Econ 136 PSET 9

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1. Discount rate

We are given:

1. $D_0 = 2.25$
2. $V_0 =$ USD 14.04

Preferred stock is calculated with the Gordon Growth model:

$$\begin{aligned} V_0 &= \frac{D_0}{r} \\ 14.04 &= \frac{2.25}{r} \\ r &= 16.03\% \end{aligned}$$

2. TSM Stock

(a) Value of TSM stock using Gordon Growth model

$$\begin{aligned} V_0 &= \frac{D_1 * (1+g)}{(r_s - g)} \\ &= \frac{1.35 * (1 + 0.071)}{(0.099 - 0.071)} \\ &= \frac{1.44585}{0.028} \\ &= 51.64 \end{aligned}$$

(b) Valuation

Since the TSM stock is valued at \$45.40 and our calculated value is \$51.64, we find that it is undervalued by the market.

3. Mining company

We are given:

1. $r_s = 0.08$
2. $g =$ -0.04
3. $D_1 =$ \$1.55

Using the Gordon growth model:

$$\begin{aligned} V_0 &= \frac{D_1}{(r_s - g)} \\ &= \frac{1.55}{(0.08 - (-0.04))} \\ &= \frac{1.55}{0.12} \\ &= 12.92 \end{aligned}$$

4. XYZ Corporation

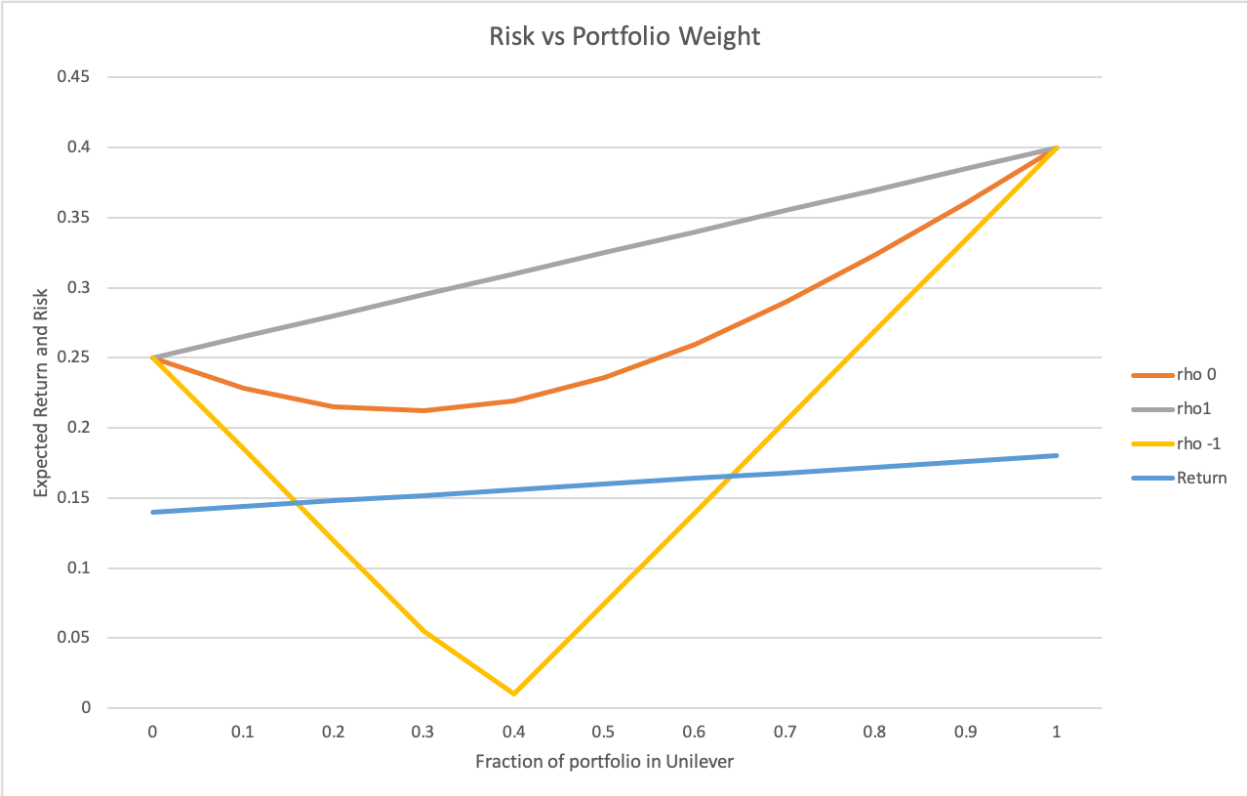
We are given:

1. $D_0 = \$2.45$
2. $V_0 = \$52.65$
3. $g = 0.0355$

Using the Gordon Growth model:

$$\begin{aligned} 52.65 &= \frac{D_0(1+g)}{(r_s - g)} \\ 52.65 &= \frac{2.45(1 + 0.0355)}{(r_s - 0.0355)} \\ 52.65r_s &= 2.54 + 1.87 \\ r_s &= 0.0837 \end{aligned}$$

5. Expected return graph



6. Sharpe Ratio

From lecture we are given the Sharpe Ratio: $\frac{E(r_m - r_f)}{\sigma_m}$. We also know the slope on the efficient frontier is $\frac{\sigma_{opt}(E(r_H) - E(r_{opt}))}{\sigma_{H,opt} - \sigma^2_{opt}}$. Equating them:

$$\begin{aligned}
\frac{E(r_m) - r_f}{\sigma_m} &= \frac{\sigma_m(E(r_i) - E(r_m))}{\sigma_{i,m} - \sigma^2_m} \\
\frac{(E(r_m) - r_f)(\sigma_{i,m} - \sigma^2_m)}{\sigma_m} &= \sigma_m(E(r_i) - E(r_m)) \\
\frac{(E(r_m) - r_f)(\sigma_{i,m} - \sigma^2_m)}{\sigma^2_m} + E(r_m) &= E(r_i) \\
E(r_i) &= \frac{(E(r_m) - r_f)\sigma_{i,m}}{\sigma^2_m} - \frac{(E(r_m) - r_f)\sigma^2_m}{\sigma^2_m} + E(r_m) \\
E(r_i) &= r_f + \beta_i(E(r_m) - r_f)
\end{aligned}$$

where $\beta_i = \frac{\sigma_{i,m}}{\sigma^2_m}$ ■.

7. Vanguard expected return and standard deviation

We are given:

1. $E(r_{van}) = 0.06$
2. $\sigma_{van} = 0.22$
3. $r_f = 0.025$
4. $w_{van} = 0.75$ since you shift \$250k/\$1000k to Treasury bills
5. $w_{treas} = 0.25$

Using the formula for the expected return of a 2 asset portfolio:

$$\begin{aligned} E(r_{port}) &= r_f + w_{van}(E(r_{van}) - r_f) \\ &= 0.025 + 0.75(0.06 - 0.025) \\ &= 0.05125 \end{aligned}$$

Since our portfolio only has 75% of risky assets, to find the new standard deviation we multiply the origianl standard deviation by the weight:

$$\sigma_{new} = w_{van}\sigma_{van} = 0.75(0.22) = 0.165$$

8. Calculate the variance of a portfolio

We set the three portfolios as:

1. SNE
2. STK
3. TSO

$$\begin{aligned} \sigma^2_{port} &= \sum_{i=1}^{N}\sum_{j=1}^{N} w_j w_i \sigma_j \sigma_i \rho_{i,j} \\ &= \left(\frac{1}{3}\right)^3 \sum_{i=1}^{3}\sum_{j=1}^{3} \sigma_j \sigma_i \rho_{i,j} \\ &= \frac{1}{9}\left(\sigma_1^2 + \sigma_2^2 + \sigma_3^2 + 2\sigma_1\sigma_2\rho_{1,2} + 2\sigma_1\sigma_3\rho_{1,3} + 2\sigma_2\sigma_3\rho_{2,3}\right) \\ &= \frac{1}{9}\left(\sigma_{SNE}^2 + \sigma_{STK}^2 + \sigma_{TSO}^2 + 2\sigma_{SNE}\sigma_{STK}\rho_{SNE,STK} + 2\sigma_{SNE}\sigma_{TSO}\rho_{SNE,TSO} + 2\sigma_{STK}\sigma_{TSO}\rho_{STK,TSO}\right) \\ &= \frac{1}{9}\left(.22^2 + .35^2 + .27^2 + 2(.22)(.35)(0.24) + 2(.22)(.27)(-.30) + 2(.35)(.27)(-.18)\right) \\ &= 0.0234 \\ \Rightarrow \sigma_{port} &= 0.1531 \end{aligned}$$

9. Utility stocks

(a) Gordon growth model

For American Electric:

$$\begin{aligned} V_{AEP} &= \frac{D_1}{(r_{AEP} - g)} \\ 42.45 &= \frac{1.7}{(r_{AEP} - 0.04)} \\ 42.45 r_{AEP} &= 1.7 + 1.698 \\ r_{AEP} &= 0.0801 \end{aligned}$$

For Southern Co.:

$$\begin{aligned} V_{SO} &= \frac{D_1}{(r_{SO} - g)} \\ 22.25 &= \frac{1.45}{(r_{SO} - 0.045)} \\ 22.25 r_{SO} &= 1.45 + 1.00125 \\ r_{SO} &= 0.1102 \end{aligned}$$

(a) CAPM

For American Electric:

$$\begin{aligned} E(r_{AEP}) &= r_f + \beta_{AEP}(E(r_m) - r_f) \\ E(r_{AEP}) &= 0.012 + 0.60(0.035) = 0.033 \end{aligned}$$

For Southern Co.:

$$\begin{aligned} E(r_{SO}) &= r_f + \beta_{SO}(E(r_m) - r_f) \\ E(r_{SO}) &= 0.012 + 0.70(0.035) = 0.0365 \end{aligned}$$

10. HP

(a) Covariance between HP and the market

$$\begin{aligned} \rho_{HP,market} &= \frac{\sigma_{HP,market}}{\sigma_{HP}\sigma_{market}} \\ 0.60 &= \frac{\sigma_{HP,market}}{(0.35)(0.20)} \\ \sigma_{HP,market} &= 0.042 \end{aligned}$$

(b) HP beta

$$\begin{aligned} \beta_{HP} &= \frac{\sigma_{HP,market}}{\sigma^2_{market}} \\ &= \frac{0.042}{0.20^2} \\ &= 1.05 \end{aligned}$$

(c) Expected Return

$$\begin{aligned} E(r_{HP}) &= r_f + \beta_{HP}(E(r_m) - r_f) \\ E(r_{HP}) &= 0.025 + 1.05(0.0525 - 0.025) = 0.053875 \end{aligned}$$

(d) Idiosyncratic Risk

$$\underbrace{\sigma^2(\epsilon_j)}_{idiosyncratic\ risk} = \sigma^2(r_j) - \underbrace{\beta_j^2\sigma^2(r_m)}_{systematic\ risk}$$

$$\underbrace{\frac{\sigma^2(\epsilon_{HP})}{\sigma^2(r_{HP})}}_{idiosyncratic\ risk\ percent} = 1 - \frac{\beta_{HP}^2\sigma^2(r_m)}{\sigma^2(r_{HP})}$$

$$= 1 - \frac{1.05^2(0.20)^2}{(0.35)^2} = 0.64$$

64% of HP's total risk is idiosyncratic.

11. Solver optimization

(i) Minimum variance portfolio (Long only)

	Weight
Weight	
0.3749	US
0.3644	UK
0.0000	France
0.0000	Germany
0.0000	Australia
0.2607	Japan
0.0000	Canada
1.0000	
0.0428	Mean Excess Return
0.1351	SD
0.3170	Sharpe Ratio

(i) Minimum variance portfolio (Long and short)

	Weight
Weight	
0.6150	US
0.8702	UK
-0.1936	France
-0.5238	Germany
0.0774	Australia
0.2058	Japan
-0.0509	Canada
1.0000	
0.0306	Mean Excess Return
0.1132	SD
0.2707	Sharpe Ratio

(ii) Optimum portfolio (Long only)

	Weight
Weight	
0.6885	US
0.0521	UK
0.0000	France
0.0000	Germany
0.1336	Australia
0.1258	Japan
0.0000	Canada
1.0000	
0.0460	Mean Excess Return
0.1402	SD
0.3281	Sharpe Ratio

(ii) Optimum portfolio (Long and short)

	Weight
Weight	
0.6972	US
0.1253	UK
-0.0845	France
0.0136	Germany
0.1294	Australia
0.1298	Japan
-0.0107	Canada
1.0000	
0.0451	Mean Excess Return
0.1373	SD
0.3283	Sharpe Ratio

(iii) Efficient portfolio w/5.5% excess return (Long only)

	Weight
Weight	
0.5526	US
0.0000	UK
0.0000	France
0.4417	Germany
0.0000	Australia
0.0056	Japan
0.0000	Canada
1.0000	
0.0550	Mean Excess Return
0.1764	SD
0.3118	Sharpe Ratio

(iii) Efficient portfolio w/5.5% excess return (Long and short)

	Weight
Weight	
0.7536	US
-0.3863	UK
-0.0095	France
0.3826	Germany
0.1651	Australia
0.0775	Japan
0.0170	Canada
1.0000	
0.0550	Mean Excess Return
0.1732	SD
0.3176	Sharpe Ratio