0.3662$

Note that this Sharpe's measure is greater than markets and the difference is 0.018

d. Complete Portfolio makeup for Risk Aversion coefficient = 2.8

We start the problem by calculating the risky portfolio beta and then mean excess return of the optimal risky portfolio and its variance.

The beta of risky portfolio

$\beta_P = W_M + (W_A \times \beta_A)$

= 1.0486 + ((-0.0486) x 2.08)

= 0.95

Mean excess return

$E(R_P) = \alpha_P + \beta_P(E(R_M))$

= ((-0.0486) X (16.90%)) + (0.95 X 8%)

= 8.42%

$\sigma_P^2 = \beta_P^2 \sigma_M^2 + \sigma_P^2(e_P)$

= ((0.95 X 23)2 + ((-0.0486)2 X 21809.6)

= 528.94

σ_P = 23%

Given that risk aversion coefficient is 2.8 = A, the optimal position in this portfolio is

y = (8.42)/(0.01 X 2.8 X 528.94) = 0.5685

The optimal position for the passive strategy is 0.5401, which indicates the difference is 0.0284

The final positions are as follows

Bills	1 - 0.5685 =	43.15%
M	0.5685 * 1.0486 =	59.61%
A	0.5685 * (-0.0486) * (-0.6142) =	1.70%
B	0.5685 * (-0.0486) * 1.1265 =	-3.11%
C	0.5685* (-0.0486) * (-1.2181) =	3.37%
D	0.5685 * (-0.0486) * 1.7058 =	-4.71%