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SolvayBrusselsSchool
of Economics and Management

Advanced Corporate Finance

Exercises Session 3

« Valuing levered companies, the WACC»

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This session

Corporate Valuation & Financing

1. Reaching end goal: Converting Cash Flows into corporate valuation:
   - What is the firm worth?

2. Financing:
   - how is the company financed
   - Discussion on capital strucuture and use of debt in particular

Start with recap of Modigliani Miller!

- MMI: "The market value of any firm is independent of its capital structure" (Assumptions perf. K market, no taxes, no transaction costs)
  - $Company\ Value\ Unlevered = Equity\ Value = Asset\ Value$

- MMII: "The weighted average cost of capital is independent of its capital structure" (Assumptions perf. K market, no taxes, no transaction costs)
  - $r_{WACC} = r_a$

➢ **Key & unrealistic assumption = no taxes**

➢ **Note: market value is independent = Assets = V = E + D**

⇨ **You only shift between E and D: V itself does not change**

This session

Q1: Modigliani Miller I : no taxes

- Starting without debt
- Introducing debt

Q2: introduction of taxes to Q1 (same input data)

Q3: use of marginal, not average tax rate

Q4: Leveraging and deleveraging beta + APV: M&A example

Q5: APV with changing debt level (rebalancing & target debt levels)

Q1 Modigliani Miller I: **No Taxes!**

Q1: To value: Freshwater Corp.

INPUT

- **No taxes** and perfectly efficient markets.
- Currently the company is **not levered all**.
- EBIT per year: 500.000 $ and should remain the same perpetually.
- The cost of equity of the company is worth **12% =Re**.

Q1.a: In this case what is the value of the company?

Q1.a $V_{unlevered}$

Q1: In this case what is the value of the company?

• The cost of equity of the company is worth 12% = Re= Ra (no leverage).

$$V_{unlevered} = \frac{EBIT}{r_a}$$

$V_{unlevered}$ = 500.000$ / 12%

= 4.166.667$

➢ **Only 1 step as no leverage**

$V_{levered} = V_{unlevered}$

➢ Reminder: EBIT = **E**arnings **B**efore **I**nterest and **T**axes

Q1.b $V_{levered}$: introducing debt & 2nd step

Q1: To value: Freshwater Corp.

- Plan to issue a perpetual debt for which you pay 30.000$, to buy back shares.
- Interest each year (the borrowing rate of the company is 3%)

Q1.b.1: What would then be the market value of the company?

⇨Note: D = not given, you need to calculate

Interests = 30.000

Rd = 3%

=> D = 1.000.000 Remember bond valuation!

P = Coupon / Discount rate

Vu = 4.166.667

=> E = 3.166.667 (E + D = Vu)

- **2nd step: leverage introduced**

Step1 = $V_{unlevered}$

Step2 = E = Vu - D

- Vu = E + D = Vu + D

Q1.b.2 the different r's after introducing debt

Q1: What are the value of r_a , the r_{WACC}, and re?

r_a = 12% Unchanged by definition

$$r_a = re * \frac{Equity}{V_{unlevered}} + rd * \frac{Debt}{V_{unlevered}}$$

- **Note: $r_e > r_a$ and $r_d < r_a$**

r_e = (Ra*Vu - Rd*D)/ E

= 14,84% = (0,12*4.166 -0,03*1.000)/3.166

Or if r_a stable, lower introduced r_d =>higher r_e

Or r_e = (EBIT – Int) / E = (500-30)/3.166

= Alternative calculation via P&L

- **1st calculation was via Ra**

r_{WACC} = 12% (because NO taxes)

Q2 Valuing levered Companies in a world with taxes

Q2: Bobland, not a perfect world: Corporate tax rates: 25% (Tc)

- Same capital structure and revenues as in Tongoland.

➢ **Q2 = Q1 +Taxes**

Q2.a.: What would then be the market value of the company?

Tax intro => $V_{unlevered} = (\frac{(EBIT * (1 - Tc)}{ra}$ $Tax\ Shield = TC * Debt$

➢**step 1 : calculate V unlevered**

EBIT (1-Tc) = 500*(1-25%) = 375.000

Vunlevered = 375.000 / 12% = 3.125.000

Q2.a step 2

➢ step 2 : calculate $V_{levered}$

$$V_{levered} = V_{unlevered} + Tax\ Shield$$

$$V_L = V_U + T_C D$$

$$PV(TaxShield) = \frac{T_C \times r_D D}{r_D} = T_C D$$

Interests = 30.000
r_d = 3%
D = Int/r_d = 1.000.000
Tax Shield = Tc*D = 250.000
V levered = Vu + Tax Shield = 3.375.000

Tax rate = Tc = 25%

Vu = 3.125.000 see Step 1

➢ Note:

1. **value increase through leverage, via the tax shield (here 8%)**
2. **BUT V levered does not equal E (Equity) => <u>you need step 3</u>**
3. **In Q1 Step = Step 2, because no value creation through tax shield (Tc=0)**

Q2.b step 3 (=Equity) & r's: r_{wacc}

Q2: And of ra, the wacc, and re?

$\mathbf{r_a}$ = 12% Unchanged by definition

$\mathbf{r_{WACC}}$ = EBIT * (1-Tc) / VL = **11,11%** via P&L = 500.000 (1-25%) / 3 375 000 = 375k / 3 375 k

Alternative calculation via Ra:

L = D/VL = 1 000 000 / 3 375 000 = 0,3

Wacc = Ra * (1 – Tc*L) = 12% (1 – 0,25 * 0,30) = 11,11%

- **Note: $r_{wacc} < r_a$**

  = cost of capital lowered through tax shield

- Luckily you were not asked to calculate via NOPLAT

  = **N**et **O**perating **P**rofit **L**ess **A**djusted **T**axes

  NOPLAT = Net Income + Interest + Tax Shield

$$V_L = NOPLAT / WACC$$

Q2.b step 3 (ctd): Equity & Re

Q2: And of ra, the wacc, and re?

Step 3: E = VL – D = 2.375.000 See Step 2

Net Earnings = (EBIT-I) * (1-Tc) = (500.000 -30.000) * (1-25%)

Re = Net Earnings / E = **14,84%**

Alternative calculation via Ra:

Re = Ra + (Ra – Rd) * (1-Tc)* D/E

= 0,12 + (0,12 - 0,03) * (1 - 0,25) * 1 000 000 / 2 375 000

Q3 Marginal versus Average Tax RateValuing

Q3 data: The subsidiary has an EBIT of 250.000$.

The tax structure in Sloland:

- the first 100.000$ are tax exempt
- the following 100.000$ taxed at 20%
- any amount above that is taxed at 30%.

SITUATION:

YOU: want to Issue a perpetual debt 75000$ to benefit from the tax shield.

CFO : Skeptical

1. Based up current average tax rate.
   - ➢ Cost of debt (= risk free rate: 4%), he values the tax shield at 10.500$
2. Hardly interesting in view of the costs associated with a debt issue.

QUESTIONS:

A. Is he right?

B. What would have been the tax shield if the debt had been reimbursed after two years?

Q3.a Is he right?

Approach: Compare PV calculations of Tax Shields= average tax vs. marginal tax

Debt = 75.000 $ @ cost of debt = 4% (=RFR)

Tax Shield 1: CFO = average (=constant tax rate)

Tax shield assuming perpetuity with constant tax rate

$$PV\ Tax\ Shield = D * rd * \frac{Tc}{r_d}$$ = D * Tax rate = Discounted tax on interest paid

Debt = 75.000 $ & **Tax rate =** Tax / EBIT

Step 1: current tax paid = 100.000 x 0% + 100.000 x 20% + 50.000 x 30% = 35.000 $

Step 2: tax rate = Tc = 35.000 / 250.000 = 14,00%

Step 3: PV Tax Shield CFO = D * Tc = 75.000 * 14% = **10.500$**

Step 4: in relative terms of bond, saving is Tc = 14%, is much higher than normal issuing costs associated, but in absolute terms costs maybe high (imagine lawyers!)

Q3.a Is he right?

<u>Tax Shield 1: YOU</u> (=marginal tax rate)

Approach: you will calculate actual tax saving based upon marginal tax scheme

Debt = 75.000 $ & Reminder of the tax structure in Sloland:

- the first 100.000$ are tax exempt
- the following 100.000$ taxed at 20%
- any amount above that is taxed at 30%.

Step 1: current tax paid = 100.000 x 0% + 100.000 x 20% + 50.000 x 30% = 35.000 $

Step 2: introduce debt and interest payment = D * Rd = 75.000 * 4% = 3.000$

Step 3: calculate Profit before tax (PBT) = EBIT – Interest = 250.000 – 3.000 = 247.000

Step 4: calculate tax to pay= PBT * Tax scheme = 100.000 x 0% + 100.000 x 20% + 47.000 x 30% = 34.100

Step 5: annual tax saving = current tax – expected tax = 35.000 -34.100 = 900$ per year, perpetual

Step 6: **PV Tax Shield You = PV of Tax Savings** = 900 / 4% = **22.500$** <u>using Rd as discount rate*</u>

- **Conlusion: your CFO is wrong!**

* Tax shield= certain so discount @ Rd

Q3.b What if perpetual is reimbursed in 2 years?

tax savings year 1 and 2 = 900 + 900 = 1.800 $

PV Tax Shield You = PV of Tax Savings = 900 /(1,04) + 900 /$(1,04)^2$

= 1697,49 $

Q4 Leveraging and deleveraging beta

SITUATION: GE wants to buy Wellstream (WSM), a higher beta bizz active in oil industry

Q4 data:

- Data for WSM
  - Cash flow next year = 50 million $
  - Growth rate = g = 1,5%
  - Debt = 50 million $ (=now)
- M&A data
  - Target D/E = 0,4 = L
  - Marginal tax rate = 20%
- Market Data
  - RFR = Rd = 2%
  - Exp Return market port= Rm = 7%

- Industry data

Comparison		β_e	D/E	Tax rate
GE		1,16	61%	15%
WSM		1,30	15%	25%
Technip		1,35	0%	33%
Prysmian		1,32	15%	30%

Q4 Leveraging and deleveraging beta

$$r = r_f + \beta * r_p$$

$$\beta_e = \beta_a * (1 + \frac{D}{E} * (1 - T_c))$$

➢ **Step 1:**

calculate Ba via 1-Tax rate

Comparison	Be	D/E*	Tax rate	= 1-T	= (1-T) x D/E	= Ba
GE	1,16	0,61	15%	85%	0,52	0,77
WSM	1,30	0,15	25%	75%	0,11	1,17
Technip	1,35	0,00	33%	67%	0,00	1,35
Prysmian	1,32	0,15	30%	70%	0,11	1,19

$$r_{WACC} = r_{Equity} * \frac{E}{V_{levered}} + r_{Debt} * (1 - T_c) * D/V_{levered}$$

a) What is operating beta?

Ba=**1,18** = an adjusted mean = (1,17+1,19) / 2 = not exact science

➢ Use common science!

* @ Market Values, not Book Values

Q4 a) b) c) Leveraging and deleveraging beta

b) What is the WACC?

Be = 1,56 = 1,18 * (1+ 0.4 * (1 – 20%)) = 1,18 * 1,32

RFR = 2% Rm = 7% => Market Risk premium = Rp = 7% - 2% = 5%

r_e=2% + 1,56 *5% = 9,79%

r_{wacc}=7,45% => *see table*

	Ri	Wi * Ri	Tgt wght%	Tgt wght
Re	9,79%	6,99%	71%	1,00
Rd	1,60%	0,46%	29%	0,40
	Rwacc	**7,45%**	100%	1,40

c) What is the value of the acquisition?

INPUTS: Debt = 50 million $ & Next Cash Flow = 50 million $

V_1 = CF1 / (R wacc – g) = 50 Mln $ / (7,45%- 1,50%) = 840,5 Mln $

=> **E** = V_1 -D = **790,5 mln $**

- Real world check: WSM market cap 515 Mln $, GE paid 830$: well done!

Q4 d) Leveraging and deleveraging beta

d) Determine the value of Wellstream with GE's WACC?

Step 1: GE's WACC

Be = 1,16 => see table

r_e = 2% + 1,16 *5% = 7,8%

r_{wacc}= 5,45% => *see table*

			Ri	Wi * Ri	Tgt wght%	Tgt wght
Cost of equity	=0,02 + 1,16* 0,05		7,80%	4,84%	62%	1,00
After tax cost of debt	=0,02 * (1 - 0,20)		1,60%	0,61%	38%	0,61
GE WACC				**5,45%**		1,61

Step 2: Value using GE's WACC => similar as in Q4 c)

INPUTS: Debt = 50 million $ & Next Cash Flow = 50 million $

V_l = CF1 / (R wacc – g) = 50 Mln $ / (5,45%- 1,5%) = **1 266 Mln $ and E = 1216**

- Real world check: GE paid 830$, a bit too much, but assuming people would forget this small decision quickly in the bigger picture of GE its was a great decision

Q4 e) Adjusted Present Value (APV)

e) Apply the APV method to value Welstream's acquisition

Reminder:

The APV Approach: adjust the NPV

1. Compute a base case NPV,
2. add to it the NPV of the financing decision ensuing from project acceptance

=> APV = Base-case NPV + NPV(FinancingDecision)

whereas Adjusted Cost of Capital Approach = adjust discount rate, not NPV

- **APV hardly used in real world**

Q4 e) Adjusted Present Value (APV)

Step 1 : calculate base case NPV (=unlevered = all equity)

Note: Cost of capital is different from Q4 d, where we were using GE's own wacc for fun

Step 1.A.: calculate cost of capital

Ba = 1,18 => see Q4.a)

Cost of capital = 0,02 + 1,18* 0,05 = 7,90%

$$r = r_f + \beta * r_p$$

Step 1.B.: calculate base NPV = V unlevered

$V_{unlevered}$ = CF1 / (R – g) = 50 Mln $ / (7,9%- 1,5%) = 781,25 Mln $

Q4 e) Adjusted Present Value (APV): Step 2

Step 2 : adjust for the NPV of the financing decisions

Step 2.A.: NPV of financing decision

what is target debt? = Target debt weight (Q4.b) * value of Acquisition (Q4.c)

= 29% * 841 Mln = 240,2 Mln $

=> calculating target debt is tricky here (iterative calculation, so I used Q4.b and c), it could also be given

PV of Tax Shield from financing = (Marginal) Tax Rate * D = 20% * 240,2 = 48,03 Mln$

Step 2.B.: calculate APV: add NPV of financing to base NPV

NPV = base NPV + NPV financing = 781,25 Mln $ + 48,03 Mln $ = 829 mln $

Q5 : APV & rebalancing

SITUATION: Analyze a 5 year project

Q5 data:

- Project
  - Capex = 10 Mln EURO
  - Extra FCF: 750 k EURO
  - Growth rate = 4% pa
- Parameters
  - Tax rate (marginal) = 35%
  - Target D/E* = 0,4 = 40% AND no reblalncing: debt is stable
- R's
  - Re = 11,3%
  - Rd = Rfr = 5%

* L = D/V not D/E => D/V=0,5 ~ D/E = 1

Q5 : APV

QUESTIONS:

a) **NPV ?**
   - What is the NPV of the new product line (including any tax shields from leverage)?

b) How much **Debt?**
   - How much debt will Markum initially take on as a result of launching this product line?

c) **PV (Tax Shield)** ?
   - How much of the product line's value is attributable to the present value of interest tax shields?

Q5 a) and b) : APV

a) NPV

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

Step1: WACC = (1 / 1.4) * (11.3%) + (0.4 / 1.4) *(5%)(1 – 0.35) = 9%

Step 2: V_L = 0.75 / (9%- 4%) = $15 million

Step3: NPV = -10 + 15 = $5 million

b) How much **Debt?**

- Step 1: You need to calculate D/V from D/E:

  Debt-to-Value ratio is (0.4) / (1.4) = 28.57% = (D/E) / [1 + (D/E)]

- Step 2: Therefore Debt is 28.57% × $15 million = $4.29 million

Q5 c) APV: PV (Tax Shield)

c) PV (Tax Shield) ?

DON'T'USE => $PV\,(TaxShield\ ) = \dfrac{T_C \times r_D D}{r_D} = T_C D$

Approach

- You can not use direct calculation because target debt ratio, so debt is not stable:
- You need to calculate indirectly via base NPV and APV
- Discounting at Ra gives unlevered value:

Step 1: You don't have Ra, so calculate:

- **Ra** = (1 / 1.4) * 11.3% + (.4 / 1.4) * 5% = **9.5%**

Step 2: calculate base NPV Vu

- **Vu** = 0.75 / (9.5% − 4%) **= $13.64 million**

- excludes tax shield: because you want Ra, and PV(Tax Shield separately)

Step 3: calculate PV (Tax Shield) = APV – Base NPV

- Tax shield value is therefore 15 – 13.64 = $**1.36 million**

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

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Reminder: comparison

	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	$r_E(E/V) + r_D(1\text{-}T_C)(D/V)$		
$L = D/V$	$r_A\,(1 - T_C\,L)$	$r_A - LT_C r_D \dfrac{1+r_A}{1+r_D}$	$r_A - r_D\,T_C\,L$
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

Concluding remarks

Corporate Valuation field check

- DCF used but still overwhelmed by multiples
- DCF better reveals dynamics between valuation and financing
- APV hardly used, M-E Wacc and H-P Wacc either, even if some use of variable wacc per year. But variable wacc is very useful tool as it reveals contradictions in modelling

Use of leverage

- Less than you would expect (20-40%)
  - Extraordinary: despite ultra low rates, corporates in developed markets have not taken real advantage of this, except for refinancing.
  - But it seems Emerging Markets have increased leverage
- Still it can work: see private equity or some M&A of last years