FIE402: Workshop 1

Chapter 14: Capital Structure in a Perfect Market

Example

Schwartz Industry is an industrial company with 135.5 million shares outstanding and a market capitalization (equity value) of \$6.25 billion[1]. It has \$4.10 billion of debt outstanding. Management have decided to delever the firm by issuing new equity to repay all outstanding debt.

A. How many new shares must the firm issue?

To calculate Schwartz Industry's share price, use the following formula:

$$Price\ per\ share = \frac{Levered\ equity\ value}{Number\ of\ shares\ outstanding}$$

Therefore,

$$Price\ per\ share = \frac{\$6\ 250\ 000\ 000}{135\ 500\ 000} = \$46.13$$

To calculate the number of new shares to be issued, use the following formula:

$$New\ shares\ issued = \frac{Debt\ value}{Price\ per\ share}$$

Therefore,

$$New\ shares\ issued = \frac{\$4\ 100\ 000\ 000}{\$46.13} = 88\ 879\ 254\ shares$$

The firm must issue 88.9 million shares.

[1] Merk at «billion» på engelsk er milliard på norsk (tusen millioner).

B. Suppose you are a shareholder holding 100 shares, and you disagree with this decision. Assuming a perfect capital market, describe what you can do to undo the effect of this decision.

You can undo the effect of the decision by borrowing to buy additional shares, in the same proportion as the firm's actions, thus relevering your own portfolio. In this case you should **buy**:

$$100 * \frac{\$4\ 100\ 000\ 000}{\$6\ 250\ 000} = 66\ new\ shares$$

and **borrow**:

$$66\ shares * \$46.13\ per\ share = \$3\ 045$$

Exercise 14.8

Schwartz Industry is an industrial company with 103.5 million shares outstanding and a market capitalization (equity value) of $4.41 billion. It has $1.21 billion of debt outstanding. Management have decided to delever the firm by issuing new equity to repay all outstanding debt.

A. How many new shares must the firm issue?

To calculate Schwartz Industry's share price, use the following formula:

$$Price\ per\ share = \frac{Levered\ equity\ value}{Number\ of\ shares\ outstanding}$$

Therefore,

$$Price\ per\ share = \frac{\$4\ 410\ 000\ 000}{103\ 500\ 000} = \$42.61$$

To calculate the number of new shares to be issued, use the following formula:

$$New\ shares\ issued = \frac{Debt\ value}{Price\ per\ share}$$

Therefore,

$$New\ shares\ issued = \frac{\$1\ 210\ 000\ 000}{\$42.61} = 28\ 397\ 090\ shares$$

The firm must issue 28.4 million shares.

B. Suppose you are a shareholder holding 100 shares, and you disagree with the decision. Assuming a perfect capital market, describe what you can do to undo the effect of this decision.

You can undo the effect of the decision by borrowing to buy additional shares, in the same proportion as the firm's actions, thus relevering your own portfolio. In this case you should buy:

$$100 * \frac{\$1\ 210\ 000\ 000}{\$4\ 410\ 000\ 000} = 27.44\ new\ shares$$

and borrow:

$$27.44\ shares * \$42.61\ per\ share = \$1\ 169$$

Example

In mid-2015, Qualcomm Inc. had $16 billion in debt, total equity capitalizations of $92 billion, and an equity beta of 1.27 (as reported on Yahoo! Finance). Included in Qualcomm's assets was $20 billion in cash and risk-free securities. Assume that the risk-free rate of interest is 2.8 % and the market risk premium is 4.2 %.

A. What is Qualcomm's enterprise value?

To calculate Qualcomm's enterprise value, use the following formula:

$$Enterprise\ value = Total\ equity + Debt - Cash\ used\ in\ business$$

Therefore,

$$Enterprise\ value = \$92\ billion + \$16\ billion - \$20\ billion = 88\ billion$$

Qualcomm's enterprise value is 88 billion.

B. What is the beta of Qualcomm's business assets?

To calculate the beta of unlevered equity, use the following formula:

$$\beta_U = \frac{E}{E+D} * \beta_E + \frac{D}{E+D} * \beta_D$$

where

- β_U is the beta of unlevered equity
- E is the market value of levered equity
- D is the market value of debt
- β_E is the beta of levered equity
- β_D is the beta of debt

Note that the denominator is the *enterprise value*, where we have subtracted cash used in business.

Therefore,

$$\beta_U = \frac{E}{E+D} * \beta_E = \frac{\$92\ billion}{\$88\ billion} * 1.27 = 1.33$$

The beta of unlevered equity is 1.33.

C. What is Qualcomm's WACC?

To compute Qualcomm's WACC, use the following formula:

$$r_{WACC} = r_f + \beta_U * \left(E\left[R_{Mkt}\right] - r_f\right)$$

where

- r_{WACC} is the WACC
- r_f is the risk-free rate
- β_U is the beta of unlevered equity

- $\left(E\left[R_{Mkt}\right] - r_f\right)$ is the market risk premium

Therefore,

$$r_{WACC} = 0.028 + 1.33 * 0.042 = 8.4\ \%$$

Qualcomm's WACC is 8.4 %.

Alternatively, solve the equation below:

$$r_E = r_f + \beta_E * \left(E\left[R_{Mkt}\right] - r_f\right)$$

Note that **r** and **β** are always related!

Then we get the following:

$$r_E = 0.028 + 1.27 * 0.042 = 8.13\ \%$$

Then use the answer in this equation:

$$r_{WACC} = \frac{E}{E+D} * r_E + \frac{D}{E+D} * r_D$$

Therefore,

Subtract cash from the debt, because cash is negative debt!

$$r_{WACC} = \frac{\$92\ billion}{\$88\ billion} * 0.0813 + \frac{\$16\ billion - \$20\ billion}{\$88\ billion} * 0.028 = 8.4\ \%$$

Qualcomm's WACC is 8.4 %.

Exercise 14.18

In mid-2015, Qualcomm Inc. had $11 billion in debt, total equity capitalizations of $89 billion, and an equity beta of 1.43 (as reported on Yahoo! Finance). Included in Qualcomm's assets was $21 billion in cash and risk-free securities. Assume that the risk-free rate of interest is 3 % and the market risk premium is 4 %.

A. What is Qualcomm's enterprise value?

To calculate Qualcomm's enterprise value, use the following formula:

$$Enterprise\ value = Total\ equity + Debt - Cash\ used\ in\ business$$

Therefore,

$$Enterprise\ value = \$89\ billion + \$11\ billion - \$21\ billion = 79\ billion$$

Qualcomm's enterprise value is 79 billion.

B. What is the beta of Qualcomm's business assets?

To calculate the beta of unlevered equity, use the following formula:

$$\beta_U = \frac{E}{E+D} * \beta_E + \frac{D}{E+D} * \beta_D$$

where

- β_U is the beta of unlevered equity
- E is the market value of levered equity
- D is the market value of debt
- β_E is the beta of levered equity
- β_D is the beta of debt

Note that the denominator is the *enterprise value*, where we have subtracted cash used in business.

Note also that the debt is risk free, and therefore β_D equals zero!

Therefore,

Subtract cash from the debt, because cash is negative debt!

$$\beta_U = \frac{E}{E+D} * \beta_E + \frac{D}{E+D} * \beta_D = \frac{\$89\ billion}{\$79\ billion} * 1.43 + \frac{\$11\ billion - 21\ billion}{\$79\ billion} * \underbrace{0}_{\beta_D \text{ equals zero}} = 1.61$$

The beta of unlevered equity is 1.61.

Note that $\beta_U > \beta_E$ → the firm has higher level of risk than the equity. This is because:

(1) Debt is risk free

(2) Because of cash, enterprise value is lower than equity value. Recall that we subtract cash used in business when we calculate enterprise value.

C. What is Qualcomm's WACC?

To compute Qualcomm's WACC, use the following formula:

$$r_{WACC} = r_f + \beta_U * \left(E\left[R_{Mkt}\right] - r_f\right)$$

where

- r_{WACC} is the WACC
- r_f is the risk-free rate
- β_U is the beta of unlevered equity
- $\left(E\left[R_{Mkt}\right] - r_f\right)$ is the market risk premium

Therefore,

$$r_{WACC} = 0.03 + 1.61 * 0.04 = 9.4\ \%$$

Qualcomm's WACC is 9.4 %.

Alternatively, solve the equation below:

$$\underbrace{r_E = r_f + \beta_E}_{\text{Note that r and β are always related!}} * \left(E\left[R_{Mkt}\right] - r_f\right)$$

Then we get the following:

$$r_E = 0.03 + 1.43 * 0.04 = 8.72\ \%$$

Then use the answer in this equation:

$$r_{WACC} = \frac{E}{E+D} * r_E + \frac{D}{E+D} * r_D$$

Therefore,

Subtract cash from the debt, because cash is negative debt!

$$r_{WACC} = \frac{\$89\ billion}{\$79\ billion} * 0.0872 + \frac{\$11\ billion - \$21\ billion}{\$79\ billion} * 0.03 = 9.4\ \%$$

Qualcomm's WACC is 9.4 %.

Chapter 15: Capital Structure in an Imperfect Market

Example

Rogot Instruments makes fine violins and cellos. It has $4 million in debt outstanding, equity valued at $5 million and pays corporate tax at rate 28 %. Its cost of equity is 15 % and its cost of debt is 9 %.

A. What is Rogot's pretax WACC?

To calculate Rogot's pretax WACC, use the following formula:

$$r_{WACC} = \frac{E}{E+D} * r_E + \frac{D}{E+D} * r_D$$

where

- r_{WACC} is the weighted average cost of capital

- E is the market value of equity
- D is the market value of debt
- r_E is the equity cost of capital
- r_D is the debt cost of capital

Therefore,

$$r_{WACC} = \frac{\$5\ million}{\$5\ million + \$4\ million} * 0.15 + \frac{\$4\ million}{\$5\ million + \$4\ million} * 0.09 = 12.33\ \%$$

Rogot's pretax WACC is 12.33 %.

B. What is Rogot's (effective after-tax) WACC?

To calculate Rogot's (effective after-tax) WACC, use the following formula:

$$r_{WACC} = \frac{E}{E+D} * r_E + \frac{D}{E+D} * r_D * (1 - \tau_C)$$

where

- r_{WACC} is the weighted average cost of capital
- E is the market value of equity
- D is the market value of debt
- r_E is the equity cost of capital
- r_D is the debt cost of capital
- τ_C is the marginal corporate tax rate

Therefore,

$$r_{WACC} = \frac{\$5\ million}{\$5\ million + \$4\ million} * 0.15 + \frac{\$4\ million}{\$5\ million + \$4\ million} * 0.09 * (1 - 0.28)$$
$$= 11.21\ \%$$

Rogot's effective after-tax WACC is 11.21 %.

Rogot's pretax WACC is 12.33 % and after-tax WACC is 11.21 %.

Exercise 15.10

Rogot Instruments makes fine violins and cellos. It has $1.3 million in debt outstanding, equity valued at $2.7 million and pays corporate tax at rate 33 %. Its cost of equity is 12 % and its cost of debt is 6 %.

A. What is Rogot's pretax WACC?

To calculate Rogot's pretax WACC, use the following formula:

$$r_{WACC} = \frac{E}{E+D} * r_E + \frac{D}{E+D} * r_D$$

where

- r_{WACC} is the weighted average cost of capital
- E is the market value of equity
- D is the market value of debt
- r_E is the equity cost of capital
- r_D is the debt cost of capital

Therefore,

$$r_{WACC} = \frac{\$2.7\ million}{\$2.7\ million + \$1.3\ million} * 0.12 + \frac{\$1.3\ million}{\$2.7\ million + \$1.3\ million} * 0.06 = 10.05\ \%$$

Rogot's pretax WACC is 10.05 %.

B. What is Rogot's (effective after-tax) WACC?

To calculate Rogot's (effective after-tax) WACC we need to adapt the debt part of the formula. We use the following formula:

$$r_{WACC} = \frac{E}{E+D} * r_E + \frac{D}{E+D} * r_D * (1 - \tau_C)$$

where

- r_{WACC} is the weighted average cost of capital
- E is the market value of equity
- D is the market value of debt
- r_E is the equity cost of capital
- r_D is the debt cost of capital
- τ_C is the marginal corporate tax rate

Therefore,

$$r_{WACC} = \frac{\$2.7\ million}{\$2.7\ million + \$1.3\ million} * 0.12 + \frac{\$1.3\ million}{\$2.7\ million + \$1.3\ million} * 0.06 * (1 - 0.33)$$

$$= 9.4\ \%$$

Tax benefit lowers cost of debt! This lowers WACC.

$< 10.05\ \%$

Rogot's effective after-tax WACC is 9.4 %.

Rogot's pretax WACC is 10.05 % and after-tax WACC is 9.4 %.

Note that pretax WACC is always higher than the after-tax WACC! This is because the tax benefit of interest payments lowers the cost of debt.

Example

Acme Storage has a market capitalization of $275 million, and debt outstanding of $105 million. Acme plans to maintain this same debt-equity ratio in the future. The firm pays an interest of 10 % on its debt and has a corporate tax rate of 38 %.

A. It Acme's free cash flow is expected to be $15.20 million next year and is expected to grow at a rate of 7 % per year, what is Acme's WACC?

To answer this question, we must remember the following relationship:

$$V^L = E + D = \frac{FCF}{WACC - g}$$

where:

- V^L is the value of the firm with leverage
- E is the market value of the firm (of equity)
- D is the market value of debt
- FCF is the free cash flow
- $WACC$ is the weighted average cost of capital
- g is the annual growth rate of free cash flow

Then, we can solve for the WACC by plugging the information we have in the formula:

$$V^L = \underbrace{\$275\,m + \$105\,m}_{\$380} = \frac{\$15.20\,million}{WACC - 0.07}$$

$$\$380 * (WACC - 0.07) = \$15.20$$

$$\$380\,WACC - (\$380 * 0.07) = \$15.20$$

$$WACC = \frac{\$15.20 + \$26.6}{\$380} = 11\,\%$$

B. What is the value of Acme's interest tax shield?

To find the value of the interest tax shield, we need to remember this relationship:

$$V^L = V^U + PV(Interest\ tax\ shield)$$

The value of the levered firm equals the value of the unlevered firm and the present value of the interest tax shield. Since we want to find the value of the interest tax shield, we rearrange the relationship:

$$PV(Interest\ tax\ shield) = V^L - V^U$$

So, we need to find the value of the levered firm (V^L) and then subtract the value of the unlevered firm (V^U).

Step 1: Find the value of the levered firm (V^L)

The value of the levered firm equals the sum of equity and debt:

$$V^L = E + D$$

Therefore,

$$V^L = \$275 + \$105 = \$380$$

Step 2: Find the value of the unlevered firm (V^U)

The value of the unlevered firm is given by:

$$V^U = \frac{FCF}{Pretax\ WACC - g}$$

First, we calculate the pretax WACC using the following formula:

$$Pretax\ WACC = WACC + \frac{D}{E+D} * r_D\ * \tau_C$$

where:

- $WACC$ is the weighted average cost of capital
- E is the market value of the firm
- D is the market value of debt
- r_D is the debt cost of capital
- τ_C is the corporate tax rate

Therefore

$$Pretax\ WACC = 0.11 + \frac{\$105\ million}{\$380\ million} * 0.10\ * 0.38 = 12.05\ \%$$

The pretax WACC is 12.05 %.

Next, we calculate the value of the firm without leverage (V^U).

$$V^U = \frac{FCF}{Pretax\ WACC - g}$$

Therefore,

$$V^U = \frac{\$15.20\ million}{0.1205 - 0.07} = \$300.99\ million$$

The value of the unlevered firm is $300.99 million.

Step 3: Calculate the present value of the interest tax shield

Now that we know the value of V^L and V^U we can easily calculate the present value of the interest tax shield:

$$PV(Interest\ tax\ shield) = V^L - V^U$$

$$PV(Interest\ tax\ shield) = \$380 - \$300.99 = \$79.01\ million$$

The value of the Acme's interest tax shield is $79.01 million.

Exercise 15.15

Acme Storage has a market capitalization of $72 million, and debt outstanding of $100 million. Acme plans to maintain this same debt-equity ratio in the future. The firm pays an interest of 7.4 % on its debt and has a corporate tax rate of 38 %.

A. It Acme's free cash flow is expected to be $13.76 million next year and is expected to grow at a rate of 2 % per year, what is Acme's WACC?

To answer this question, we must remember the following relationship:

$$V^L = E + D = \frac{FCF}{WACC - g}$$

where:

- V^L is the value of the firm with leverage
- E is the market value of the firm (of equity)
- D is the market value of debt
- FCF is the free cash flow
- $WACC$ is the weighted average cost of capital
- g is the annual growth rate of free cash flow

Then, we can solve for the WACC by plugging the information we have in the formula:

$$V^L = \underbrace{\$72\ m + \$100\ m}_{\$172\text{m}} = \frac{\$13.76\ million}{WACC - 0.02}$$

$$\$172 * (WACC - 0.02) = \$13.76$$

$$\$172\ WACC - (\$172 * 0.02) = \$13.76$$

$$WACC = \frac{\$13.76 + \$3.44}{\$172} = 10\ \%$$

B. What is the value of Acme's interest tax shield?

To find the value of the interest tax shield, we need to remember this relationship:

$$V^L = V^U + PV(Interest\ tax\ shield)$$

The value of the levered firm equals the value of the unlevered firm and the present value of the interest tax shield. Since we want to find the value of the interest tax shield, we rearrange the relationship:

$$PV(Interest\ tax\ shield) = V^L - V^U$$

So, we need to find the value of the levered firm (V^L) and then subtract the value of the unlevered firm (V^U).

Step 1: Find the value of the levered firm (V^L)

The value of the levered firm equals the sum of equity and debt:

$$V^L = E + D$$

Therefore,

$$V^L = \$72 + \$100 = \$172$$

Step 2: Find the value of the unlevered firm (V^U)

The value of the unlevered firm is given by:

$$V^U = \frac{FCF}{Pretax\ WACC - g}$$

First, we calculate the pretax WACC using the following formula:

$$Pretax\ WACC = WACC + \frac{D}{E + D} * r_D\ * \tau_C$$

where:

- $WACC$ is the weighted average cost of capital
- E is the market value of the firm
- D is the market value of debt
- r_D is the debt cost of capital
- τ_C is the corporate tax rate

Therefore

$$Pretax\ WACC = 0.10 + \frac{\$100\ million}{\$172\ million} * 0.074\ * 0.38 = 11.63\ \%$$

The pretax WACC is 11.63 %.

Next, we calculate the value of the firm without leverage (V^U).

$$V^U = \frac{FCF}{Pretax\ WACC - g}$$

Therefore,

$$V^U = \frac{\$13.76\ million}{0.1163 - 0.02} = \$142.89\ million$$

The value of the unlevered firm is $142.89 million.

Step 3: Calculate the present value of the interest tax shield

Now that we know the value of V^L and V^U we can easily calculate the present value of the interest tax shield:

$$PV(Interest\ tax\ shield) = V^L - V^U$$

$$PV(Interest\ tax\ shield) = \$172 - \$142.89 = \$22.11\ million$$

The value of the Acme's interest tax shield is $22.11 million.

Example

We R Toys (WRT) is considering expanding into new geographic markets. The expansion will have the same business risk as WRT's existing assets. The expansion will require an initial investment of $59 million and is expected to generate perpetual EBIT of $22 million per year. After the initial investment, future capital expenditures are expected to equal depreciation, and no further additions to net working capital are anticipated.

WRT's existing capital structure is composed of $575 million in equity and $285 million in debt (market values), with 10 million equity shares outstanding. The unlevered cost of capital is 7% and WRT's debt is risk free with an interest rate of 6 %. The corporate tax rate is 38 % and there are no personal taxes.

A. WRT initially proposed to fund the expansion by issuing equity. If investors were not expecting this expansion, and if they share WRT's view of the expansion's profitability, what will the share price be once the firm announces the expansion plan?

The firm's equity value will change by the NPV of the new investment, which can be calculated using the following formula:

$$NPV\ of\ expansion = -\ Initial\ investment + \frac{EBIT * (1 - \tau_C)}{Cost\ of\ capital}$$

Therefore,

$$NPV\ of\ expansion = -\$59\ million + \frac{\$22\ million * (1 - 0.38)}{0.07} = \$135.9\ million$$

The NPV of the expansion is $135.9 million.

To compute the share price, use the following formula:

$$Share\ price = \frac{Equity + NPV}{Number\ of\ outstanding\ shares}$$

$$Share\ price = \frac{\$575\ million + \$135.9\ million}{10\ million\ shares} = \$71.09$$

Once the firm announces this expansion plan, the share price will be $71.09 per share.

B. Suppose investors think that the EBIT from WRT's expansions will be only $4 million. What will the share price be in this case? How many shares will the firm need to issue?

The firm's equity value will again change by the NPV of the new investment, which can be calculated using the following formula:

$$NPV\ of\ expansion = -\ Initial\ investment + \frac{EBIT * (1 - \tau_C)}{Cost\ of\ capital}$$

Therefore,

$$NPV\ of\ expansion = -\$59\ million + \frac{\$4\ million * (1 - 0.38)}{0.07} = -\$23.6\ million$$

If investors think that the EBIT from WRT's expansion will be only $4 million, the NPV of the expansion is -$23.6 million.

To compute the share price, use the following formula:

$$Share\ price = \frac{Equity + NPV}{Number\ of\ outstanding\ shares}$$

$$Share\ price = \frac{\$575\ million + (-\$23.6\ million)}{\$10\ million\ shares} = \$55.14$$

If investors think that EBIT from WRT's expansion will be only $4 million, the share price be $55.14 per share.

To calculate the number of new shares to be issued, use the following formula:

$$New\ shares = \frac{Initial\ investment}{Price\ per\ share}$$

Therefore,

$$New\ shares = \frac{\$59\ million}{\$55.14} = 1.07\ million\ shares$$

The firm will need to issue 1.07 million shares.

C. Suppose WRT issues equity as in part B. Shortly after the issue, new information emerges that convinces investors that management was, in fact, correct regarding the cash flows from the expansions. What will the share price be now? Why does it differ from that found in part A?

The firm's equity will change by the present value of the free cash flow of the new investment since the investment has already been made. To compute the share price based on the firm's new number of shares outstanding, use the following formula:

$$I_o + NPV = I_o + [-I_0 + PV(cash\ flows)] = PV(cash\ fows)$$

$$Share\ price = \frac{Equity + Initial\ investment + NPV}{Number\ of\ original\ shares + Number\ of\ new\ shares}$$

Therefore,

$$Share\ price = \frac{\$575\ million + \$59\ million + \$135.9\ million}{10\ million\ shares + 1.07\ million\ shares} = \$69.55$$

If WRT issues equity, then shortly after the issue, new information emerges that convinces investors that management was, in fact, correct regarding the cash flows from the expansion ($22 million in EBIT per year), the share price will be $69.55 per share.

The share price is now lower than the answer from part A because in part A share price is fairly valued, while here shares issued in part B are undervalued.

New shareholders gain:

$$(\$69.55 - \$55.14) * 1.07\ million\ shares = \$15.42\ million$$

Old shareholders lose:

$$(\$69.55 - \$71.09) * 10\ milion\ shares = -15.4\ million$$

D. Suppose WRT instead finances the expansion with a $59 million issue of permanent risk-free debt. If WRT undertakes the expansion using debt, what is the new share price once the new information comes out? Comparing your answer with that in part C, what are the two advantages of debt financing in this case?

To calculate the tax shield, use the following formula:

$$Tax\ shield = Tax\ rate * Initial\ investment$$

Therefore,

$$Tax\ shield = 0.38 * \$59\ million = \$22.4\ million$$

The value of the tax shield from the new debt is $22.4 million.

The firm's equity will change by the NPV of the new investment and the value of the interest tax shield. To compute the share price, use the following formula:

$$Share\ price = \frac{Equity + Initial\ investment + NPV + Tax\ shield - Initial\ investment}{Number\ of\ original\ shares}$$

Therefore,

$$Share\ price = \frac{\$575\ million + \$59\ million + \$135.9\ million + \$22.4\ million - \$59\ million}{10\ million}$$

$$= \$73.33$$

If WRT instead finances the expansion with a $59 million issue of permanent risk-free debt, the share price is $73.33 per share.

The two advantages are:

(1) Avoiding issuing undervalued equity

(2) The interest tax shield

Exercise 16.33

We R Toys (WRT) is considering expanding into new geographic markets. The expansion will have the same business risk as WRT's existing assets. The expansion will require an initial investment of $45 million and is expected to generate perpetual EBIT of $15 million per year. After the initial investment, future capital expenditures are expected to equal depreciation, and no further additions to net working capital are anticipated.

WRT's existing capital structure is composed of $600 million in equity and $250 million in debt (market values), with 10 million equity shares outstanding. The unlevered cost of capital is 10% and WRT's debt is risk free with an interest rate of 4 %. The corporate tax rate is 40 % and there are no personal taxes.

A. WRT initially proposed to fund the expansion by issuing equity. If investors were not expecting this expansion, and if they share WRT's view of the expansion's profitability, what will the share price be once the firm announces the expansion plan?

Option 1: Finance project by issuing equity

The firm's equity value will change by the NPV of the new investment, which can be calculated using the following formula:

$$NPV\ of\ expansion = -\ Initial\ investment + \frac{EBIT * (1 - \tau_C)}{Cost\ of\ capital}$$

The equity value is reduced by the initial investment value. However, it is then increased by the present value of the cash flows. In sum, this means the net change in equity is the NPV of the project.

Therefore,

$$NPV\ of\ expansion = -\$45\ million + \frac{\$15\ million * (1 - 0.40)}{0.10} = \$45\ million$$

The NPV of the expansion is $45 million.

To compute the share price, use the following formula:

$$Share\ price = \frac{Equity + NPV}{Number\ of\ outstanding\ shares}$$

$$Share\ price = \frac{\$600\ million + \$45\ million}{10\ million\ shares} = \$64.5$$

Once the firm announces this expansion plan, the share price will be $64.5 per share.

B. Suppose investors think that the EBIT from WRT's expansions will be only $4 million. What will the share price be in this case? How many shares will the firm need to issue?

The firm's equity value will again change by the NPV of the new investment, which can be calculated using the following formula:

$$NPV\ of\ expansion = -\ Initial\ investment + \frac{EBIT * (1 - \tau_C)}{Cost\ of\ capital}$$

Therefore,

$$NPV\ of\ expansion = -\$45\ million + \frac{\$4\ million * (1 - 0.40)}{0.10} = -\$21\ million$$

If investors think that the EBIT from WRT's expansion will be only $4 million, the NPV of the expansion is -$21 million.

To compute the share price, use the following formula:

$$Share\ price = \frac{Equity + NPV}{Number\ of\ outstanding\ shares}$$

$$Share\ price = \frac{\$600\ million + (-\$21\ million)}{\$10\ million\ shares} = \$57.9$$

If investors think that EBIT from WRT's expansion will be only $4 million, the share price be $57.9 per share. Note that the project destroys share price since the net present value is negative.

To calculate the number of new shares to be issued, use the following formula:

$$New\ shares = \frac{Initial\ investment}{Price\ per\ share}$$

Therefore,

$$New\ shares = \frac{\$45\ million}{\$57.9} = 0.78\ million\ shares$$

The firm will need to issue 0.78 million shares.

C. Suppose WRT issues equity as in part B. Shortly after the issue, new information emerges that convinces investors that management was, in fact, correct regarding the cash flows from

the expansions. What will the share price be now? Why does it differ from that found in part A?

The firm's equity will change by the present value of the free cash flow of the new investment since the investment has already been made. To compute the share price based on the firm's new number of shares outstanding, use the following formula:

$$I_o + NPV = I_o + [-I_0 + PV(cash\ flows)] = PV(cash\ fows)$$

$$Share\ price = \frac{Equity + Initial\ investment + NPV}{Number\ of\ original\ shares + Number\ of\ new\ shares}$$

Therefore,

$$Share\ price = \frac{\$600\ million + \$45\ million + \$45\ million}{10\ million\ shares + 0.78\ million\ shares} = \$64$$

If WRT issues equity, then shortly after the issue, new information emerges that convinces investors that management was, in fact, correct regarding the cash flows from the expansion ($22 million in EBIT per year), the share price will be $64 per share.

The share price is now lower than the answer from part A because in part A share price is fairly valued, while here shares issued in part B are undervalued.

New shareholders gain:

$$(\$64 - \$57.9) * \underbrace{0.78\ million\ shares}_{\text{New shares issued under A.}} = \$4.76\ million$$

Old shareholders lose:

$$(\$64 - \$64.5) * 10\ milion\ shares = -\$5\ million$$

Note that someone gains at other's expense!

D. Suppose WRT instead finances the expansion with a $45 million issue of permanent risk-free debt. If WRT undertakes the expansion using debt, what is the new share price once the new information comes out? Comparing your answer with that in part C, what are the two advantages of debt financing in this case?

Option 2: Finance project by issuing debt

To calculate the tax shield, use the following formula:

$$Tax\ shield = Tax\ rate * Initial\ investment$$

Therefore,

$$Tax\ shield = 0.40\ * \$45\ million = \$18\ million$$

The value of the tax shield from the new debt is $18 million.

The firm's equity will change by the NPV of the new investment and the value of the interest tax shield. Note that we need to subtract the initial investment because we use debt to finance the investment. To compute the share price, use the following formula:

$$Share\ price = \frac{Equity + Initial\ investment + NPV + Tax\ shield - Initial\ investment}{Number\ of\ original\ shares}$$

Therefore,

$$Share\ price = \frac{\$600\ million + \$45 million + \$45\ million + \$18\ million - \$45\ million}{10\ million} = \$66.3$$

If WRT instead finances the expansion with a $45million issue of permanent risk-free debt, the share price is $66.3 per share.

By comparing the answers in C and D we see that debt financing leads to higher share price:

	C	D
Share price	\$64 per share	\$66.3 per share
Financing	Issue equity	Issue risk free debt

The gain of debt financing is

$$\$66.3 - \$64 = \$2.3\ per\ share$$

We can decompose this advantage in two:

(1) Avoiding issuing undervalued equity

$\$64.5 - \$64 = \$0.50$

(2) The interest tax shield

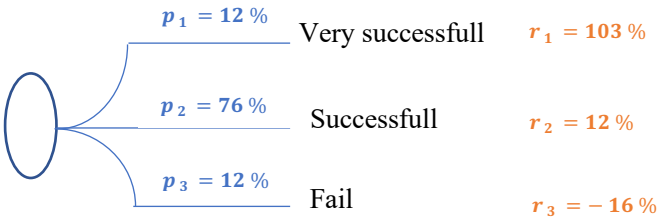
$$Interest\ tax\ shield\ per\ share = \frac{Interest\ tax\ shield}{Number\ of\ shares\ outstanding} = \frac{\$18\ million}{10\ million} = \$1.8$$

$$Sum = \$0.50 + \$1.8 = \$2.3$$

Chapter 23: Raising equity capital

Example

You have an arrangement with your broker to request 950 shares of all available IPOs. Suppose that 12 % of the time, the IPO is "very successful" and appreciates by 103 % on the first day, 76 % of the time it is "successful" and appreciates by 12 %, and 12 % of the time it "fails" and falls by 16 %.



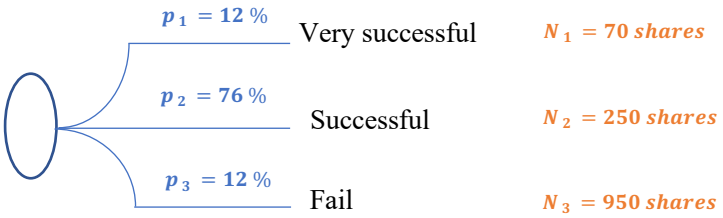
A. By what amount does the average IPO appreciates the first day; that is, what is the average IPO underpricing?

The average IPO appreciation the first day is:

$$Appreciation = (r_1 * p_1) + (r_2 * p_2) + (r_3 * p_3)$$

$$Appreciation = (103\% * 0.12) + (12\% * 0.76) + (-16\% * 0.12) = 19.6\%$$

B. Suppose you expect to receive 70 shares when the IPO is very successful, 250 shares when it is successful, and 950 shares when it fails. Assume the average IPO price is $11. What is your expected one-day return on you IPO investment?



The average investment is:

$$Investment = (p_1 * N_1 * P_1) + (p_2 * N_2 * P_2) + (p_3 * N_3 * P_3)$$

$$Investment = (0.12 * 70\ shares * \$11) + (0.76 * 250\ shares * \$11) + (0.12 * 950\ shares * \$11) = \$3\,436.4$$

The average gain is:

$$Average\ return = (p_1 * N_1 * P_1 * r_1) + (p_2 * N_2 * P_2 * r_2) + (p_3 * N_3 * P_3 * r_3)$$

$$Average\ return = (0.12 * 70\ shares * \$11 * 1.03) + (0.76 * 250\ shares * \$11 * 0.12) + (0.12 * 950\ shares * \$11 * -0.16) = \$145.33$$

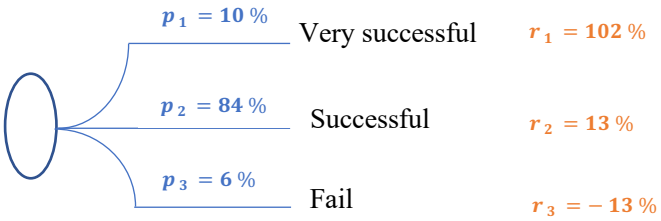
The expected one-day return on the IPO investment is:

$$Return = \frac{Average\ return}{Investment}$$

$$Return = \frac{\$145.33}{\$3\,436.4} = 0.042 = 4.2\,\%$$

Exercise 23.17

You have an arrangement with your broker to request 1 050 shares of all available IPOs. Suppose that 10 % of the time, the IPO is "very successful" and appreciates by 102 % on the first day, 84 % of the time it is "successful" and appreciates by 13 %, and 6 % of the time it "fails" and falls by 13 %.



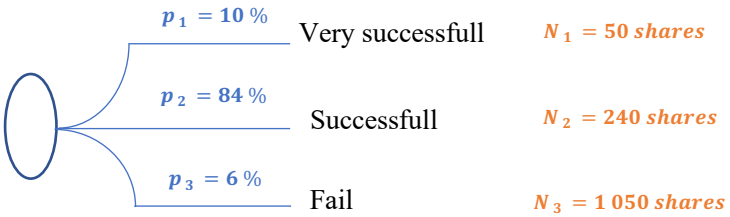
A. By what amount does the average IPO appreciates the first day; that is, what is the average IPO underpricing?

The average IPO appreciation the first day is:

$$Appreciation = (r_1 * p_1) + (r_2 * p_2) + (r_3 * p_3)$$

$$Appreciation = (102\,\% * 0.10) + (13\,\% * 0.84) + (-13\,\% * 0.06) = 20.34\,\%$$

B. Suppose you expect to receive 50 shares when the IPO is very successful, 240 shares when it is successful, and 1 050 shares when it fails. Assume the average IPO price is $14. What is your expected one-day return on you IPO investment?



Note that average return is a function of average investment and average gain. We therefore need to compute the two.

Fist we calculate the average investment:

$$Investment = (p_1 * N_1 * P_1) + (p_2 * N_2 * P_2) + (p_3 * N_3 * P_3)$$

$$Investment = (0.10 * 50\ shares * \$14) + (0.84 * 240\ shares * \$14) + (0.06 * 1\,050\ shares * \$14) = \$3\,774.40$$

Then we calculate the average return:

$$Average\ return = (p_1 * N_1 * P_1 * r_1) + (p_2 * N_2 * P_2 * r_2) + (p_3 * N_3 * P_3 * r_3)$$

$$Average\ return = (0.10 * 50\ shares * \$14 * 1.02) + (0.84 * 240\ shares * \$14 * 0.13) + (0.06 * 1\,050\ shares * \$14 * -0.13) = \$323.65$$

The expected one-day return on the IPO investment is:

$$Return = \frac{Average\ return}{Investment}$$

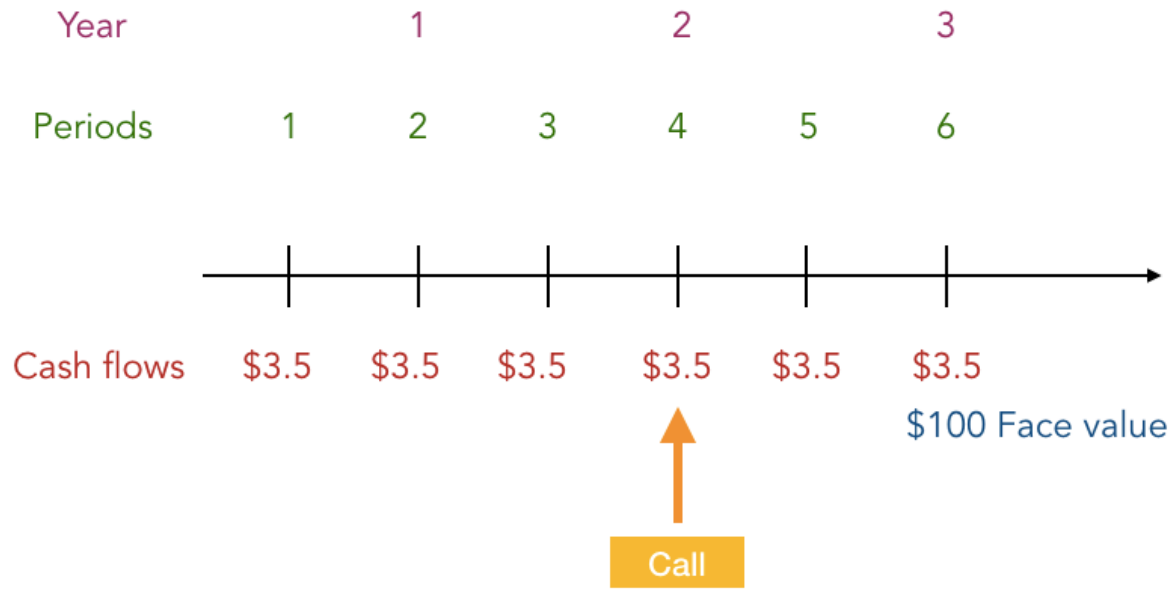
$$Return = \frac{\$323.65}{\$3\,774.50} = 0.0857 = 8.57\ \%$$

Chapter 24: Debt Financing

💡 Example

Boeing Corporation has just issued a callable (at par) three-year 7 % coupon bond with semi-annual coupon payments. The bond can be called at par in two years or anytime thereafter on a coupon payment date. It has a price of $96. What is the bond's yield to maturity and yield to call?

Here is the cashflow timeline:



How do I calculate the coupon payments? A coupon rate of 7 % means that the annual coupon payment is 7 % of face value of \$100, which is \$7. However, since the coupon payments are semiannual, this means that there are two coupon payments per year. The semiannual coupon payments are therefore $\frac{\$7}{2} = \$3.5$.

1. Yield to maturity (YTM)

We use the present value formula to calculate the yield to maturity (i):

$$P_0 = \$96 = \frac{\$3.5}{(1+i)} + \frac{\$3.5}{(1+i)^2} + \frac{\$3.5}{(1+i)^3} + \frac{\$3.5}{(1+i)^4} + \frac{\$3.5}{(1+i)^5} + \frac{\$3.5+\$100}{(1+i)^6}$$

We can rewrite this using the annuity formula:

$$P_0 = \$96 = \frac{\$3.5}{i}\left[1 - \frac{1}{(1+i)^6}\right] + \frac{\$100}{(1+i)^6}$$

If we solve for i we get:

$$i = 4.270\ \%$$

Note that i = 4.270 % is the semiannual rate. However, **yield to maturity** is quoted as an **annual percentage rate.** We therefore need to transform the semiannual rate to an annual rate, by multiplying by 2:

$$YTM = i * 2$$

$$YTM = 4.270\ \% * 2 = 8.54\ \%$$

2. Yield to call (YTC)

To find the yield to call we need to change the number of periods. Since we can call the bond at the end of second year, we now only have **four** periods. Using the present value formula, we therefore get:

$$P_0 = \$96 = \frac{\$3.5}{(1+i)} + \frac{\$3.5}{(1+i)^2} + \frac{\$3.5}{(1+i)^3} + \frac{\$3.5 + \$100}{(1+i)^4}$$

We can rewrite this using the annuity formula:

$$P_0 = \$96 = \frac{\$3.5}{i}\left[1 - \frac{1}{(1+i)^4}\right] + \frac{\$100}{(1+i)^4}$$

If we solve for i we get:

$$i = 4.616\ \%$$

Note that i = 4.616 % is the semiannual rate. However, **yield to call** is quoted as an **annual percentage rate.** We therefore need to transform the semiannual rate to an annual rate, by multiplying by 2:

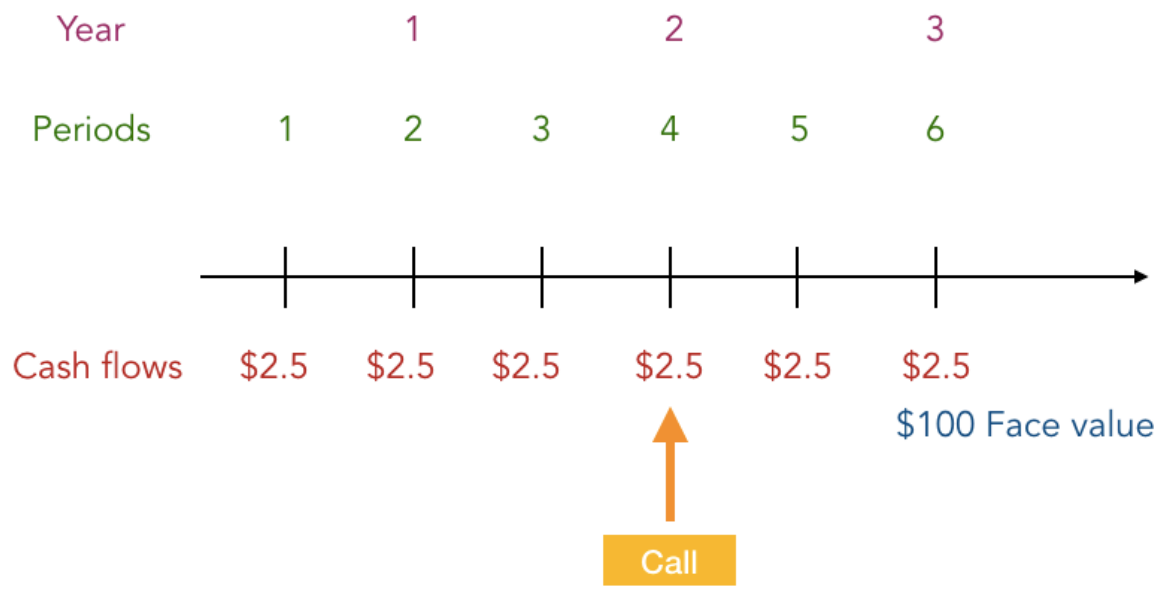
$$YTC = i * 2$$

$$YTC = 4.618\ \% * 2 = 9.24\ \%$$

Exercise 24.12

Boeing Corporation has just issued a callable (at par) three-year 5 % coupon bond with semi-annual coupon payments. The bond can be called at par in two years or anytime thereafter on a coupon payment date. It has a price of \$99. What is the bond's yield to maturity and yield to call?

Here is the cashflow timeline:



How do I calculate the coupon payments? A coupon rate of 5 % means that the annual coupon payment is 5 % of face value of \$100, which is \$5. However, since the coupon payments are semiannual, this means that there are two coupon payments per year. The semiannual coupon payments are therefore $\frac{\$5}{2} = \$2.5$.

1. Yield to maturity (YTM)

We use the present value formula to calculate the yield to maturity (i):

$$P_0 = \$99 = \frac{\$2.5}{(1+i)} + \frac{\$2.5}{(1+i)^2} + \frac{\$2.5}{(1+i)^3} + \frac{\$2.5}{(1+i)^4} + \frac{\$2.5}{(1+i)^5} + \frac{\$2.5+\$100}{(1+i)^6}$$

We can rewrite this using the annuity formula:

$$P_0 = \$99 = \frac{\$2.5}{i}\left[1 - \frac{1}{(1+i)^6}\right] + \frac{\$100}{(1+i)^6}$$

If we solve for i we get:

$$i = 2.68\ \%$$

Note that i = 2.68 % is the semiannual rate. However, **yield to maturity** is quoted as an **annual percentage rate.** We therefore need to transform the semiannual rate to an annual rate, by multiplying by 2:

$$YTM = i * 2$$

$$YTM = 2.68\ \% * 2 = 5.36\ \%$$

2. Yield to call (YTC)

To find the yield to call we need to change the number of periods. Since we can call the bond at the end of second year, we now only have **four** periods. Using the present value formula, we therefore get:

$$P_0 = \$99 = \frac{\$2.5}{(1+i)} + \frac{\$2.5}{(1+i)^2} + \frac{\$2.5}{(1+i)^3} + \frac{\$2.5 + \$100}{(1+i)^4}$$

We can rewrite this using the annuity formula:

$$P_0 = \$99 = \frac{\$2.5}{i}\left[1 - \frac{1}{(1+i)^4}\right] + \frac{\$100}{(1+i)^4}$$

If we solve for i we get:

$$i = 2.77\ \%$$

Note that i = 2.77 % is the semiannual rate. However, **yield to call** is quoted as an **annual percentage rate.** We therefore need to transform the semiannual rate to an annual rate, by multiplying by 2:

$$YTC = i * 2$$

$$YTC = 2.77\ \% * 2 = 5.54\ \%$$