**ICP: Stocks, Bonds and WACC[1]**
**Solution Set[2]**

## Dividend Paying Stock Valuation

**Problem**

Suppose a firm has just paid an annual dividend on its common stock in the amount of $1.56 and that this dividend is expected to increase at 7% for each of the next three years, after which the firm is willing to commit to a 2% annual increase in yearly dividends. Given the following information, what would you expect to be the total value of the firm's common equity shares in the market today?

| | |
|---|---|
| 2-year CD rate | 2.34% |
| Average stock market return | 14.48% |
| Beta | 2.39 |
| Common shares outstanding | 378,000 |

**Solution**

This question combines the stock valuation metrics we've discussed with the CAPM method for identifying the cost of equity capital (RE). Let's start with solving for RE and then we can use that as the discount rate in the stock valuation question.

RE via the CAPM method is RE = RF = (RM – RF) x B. In this case RF is represented by the 2-year CD rate since most CD's are backed by FDIC insurance and as such is guaranteed against loss by the federal government. Average stock market return is a good proxy for RM and Beta is, well, Beta.

So… RE = RF = (RM – RF) x B = .0234 + (.1448 - .0234) x 2.39 = .3135 or 31.35%

Recall that Modigliani and Miller helped us see that RE is the discount rate applied in the Gordon Growth Model when the dividend, price and growth are relative to a firm's common stock.

Now we can think about the amount of each dividend. We start with D0 and grow it at the given growth rate of 7% for each of the next three years and then by 2% for the following period as follows:

- D0 = 1.56
- D1 = 1.56 x 1.07 = 1.6692
- D2 = 1.56 x $1.07^2$ = 1.7860
- D3 = 1.56 x $1.07^3$ = 1.9111
- D4 = 1.56 x $1.07^3$ x 1.02 = 1.9493

---

[1] This problem and solution set is intended to present an abbreviated discussion of the included finance concepts and is not intended to be a full or complete representation of them or the underlying foundations from which they are built.

[2] This problem set was developed by Richard Haskell, PhD (rhaskell@westminstercollege.edu), Gore School of Business, Westminster College, Salt Lake City, Utah (2021)

$$P0 = \frac{D1}{(1+r)^1} + \frac{D2}{(1+r)^2} + \frac{D3}{(1+r)^3} + \frac{P3}{(1+r)^3}$$

Notice that the last term in the equation includes P3 in the numerator. To calculate this future price of the stock we use the Gordon Growth model: $P0 = \frac{D1}{r-g}$ but we'll use the dividend from year 4 as a representative dividend for all future possible dividends resulting from a 2% annual growth rate in perpetuity. If the dividend we're using is from year 4, then the price this estimates is a present value in year 3 and must be discounted back to today to come up with a true present value.

So the equation can be stated as

$$P0 = \frac{D1}{(1+r)^1} + \frac{D2}{(1+r)^2} + \frac{D3}{(1+r)^3} + \frac{\frac{D4}{r-g}}{(1+r)^3}$$

We can then add the known values

$$P0 = \frac{1.669}{(1.3135)^1} + \frac{1.1.786}{(1.3135)^2} + \frac{1.911}{(1.3135)^3} + \frac{\frac{1.949}{.3135-.02}}{(1.3135)^3}$$

$$= \frac{1.669}{(1.3135)^1} + \frac{1.1.786}{(1.3135)^2} + \frac{1.911}{(1.3135)^3} + \frac{+\,6.6415}{(1.3135)^3}$$

$$= \frac{1.669}{(1.3135)^1} + \frac{1.1.786}{(1.3135)^2} + \frac{1.911 + 6.6415}{(1.3135)^3}$$

$$= \frac{1.669}{(1.3135)^1} + \frac{1.1.786}{(1.3135)^2} + \frac{8.5908}{(1.3135)^3}$$

= 6.0969

We're given information telling us the firm has 378,000 common shares outstanding in the market, so in order to find the total value of the firm's common equity shares we'll multiply the price per share (P0) by the outstanding shares: ***6.0969 x 378,000 = 2,304,643*** rounded to the nearest dollar.

## Bond Valuation

**Problem**

Suppose a firm issues 2,000 20-year bonds to the general public on 1/1/2012 with a coupon rate of 10.09% and that the bonds conform to the basic structure of a marketable bond as we've discussed them in class. Assuming the firm would be able to issue new bonds today at a rate of 7.49%, what would be the market value of the firm's outstanding portfolio of bonds in the market today if today's date is 11/30/2021?

**Solution**

The Bond Value equation is = $C\ \frac{\left[1-\frac{1}{(1+YTM)^N}\right]}{YTM}+\frac{F}{(1+YTM)^N}$

In which we have the following input relationships and recall that bonds pay interest semi-annually starting six months following the date of issue. This means a bond issued 1/1/2012 would pay interest to investors on 7/1 and 1/1 of each year. Also, this means that this 20-year bond has last paid interest on 7/1/2021, which was 10 ½ years from the maturity date.

| Variable Construct | Equation | Input Value |
|---|---|---|
| $Periods\ per\ year$ | | 2 |
| $F\ =\ Face\ Value$ | | 1,000 |
| $C=\frac{F\ *\ Coupon\ Rate}{Periods\ per\ year}$ | $C=\frac{1{,}000\ *\ .1009}{2}$ | 50.45 |
| $YTM=\frac{Current\ Market\ Yield}{Periods\ per\ year}$ | $YTM=\frac{.0749}{2}$ | .03745 |
| $N=Years\ to\ Maturity\ x\ \ Periods\ Per\ Year$ | $N=10\frac{1}{2}\ x\ 2$ | 21 |

So the per bond value is

$$BV = C\ x\ \left[\frac{1-\frac{1}{(1+YTM)^N}}{YTM}\right]+\frac{F}{(1+YTM)^N}$$

$$= 50.45\ x\ \left[\frac{1-\frac{1}{(1+.03745)^{21}}}{.03745}\right]+\frac{1{,}000}{(1+03745)^{21}}$$

$$= 724.69\ +\ 462.05\ =\ 1{,}186.74$$

Given that this firm issued 2,000 bonds the total value of the firm's outstanding bond portfolio is ***2,000 x 1,186.74 = 2,373,476*** rounded to the nearest dollar.

## Weighted Average Cost of Capital

**Problem**

Assuming a business tax rate of 26% (21% federal and 5% state), what is the firm's weighted average cost of capital (WACC) given the inputs and outcomes from the problems and solutions above?

**Solution**

**WACC =** Weighted Average Cost of Capital = $\left(\frac{E}{V}\ x\ R_E\right)\ +\ \left(\frac{P}{V}\ x\ R_P\right)\ +\ \left(\frac{D}{V}\ x\ R_D\right)(1-T_C)$

Recall that there are no preferred shares referenced in this scenario so we'll hold the value of preferred (P) equal to 0 and it falls out of the equation. In the problems and solutions above we see the following variable inputs and values:

| **Input** | **Value** |
|---|---|
| E | 2,304,643 |
| RE | 31.35% |
| D | 2,373,476 |
| RD | 7.49% |
| $T_C$ | 26% |

If we recall that E + D = V, we can then say

WACC = $\left(\frac{E}{V}\ x\ R_E\right)\ +\ \left(\frac{D}{V}\ x\ R_D\right)(1-T_C)$

= $\left(\frac{2{,}304{,}643}{4{,}678{,}119}\ x\ .3135\right)\ +\ \left(\frac{2{,}373{,}476}{4{,}678{,}119}\ x\ .0749R_D\right)(1-.26)$

= $.4926\ x\ .3135\ +\ .5074\ x\ .0749\ x\ .74$

= $.1544\ +\ .02812$

= $.1825$ or ***18.25%***