CHAPTER 17: VALUATION AND CAPITAL BUDGETING FOR THE LEVERED FIRM

Assigned problems are 3, 5, 8a, 14, and 15. Read Appendix 17A.

Chapter 7 covered capital budgeting for an all equity firm. Chapters 10 and 11 introduce asset pricing models that can be applied to determine the appropriate discount rate given the risk of a project. Chapter 17 incorporates the effects of financial leverage into capital budgeting. Using a Modigliani-Miller (Chapter 15) world to simplify the exposition, we cover two complementary valuation approaches:

1. **Adjusted present value (APV) approach**
2. **Flow to equity (FTE) approach**
3. **Weighted average cost of capital (WACC) approach**

I. The Adjusted Present Value Approach

The Adjusted Present Value (APV) for a project with debt financing is:

$$\mathbf{APV = NPV_U + NPVF}$$

APV has the conceptual advantage of separating the value of the unlevered investment from the value that comes from the *financing effects* (what we see here is an extension of Chapter 15).

1. **NPV_U** is defined as the Net Present Value of the project to an all-equity or **unlevered** firm:
   - **$NPV_U = PV_{UCF}$ – Initial investment**
     - **PV_{UCF}** is defined as the PV of **Unlevered Cash Flows** or **UCFs**. The discount rate used is: **r_0**, the Unlevered cost of capital or required return on the Assets, where from Chapter 12:
       $r_0 = r_F + \beta_{ASSETS}[r_M - r_F]$

2. **NPVF** is the Net Present Value of *financial* effects, which should include:
   - tax subsidy to debt (the *tax shield*)
   - costs of issuing new debt and equity securities (*flotation* costs)
   - costs of financial distress arising from the use of debt
   - subsidies to debt financing

You have already seen one of these financing side effects. In Chapter 15, using perpetual debt, the value of a levered firm is: $\mathbf{V_L = V_U + T_C B}$, where $\mathbf{T_C B}$ is the PV of the *tax shield*.

An Example of APV and the Tax Subsidy to Debt

The following example takes advantage of the simplicity in the Modigliani-Miller world. Suppose PMM Inc. has an investment with the following characteristics:

Initial cost of project or investment is **CF_0 = –$100,000**

The assets of this project generate an expected **EBIT = $15,000** per year forever (perpetuity).

This project or investment can be financed either with $100,000 in equity (assume from internally generated cash flow) or with $40,000 of debt and $60,000 equity.

The discount rate on an **all equity** financed project in this risk class is $\mathbf{r_0 = 10\%}$. The firm's marginal tax rate is $\mathbf{T_C = 40\%}$. The cost of any debt is $\mathbf{r_D = 5\%}$ before taxes. We will let the coupon rate and cost of debt be equal, i.e., $\mathbf{r_D = r_B}$.

1. <u>All equity value</u> (Unlevered NPV):

Annual after-tax cash flow to unlevered equity is $\mathbf{EBIT(1 - T_C)}$ = ($15,000)(1 – 0.40) = **$9000** in perpetuity. The Net Present Value of the project if financed with internal equity is therefore:

$\mathbf{NPV_U}$ **= PV(UCFs) – Initial Investment**

$\mathbf{NPV_U = EBIT[1 - T_C]/r_0}$ **– initial investment** = $9000/0.10 – $100,000 = **–$10,000**

Since $\mathbf{NPV_U}$ **= –$10,000**, the all-equity firm should **reject** the project since the $100,000 initial investment will create an asset only worth $90,000

2. <u>Financing side effect</u>: (using D=$40,000 and E=$60,000)

Note that in the MM world, all cash flows are perpetual and debt does not mature. Interest expense on debt is tax deductible. In this example, the annual coupon interest payment is $\mathbf{r_B B}$ = (0.05)($40,000) = **$2000**. The annual tax subsidy (tax savings from the debt) is $\mathbf{r_B B T_C}$ = (0.05)($40,000)(0.40) = **$800**, and the present value of this financing side effect discounted at the market cost of debt $\mathbf{r_D = 5\%}$.

$\mathbf{NPVF = r_B B T_C / r_D}$; the PV of Tax Shield from Chapter 15 (here, $r_B = r_D = 5\%$), yielding:

$\mathbf{NPVF = T_C B}$ =(0.40)(40,000) = **$16,000**

The Adjusted Present Value of the project is then

$\mathbf{APV = NPV_U + NPVF}$ = –10,000 + 16,000 = **$6000**

After including the value of the tax subsidy or PV(tax shield), stockholders can now expect to gain $6000. The firm should **accept** this project if it is financed with $40,000 in debt at 5%.

Think of this project as a separate firm. The value of the **unlevered** firm is the value of the original $100,000 investment plus the negative $10,000 NPV, i.e. V_U = $100,000 – 10000 = $90,000. The value of the levered firm is $\mathbf{V_L = V_U + T_C B}$ = $90,000 + $16,000. The value of debt is D = $40,000 (the face or par value B, since $r_B = r_D = 5\%$) and the entire tax shield subsidy is captured by the stockholders; $\mathbf{E = V_L - D}$ = 106,000 – 40,000 = **$66,000**. Note that the stockholders originally invested $60,000 of equity.

3. Flotation (Issuance) Costs

When a firm raises funds through external debt or equity, it must incur flotation costs (investment bankers will certainly demand a fee for their services of issuing securities). The cost of issuing debt is going to be around 1 to 4% of the total proceeds that you expect to raise from the bond issue. The firm is allowed to *amortize* these issuance or flotation costs during future years. I ignore flotation costs in this example, but be aware that these costs exist. Equity flotation costs are the highest, about 7% of the total proceeds of the equity issue!

4. Costs of Financial Distress

Firms should continue to exploit tax shields on interest until the benefits are offset by the marginal costs of financial distress. This means that financial distress costs are likely to be non-trivial for an optimally-financed firm. Unfortunately, financial economists are no help here, as there is no easy method to calculate this figure.

II. The Flow To Equity (FTE) Approach

The value of the equity component of a project can be calculated by discounting the project's **Levered Cash Flows** or **LCFs** at the project's cost of equity capital. For the sake of continuity, the following example uses the data given in Section I.

A project will generate **EBIT = $15,000** per year in perpetuity. The project is financed with a Debt to Equity ratio of **D/E = 0.6060606** and the amount of debt is **D = $40,000**. The cost of the debt is **r_D=5%** and the tax rate is **T_C=40%**. The unlevered cost of capital (required return on the assets) is **r_0=10%**. The first step is to calculate the **Levered Cash Flows** or **LCFs** to the equity.

$$\mathbf{LCF} = [\mathbf{EBIT} - \mathbf{r_B B}][\mathbf{1} - \mathbf{T_C}] = [15{,}000 - (0.05)(40{,}000)][1 - 0.40] = \mathbf{\$7800}$$

Since this example is in the Modigliani-Miller Chapter 15 world, we can use MM Proposition II (with corporate taxes) to estimate the cost of **levered equity or r_E**. The Debt to Equity ratio (to be held constant for the project's life) is D/E = 0.6060606.

$$\mathbf{r_E = r_0 + (r_0 - r_D)(1 - T_C)(D/E)}$$

$$\mathbf{r_E} = 0.10 + (0.10 - 0.05)(1 - 0.40)(0.6060606) = 0.11818 \text{ or } \mathbf{11.818\%}$$

The equity value will consist of a perpetuity of **LCF=$7800** per year, discounted at **r_E=0.11818**. The value of the equity is **E = 7800/r_E** = 7800/0.11818 = **$66,000**.

Now we find the NPV, still using the data from the example of Section 1 and as continued here. The initial equity invested in the project is $60,000, as $40,000 of the $100,000 initial investment was borrowed as debt. The NPV of the project for the equity providers is thus:

$$\mathbf{NPV} = \mathbf{LCF/r_E} - \textbf{initial eqity investment} = 7800/0/11818 - 60{,}000 = \mathbf{\$6000}$$

III. The Weighted Average Cost Of Capital (WACC) Approach

The value of any firm or project, whether levered or unlevered, can always be calculated by **discounting** the **Unlevered Cash Flows** at the **weighted average cost of capital**. This example uses the data from the example in Section 1. Due to using this data, some of this may appear as circular reasoning, although this is not the intention.

Recall that the expected EBIT of the project is $15,000 in perpetuity. If PPM Inc. financed the project with $40,000 debt at 5% interest, the net after-tax cash flows to stockholders is:

Cash Flows to Levered Equity = $[EBIT – r_B B][1 – T_C]$ = [$15,000 – $2000][1 – 0.40] = **$7800**

Since this example is in the Modigliani-Miller Chapter 15 world, we can use MM Proposition II (with corporate taxes) to estimate the cost of **levered equity**:

$$\mathbf{r_E = r_0 + (r_0 - r_D)(1 - T_C)(D/E)}$$

We need to know the Debt to Equity ratio. From the prior example, **D=40,000** and **E=66,000**.

$\mathbf{r_E}$ = 0.10 + (0.10 – 0.05)(1 – 0.40)(40,000/66,000) = 0.11818 or **11.818%**

The value of the equity is $\mathbf{E = 7800/r_E}$ = 7800/0.11818 = **$66,000** (which we already knew)

A firm's overall WACC (originally introduced in Chapter 12) is a market value weighted average of the after-tax cost of debt and cost of equity:

$$\mathbf{r_{WACC} = [D/(D + E)](1 - T_C)r_D + [E/(D + E)]r_E}$$

The intuition of the WACC approach is simple and appealing. If a project's expected after-tax return (IRR) is higher than the weighted average of the after-tax required returns on debt and equity capital, it is a positive NPV project.

Continuing our previous example, the weighted average cost of capital for a levered firm in the MM world is:

D = $40,000

E = $66,000

$r_D = r_B$ = 5%

r_E = 11.818%

T_C = 40%

$\mathbf{r_{WACC}}$ = [40,000/106,000](0.60)(0.05) + [66,000/106,000](0.11818) = 0.084906 or **8.4906%**

The benefit that is associated with the tax shield of debt is thus already incorporated into the WACC. We always calculate the project’s cash flows as if they are <u>Unlevered</u>, (as done in Chapter 7). The present value of the <u>Unlevered</u> after-tax cash flows to the firm discounted at r_{WACC} is:

$$\mathbf{PV_{WACC} = V_L = (Unlevered\ after\text{-}tax\ cash\ flows)/r_{WACC}}$$

$$\mathbf{PV_{WACC}} = (\$15{,}000)(1 - 0.40)/0.084906 = \mathbf{\$106{,}000}$$

and the $\mathbf{NPV_{WACC} = V_L}$ **– Initial Investment** = \$106,000 - \$100,000 = **\$6000**

Of course, this is the same firm value as in the APV approach and the result is identical. This example illustrates that APV and WACC are different but complementary ways of valuing the firm. Each method accounts for the tax benefits of financial leverage differently but the value of the benefits is the same under each approach in the MM world.

When and How to Use the WACC

It is important to remember that a firm's existing WACC is only appropriate as a discount rate for a project when both of the following conditions are met:

1. The project has similar systematic risk (asset beta) as the firm.
2. The project and firm have the same debt capacity.

This WACC approach is often inappropriate for new projects, since a project's systematic risk may be different from that of the existing firm. A project's debt capacity can also be different than the average debt capacity of the firm. If either (1) or (2) above is not met, then the project should be treated as if it were a mini-firm, with its own proportion of debt and equity and its own capital costs. The WACC is typically used to value *scale expanding* projects.

A convenient feature of the WACC approach is that it is often easy to obtain estimates of r_E, r_D, D and E. For a publicly traded firm, the market values of debt and equity can be obtained from the financial press (e.g. the *Wall Street Journal).* The next section discusses how to estimate required returns on debt and equity.

The cost of debt

The easiest way to estimate the cost of debt is to calculate the yield to maturity on a similar-risk bond in the market. Suppose a firm is considering selling 12% coupon bonds (\$1000 par) with a 20-year life and annual payments. If similar bonds of the same rating sell for \$1,170.30, then the implied Yield to Maturity or YTM is 10%.

The cost of equity

The asset pricing models introduced in Chapters 10 and 11 are useful for estimating the cost of equity. Using the CAPM model, the cost of equity is:

$$\mathbf{r_E = r_F + \beta_E[r_M - r_F]}$$

Many information services publish betas for publicly traded stocks. Chapter 10 provided a discussion on how to estimate variance, covariance, and beta. If you use betas from an external source (such as ValueLine) to estimate r_E, you must use the market index used by the information service to estimate beta as r_M.

Once r_D, r_E, and the proportions of debt and equity financing are known, the following analysis will estimate the PV of a firm or project.

$$\mathbf{r_{WACC} = [D/(D + E)](1 - T_C)r_D + [E/(D + E)]r_E}$$

$$PV_0 = \sum_{t=1}^{\infty} \frac{UCF_t}{(1 + r_{wacc})^t}$$

IV. Perfect Models For An Imperfect World: APV, FTE, and WACC

These three methods for calculating the value of a proposed project should be viewed as complementary.

	APV	FTE	WACC
Initial Investment	All	*book* E	All
Cash Flows	UCF	LCF	UCF
D or D/E held constant	D	D/E	D/E
Discount Rates	r_0	r_E	r_{WACC}
PV of financing effects	Yes	No	No

We suggest the following guideline for choosing between these models:

- Use the WACC method if the target debt ratio will be constant throughout the life of the project.
- Use the APV method if the debt level will be constant through out the life of the project.

V. Beta and Leverage

It is never too repetitive to remind students that if the systematic risk of the project differs significantly from the average risk of the firm, the discount rate should reflect the risk of the project. For example, we can use CAPM to estimate the unlevered discount rate:

Asset beta $\boldsymbol{\beta_{ASSET}}$**) = Cov(UCF,Market) / Var(Market)**

and the unlevered discount rate is $\mathbf{r_0 = r_F + \beta_{ASSET}[r_M - r_F]}$. The Asset Beta and unlevered discount rate do not take into account the effects of financial leverage. If the project generates debt capacity, the following formulas can be used to adjust beta for financial leverage.

The No-tax Case:

In a world without taxes, the asset beta of a levered firm is simply the weighted average of the betas of debt and equity:

$$\boldsymbol{\beta_{ASSET} = [D/(D+E)]\beta_{Debt} + [E/(D+E)]\beta_{Equity}}$$

If corporate debt is risk-free, i.e., $\boldsymbol{\beta_{Debt} = 0}$ then:

$$\boldsymbol{\beta_{ASSET} = [E/(D+E)]\beta_{Equity}}$$

Note: this equation is just a rearrangement of equation 17.3 in the text: $\boldsymbol{\beta_{Equity} = (1 + D/E)\beta_{Asset}}$

The Corporate tax case (yes, the real world example):

In a world with corporate taxes and risk-free corporate debt, i.e., $\beta_{Debt} = 0$, the relationship between levered equity beta and unlevered or asset beta is:

$$\beta_{Equity} = [1 + (1 - T_C)D/E]\beta_{ASSET}.$$

In this case, since corporate debt is risk-free, the tax shield benefit from debt is also risk-free. The levered equity Beta is always greater than the Asset (unlevered) Beta in all scenarios.

If corporate debt is not risk-free, the relationship between the levered equity beta and the unlevered or asset beta becomes:

$$\beta_{Equity} = \beta_{ASSETS} + (1 - T_C)(\beta_{ASSETS} - \beta_{DEBT})D/E$$

These two formulas combine assumptions of the CAPM and the MM Model. Recall that in the MM world with corporate tax, the optimal capital structure policy is to use 100% debt because the costs of financial distress are assumed to be zero. Consequently, applying the levered beta equations to real world situations that differ markedly from the MM assumptions can be hazardous.

VI. CREATING NPV THROUGH DEBT FINANCING:

This section expands on a topic we first covered in Chapter 15, the **PV(tax shield of debt)**. In Chapter 15, the focus is entirely on the subject of capital structure and we assumed that all cash flows come as perpetuities in order to narrow that focus. Here, we focus solely on the PV created by the Tax Shield of debt and also for a non-perpetual debt.

NPVF = Amount received – PV(interest payments) – PV(par value repayment)

1. **Perpetual debt**: sell a perpetual bond having a face value of **B = $100,000** Par value and coupon rate $r_B = 10\%$. The corporate tax rate is $T_C = 40\%$. The market requires a return or Yield-To-Maturity or YTM of $r_D = 10\%$ on this bond.

   Interest payments = $r_B B$ = (0.10)(100,000) = **$10,000** per year

   After-tax cost of interest payments = $(1 - T_C)(r_B B)$ = (1 – 0.40)(10,000) = **$6000** per year

   PV of after-tax interest payments = $6000/r_D$ = 6000/0.10 = **$60,000**

   PV of repayment of Par value = **zero**, since the par value is never paid with perpetual debt.

   NPVF = amount received – PV(interest payments) – PV(par value repayment)

   NPVF = 100,000 – 60,000 – 0 = **$40,000**, this is also the PV(tax shield)

   Short cut method: with a perpetual bond; **PV(tax shield) =** $r_B B T_C / r_D$. Here, since $r_B = r_D$, we arrive at a PV(tax shield) = **NPVF =** $T_C B$ **= $40,000**

2. **Debt that is not perpetual**. A 5-year bond (coupons paid annually) is issued at $\mathbf{r_B = r_D = 10\%}$, and the **Par value = $1000**. When the Yield-To-Maturity equals r_D, the bond's market price will be equal to the Par value. This bond will receive a coupon of $\mathbf{r_B B}$ = (0.10)(1000) = **$100** each year, and the Par value of $1000 will be repaid when the bond matures 5 years from today. Assume that $\mathbf{T_C = 40\%}$.

   PV(Par value repayment) = $1000/(1 + 0.10)^5$ = **$620.92**, this payment is **NOT** tax deductible.

   PV(after-tax interest payments): the $100 coupon paid each year is fully tax deductible. There are five coupon payments. The **after-tax cost** of each coupon payment is ($100)(1 – T_C) = **$60**. These annual $60 payments constitute an **annuity** of **n=5** years.

   PV(after-tax interest payments) = $(1 - T_C)(\text{coupon})[1/r_D - 1/(r_D(1+r_D)^n)]$

   PV(after-tax interest payments) = $60[1/0.10 - 1/(0.10(1+0.10)^5)]$ = **$227.45**

   NPVF = amount received – PV(interest payments) – PV(par value repayment)

   NPVF = 1000 – 227.45 – 620.92 = **$151.63**, this is the bond's PV(tax shield)

   Shortcut method:

   For this 5-year bond, the annual tax savings is $\mathbf{r_B B T_C}$ = (100)(0.40) = $40. The NPVF will simply be the Present Value of all of the annual $40 tax savings. There will be **five** of these $40 annual tax savings due to the tax deductibility of interest payments. Treat this as an Annuity of PMT = 40, N = 5, I = 10%, and obtain **PV = $151.63**, the same result as above.

Chapter 17 Supplemental Problems for practice

Problem 17.1

The Peach Computer Company has $10 million of debt outstanding at book (par) value. The debt is trading in the market at 90% of book (par) value. The yield to maturity at current market prices is 12%. The 1 million shares of Peach stock are selling at $20 per share. The required return on Peach stock is 20%. The tax rate is 34%. Calculate the WACC for Peach Computer. Assume that a Modigliani and Milller world exists and that cash flows are perpetuities.

Solution 17.1

D = (0.9)($10 million) = $9 million current market value

E = (1 million shares)($20/share) = $20 million

r_{WACC} = (9/29)(0.12)(1 – 0.34) + (20/29)(0.20) = 16.25%

Problem 17.2

Use the MM equations to determine EBIT for the above firm.

Solution 17.2

Value of the firm = $20 million + $9 million = $29 million

From Chapters 15 and 17, we have the equation: $V_L = EBIT(1 - T_C)/r_{WACC}$

$\longrightarrow$ $EBIT = V_L[r_{WACC}/(1 - T_C)]$ = ($29 million)(.1625)/(1 – 0.34) = $7.14 million per year