**Chapter Four**

**Hurdle Rate**

In order to be able to use CAPM we need the following inputs:

1. Risk free rate
2. Beta
3. Expected market risk premium (ERP)

E(r) = Rf + b \*(E(rm) – Rf)

For an asset to be risk free two conditions must be met:

1. No default risk
2. No uncertainty about reinvestment rates.

So we usually use the rate on a long-term governmental security as risk free rate.

Risk free rate 🡪 governments have default risk:

Governments don’t default at least when borrowing in local currencies. Sometimes this assumption might not be reasonable.

If the government issues long-term bonds in the local currency, then to calculate the risk free rate we can do the following:

Local currency risk-free rate: government’s bond rate – default spread.

If the government does not issue long-term bonds in the local currency or these bonds are not traded, we can use the following approaches to calculate Rf:

1. Build up approach:
2. Rf = r + IP
3. R = Real rate of interest
4. IP = Inflation premium
5. Differential inflation approach:

We start with a risk free rate in the US dollar and add the differential between expected inflation in the currency in question.

**Estimating Equity Risk Premium (Expected market risk premium):**

Three approaches can be used to estimate ERP which are:

1. **Survey approach**

Limitations:

1. There are no constraints on reasonability.
2. Survey approach used in calculating ERP reflects the past and not the future.
3. Survey tend to be short-term.
4. **Historical approach**

Limitations:

1. It assumes that risk aversion of investors does not change across time.
2. It assumes that the riskiness of the risky portfolio does not change over time.

*A modified Equity risk premium in emerging markets:*

Historical ERP (emerging market) = Risk premium for a mature market + country premium

Risk premium for a mature market = Historical ERP (US market)

Country premium = needs to be estimated

To estimate the country premium, we can use one of the following approaches:

1. Country Bond default spread.

The country’s bond default spread will be used as a measure of the country premium.

ERP in country X =US ERP + Default spread

Example:

ERP for India =?

ERP for Brazil =?

US ERP = 4.2%

Default spread for India = 2.25%

Default spread for Brazil = 2%

ERP for India = 4.2% + 2.25% = 6.45%

ERP for Brazil = 4.2% + 2% = 6.2%

1. Relative standard deviation:

Relative standard deviation = measure of the country premium

 = SDx(stock prices)/ SDUS( stock prices)

Example:

US ERP = 4.2%

SD us = 15%

SD Brazil = 21%

ERP for Brazil =?

ERP in Brazil = US ERP\* relative standard deviation

 = 4.2% \* 21%/15% = 5.88%

Country premium = ERP in Brazil – US ERP = 5.88% - 4.2% = 1.68%

1. Default spread + relative standard deviations:

Country risk premium = Country default spread \* SD equity/SD country bonds

Example:

US ERP = 4.2%

SD equity in Brazil = 21%

SD in the Brazilian US denominated bonds = 14%

Default spread (Brazil) = 2%

ERP in Brazil =?

Country risk premium = 2%\*(21%/14%) = 3%

ERP in Brazil = US ERP + country risk premium

 = 4.2% + 3% = 7.2%

**3)Implied ERP**

**Stock valuation:**

Price = the sum of the present value of expected cash flows

Dividends are the expected cash flows from the stocks.

Price of the stock = the sum of the present value of dividends.

In order to calculate the PV we need:

R = interest rate = rate of return

N = maturity

Special case of an annuity:

Perpetuity: Equal cash flows to be receive or paid for an infinite period of time.

PV of a perpetuity = CF per period /r

To calculate the PV of a preferred stock = Div/r

To evaluate common stocks, we can use the constant growth model that assumes dividends will be growing at a constant rate (growing perpetuity)

P = D1/(r-g)

P = price

D1 = expected dividends to be paid = D0 \*(1+g)

G = Growth rate

R = required rate of return

Estimating beta:

1. Regression beta (historical beta)

Y = mx + c

Y = dependent variable = stock return

X = independent variable = market return

C = intercept

M = slope = beta

Stock return = b\* market return + a

Rs = alpha + b\* Rm

Hurdle rate= WACC = Wd\*Kd + Wp \*Kp + We\*Ke

We have used the CAPM to calculate Ke.

E(r) = Rf + b (E(rm) – Rf)

The equity risk premium can be calculated using one of the following approaches:

1. Survey approach
2. Historical approach
3. Implied ERP.

Beta can be calculated as one of the following:

1. Regression beta (historical beta)
2. Fundamental beta (bottom-up beta)
3. Accounting beta
4. Regression beta

Y = a + bX

a = intercept

b = slope

Y = dependent variable

X = independent variable

E(r) = Rf + b (E(rm ) – Rf)

E(r) = Rf+ b E(rm) – b Rf

E(r) = Rf – b Rf + b E(rm)

E(r) = Rf (1-b) + b E(rm) Theoretical model

Intercept = Rf(1-b)

Regression equation:

Rj = a + b Rm

Disney example:

B = estimated b = 1.25

SE (b) = 0.1

67% confidence interval:

[ estimated b – SE(b)\*1, estimated b + SE(b)\*1]

[ 1.25 – (0.1\*1), 1.25 + (0.1\*1)]

[1.15,1.35]

95% confidence interval:

[ estimated b – SE(b)\*2, estimated b +SE(b) \*2]

[ 1.25 – (0.1\*2), 1.25 + (0.1\*2)]

[1.05,1.45]

Determinants of beta:

1. Product type
2. Degree of operating leverage
3. Degree of financial leverage

Beta levered = Regression beta = equity beta: Shows the impact of the three determinants of beta which are product type, operating leverage and financial leverage.

Beta unlevered = asset beta: shows the impact of two determinants of beta which are product type and operating leverage.

\*Beta levered is a function of beta unlevered.

B(L) = B(U) \*(1+((1-t) \*D/E))

B(L) >= B(U)

B(L) = B(U) if D/E = 0 (No financial leverage)

Example:

Disney

B(L) = 1.25

Average debt to equity ratio = 19.44%

Marginal tax rate = 36.1%

B(U) =?

B(L) = B(U) \*(1+((1-t) \*D/E))

1.25 = B(U) \* (1+((1-0.361) \*0.1944))

1.25 = B(U) \* 1.124

B(U) = 1.25/1.124 = 1.11

Effect of financial leverage on beta:

Example:

Disney

Debt to capital = 0

D/E = 0

B(U) = B(L) = 1.11

If debt to capital = 10%

B(L) =?

Capital = Vd+Ve

Vd/(Vd+Ve) = 10%

Vd/(Vd+Ve) = 10/100

Vd = 10

Ve = 100 – 10 = 90

D/E = 10/90 = 0.1111 = 11.11%

B(L) = B(U) \*(1+((1-t) \*D/E))

B(L) = 1.11 \*(1+(1-0.361) \*0.1111)) = 1.19

Properties of beta:

Beta could be a weighted average.

Example:

Calculate beta for portfolio V?

Asset beta proportion(weight)

A 1.5 20%

B 1 50%

C 0.8 30%

Beta of the portfolio = the sum of weights\*beta for each asset = weighted average

Beta ( portfolio V) = 1.5\*0.2+1\*0.5+0.8\*0.3 = 0.3+0.5+0.24= 1.04

Calculating beta for a combined company:

Example:

1. Disney

B(L) = 1.15

Debt = $3,186m

Equity = $31,100 m

Firm value = debt + equity = 3,186 m + 31,100 m = $34,286 m

D/E = 3,186 m / 31,100 m = 0.1 =10%

1. Capital Cities

B(L) = 0.95

Debt = $615 m

Equity = $18,500 m

Firm value = 615 m + 18,500 m = $19,115 m

D/E = 615 m / 18,500 m = 0.03 = 3%

Step 1: calculate beta unlevered for each company.

Disney:

B(U) =?

B(L) = B(U) \* (1+((1-t)\*D/E))

1.15 = B(U) \*(1+((1-0.361)\*0.1))

1.15 = B(U)\*1.0639

B(U) = 1.15/1.0639 = 1.08

Capital Cities:

B(U) =?

B(L) = B(U) \* (1+((1-t) \*D/E))

0.95 = B(U) \*(1+((1-0.361) \*0.03))

B(U) = 0.93

Step 2: calculate the unlevered beta for the combined company (weighted average)

B(U) (Disney) = 1.08

B(U) (Capital Cities) = 0.93

Combined firm value = $34,286 m + 19,115 m =$ 53,401 m

B(U) (Combined Company) = ((1.08 \* 34,286m /53,401m) + (0.93 \* 19,115 m/53,401 m)) = 1.022

Step 3: calculate beta levered for the combined company under 3 scenarios

S1: If Disney bought Capital Cities with all equity

Disney (pre)

Assets Liabilities + owners’ equity

 Debt= $3,186 m

 Equity = $31,100 m

 Value = $3,186 m + 31,100 m =$ 34,286 m

Capital Cities (pre)

Assets Liabilities + owners’ equity

 Debt = $615 m

 Equity = $ 18,500 m

 Value = 615 m + 18,500 m = $ 19,115 m

Disney + CC (combined)

Assets Liabilities + owners’ equity

 Debt = 3,186 m + 615 m = $3,801 m

 Equity = 31,100 m + 18,500 m = $ 49,600 m

 B(L) = B(U) \* (1+((1-t)\*D/E))

B(L ) = 1.022 \*(1+((1-0.361)\*3,801m/49,600m)) = 1.07

S2: If Disney bought Capital Cities with all debt.

Disney (pre)

Assets Liabilities + owners’ equity

 Debt= $3,186 m

 Equity = $31,100 m

 Value = $3,186 m + 31,100 m =$ 34,286 m

Capital Cities (pre)

Assets Liabilities + owners’ equity

 Debt = $615 m

 Equity = $ 18,500 m

 Value = 615 m + 18,500 m = $ 19,115 m

Disney + CC (combined)

Assets Liabilities + owners’ equity

 Debt = 615 m + 3,186 m + 18,500 m = 22,301 m

 Equity = $31,100 m

B(L) = B(U) \* (1+((1-t) \*D/E))

B(L) = 1.022 \*(1+((1-0.361) \*22,301m/31,100m)) = 1.49

S3: If Disney used a mix of debt and equity to buy Capital Cities.

Debt = $10 billion

The rest was all equity

Disney (pre)

Assets Liabilities + owners’ equity

 Debt= $3,186 m

 Equity = $31,100 m

 Value = $3,186 m + 31,100 m =$ 34,286 m

Capital Cities (pre)

Assets Liabilities + owners’ equity

 Debt = $615 m

 Equity = $ 18,500 m

 Value = 615 m + 18,500 m = $ 19,115 m

Disney + CC (combined)

Assets Liabilities + owners’ equity

 Debt = 615m + 3,186 m + 10,000 m = $13,801 m

 Equity = 31,100 m + 8,500 m (18,500 m -10,000m) =

 $39,600m

B(L) = B(U) \* (1+((1-t) \*D/E))

B(L) = 1.022\*(1+((1-0.361) \*13,801m/39,600m)) = 1.25

In order to calculate bottom-up beta we do the following:

1. Determine the firm’s business divisions.
2. For each business division we should do the following steps:
3. Find comparable firms (sample size). The more firms the better.
4. Get levered beta (regression beta) for each firm of the comparable firms.
5. Calculate the average(mean) and the median of the levered beta.
6. Collect data on equity and debt for each of the comparable firms.
7. Calculate debt to equity ratio for each of the comparable firms.
8. Calculate the average(mean) and the median of the debt to equity ratio
9. Calculate the average tax rate or the median.
10. Unlever the beta: B(L) = B(U) \* (1+((1-t) \*D/E))

 1.24 = B(U)\*(1+((1-0.4) \*0.2706))

 B(U) = 1.06

1. Calculate B(U) for all the firm’s operation.

B(U) (all business divisions/operations) = the sum of weight for each division \* B(U) for each division

Weight for each division = Revenue from each division/total revenues.

Weight for each division = value of each division/total firm value.

1. Calculate beta levered for each division by using the following formula: B(L) = B(U) \* (1+((1-t) \*D/E))
2. Calculate cost of equity (for each division) and the cost of equity for all business operations using CAPM.

Calculating bottom up beta for an unlisted firm:

1. Get comparable firms (The larger the sample size the better)
2. Get levered beta for each of the comparable firms and calculate the mean or median of levered beta.
3. Get D/E ratio for each of the comparable firms and calculate the mean or median of D/E ratio
4. Calculate mean or the median of the marginal tax rate.
5. Unlever the beta
6. Calculate beta levered for the company using the average D/E ratio for the whole industry the company operates in.

Example:

Beta levered ( median) = 0.81

Tax rate ( median) = 40%

D/E ratio ( median) = 0.2141

B(L) = B(U) \*(1+((1-t)\*D/E))

* 1. B(U) \*(1+((1-0.4)\*0.2141))

 B(U) for the book company = 0.7025

 B(L) Bookscape = 0.7025 \*(1+((1-0.4)\*0.2141)) =

**Calculating cost of capital:**

**WACC= Ke\*We+Kd\*Wd+Kp\*Wp**

**Ke = E(r) = Rf+ b\*[E(rm) –Rf]**

**Calculating cost of debt:**

1. If the firm issued bonds and they were liquid and traded, then:

Pre-tax cost of debt = yield to maturity

Price of a bond = The sum of the present value of expected cash flows from the bond.

Expected cash flows from a bond:

1. Interest payment (annuity)
2. Par (face value) at the end of the maturity

Price of a bond = present value of interest payments (annuity) + present value of par (single amount)

P(B) = I \*((1-1/(1+YTM)^n)/YTM) + par /(1+YTM)^n

A bond is usually sold at:

1. Par (if YTM (r) = i)
2. Discount (< par) if YTM > i
3. Premium (> par) if YTM < i
4. If the firm issued a traded bond but illiquid then look at the issuer’s rating (rating done by credit agencies).

Pre-tax cost of debt = RF + default spread (associated with the firm’s rating)

1. If the firm is not rated or if it has not issued bonds, then:
2. Look at the last loan received by the firm; the interest on this loan would be the pre-tax cost of debt.
3. Do a synthetic rating for the firm (issuer); pre-tax cost of debt = Rf + default spread associated with the rating done,

After tax cost of debt = Pre-tax cost of debt \*(1-tax rate)

WACC is calculated on after tax basis.

**Calculating cost of preferred stock:**

P = D/Kp

Kp = D/market price /share

**Weights:**

1. Book value weights
2. Market value weights

Calculating Book value weights:

Capital = Debt + Preferred equity + Common equity

Wd= debt/(debt + preferred equity + Common equity)

Wp = Preferred equity/ (debt + Common equity + Preferred equity)

We= Common equity/(debt+ common equity + Preferred equity)

**Calculating market value weights:**

Wd= market value of debt / (market value of debt + market value of common equity + market value of preferred equity)

We= market value of common equity/ market value of debt + market value of common equity + market value of preferred equity)

Wp = market value of preferred equity/ market value of debt + market value of common equity + market value of preferred equity)

Market value of common equity = common stock price \* number of common stocks

Market value of preferred equity = preferred stock price \* number of preferred stocks.

Market value of debt= interest payment\*((1-1/(1+before tax cost of debt)^duration)/before tax cost debt) + par /(1+before tax cost of debt)^duration

Duration = the sum of time due \* weight of each amount of debt

Weight of each amount of debt = amount of debt/total debt