# Masters in FINANCE

# COST OF CAPITAL: Cost of Equity & Cost of Debt

## Corporate Investment Appraisal

Fall 2017

ISEG 100 1911-2011 ANOS

100 ANOS A PENSAR NO FUTURO

# BIBLIOGRAPHY

- In any of the standard Corporate Finance textbooks, the chapters on Bond Pricing, Stock Pricing and CAPM.

# OUTLINE

We will study the capital structure choice of firms – i.e., their composition of equity and debt financing.

So we start by examining simple models to calculate the costs of financing of the two sources of capital.

1. Cost of Equity:
    1. Based on the simplest models of dividend growth;
    2. Based on portfolio analysis and the CAPM (Capital Asset Pricing Model).
2. Cost of Debt:
    1. Based on the simplest bond valuations and their yields to maturity;
    2. Based on the CAPM.

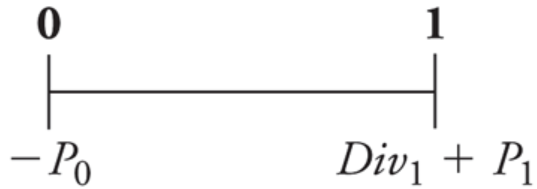
Later, we will study how the capital structure choice of a firm might influence the overall cost of capital of the firm.

Finally we will have a look at the practice of capital structure decisions: how firms do finance themselves, what are the costs involved in new issues, etc.

# 1. Cost of Equity ($r_E$):
# 1.1 The Dividend Discount Model

Start with a one-year investor (buy now, sell after 1 year).

The timeline with associated cash flows would be:




Since the cash flows are risky, we must discount them at the **equity cost of capital ($r_E$).** Price would be:

$$P_0 = \left( \frac{Div_1 + P_1}{1 + r_E} \right)$$

Total Equity Return is due to:

$$r_E = \frac{Div_1 + P_1}{P_0} - 1 = \underbrace{\frac{Div_1}{P_0}}_{\text{Dividend Yield}} + \underbrace{\frac{P_1 - P_0}{P_0}}_{\text{Capital Gain Rate}}$$

What is the price if we plan on holding the stock for N years?

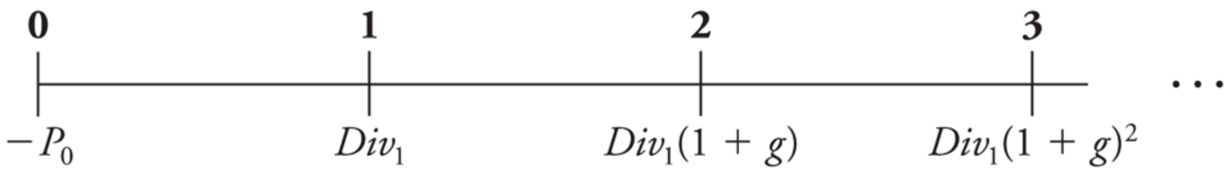
$$P_0 = \frac{Div_1}{1 + r_E} + \frac{Div_2}{(1 + r_E)^2} + \cdots + \frac{Div_N}{(1 + r_E)^N} + \frac{P_N}{(1 + r_E)^N}$$

This is known as the Dividend Discount Model. Therefore:

$$P_0 = \frac{Div_1}{1 + r_E} + \frac{Div_2}{(1 + r_E)^2} + \frac{Div_3}{(1 + r_E)^3} + \cdots = \sum_{n=1}^{\infty} \frac{Div_n}{(1 + r_E)^n}$$

How to Apply the Dividend Discount Model?

One possibility is assuming Constant Dividend Growth, at a constant rate, *g*, forever.



# The Dividend Discount Model: with Constant Growth Rate (cont.)

LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

With the Constant Dividend Growth Model we have:

$$P_0 = \frac{Div_1}{r_E - g}$$

$$r_E = \frac{Div_1}{P_0} + g$$

Where does the growth rate g come from? A simple model assumes:

$$Div_t = \underbrace{\frac{\text{Earnings}_t}{\text{Shares Outstanding}_t}}_{EPS_t} \times \text{Dividend Payout Rate}_t$$

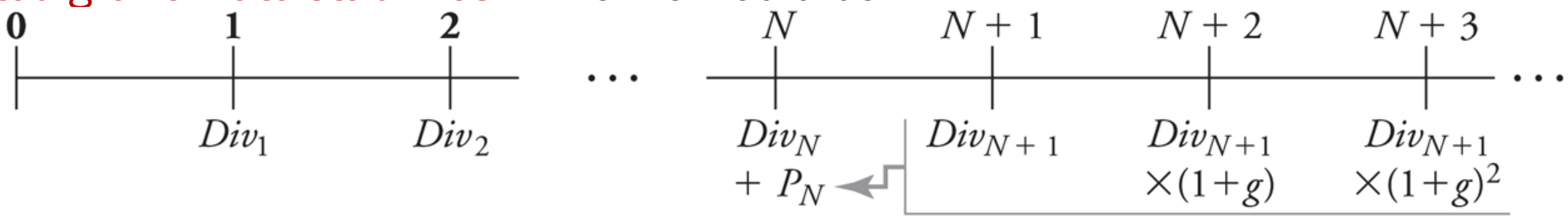
**Dividend Payout Rate**: the percentage of earnings distributed as dividends.

$$g = \text{Retention Rate} \times \text{Return on New Investment}$$

**Retention Rate:** the fraction of earnings that the firm reinvests

# The Dividend Discount Model: With Changing Growth rates (cont.)

We cannot use the constant dividend growth model to value a stock if the growth rate is not constant. But we can use the general form of the model to value a firm by applying the constant growth model to calculate the future share price of the stock once the expected growth rate stabilizes. Timeline would be:




With constant growth from year N+1 onwards:

$$P_N = \frac{Div_{N+1}}{r_E - g}$$

Finally, the Dividend-Discount Model with Constant Long-Term Growth gives us:

$$P_0 = \frac{Div_1}{1 + r_E} + \frac{Div_2}{(1 + r_E)^2} + \cdots + \frac{Div_N}{(1 + r_E)^N} + \frac{1}{(1 + r_E)^N}\left(\frac{Div_{N+1}}{r_E - g}\right)$$

# The Total Payout Model

- With a Stock Repurchase the firm uses excess cash to buy back its own stock.
- If a firm uses Stock Repurchases as a method of paying out, the DDM is restrictive:
  - The more cash the firm uses to repurchase shares, the less it has available to pay dividends.
  - By repurchasing, the firm decreases the number of shares outstanding, which increases its earnings per and dividends per share.

With Share Repurchases we may use the Total Payout Model.

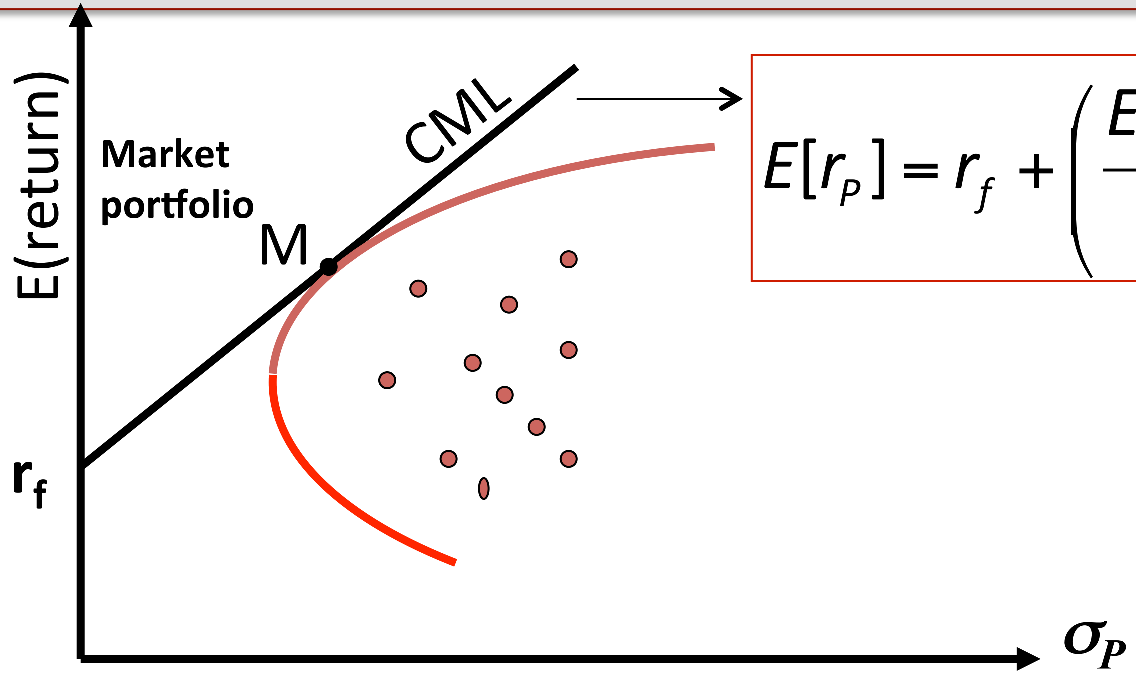
$$PV_0 = \frac{PV(\text{Future Total Dividends and Repurchases})}{\text{Shares Outstanding}_0}$$

# 1. Cost of Equity ($r_E$):
# 1.2 Capital Asset Pricing Model

- The Capital Asset Pricing Model (CAPM) is an equilibrium model that establishes a relationship between the price of a security and its risk.
- In particular, the CAPM is used to determine the cost of capital: minimum return required by investors for a certain level of risk.
- The CAPM assumes investors are well diversified. Hence the risk premium is proportional to a measure of market (or systematic) risk, known as Beta.

# Capital Market Line

LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA




$$E[r_P] = r_f + \left(\frac{E[r_M] - r_f}{\sigma_M}\right)\sigma_P$$

Investors choose a point along the line – Capital Market Line (CML)

Efficient portfolios are combination of the risk-free asset and the market portfolio *M.*

Where the investor chooses to be along the CML depends on his risk aversion – but all investors face the same CML

# Security Market Line

- The CML gives risk-return trade-off for efficient portfolios.
- In equilibrium, what is the relation between expected return and risk for individual stocks?
  - Individual stocks are below CML.
  - This relation is named Security Market Line (SML).
  - Individual stock risk is measured by its covariance with market portfolio because it is the *marginal variance.*
    - How does a small increment to the weight of a stock change the variance of the portfolio?
    - As in Economics, it is the marginal cost of goods that determines their prices, not their total or average cost.

# Beta

According to the Security Market Line, for any security *i*:

$$E(r_i) = r_f + \beta_i \, [E(r_M) - r_f]$$

where

$$\beta_i = \frac{Cov(r_{i,}r_M)}{Var(r_M)}$$

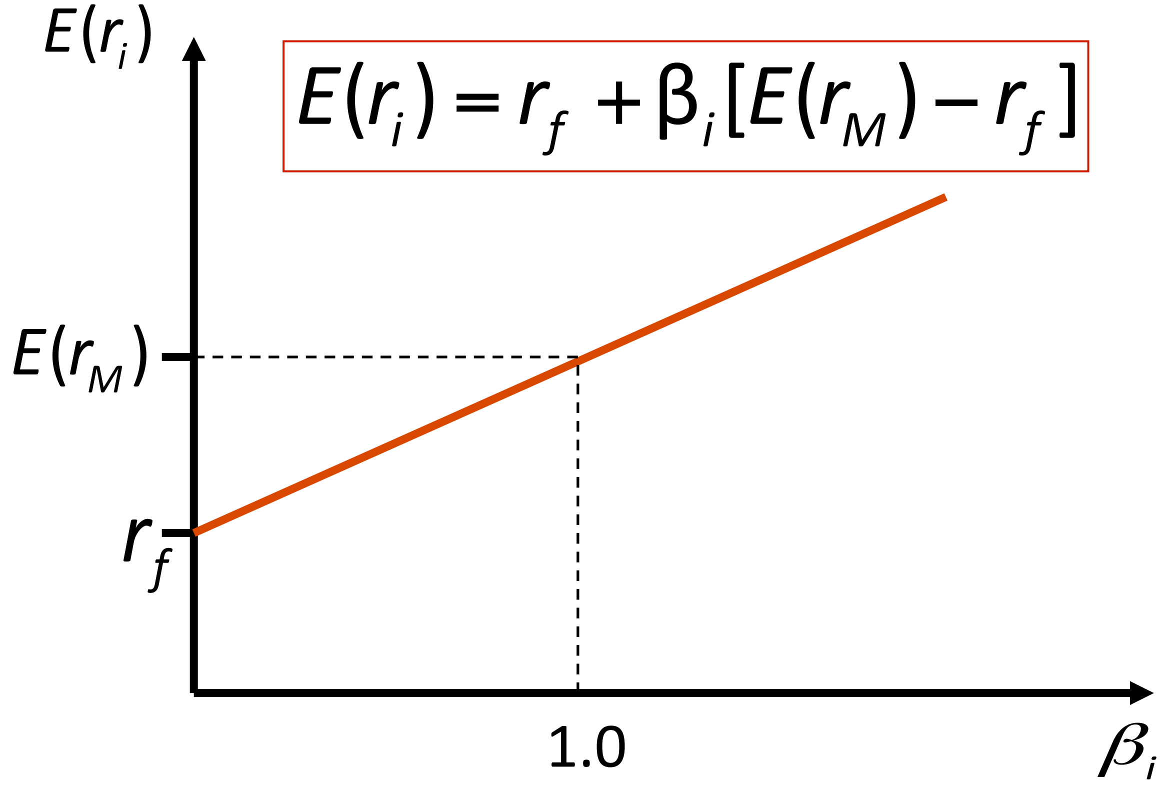
Beta measures the responsiveness of a stock to movements in the market portfolio (i.e., systematic risk).

You see this in more detail in IPM (Investments and Portfolio Management).

# CAPM: Expected Return of a Stock

Expected return on a stock = Risk-free rate + Beta of stock × Market risk premium

$$E(r_i) = r_f + \beta_i [E(r_M) - r_f]$$



# Beta of a Portfolio

Beta of a portfolio is portfolio-weighted average of individual assets:

$$\beta_P = \sum_{i=1}^{N} w_i \beta_i$$

Thus, we can use SML for any portfolio:

$$E(r_P) = r_f + \beta_P [E(r_M) - r_f]$$

# Why Beta?
# Estimating Beta.

**Why Beta?** Because investors can diversify their portfolios, they only require a risk premium for non-diversifiable (market, systematic) risk. This is what **Beta** measures.

High beta stocks are risky, and must therefore offer a higher return on average to compensate for the risk.

$\beta_i$ usually **estimated** using a time-series regression

$$r_{i,t} - r_{f,t} = \alpha_i + \beta_i (r_{M,t} - r_{f,t}) + \varepsilon_{i,t}$$

Typical $R^2$=25%

Estimation issues:

- Betas may change over time
- Data might be too old
- Five years of weekly or monthly data is reasonable
- Use Data Analysis / Regression or Linest in Excel

# Special Concerns with the CAPM

Betas of shares vary with the debt levels of firms:

when leverage changes, beta of equity changes.

Betas of projects  can differ from betas of firms:

especially in well-diversified firms.

When are firms are not listed in a stock exchange, how to use the CAPM?

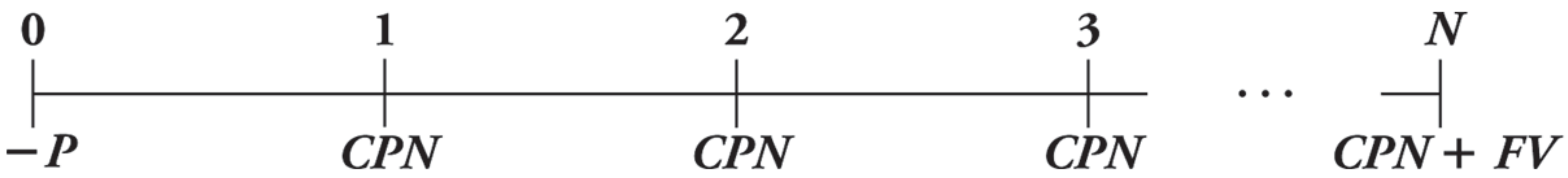
Many times by finding Comparable firms in the same industry that are publicly listed, and estimating an industry beta.

# 2. Cost of Debt:
# Think of a Simple Bond

LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

A **Coupon Bond**:

- Pays face value at maturity
- Pays regular coupon interest payments




**Yield to Maturity**: The YTM is the *single* discount rate that equates the present value of the bond's remaining cash flows to its current price.

**Yield to Maturity of a Coupon Bond**:

$$P = CPN \times \frac{1}{y}\left(1 - \frac{1}{(1+y)^N}\right) + \frac{FV}{(1+y)^N}$$

# The Debt Cost of Capital ($r_D$)

The most common way of estimating the Cost of Debt is using

Debt Yields:

Yield to maturity is the IRR an investor will earn from holding the bond to maturity and receiving its promised payments.

*If there is significant risk of default, yield to maturity will overstate investors' expected return.*

In that case we must adjust for the *truly expected return* for the firm's creditors, taking into account the probability of default and the amount of expected loss in case of default.

# The Debt Cost of Capital ($r_D$)

LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

Consider a one-year bond with YTM of *y*.

For each \$1 invested in the bond today, the issuer promises to pay \$(1+*y*) in one year.

Suppose the bond will default with probability *p*, in which case bond holders receive only \$(1+*y*-*L*), where *L* is the expected loss per \$1 of debt in the event of default.

So the expected return of the bond is:

$$r_D = (1-p)y + p(y-L) = y - pL =$$

$$= \text{Yield to Maturity} - \text{Prob(default)} \times \text{Expected Loss Rate}$$

# The Debt Cost of Capital ($r_D$)

LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

Annual Default Rates by Debt Rating (1983–2008):

| Rating: | AAA | AA | A | BBB | BB | B | CCC | CC-C |
|---|---|---|---|---|---|---|---|---|
| **Default Rate:** | | | | | | | | |
| Average | 0.0% | 0.0% | 0.2% | 0.4% | 2.1% | 5.2% | 9.9% | 12.9% |
| In Recessions | 0.0% | 1.0% | 3.0% | 3.0% | 8.0% | 16.0% | 43.0% | 79.0% |

*Source*: "Corporate Defaults and Recovery Rates, 1920–2008," *Moody's Global Credit Policy*, February 2009.

The average loss rate for unsecured debt is 60%.

Example: The expected return to A-rated bondholders during average times is 0.002X60%=0.120% below the bond's quoted yield.

# The Debt Cost of Capital ($r_D$)

Another way of estimating the Cost of Debt would be using the CAPM and Debt Betas.

- Debt betas are difficult to estimate because corporate bonds are traded infrequently.
- One approximation is to use estimates of betas of bond indices by rating category.

| **By Rating** | *A and above* | *BBB* | *BB* | *B* | *CCC* |
|---|---|---|---|---|---|
| Avg. Beta | < 0.05 | 0.10 | 0.17 | 0.26 | 0.31 |
| **By Maturity** | (BBB and above) | *1–5 Year* | *5–10 Year* | *10–15 Year* | *> 15 Year* |
| Avg. Beta | | 0.01 | 0.06 | 0.07 | 0.14 |

*Source*: S. Schaefer and I. Strebulaev, "Risk in Capital Structure Arbitrage," Stanford GSB working paper, 2009.

# The Debt Cost of Capital ($r_D$)

LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

Example:

In mid-2009, company XYZ had outstanding 5-year bonds with a YTM of 9.0% and a BB rating.

Consider that the corresponding risk-free rate was 3%, and the market risk premium is 5%.

XYZ's Cost of Debt was:

Using the YTM, the probability of default of BB rating bonds, and the expected loss in default of 60%:

$$r_D^{XYZ} = 9\% - 8\% \times 0.6 = 4.2\%$$

Using the Debt Beta of a BB rating bond, and CAPM:

$$r_D^{XYZ} = 3\% + 0.17 \times 5\% = 3.85\%$$

# The Cost of Capital of a Firm

LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

It is common to compute the weighted average of the costs of equity and debt. This rate is known as the WACC (weighted average cost of capital).

(In the absence of corporate taxes) the pre-tax WACC is computed as: $r_{wacc} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D$

In the presence of corporate taxes, due to the more favorable tax treatment given to debt financing, the WACC is computed as:

$$r_{wacc} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D \left(1 - T_C\right)$$

Note: The value of Debt considered here can be understood as "Net Debt" – by this we mean debt net of excess cash that the firm might hold. The denominator is the Enterprise Value.

# Appendix: Bond Ratings

| Rating* | Description (Moody's) |
|---|---|
| **Investment Grade Debt** | |
| Aaa/AAA | Judged to be of the best quality. They carry the smallest degree of investment risk and are generally referred to as "gilt edged." Interest payments are protected by a large or an exceptionally stable margin and principal is secure. While the various protective elements are likely to change, such changes as can be visualized are most unlikely to impair the fundamentally strong position of such issues. |
| Aa/AA | Judged to be of high quality by all standards. Together with the Aaa group, they constitute what are generally known as high-grade bonds. They are rated lower than the best bonds because margins of protection may not be as large as in Aaa securities or fluctuation of protective elements may be of greater amplitude or there may be other elements present that make the long-term risk appear somewhat larger than the Aaa securities. |
| A/A | Possess many favorable investment attributes and are considered as upper-medium-grade obligations. Factors giving security to principal and interest are considered adequate, but elements may be present that suggest a susceptibility to impairment some time in the future. |
| Baa/BBB | Are considered as medium-grade obligations (i.e., they are neither highly protected nor poorly secured). Interest payments and principal security appear adequate for the present but certain protective elements may be lacking or may be characteristically unreliable over any great length of time. Such bonds lack outstanding investment characteristics and, in fact, have speculative characteristics as well. |
| **Speculative Bonds** | |
| Ba/BB | Judged to have speculative elements; their future cannot be considered as well assured. Often the protection of interest and principal payments may be very moderate, and thereby not well safeguarded during both good and bad times over the future. Uncertainty of position characterizes bonds in this class. |
| B/B | Generally lack characteristics of the desirable investment. Assurance of interest and principal payments of maintenance of other terms of the contract over any long period of time may be small. |
| Caa/CCC | Are of poor standing. Such issues may be in default or there may be present elements of danger with respect to principal or interest. |
| Ca/CC | Are speculative in a high degree. Such issues are often in default or have other marked shortcomings. |
| C/C, D | Lowest-rated class of bonds, and issues so rated can be regarded as having extremely poor prospects of ever attaining any real investment standing. |

*Ratings: Moody's/Standard & Poor's
*Source*: www.moodys.com

Several rating agencies (Moody's S&Ps, Fitch) classify bond issues of firms according to their risks. They make a clear distinction between Investment Grade Bonds, and Speculative Bonds (also known as Junk Bonds or High-Yield Bonds).