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# Advanced Corporate Finance

## 4. Project Valuation using the WACC

# Objectives of the session

- So far, NPV concept and possibility to move from accounting data to cash flows. Influence on taxation on firm value: OK. But necessity to go further and understand the impact of the capital structure on project valuation in general. This sessions' objectives

1. Review the ways to analyze the impact of capital structure on investment decisions (APV, wacc and FTE)
2. Determine values of the wacc in function of capital structure objectives

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# Interactions between capital budgeting and financing

- The NPV for a project could be affected by its financing.

  (1) Transactions costs

  (2) Interest tax shield

- There are several ways to proceed, one relies on adjusting the NPV for the financing cost, the others adjust the discount rate:

- ***The APV Approach:***
  - Compute a base case NPV, and add to it the NPV of the financing decision ensuing from project acceptance
    - APV = Base-case NPV + NPV(FinancingDecision)

- ***The Adjusted Cost of Capital Approach:***
  - Adjust the discount rate to account for the financing decision



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## Basis of reasoning

- Do you remember this expression? (remember also its assumptions!)

$$V_L = V_U + T_c D = E + D$$

$$\frac{FCF_{unlevered}}{WACC} \qquad \frac{FCF_{Unlevered}}{r_a} \quad \sum_{t=1}^{\infty} \frac{T_c \times (r_d \times D)}{(1+r_d)^t} \qquad \frac{FCF_{levered} \text{ or } FCF_{to\ equity}}{k_e}$$

WACC way — APV — FTE

- Three methodologies that should be consistent under certain assumptions and context!
  - Simple context: everything can be summarized in a rate
  - Perpetuity! → there is a single WACC (à priori) while we can discount any series of CFs quite explicitly with any specific value each period.

## For a given project, three methods

- If we assume perpetual Cash Flows
- WACC

$$\sum_{t=1}^{\infty} \frac{FCF_{U,t}}{(1+WACC)^t} - I$$

- APV

$$\sum_{t=1}^{\infty} \frac{FCF_{U,t}}{(1+r_a)^t} + PV(financing\ effects) - I$$

- FTE

$$\sum_{t=1}^{\infty} \frac{FCF_{L,t}}{(1+r_e)^t} - (I - D)$$

## MM (1963) with taxes: Corporate Tax Shield

- Interest payments are tax deductible ➔ tax shield
- Tax shield = Interest payment × Marginal Corporate Tax Rate

$$r_d \times D \times T_c$$

  - $r_D$ : cost of new debt
  - $D$ : market value of debt
  - Value of levered firm

    = Value if all-equity-financed + PV(Tax Shield)
- PV(Tax Shield) - Assume permanent borrowing

$$PV\ (TaxShield\ ) = \frac{T_c \times D \times r_d}{r_d} = T_c \times D$$

- Other assumptions?
- Value of the firm: $V_L = V_U + T_c D$

# The Adjusted Present Value

- The most straightforward. Permits the user to see the sources of value in the project, if it's accepted
- Procedure:
  - (1) Compute the base-case NPV using a discount rate that employs all equity financing ($r_A$), applied to the project's cash flows
  - (2) Then, adjust for the effects of financing which arise from:
    - Flotation costs
    - Tax Shields on Debt Issued
    - Effects of Financing Subsidies

» APV = NPV + NPVF

# APV Example

- Data
  - Cost of investment 10,000
  - Incremental earnings 1,800 / year
  - Duration 10 years
  - Discount rate $r_A$ 12%

- NPV = -10,000 + 1,800 x $a_{10}$ = 170

- <u>(1) Stock issue:</u>
- Issue cost : 5% from gross proceed
- Size of issue : 10,526 (= 10,000 / (1-5%))
- Issue cost = 526
- APV = + 170 - 526 = - 356

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# APV Example

- (2) Borrowing

Suppose now that 5,000 are borrowed to finance partly the project

- Cost of borrowing : 8%
- Constant annuity: 1,252/year for 5 years
- Corporate tax rate = 40%

| Year | Balance | Interest | Principal | Tax Shield |
|---|---|---|---|---|
| 1 | 5,000 | 400 | 852 | 160 |
| 2 | 4,148 | 332 | 920 | 133 |
| 3 | 3,227 | 258 | 994 | 103 |
| 4 | 2,223 | 179 | 1,074 | 72 |
| 5 | 1,160 | 93 | 1,160 | 37 |

- PV(Tax Shield) = 422
- APV = 170 + 422 = 592

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# Adjusted Present Value

- Has some strong defenders => see Luerhman (1997) for an easy to read discussion
- Strong points

⇒ allows easily to determine and analyze the precise impact of very different actions linked to capital structure (tax shields but also costs of financial distress, subsidies, hedges, cost of issue etc..)

⇒ Unbundling of each factor (in this respect $r_{wacc}$ is much more opaque)

⇒ Possible to understand the respective contribution of each assumption (see Luerhman, 1997)

⇒ Probably easier to communicate

⇒ Easy when amount of debt to issue is known

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# Adjusted Present Value

- Minus points

⇒ Need to determine the proper rate to discount the Tax shield (not so simple, so far assumption that $r_d$ is the proper rate)

⇒ When we have a target leverage ratio : necessity to solve for both the debt level AND the project value (but less of an issue with a spreadsheet allowing iterative calculation)

⇒ Not easy to implement when we have a debt/equity ratio

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# Playing with the discount rate

- Alternative approaches rely on a discount rate adjusted for the financial decisions
- One of the most commonly used measure: the weighted average cost of capital (wacc)
- After tax WACC for levered company:

$$WACC = r_E \times \frac{E}{V} + r_D \times (1 - T_C) \times \frac{D}{V}$$

- !NB!: E, D and V are MARKET VALUES **not** book value
- *NB: With this formula, only the tax shield is taken into account*

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# WACC -Sangria Corporation

Balance Sheet (Book Value, millions)

| | | | |
|---|---|---|---|
| Assets | 100 | Debt | 50 |
| | | Equity | 50 |
| Total | 100 | Total | 100 |

Balance Sheet (Market Value, millions)

| | | | |
|---|---|---|---|
| Assets | 125 | Debt | 50 |
| | | Equity | 75 |
| Total | 125 | Total | 125 |

| | |
|---|---|
| Cost of equity | 14.6% |
| Cost of debt (pretax) | 8% |
| Tax rate | 35% |

Equity ratio = $E/V$ = 75/125 = 60%
Debt ratio = $D/V$ = 50/125 = 40%

$$WACC = .146 \times \frac{75}{125} + .08 \times (1 - .35) \times \frac{50}{125} = .1084$$

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# Using the WACC

- WACC is used to discount free cash flows (unlevered)
- Example: Sangria Corp. considers investing $12.5m in a machine.
- Expected pre-tax cash flow = $ 2.085m (a perpetuity)
- After-tax cash flow = 2.085 (1 - 0.35) = 1.355

$$NPV = -12.5 + \frac{1.355}{.1084} = 0$$

- Beware of two traps:
- (1) Risk of project might be different from average risk of company
- (2) Financing of project might be different from average financing of company

# Using the WACC

- New project may have an influence on the capital structure itself!
- WACC may change over time! A change in the capital structure in the future will automatically lead to a change in wacc value

- Need to determine the WACC value under several scenario
  - Modigliani-Miller (1963) => assumptions: CF is a perpertuity, debt is a constant
  - Miles-Ezzel (1980, 1985) => assumptions any FCF, target leverage ratio ($L = D_t/V_t$) is a constant with a rebalancing of the debt at a given time interval
  - Harris and Pringle (1985) assumptions any FCF, target leverage ratio ($L = D_t/V_t$) is a constant with a continuous rebalancing of the debt

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# WACC - Modigliani-Miller formula

- Remember that
$$r_a \times \frac{V_u}{V_L} + r_d \times \frac{T_c D}{V_L} = r_e \times \frac{E}{V_L} + r_d \times \frac{D}{V_L}$$

- And $V_L = V_U + T_c D$, thus
$$r_a \times \frac{V_L - T_c D}{V_L} = r_e \times \frac{E}{V_L} + r_d \times (1 - T_c) \times \frac{D}{V_L}$$

- Since
$$WACC = r_E \times \frac{E}{V} + r_D \times (1 - T_C) \times \frac{D}{V}$$

- Then
$$WACC = r_A (1 - T_C L)$$

## Another presentation

- Assumptions!!! => $FCF_t = EBIT(1\text{-}T_C)$
- Market value of unlevered firm:

$$V_U = EBIT\,(1\text{-}T_C)/r_A$$

- Market value of levered firm: $V = V_U + T_C\,D$

$$V = \frac{EBIT\,(1-T_C)}{r_A} + T_C\,\frac{D}{V}V$$

- Define: $L \equiv D/V$
- Solve for $V$:

$$V = \frac{EBIT\,(1-T_C)}{r_A(1-T_C L)} = \frac{EBIT\,(1-T_C)}{WACC}$$

# MM formula: example

| Data | |
|---|---|
| Investment | 100 |
| Pre-tax CF | 22.50 |
| $r_A$ | 9% |
| $r_D$ | 5% |
| $T_C$ | 40% |

Base case NPV: -100 + 22.5(1-0.40)/.09 = 50

Financing:
Borrow 50% of PV of future cash flows after taxes
$D = 0.50\ V$

Using MM formula: $WACC = 9\%(1-0.40 \times 0.50) = 7.2\%$

NPV = -100 + 22.5(1-0.40)/.072 = 87.50

Same as APV introduced previously? To see this, first calculate *D*.
As: $V = V_U + T_C\, D = 150 + 0.40\ D$
and: $D = 0.50\ V$
$V = 150 + 0.40 \times 0.50 \times V \rightarrow V = 187.5 \rightarrow D = 93.75$
$\rightarrow APV = NPV_0 + T_C\, D = 50 + 0.40 \times 93.750 = 87.50$

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# Using standard WACC formula

Step 1: calculate $r_E$ using

$$r_E = r_A + (r_A - r_D)(1 - T_C)\frac{D}{E}$$

As $D/V$ = 0.50, $D/E$ = 1
$r_E$ = 9% + (9% - 5%)(1-0.40)(0.50/(1-0.50)) = 11.4%

Step 2: use standard WACC formula

$$WACC = r_E\frac{E}{V} + r_D(1 - T_C)\frac{D}{V}$$

*WACC* = 11.4% x 0.50 + 5% x (1– 0.40) x 0.50 = 7.2%

Same value as with MM formula

# Miles-Ezzel: WACC formula with target leverage ratio

- Assumptions:
  - Any set of cash flows
  - Debt ratio $L = D_t / V_t$ constant

- where $Vt$ = PV of remaining after-tax cash flow

- Demonstration see Miles-Ezzel (1980) => main point to understand, since debt is adjusted annually, tax shield will change, the value of the shield will be known only one year in advance, for the rest of the time the shield is risky and should be discounted at $r_a$

$$WACC = r_A - LT_C r_D \frac{1 + r_A}{1 + r_D}$$

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# Miles-Ezzel example

**Data**

| | |
|---|---|
| Investment | 300 |
| EBIT (1-Tc) | |
| Year 1 | 50 |
| Year 2 | 100 |
| Year 3 | 150 |
| Year 4 | 100 |
| Year 5 | 50 |
| $r_A$ | 10% |
| $r_D$ | 5% |
| $T_C$ | 40% |
| $L$ | 25% |

**Base case NPV** = -300 + 340.14 = +40.14

**Using Miles-Ezzel formula**

WACC = 10% - 0.25 x 0.40 x 5% x 1.10/1.05 = 9.48%

APV = -300 + 340.14+PV(Taxshield)

= 40.14+4.71 = 44.85

WACC FCF discount = 344.85-300 = 44.85

Initial debt: $D_0$ = 0.25 $V_0$ = (0.25)(344.55)=86.21

Debt rebalanced each year:

| Year | $V_t$ | $D_t$ | Tax Shield |
|---|---|---|---|
| 0 | 344.85 | 86.21 | 4.70 |
| 1 | 327.52 | 81.88 | 3.37 |
| 2 | 258.56 | 64.64 | 1.99 |
| 3 | 133.06 | 33.27 | 0.83 |
| 4 | 45.67 | 11.42 | 0.22 |

**Using MM formula:**

WACC = 10%(1-0.40 x 0.25) = 9%

APV = -300 + 349.21 = 49.21

Debt: $D$ = 0.25 $V$ = (0.25)(349.21) = 87.30

No rebalancing

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# Harris and Pringle (1985)

- Assumption:
  - any free cash flows
  - debt rebalanced continously $D_t = L\ V_{L,t}$
  - the risk of the tax shield is equal to the risk of the unlevered firm

- Demonstration see Harris and Pringle (1985). Idea very close to Miles-Ezzel, main difference here continuous rebalancing => uncertainty related to next year's tax shield => need to discount it at $r_a$

$$WACC = r_A - r_d T_C L$$

# Harris and Pringle: Example

- **Using Harris and Pringle's formula**
- WACC = 10% - 0.25 x 0.40 x 5% = 9.50%
- APV = -300 + 340.14+PV(Taxshield)
- = 40.14+4.49 = 44.63
- WACC FCF discount = 344.63-300 = 44.63
- Initial debt: $D_0 = 0.25\ V_0$ = (0.25)(344.63)=86.16
- Debt rebalanced each year:

| Year | $V_t$ | $D_t$ | Tax Shield |
|---|---|---|---|
| 0 | 344.63 | 86.16 | 4.49 |
| 1 | 327.37 | 81.84 | 3.21 |
| 2 | 258.47 | 64.62 | 1.90 |
| 3 | 133.02 | 33.26 | 0.79 |
| 4 | 45.66 | 11.42 | 0.21 |

# « In short »

| | Modigliani Miller | Miles Ezzel | Harris-Pringle |
|---|---|---|---|
| Operating CF | Perpetuity | Finite or Perpetual | Finite of Perpetual |
| Debt level | Certain | Uncertain | Uncertain |
| First tax shield | Certain | Certain | Uncertain |
| WACC<br>$L = D/V$ | $r_E(E/V) + r_D(1\text{-}T_C)(D/V)$ | | |
| | $r_A\,(1 - T_C\,L)$ | $r_A - LT_C r_D \dfrac{1+r_A}{1+r_D}$ | $r_A - r_D\,T_C\,L$ |
| Cost of equity | $r_A+(r_A-r_D)(1\text{-}T_C)(D/E)$ | $r_a + (r_a - r_d \times (1 + T_c \times (\frac{r_a - r_d}{1+r_d})) \times \frac{L}{1-L}$ | $r_A+(r_A-r_D)\ (D/E)$ |
| Beta equity | $\beta_A+(\beta_A - \beta_D)\ (1\text{-}T_C)\ (D/E)$ | $\beta_a \times (1+\frac{D}{E}) \times (\frac{1+r_d(1-T_c)}{1+r_d})$ | $\beta_A + (\beta_A - \beta_D)\ (D/E)$ |

Source: Taggart – Consistent Valuation and Cost of Capital Expressions With Corporate and Personal Taxes *Financial Management* Autumn 1991

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# Adjusting WACC for debt ratio or business risk

- Step 1: unlever the WACC

$$r = r_E \frac{E}{V} + r_D \frac{D}{V}$$

- Step 2: Estimate cost of debt at new debt ratio and calculate cost of equity

$$r_E = r + (r - r_D)\frac{D}{E}$$

- Step 3: Recalculate WACC at new financing weights

**Or**

- Step 1: Unlever beta of equity

$$\beta_{asset} = \beta_{equity} \frac{E}{V} + \beta_{debt} \frac{D}{V}$$

- Step 2: Relever beta of equity and calculate cost of equity

$$\beta_{equity} = \beta_{asset} + (\beta_{asset} - \beta_{debt})\frac{D}{E}$$

- Step 3: Recalculate WACC at new financing weights