AG312 Summary:

Advanced Corporate Finance & Financial Markets

Lewis Britton {201724452}

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AG313 Course Summary

Real Options

1: Abandonment Options

Initial NPV

$$\boldsymbol{NPV_I = -CF_0 + \sum \frac{p_s CF_{s_t} + p_f CF_{f_t}}{(1+r)^t}}$$

Where:
p_s = Probability of a Successful Project
p_f = Probability of a Failed Project

Individual NPVs

$$\boldsymbol{NPV_s = -CF_0 + \sum \frac{CF_{s_t}}{(1+r)^t};\ NPV_f = -CF_0 + \sum \frac{CF_{f_t}}{(1+r)^t} + \cdots + \frac{CF_{f_t} + V_{svg}}{(1+r)^N}}$$

Where:
V_{svg} = Salvage Value

NPV of Abandonment Option

$$\boldsymbol{NPV_{AO} = p_s NPV_s + p_f NPV_f}$$

Value of Abandonment Option

$$\boldsymbol{V_{AO} = NPV_{AO} - NPV_I}$$

2: Call Options – Black & Scholes Model

Normal Probability Distribution Function 1

$$d_1 = \frac{\ln \frac{S_t}{K} + t\left(r + \frac{\sigma^2}{2}\right)}{\sigma\sqrt{t}}$$

Normal Probability Distribution Function 2

$$d_2 = d_1 - \sigma\sqrt{t}$$

Call Option Price

$$C = S_t N(d_1) - Ke^{-rt} N(d_2)$$

Where:

C = Call Option Price
S = Current Asset Price (Equity)
K = Strike Price (Debt)
r = Risk Free Interest Rate
t = Time to Maturity
N = Relative Normal Distribution
e = A Constant

Value of Outstanding Debt

$$V_D = S - C$$

Interest Rate on Outstanding Debt

$$r_D = \left(\frac{K}{V_D}\right)^{\frac{1}{t}} - 1$$

International Capital Budgeting

1: International Capital Budget

Fisher Hypothesis: Real Interest Rate

$$(1 + r)(1 + \pi) = (1 + i)$$

$$\boldsymbol{r = \frac{(1 + i)}{(1 + \pi)} - 1}$$

Where:
$r =$ Real Domestic Interest Rate
$i =$ Nominal Domestic Interest Rate
$\pi =$ Domestic Inflation Rate

Foreign Currency Nominal Interest Rate

$$\frac{(1 + i)}{(1 + \pi)} = \frac{(1 + i^*)}{(1 + \pi^*)}$$

$$\boldsymbol{i^* = \frac{(1 + i)(1 + \pi^*)}{(1 + \pi)} - 1}$$

Where:
$r^* =$ Real Foreign Interest Rate
$i^* =$ Nominal Foreign Interest Rate
$\pi^* =$ Foreign Inflation Rate
Real Rates Are Equal $\{r = r^*\}$

NPV in Foreign Terms

$$\boldsymbol{NPV^* = -CF_0^* + \sum \frac{CF_t^*}{(1 + i^*)^t}}$$

NPV Conversion to Domestic Currency

$$\boldsymbol{NPV = E^*(NPV^*)}$$

Where:
$E =$ Relative Exchange Rate

Uncovered Interest Parity

$$(1+i) = (1+i^*)\frac{E}{E^e}$$

$$\boldsymbol{E^e = \frac{E}{\frac{(1+i)}{(1+i^*)}}}$$

$$\boldsymbol{E^{e^*} = \frac{E^{-1}}{\frac{(1+i^*)}{(1+i)}}}$$

Where:

E^e = Expected Relative Exchange Rate

$E^{-1} = E^*$ = Foreign Exchange Rate

2: Domestic Capital Budget – Additional Reminder

$$\boldsymbol{NPV = -CF_0 + \sum \frac{CF_t}{(1+K)^t} + \frac{TV_N}{(1+K)^N}}$$

Where:

TV_N = Terminal Value After Tax of Net Working Capital

K = Weited Average Cost of Capital

And:

$NPV > 0$: Accept Project

$NPV \leq 0$: Reject Project

3: Adjusted Present Value Model (APV) – Not Historically Examined

$$\boldsymbol{APV = -CF_0 + \sum \left(\frac{CF_t(1-\tau)}{(1+K)^t} + \frac{\tau D_t}{(1+i)^t} + \frac{\tau I_t}{(1+i)^t} \right) + \frac{TV_N}{(1+K)^N}}$$

Where:

K = Weighted Average Cost of Capital

i = Interest Rate on Finance Method

τ = Tax Rate

τI_t = Tax on Interest

$i(\tau I_t)$ = Tax Shield on Interest

Seeking:

Financing of the project: Leveraged vs. Unleveraged

Each CF is considered individually (each discounted at relative rate)

Formulae Summary

Real Options: Abandonment Options

1) $\mathbf{NPV_I} = -\mathrm{CF}_0 + \sum \frac{p_s \mathrm{CF}_{s_t} + p_f \mathrm{CF}_{f_t}}{(1+r)^t}$
2) $\mathbf{NPV_s} = -\mathrm{CF}_0 + \sum \frac{\mathrm{CF}_{s_t}}{(1+r)^t}$; $\mathbf{NPV_f} = -\mathrm{CF}_0 + \sum \frac{\mathrm{CF}_{f_t}}{(1+r)^t} + \cdots + \frac{\mathrm{CF}_{f_t} + V_{svg}}{(1+r)^N}$
3) $\mathbf{NPV_{AO}} = p_s \mathrm{NPV}_s + p_f \mathrm{NPV}_f$
4) $\mathbf{V_{AO}} = \mathrm{NPV}_{AO} - \mathrm{NPV}_I$
5) $\mathbf{p_{BO}} = s_{BO} - c_{BO}$; $\mathbf{p_O} = p_{BO} + (s_O - c_O)$

Real Options: Black & Scholes

1) $\mathbf{d_1} = \frac{\ln\left(\frac{S}{K}\right) + t\left(r + \frac{\sigma^2}{2}\right)}{\sigma\sqrt{t}}$; $\mathbf{d_1} = \frac{\ln\left(\frac{S}{K}\right) + t\left((r-y) + \frac{\sigma^2}{2}\right)}{\sigma\sqrt{t}}$; $\mathbf{d_2} = d_1 - \sigma\sqrt{t}$
2) $\mathbf{C} = SN(d_1) - Ke^{-rt}N(d_2)$
3) $\mathbf{C} = Se^{-yt}N(d_1) - Ke^{-rt}N(d_2)$; $\mathbf{S} = \frac{\dots}{(1+y)^{t_1}}$
4) $\mathbf{P} = Ke^{-rt}(1 - N(d_1) - S(1 - N(d_2))$
5) $\mathbf{V_D} = S - C$; $\mathbf{r_D} = \left(\frac{K}{V_D}\right)^{\frac{1}{t}} - 1$

International Capital Budgeting

1) $\mathbf{r} = \frac{(1+i)}{(1+\pi)} - 1$
2) $\boldsymbol{i}^* = \frac{(1+i)(1+\pi^*)}{(1+\pi)} - 1$
3) $\mathbf{NPV}^* = -\mathrm{CF}_0^* + \sum \frac{\mathrm{CF}_t^*}{(1+i^*)^t}$; $\mathbf{NPV} = E^*(\mathrm{NPV}^*)$
4) $\mathbf{E^e} = \frac{E}{\frac{(1+i)}{(1+i^*)}}$; $\mathbf{E^{e^*}} = \frac{E^{-1}}{\frac{(1+i^*)}{(1+i)}}$

Essays & Short Questions

Question 4

1) Statement Comparison
2) Embedded Option Types

1: Statement Comparison

- Statement 1 **incorrect**
- (1) Real option values are always positive
- (2) If the project is profitable, an option will add value rather than creating separate
- Statement 2 **correct**
- (1) If remaining CFs are greater keep going, if they're smaller abandon

2: Embedded Options

- **Timing Option**, Flexibility Option, Fundamental Option
- Delay investment in hope of better opportunity
- Better information could mean better NPV

Question 5

1) Convertible Bonds – Multiple Embedded Options
2) Motivations for Convertible Bonds & Breakeven
3) Valuing Firms with High Numbers of Patents

1: Convertible Bonds

- Conversion option to exchange bond for shares
- Recall: call: agreeing to buy at date and price; put: agreeing to sell at date and price
- (1) **Call**: option to **convert** to common stock at date and price
  - Bought at premium to market share price – relative to value of call option
  - Break Even: time taken to recover premium
  - Coupons: higher/certain; Dividends: lower/uncertain
  - Converting to stock changes coupons to dividends
- (2) **Call**: option to **retire/redeem** bond
  - Redeem at the call price (rather than convert)
  - The issuer would rather you **convert** or **redeem**

- Tricky to value: (1) calling stock requires future stock price estimations, (2) calling the bond requires future interest rate estimations therefor a model of both is required

2: Motivations for Convertible Bonds & Breakeven

- Claiming premium over market share price when the buyer converts
- Encourage investment due to less risk for the investor
- Shorter ytm so easier to finance long-term projects (i.e. not long-term debt)

3: Valuing Firms with High Numbers of Patents

- **Innovation**: invention is unknown
- **Description**: invention can be understood by the mentally less able

- **Plant Patent**: discovering a new plant, granted by government (20 years)
- **Utility Patent**: invent a new useful process/software/machine (20 years)
- **Design Patent**: appearance is improved in existing product, not function (14 years)

- *The Answer:*
- $\boldsymbol{v_{firm}} = v_{\text{commercial products}} + v_{\text{existing patents}} + (v_{\text{new patents}} - c_{\text{obtainment}})$
  - $v_{\text{commercial products}} = \text{Discounted CF Values of Existing Products}$
  - $v_{\text{existing patents}} = \text{Using Option Pricing}$
  - $(v_{\text{new patents}} - c_{\text{obtainment}}) = \text{Efficiency of R\&D} \rightarrow \text{Product Conversion}$

Question 6

1) Types & Reasons for Mergers
2) Why Acquirers Pay Premium Over the Market Value of Target Company
3) Repo Market Mechanics

1: Types & Reasons for Mergers

– Horizontal, vertical, conglomerate
1) **Horizontal:** Acquisition in same industry/market
2) **Vertical:** Acquisition in different leagues (e.g. Boeing buys TUI)
3) **Conglomerate:** Acquisition by an unrelated body

– *Reasons:*
1) Efficiency/expertise
2) Economies of scale
3) Declining firms

2: Why Acquirers Pay Premium Over the Market Value of Target Company

– When **target firm** shareholders are req. by law to sell shares, they get 'fair' value
– Hence, no incentive to pay more than market price for company
– $\boldsymbol{\alpha} = 100\left(\frac{p_{\text{merger}}}{p_{\text{pre-merger}}} - 1\right)$
– Market average of 43%

– *Reasons:*
1) Efficiency/expertise
2) Economies of scale
3) Declining firms