Econ 138
Financial and Behavioral Economics

Lecture 1
Introduction + the MM Theorem

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Outline

1. Organization: Syllabus, Course Requirements

2. The Basics of CF:

   - Intro

   - NPV

   - Modigliani-Miller Theorem

1 Organization

1.1 Who am I?

Ulrike Malmendier

- Assistant Professor, Department of Economics, Berkeley
  (previously Stanford GSB)
- Background: Bonn (Germany) undergraduate (Math/Econ, Law),
  Bonn/Oxford PhD (Law), Harvard PhD (BusEc)
- Behavioral Economics/Finance, Corporate Finance;
  Applied Micro, Organizational Economics, Contract Theory
- Evans 643
  OH: Th 12:30-2:30pm
- Assistant: Judi Chan (Evans 645)
  OH: MW 7:15am-2:15pm, TTh 7:15am-4:15pm, F 7:15-1:15pm

1.2 Who are you?

- Undergraduate students with advanced training in micro-economics and math, or PhD students in related fields
- Requirements
  - **100A or 101A**
    - If you have taken 100A instead of 101A, it is strongly recommended that you also have taken advanced theory classes such as Econ 104 and/or have advanced training in math (e.g. Real Analysis).
  - **1 semester of statistics**
    - You also need some familiarity with econometrics. Highly recommended to have taken an econometrics class (140 or 141).
  - **Not a requirement:** Econ 136 (but will make this class easier). If you are interested in Finance, take both classes, in either order.
  - **STATA** (software for the empirical homework)

- **Your interests**
  - looking for a challenging (and hopefully interesting) advanced class;
  - consider going to grad school in Economics or in Finance;
  - consider a career in finance, e.g. in a hedge fund or an investment bank (BUT: this is not your typical corporate finance class; this will be much more challenging from a mathematical / technical perspective; link more to the deeper questions in economics; link much less to practical issues in banking);
  - your main interest is not finance, but for example Political Economy, Institutional Economics, or Development Economics. This class might still be of interest since some of the most interesting work in Political Economy is about the regulation of financial markets and a lot of research in Development Economics focused on financing instruments such as Microcredit Institutions, which we will cover in class.

1.3 What is this course?

- Let's go over the syllabus together.

- Go to www. nber.org/confer
  ==> choose any year or Summer Institute of any year
  ==> choose cf (also entrepreneurship, corporate governance, behavioral finance)

2 The Basics of Corporate Financing

2.1 The Big Picture

- Finance up to the early 1970s:
  - Arrow-Debreu general equilibrium model of frictionless markets (perfectly competitive and and so-called ‘complete’ market, no taxes, no transaction costs, no informational asymmetries).
    * Pricing of financial securities.
    * Mathematically beautiful ... but useful in practice?
  - Peak: Modigliani and Miller’s (1958, 1963) work: In an Arrow-Debreu world, the choice of corporate financing is ‘irrelevant’; it does not matter how much debt financing and how much equity financing a firm chooses, what its dividend policy is etc. (**Will discuss MM below**.)

Reaction: MM must be wrong ...

- **Reaction 1**: MM are wrong because of frictions such as taxes, bankruptcy costs, other transaction costs.
- **Reaction 2**: MM are wrong because they neglect agency problems. Managers maximize their own compensation and their status, not necessarily their shareholders' wealth.
- **Reaction 3**: MM are wrong because they neglect informational asymmetries. Managers have knowledge about their companies that outside capital-providers (lenders, shareholders) do not have. Result: e.g., the 'lemons problem.'
- **Reaction 4**: MM wrong because both managers and investors are not always the rational optimizers they are assumed to be. Investors overvalue stocks during 'bubbles,' managers are overconfident about how well their investment projects or takeovers will work out.

- Those four reactions characterize what CF research is about today:

  1. More complex markets (incomplete markets, transaction costs) ... immediate reaction to MM papers.

  2. Agency problems ... since the late 1970s.

  3. Informational asummetries ... since the 1980s.

  4. Behavioral finance ... since the 1990s.

- Unfortunately, the standard undergrad / MBA courses in CF revolve mostly around (1). This course tries to fill this gap.

- An aside: If you want to learn more about (4), apply to my URAP group.

2.2 Recap: NPV

- **Basic question**: How does a firm know if an investment project is desirable and how to finance it?

- **Consider a simple setting:**

  – Payoffs (dividends) and costs of investment project at any given future time t, denoted by D_t and C_t, are perfectly known now, at time 0.

  – Constant real interest rate r (though only slightly more complicated if varying over time.)

- The **Net Present Value (NPV)** of an investment is a way of to translate the value of this dividend stream, net of costs, into current money.

- Formally: NPV $= \sum_{t=0}^{\infty}(1+r)^{-t}(D_t - C_t)$.

- Informal description: add up the (positive or negative) value at each time, but multiply by $\frac{1}{\text{interest rate}}$ once for each period into the future.

NPV - Example 1

- Suppose the real interest rate were 10% per year. What is the NPV of an investment that costs \$10 today and pays \$11 in one year, \$12 in two years and \$13 in 3 years?

- *Answer:* $-\$10 + \frac{\$11}{1.1} + \frac{\$12}{1.1^2} + \frac{\$13}{1.1^3} \approx 19.68$

NPV - Example 2

- How much should be the most you would pay for an asset that pays \$1 per year every year (every period) from next year until the end of time, if the real interest rate is constant at 2.5%.

- *Answer:* $\sum_{t=1}^{\infty}(1.025)^{-t} = \sum_{t=0}^{\infty}(1.025)^{-t} - 1 \underset{\text{Using the geometric series}}{=} \frac{1}{1-\frac{1}{1.025}} - 1 = 40.$

Reminder (for me and those of you whom I confused in class ...) of the derivation of geometric-series formula:

$$\sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t = 1 + \frac{1}{1+r} + \left(\frac{1}{1+r}\right)^2 + \left(\frac{1}{1+r}\right)^3 + \ldots$$

$$\frac{1}{1+r}\sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t = \qquad \frac{1}{1+r} + \left(\frac{1}{1+r}\right)^2 + \left(\frac{1}{1+r}\right)^3 + \ldots$$

$$\Longrightarrow (1 - \tfrac{1}{1+r}) \cdot \sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t = 1$$

$$\Longleftrightarrow \sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t = \frac{1}{1-\frac{1}{1+r}}$$

That's what I wanted to hear in class, and I must have misunderstood the suggestions you guys were making. My apologies!

Two more comments thanks to helpful questions and comments I got from you:

1. My derivation assumes that the sum converges. If you wanted to ensure this, you would start with a finite sum (summing up to "n") rather than to infinity and check convergence. (I guess that's why Jeff suggested a derivation using a finiate sum, right?) So, here is the same with a finite sum:
$$\sum_{t=0}^{n}\left(\frac{1}{1+r}\right)^t = 1 + \frac{1}{1+r} + \left(\frac{1}{1+r}\right)^2 + \left(\frac{1}{1+r}\right)^3 + ... + \left(\frac{1}{1+r}\right)^n$$
$$\frac{1}{1+r}\sum_{t=0}^{n}\left(\frac{1}{1+r}\right)^t = \frac{1}{1+r} + \left(\frac{1}{1+r}\right)^2 + \left(\frac{1}{1+r}\right)^3 + ... + \left(\frac{1}{1+r}\right)^n + \left(\frac{1}{1+r}\right)^{n+1}$$
$$\Longrightarrow (1 - \frac{1}{1+r}) \cdot \sum_{t=0}^{n}\left(\frac{1}{1+r}\right)^t = 1 - \left(\frac{1}{1+r}\right)^{n+1}$$
$$\Longleftrightarrow \sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t = \frac{1-\left(\frac{1}{1+r}\right)^{n+1}}{1-\frac{1}{1+r}}$$

But, since $\left(\frac{1}{1+r}\right)^{n+1} \longrightarrow 0$ for $\left|\frac{1}{1+r}\right| < 1$,

the limit is $\lim\limits_{n \longrightarrow \infty} \frac{1-\left(\frac{1}{1+r}\right)^{n+1}}{1-\frac{1}{1+r}} = \frac{1}{1-\frac{1}{1+r}}$.

2. I may have induced additional confusion by starting my summation at $t = 0$. Obviously, we are considering payoffs starting in period $t = 1$ here! The formula starts is for a summation starting at $t = 0$; and thus we have to subtract But, of course, the trick is that $\left(\frac{1}{1+r}\right)^{0} = 1$ in the end.

Hope this helps! Please let me know if there are any more questions.

Back to the basic question: Should the investment projects be implemented?

- With free borrowing and lending, firm takes anything with positive NPV.
  - Idea: could borrow the NPV now at the real interest rate, and you would be able to pay it back in the future using only the returns on this investment borrowing and lending as needed.

- Problem: In real world no free borrowing/lending.
  Still, useful as a benchmark.

2.3 The Modigliani-Miller Theorem

- **Question**: Conditional on choosing to implement a project, which forms of financing should the firm choose for which investment projects?

- Firms can finance investment projects with

  - internal funds (cash flow = profits from previous projects)

  - debt (e.g. bank loans, bonds)

  - equity (issuing equity = selling shares of the stock at the current market price.

- In reality firms use a mix of all options (and more complicated hybrid financing instruments) to finance investments.

- Surprising Answer: Under some conditions it does not matter: $\Longrightarrow$

- **Modigliani-Miller Theorem:** If capital markets are perfect, meaning:
  - perfect competition (no unique/big buyers or sellers);
  - no taxes;
  - no transaction costs;
  - no informational asymmetries and no 'agency costs';

  then the means of financing does not matter.

  $\Longrightarrow$ The profits to the firm (the owners of the firm) are the same.

  $\Longrightarrow$ Firm should invest *iff* investment has positive NPV.

Example:

- Suppose a firm has 100 shares and is trading at \$1 per share.
  - Value of the firm?

- Suppose firm encounters a project with an NPV of \$10, including upfront financing of $C_0 = \$100$.

- Suppose firm *borrows* the \$100 and makes the investment.
  - New value of the firm?

- Firm could sell the rights to the income stream from the investment for \$110 (NPV of new project $=$ \$10; 'gross' NPV after having paid already the C_0 of \$100 $=$ \$110), use \$100 (in t_0-terms) to pay off the debt, leaving the firm with \$10 and no debt. $\Longrightarrow$ Firm is exactly as before (no debt; same cash if any, same shares) but now with \$10 more cash $\Longrightarrow$ Value $=$ \$110.

- If an investor wanted to buy all the claims to the firm's future income, would need to pay \$100 (for debt) $+$ \$110 (for equity)$=$ \$210.

• Suppose firm *sells equity* to raise \$100 and makes the investment.

  - New value of firm?

  - Firm sells s shares (s to be determined) to raise \$100, i.e. at a price of \$100$/s$ per share.

- Each new shareholder owns $1/(100+s)^{th}$ of the firm.

- After raising the \$100 and investing them, the firm is worth \$100 (old value) $+$ \$100 (cash payments of new equity holders) $-$ \$100 (cash is invested in the project) $+$ \$110 ('gross' NPV of project) $=$ \$210.

- Each new shareholder demands a percentage of the company such that $s *$ (new price per share) $=$ \$100, i.e. they demand their financing's worth.
  $\Longleftrightarrow s * (\$210/[100+s]) = \$100$
  $\Longleftrightarrow s * \$210 = \$100^2 + \$100s$
  $\Longleftrightarrow s * \$110 = \$100^2$
  $\Longleftrightarrow s = 1000/11$

- Price per share $= \$210/[100 + 1000/11] = \$1.10$.

- New value of firm $=$ \$210. Value of firm "to old shareholders" $=$ \$110.

- The values of the firm *for old shareholders* (the original owners) are the same in either case: \$110.

- The price for *buying all financial claims* to the firm's future income are the same: \$210.

- Would extra cash holdings change the result?
  - No; whether internal cash used or not used for (partial) investment financing, 'value added' from project remains the same.

- Would dividend payouts change the result?
  - No; if a firm issues a dividend, less cash is available in the firm, but the price per share goes down by exactly as much as a shareholder gets in cash, and these two effects exactly offset.

- **We will go over these arguments formally next class.**

- Theorem originally meant as a provocation. ("Corporate Finance does not matter. All the research and work on capital structure is useless.")

- Reasonable interpretation: In reality, capital structure decisions *do* matter, and if we want to understand why and how, we must understand which of the perfect-markets assumptions are wrong.
  - Taxes easiest distortions to understand; they are a matter of public record and can be computed by an accountant. (**Next class.**)
    BUT they aren't enough to explain why debt and when is preferred to equity by real firms.
  - Transaction costs are also important:
    For IPOs and SEOs, fees to the investment bank around 15%.
    Loans can have monitoring and litigation costs that may prevent the firm from borrowing at the real interest rate. Bankruptyc costs.
    BUT they aren't enough ...

- Information asymmetries are traditionally seen as most important.
  - What if firm has private information about its cash flow and debt access?
    $\Longrightarrow$ Issues equity only when the value of rest of firm is low.
    $\Longrightarrow$ Equity issues are "bad news" about the value of the firm, market will react and shares of the firm sell for less meaning an equity issue dilutes current value for the old investors.

- Agency costs
  - What if manager tends to "steal" money (increase own salary, salary of friends, invest in 'pet' or prestigious projects)?

- Behavioral reasons
  - What if manager thinks the NPV is higher than it actually is?

- So firms might not take all positive NPV investments, and which ones they do take will depend on the real costs and benefits of their financing options.

- In future classes, we will examine ways in which each distortion influences real-world financing behavior.

- **Goal**: Understand the financing and investment behaviors of real firms as products of these distortions.