Advanced Corporate Finance
Exercises Session 6
« Review Exam 2012» / Q&A

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This session

Review Exam 2012

1. **Company Valuation**
2. **Bond Valuation: Risky bond**

Extra Question

3. **Bond Valuation: Callable bond**

Q&A

Q1: Company and Project valuation

- Story

  - You
    - You graduated from SBS, hired by the famous Belgian Big Bank.
    - Your job = valuation IPO's

  - The first company you need to analyze is the Huge Bakery of Special Cakes (HSBC).

Q1: Company and Project valuation

- DATA

  - Company HSBC
    - EBIT is perpetuity = 2.500.000€
    - marginal tax rate = 30%.
    - perpetual debt valued at 6.000.000€ @ yearly coupon of 3%.

  - Market data
    - RFR = 3%
    - Similar unlevered Re = 8%

EBIT	€ 2 500 000
Debt	€ 6 000 000
Tc	30%
r_a	8,00%
r_f	3,00%
r_d	3,00%

Q1: Company and Project valuation

- Questions

  a) What is value of the **unlevered** company?

  b) What is then the value of the **levered** company and of its equity?

  c) What are the **expected return on equity** and the **wacc** worth?

  d) What would the company be worth if it had a clear policy regarding leverage and wished to **rebalance the debt continuously** so as to reach the target leverage of 25%? What is then the value of the wacc ?

  e) How can you **explain the difference in value** for the company between b and d? Give the intuition.

Q1.a &b: Company valuation: Theory

- **step 1 : calculate $V_{unlevered}$**

Tax intro => $$V_{unlevered} = EBIT * \frac{1 - Tc}{R_a}$$

- **step 2 : calculate $V_{levered}$** $V_{levered} = V_U + Tax\ Shield$

$$V_L = V_U + T_C\ D$$

$$PV(TaxShield) = \frac{T_C \times r_D D}{r_D} = T_C\ D \Rightarrow Tax\ Shield = T_C * Debt$$

- **step 3 : calculate E**

$V_L = E + D \Rightarrow E = V_L - D$

Q1.a &b: Company valuation

- **step 1 : calculate $V_{unlevered}$**

$$V_{unlevered} = EBIT \times \frac{1 - Tc}{R_a} = 2\,500\,000\,€ \times \frac{1 - 0{,}30}{8\%} = \frac{1\,750\,000\,€}{8\%} = 21\,875\,000\,€$$

- **step 2 : calculate $V_{levered}$**

$$Tax\ Shield = T_C * Debt = 30\% \times 6\,000\,000\,€ = 1\,800\,000\,€$$

$$V_{levered} = V_U + Tax\ Shield = 21\,875\,000\,€ + 1\,800\,000\,€ = 23\,675\,000\,€$$

- **step 3 : calculate E**

$$V_L = E + D \Rightarrow E = V_L - D = 23\,675\,000\,€ - 6\,000\,000\,€ = 17\,675\,000\,€ = E$$

Q1.c **expected return on equity** and the **wacc**

=>	VL	23 675 000		
	Debt	6 000 000	D/V =	25,3%
	E	17 675 000	E/V =	74,7%
			D/E=	33,9%

c.1 $r_e = r_a + [(r_a - r_f)*(1-Tc)*(D/E)]$

r_a = 8,00% r_f = 3,00%

=> $(r_a - r_f) = r_p$ = 5,00%

Tc = 30% => 1 - Tc = 70%

r_e = 8% + (5% * 70% * 33,9%)

r_e = 9,19%

c.2 wacc = [(r_d*Debt*(1-Tc) + (r_e*E)] / VL

OR wacc = (r_d*(1-Tc)*(D/V) + (r_e*E) *(E/V)

r_d = 3,00%

wacc = [(3%*6000*70%) + (9,19%*17675)] / 23675

= (3%*70%*25,3%) + (9,19%*74,7%)

wacc = **7,39%**

Q1.d continuously rebalanced debt: theory

	Modigliani Miller	Harris-Pringle
Debt level (Absolute)	*Certain*	*Uncertain*
First tax shield	*Certain*	*Uncertain*
WACC	$r_a (1 - T_C L)$	$r_a - r_d T_C L$

Main point to understand, since debt is adjusted annually, tax shield will change, the value of the shield willbe unknown and thus risky and should be discounted at r_a

- The risk of the tax shield is equal to the risk of the unlevered firm
- The value of the tax shield will decrease and the WACC will get closer to to r_a (WACC of the unlevered firm)

Q1.d continuously rebalanced debt

➢ **step 1 : calculate new WACC**

Wacc = ra-rd*Tc*Target L

Target L = 25% Tc = 30%

r_a = 8,00%

r_d = 3,00%

Wacc = 7,78% = 8% - 3% *30%* 25%

➢ **step 2: calculate new V levered**

$$V_{levered,\,rebalanced} = EBIT \times \frac{1 - Tc}{WACC} = 2\,500\,000\,€ \times \frac{1 - 0{,}30}{7{,}78\%} = \frac{1\,750\,000\,€}{7{,}78\%} = 22\,508\,039\,€$$

Q1.e continuously rebalanced debt

➢ **new $V_{levered}$**

$$V_{levered,\,rebalanced} = EBIT \times \frac{1 - Tc}{WACC} = 2\,500\,000\,€ \times \frac{1 - 0{,}30}{7{,}78\%} = \frac{1\,750\,000\,€}{7{,}78\%} = 22\,508\,039\,€$$

➢ **step 3: compared with**

$$V_{levered} = EBIT \times \frac{1 - Tc}{WACC} = 2\,500\,000\,€ \times \frac{1 - 0{,}30}{7{,}39\%} = \frac{1\,750\,000\,€}{7{,}39\%} = 23\,675\,000\,€$$

$$V_{unlevered} = EBIT \times \frac{1 - Tc}{R_a} = 2\,500\,000\,€ \times \frac{1 - 0{,}30}{8\%} = \frac{1\,750\,000\,€}{8\%} = 21\,875\,000\,€$$

➢ ANSWER:

- Levering up adds value through tax shield (= 1 800 000€)
- Rebalancing through target debt level introduces uncertainty to tax shield and thus reduces value again, but value remains above unlevered value. Details on next slide

Q1.e continuously rebalanced debt: EXTRA

➢ **step 2: new $V_{levered}$**

➢ ANSWER:

- The Tax Shield drops by 65% from 1 800 000€ to 633 039€
- Is this through the change in debt level itself or the introduced risk on the tax shield, that implies a higher discount rate)?

- Keep target level equal to current L, and thus keeping risk on Tax Shield same only reduces Tax Shield by 8 945 €, barely 1%
- Thus the main source of the lower Tax Shield comes from the higher discount rate used r_a (8%) instead of r_d (3%)

$V_{L,\ rebalanced}$	22 508 039	
PV Tax shield	$= V_L - V_U$	
	= 22 508 039 - 21 875 000	
Rebalanced Tax Shield	633 039	
MM Tax Shield	1 800 000 = 6.000.000 * 30%	
Rebalanced Tax Shield - MM Tax Shield	-1 166 961 =	-65%
L initial (=current)	25,3%	
given Target L	25,0%	
if target L equal current L		
=>Wacc =	7,77%	
$V_{L,\ rebalanced}$	22 516 984	
through different L	-8 945	-0,8%
through risk on Tax Shield	-1 158 016	-99,2%
Total change in Tax Shield	-1 166 961	

Q2: Bond valuation

- Story
  - you have been asked to work on risky debt valuation.
  - Apply Merton Model
- DATA
  - ❑ Company
    - market value of 1.000.000€
    - highly volatile sector, with yearly volatility equal to 50%!
    - ➢ Implicit assumption: no dividends
  - ❑ Callable Bond features
    - Coupon = 0 (ok = Merton Model)
    - T = 2 years
    - Amount = 500.000€
  - ❑ Market
    - risk-free rate (annual equivalent rate) = 5%.

=>

Value =	€ 1 000 000
volatility =	50%
Face value =	€ 500 000
r_f =	5,00%
T =	2,0
C =	0,00

Q2: Value of the bond: steps

- Step 1: Risk neutral probability
  - ➢ Unless if interest tree needed: p = 0,5 = 1-p
  1. Calculate U based on sigma
  2. Calculate D
  3. Calculate Risk Neutral Probability
- Step 2: Draw binomial trees
  1. Tree of company value or interest rates: left to right ↗
  2. Tree of debt (and if applicable): right to left ↙
     a) Callable debt right to left
     b) Option-free bond value right to left
- Step 3: Analyse results
  - ❖ Option Value = Option-free bond value – Optional bond value
  - ❖ Calculate yield and risk premium

Q2.b. Step 1: what is risk neutral probability?

- Risk neutral probability:
  - ❖ "Probability that the stock rises in a risk neutral world" and
  - ❖ "where the expected return is equal to the risk free rate.

=> In a risk neutral world : $p \times uS + (1-p) \times dS = (1+r\Delta t) \times S$ => $Prob_{RN} = \frac{(1+rf-d)}{u-d}$

volatility = 50%

r_f = 5,00% =>

T = 2,0

$u = e^{\sigma\sqrt{\Delta t}}$

u = 1,649 = EXP (50%)

d = 0,607 = 1 / u

- Solving: with u = 2,028 and d = 0,493

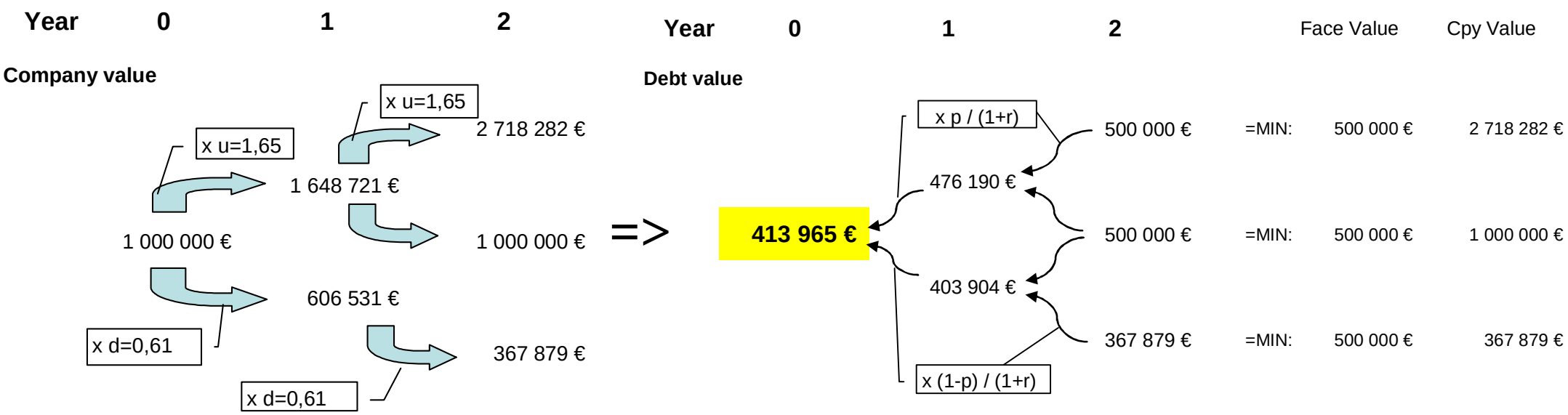
$$\text{Prob}_{RN} = p = \frac{1+ rf -d}{u - d} = \frac{(1+0{,}05 -0.607)}{1{,}649-0{,}607} = \frac{0{,}443}{1{,}042} = \mathbf{0{,}426}$$ => 1-p = 0,574

Q2.b. Step2: Binomial tree of the bond

- drawing binomial trees

Tree 1: possible company values => **Tree 2: possible debt values**

- Every T: you weigh next period by probability and you discount



Q2.c: yield & risk premium and rating

(c) What is the risk premium of the company?

$$\text{Price} = \frac{\text{Face Value}}{(1+\text{yield})^{\text{maturity}}} = 413\,965\,€ = \frac{500\,000\,€}{(1+y)^{2}}$$

- Step 1: yield y = 9,90%
- Step 2: **risk premium** : yield – risk free rate = 9,90% - 5% = 4,90% = **490 bps**

	Moody's	Standard & Poor's	
Highest Quality	Aaa	AAA	Investment Grade
High Quality	Aa	AA	
Upper Medium	A-1, A	A	
Medium	Baa-1, Baa	BBB	
Speculative	Ba	BB	Not Investment Grade
Highly Speculative	B, Caa	B, CCC, CC	
Default	Ca, C	D	

Source: Watson Wyatt Europe

- Rating will be **"Highly Speculative"**

Q3: EXTRA QUESTION: Callable bond

- DATA
  - ❑ Callable Bond features
    - Coupon = 0,00%
    - T = 3 years
    - Amount => Face value = 107 €
    - Callable in year 1&2 @ 100 €
  - ❑ Market
    - 1 Yr rate = 5,5% and its variance = 4%
      - ➢ Binomial Node 1 in T1: try 4,85%
        ⇒ lower so bottom node
      - ➢ Binomial Node 2 in T1: try 4,00%

=>

Data					
	σ^2 =	**4,00%**		= variance	
current 1Y rate =		5,50%	=> Try	4,85%	4,00%
	K =	100			
	T =	3			
	F @ T3=	107			
	C=	0,00			

- STORY
  - ❑ Need cash
  - ❑ Equity needed, but can't / won't => issue bond, but think IR will fall => issue callable bond

Q3: Callable bond

- Questions

➢ Based upon Binomial tree

(a) Construct interest rate tree

- No need to check tree with on the run
- Just build tree with 2 nodes given

(b) What would be the **value of an option-free bond** taking into account your interest rate binomial tree?

(c) What is the value of the **callable bond**?

(d) What is the value of the **embedded call option**?

Q3.a: Construction of Binomial interest tree

Data							
	$\sigma^2 =$	4,00%		= variance			
	$\sigma =$	20,0%	= 4% ^ 0,5	= volatility	= the square root of the Variance		
current 1Y rate =		5,50%	=> Try	4,85%	4,00%		
				-0,65%	-0,85%	vs. previous year	

a) Interest rate tree

Year	0	1	2	3
			8,90%	
			$r_{2,HH} = r_{2,LL} \times e^{4\sigma} = 4{,}00\% \times e^{4\sigma}$	
		7,24%		
		$r_{1,H} = r_{1,L} \times e^{2\sigma} = 4{,}85\% \times e^{2\sigma}$		
	5,50%		5,97%	
			$r_{2,HL} = r_{2,LL} \times e^{2\sigma} = 4{,}00\% \times e^{2\sigma}$	
		4,85%		
		$r_{1,L}$		
			4,00%	
			$r_{2,LL}$	

- For IR tree you need volatility, not the variance, that was given!

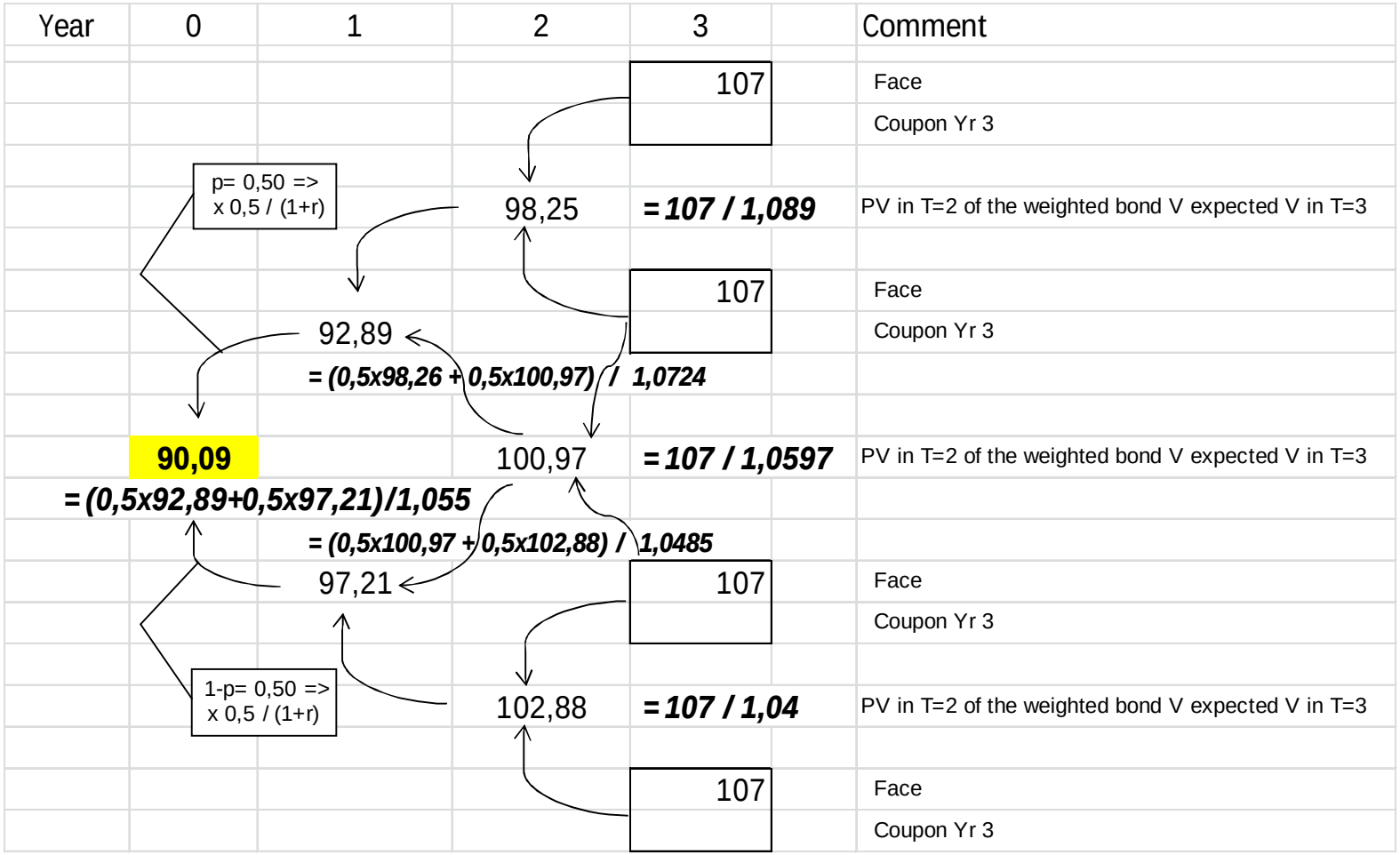
- THEORY:

- If σ = assumed volatility of the one-year forward rate
- Then $r_{1,H} = r_{1,L}(e^{2\sigma})$

⇨ The one-year forward rate is assumed to follow a lognormal random walk,

Q3.b: Binomial tree of Option-free Bond (straight bond)

- Risk neutral probability is assumed p= 0.50, so no need to calculate



Q3.c: Binomial tree of Callable bond & d. Option Value

c) Callable bond value — K = 100

Year	0	1	2	3	Comment
				107	Face
					Coupon Yr 3
				= 107 / 1,089	PV in T=2 of the weighted bond V expected V in T=3
			98,25	***--> don't call***	=Min (Call price,Bond value)
				= 98,25 < 100	=Min (100; 98,25)
				107	Face
		92,44			Coupon Yr 3
		= (0,5x98,26 + 0,5x100) / 1,0724			
				= 107 / 1,0597	PV in T=2 of the weighted bond V expected V in T=3
	89,01		*100,00*	***--> call***	=Min (Call price,Bond value)
	= (0,5x92,44+0,5x95,37)/1,055			***= 100,97 > 100***	=Min (100; 100,97)
		= (0,5x100 + 0,5x100) / 1,0485			
		95,37		107	Face
					Coupon Yr 3
				= 107 / 1,04	PV in T=2 of the weighted bond V expected V in T=3
			100,00	***--> call***	=Min (Call price,Bond value)
				= 102,88 > 100	=Min (100; 102,88)
				107	
				0	

p= 0,50 => x 0,5 / (1+r)

1-p= 0,50 => x 0,5 / (1+r)

d)	Call option	**1,08**	= Option-free bond value - Callable bond value	= 90,09 - 89,01