Introduction to Finance

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MBA Programs

- MBA Programs are "local," not national
  - Strong local alumn networks
  - If you want to live in LA, try UCLA (or USC)
  - If you want to live in North Carolina, try Duke and UNC
  - Ranks 20-80 are not bad, either.
  - Only exceptions: HBS, Stanford, maybe Chicago
- MBA program curricula are similar
- Our profs were educated there, their profs were educated here.

- Easy to fall behind.
    - Courses starts deceptively simple.
    - Not higher math, but lots of algebra
        - think SAT or GRE or GMAT
    - Strong Self-Discipline needed.
    - Used to be party degree…no more.
- Feel free to ask me program questions after class.
    - Warning: I have a terrible (German) sense of humor
    - …which often gets me into trouble
- Name signs!

Finance is typically the most quant course in the curriculum.

My corporate finance textbook at http://book.ivo-welch.info/ is free.

Go through it *before* you enroll?!

Plan

1. Teach my First Class in Corporate Finance
2. Maybe Mention 2nd Big Idea: Diversification

Motivating Questions

Can you add rates of return and interest rates?

Can you average interest rates?

If the bank posts an 8% interest rate, how much money will $100 give you at year-end?

Do fast-growing companies earn more return then slow-growing ones?

A Perfect Market for Capital

For the next few chapters, we pretend we live in a *perfect market* for the provision of investment capital (money). A perfect market must satisfy four assumptions:

(A Perfect Market for Capital)

1. No differences in opinion

- Uncertainty is okay, but everyone must agree to exactly what it is. We must not have different information or opinions

(A Perfect Market for Capital)

2. No taxes

– or government interference or regulation [except government enforces property rights]

(A Perfect Market for Capital)

3. No transactions costs

– Neither direct nor indirect

(Perfect Markets)

4. No big sellers/buyers

- There must always be more where they came from. No (few) investors or firms are special. If investors differ, there must be infinitely many clones competing for each type of investor.

Why assume perfect markets?

- Any analysis is easier in a perfect market, so we start with it.
- Any logic that fails even in a perfect market will surely fail (be wrong) in a realistic market
  - Put differently, as real-world financial markets become closer to perfection (and they do), any financial methods we would use needs to become closer to the perfect market solution,
  - …until they perfectly converge in the limit.

(Why assume perfect markets?)

– Ch. 12 & 13 will explain about how rules have to change (become more difficult, complex, and general) in a non-perfect market
  - Some capital markets are less perfect than others.
  - Perfect market makes borrowing and lending rates equal and allows for a unique price for goods
  - Preview: Without perfect markets, the price depends on the specific owner…Yikes!

Real vs. Nominal Rates

- Unless otherwise specified as “real”, all quantities are nominal.
  - This is not just for my class, but the standard.
- If the interest rate is 15%, it means 15% nominal.
- i.e., we quote returns in terms of currency units, not in terms of apples.
- We will discuss inflation in Chapter 4.
  - Preview: presumably, nominal rates are set partly by the expectation of future inflation.

Extra Chapter 2 Assumption

- In Chapter 2, we assume **perfect certainty**.
  - We *know* what the rates of return on every investment project will be
  - No need to worry about statistics and investor risk preferences
  - All same-period (interest) rates of returns must be the same.
- This assumption is only to start the exposition

Extra Extra Chapter 2 Assumption

- In Chapter 2, we assume *equal* rates of returns
  - …per period, of course!
- Example:
  - A 1-year bond offers 10%,
  - a 1-year bond next year offers 10%,
  - a 2-year bond offers 21%.
  - a 1-year bond in 10 years offers 10%.
  - a 30-year bond offers 10% *per year*.
- Eliminates concern for the “yield curve” (Ch. 5)

Notation

- Time Convention:
  - 0 = today, right now
  - 1 = next period (e.g., day, year, etc.)
  - t = some time period (in the future)
  - T = often to denote a final time period

(Notation)

– **Flows**: something accumulating over a time span
– **Stock**: an "instant moment" snapshot quantity.
– Examples:
  - Firm assets are a stock. Earnings are a flow.
  - A price is a stock. A rate of return is a flow.
– The distinction is not always so clear.
  - Example: Dividends
  - if they accrue, use two subscripts;
  - if its instance of payment, use only one subscript.

(Notation)

- C = cash amount
- CF = cash flow (last instant?)
- C_t = instant cash amount at time t (or at end)
- $D_{t-1,t}$ = a flow of D (e.g., dividends) from t-1 to t
- D_t = common casual notation for $D_{t-1,t}$
- $D_{15,20}$ = a flow of D from t=15 to t=20
- Return vs. Net Return vs. Rate of Return
- r, r_1, $r_{15,20}$, r_4: all rates of return

Jargon Notes

- If an investment is a loan, the rate of return is usually called interest rate
  - either “rate of return” or “interest rate” are correct.
- Verbal statements are often unclear, although there is a difference between
  - a return (CF_1),
  - a net return ($CF_1 – CF_0$),
  - and a (net) rate of return ($(CF_1 – CF_0)/CF_0$),
  - you are usually assumed to know what the speaker means

Rate of Return

The rate of return from investing CF_0 today and getting CF_1 at time 1 is

$$r = r_{0,1} = \frac{(CF_1 - CF_0)}{CF_0} = \frac{CF_1}{CF_0} - 1\ .$$

This could be called

The fundamental formula of finance.

(Rate of Return)

$$r_{0,1} = \frac{(CF_1 + D_{0,1} - CF_0)}{CF_0} = \frac{(CF_1 + D_{0,1})}{CF_0} - 1\ .$$

It assumes no interim reinvestment of dividends D (or coupons or rent)—as if dividends were paid at the *end* of the period.

Using our convenient abbreviations,

$$r_1 = \frac{(CF_1 + D_1 - CF_0)}{CF_0} = \frac{(CF_1 + D_1)}{CF_0} - 1\ .$$

(Rate of Return)

- *Dividend yield*: $D_{0,1}/CF_0$
  - For bonds, this is called the *coupon yield*.
- *Capital gain*: CF_1 - CF_0
- *Percent price change*: $(CF_1 – CF_0)/CF_0$
- *(Total) Rate of return*: percent price change plus the interim payment yield.

If I write $r_1 = P_1/P_0 - 1$, I usually mean P_1 including all interim payments.

Q: Percent price changes

If the rate of return is positive, can the percent price change be negative?

If the rate of return is negative, can the percent price change be positive?

Q: Holding rate of return

If you invest $5 and will receive 8 in 10 years, what is your (holding) rate of return?

Q: Negative Rates of Return?

Can a rate of return be negative?

Q: Negative Interest Rates?

Can an *interest* rate be negative?

Q: Negative *Ex-Ante* Interest Rates?

Can interest rates be negative *ex-ante?*

– recall: nominal!

Q: Application

What is today's prevailing interest rate?

Compare 10% to 5%.

Would you say that 10% is 5% more than 5% or that 10% is 100% more than 5%?

Points and Basic Points (``bp'')

– Rate changes can be easily misunderstood, which is why **points** and *basis points* were invented:

– 1 full **point** is 1%

– 1 **basis point** (“bip”) means 0.01%.

– Example:

  - the difference between 5% and 10% is 5 points
  - the difference between 5% and 10% is 500 bp

Q: Practice

If you invest $55,000 at an interest rate of 350 basis points above the 5% interest rate, what will you receive at the end of the period?

(This is called the future value of money, FVM.)

Q: Practice

If you have \$5 and you earn a rate of return of 250%, how much will you have?

Q: Practice

If you have $5 and you earn a rate of return of 40%, how much money will you have?

Q: Future Value

What is the formula for the FV (Future Value) of money? How does it relate to the rate of return formula?

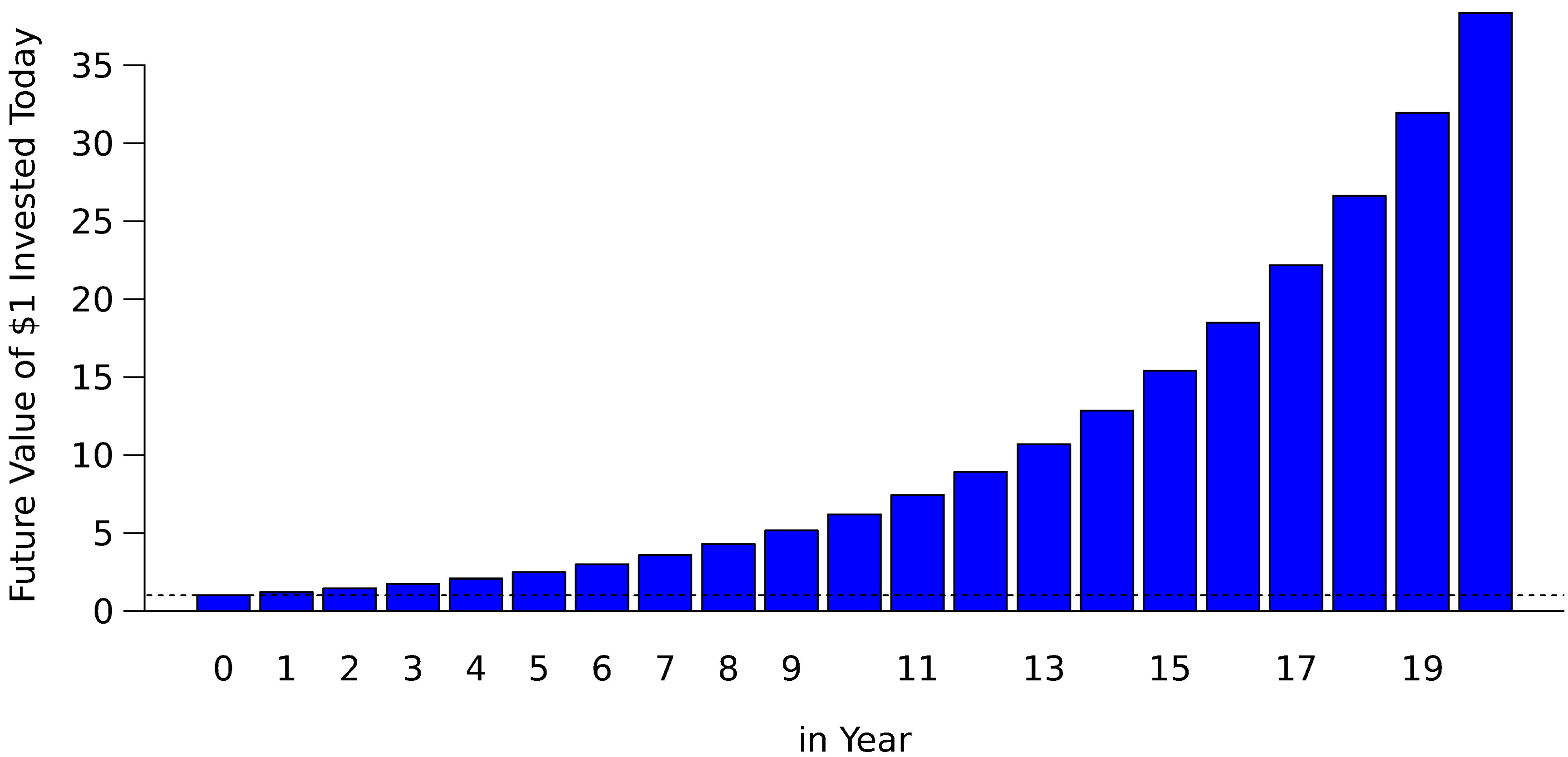
Q: Rate of return

If you have $5 and you earn a rate of return of 20% in the first year and a rate of return of 20% the following year, how much money will you have?

Q: Rate of Return

If you have \$5 and you earn a rate of return of 20% in each year, how much money will you have in *x* years?

Compounding at 20% Rate of Return Per Year



compounding returns

Q: Preview: Different Interest Rates

If the 1-year interest rate is 20% this year, how much money will you get for a 500 investment today in one year? If the following 1-year interest will be 50%, how much money will you have after 2 years?

Q: Holding rate of return

What is your total holding rate of return from 20% followed by 50%?

- Is it $50\% + 20\% = 70\%$?

Q: Holding rate of return

What is the formula for the total holding rate of return, given the two individual rates of return?

The Compounding Formula

The Compounding Formula:

$$r_{0,x} = (1 + r_{0,1}) \cdot (1 + r_{1,2}) \ldots \cdot (1 + r_{x-1,x})$$

If the interest rate remains constant, $r_{t,t+1} = r$ for all T, then

$$r_{0,T} = (1 + r_{0,1})^{T}$$

NO! The Compounding Formula

The Compounding Formula:

$$1 + r_{0,x} = (1 + r_{0,1}) \cdot (1 + r_{1,2}) \ldots \cdot (1 + r_{x-1,x})$$

If the interest rate remains constant, $r_{t,t+1} = r$ for all T, then

$$1 + r_{0,T} = (1 + r_{0,1})^T$$

I introduce errors. You must catch them!

Q: Rate of return

If your bank pays you 50% per year, what is your rate of return after 2 years?

Q: Earnings rate

You have \$100. You invest half each in two firms. Firm 1 makes 10% this month. Firm 2 makes 20% this month. How much did your portfolio make in total?

Hint: $1.2 \cdot 1.1 = 1.31.$

The Cross-Term

Can you guess what people mean by the "cross-term" in the compounding formula?

- The difference between adding rates $(r_{0,1} + r_{1,2})$ and compounding returns $[(1 + r_{0,1})\times(1 + r_{1,2}) - 1]$ is the term $r_{0,1}\times r_{1,2}$, which is the interest on the interest.
- This is also called the **cross-term**.
- It is often small *in the short run*.

Q: Interest rate

If the 1-month interest rate is 1%, what is the 1-year rate?

Q: Interest rate

If the 1-day rate is 0.02%, what is the 7-day (weekly) rate?

Approximation

How good an approximation is simply adding interest?

- This depends on the crossproduct. It may or may not be worth worrying about.
- This will be covered again below.

Algebra

$$x^a = b \Leftrightarrow x = b^{1/a}$$

$$a^x = b \Leftrightarrow x = \frac{\log(b)}{\log(a)}$$

Q: Interest rate

A project for $200 promises to return 8% per year. How much will you have after one month?

Q: Annual interest rate

If the annual interest rate is 14%, once compounded, what is the daily rate?

Q: Interest rate

The monthly interest rate is 1.5%. There are 30.4 days in the average month. What is the weekly rate? Are there different ways to calculate it?

Q: Rate of return

If you are doubling your money every 12 years, what is your rate of return per year?

Q: Rate of return

If a project promises to return 8% per year, how long will it take for you to double your money?

Q: Compounding

Is compounding more like “adding” rates or “averaging” rates?

Rule of Thumb

- If both the interest rate and the number of time periods is small,
- $(1 + r_n)^t \approx 1 + t \cdot r_n$
- Adding up instead of compounding gets to be a worse approximation if time increases and if the interest rate increases. (It also matters how much money is at stake.)

Warning: Conventions and Jargon

- Interest rates (and quotes) are tedious and often confusing because everyone computes and quotes them slightly differently
- Sometimes, interest rates are intentionally obscure in order to deceive you
- Always know what you are talking about and ask if you are unclear

Q: Interest *Quote*

A bank quotes you 8% interest per year. If you invest $1 million in the bank, what will you end up with?

Interest Quotes (Not Rates)

– Unfortunately, many institutions give you interest "quotes," rather than interest rates, and the two are easy to confuse.
    - This is especially bad with annualized interest quotes. There are many "pseudo interest rates" which are really "interest quotes" and not true "interest rates."

Bank Interest Quotes (Not Rates)

- Banks and lenders sometimes calculate and pay daily interest rates, although they only credit the interest payment to accounts once per month
  - Such banks' daily interest rate calculation is the quoted annual interest rate divided by 365 ($r_d = r_y/365$) (Note: some banks use 360 days)
- Some banks quote for clarity
  - Interest rate: 8% compounded daily
  - Effective annual yield: 8.33%

Q: Bank Interest Rate

Is the 8% posted by the bank a true annual interest rate?

Q: Bank Interest Rate

Is the ”effective annual yield” a true annual interest rate?

Quotes vs. Rates: Treasuries

At US Treasury auctions, the government sells Treasury bills that pay \$10,000 in 180 days. If the government discount quote is 10% (which is absolutely *not* an interest rate), then it means you can purchase the Treasury bill at the auction for \$9,500.

This is because Treasuries use the formula

$$\text{TB Price} = \$100 \cdot [100 - (\text{days to maturity}/360) \cdot \text{discount quote}]$$

$$= \$100 \cdot [100 - (180/360) \cdot 10] = \$9{,}500$$

- Do not memorize this formula
- Note: Financial newspapers and websites often print “95” instead of “9,500,” because it is shorter, and T-bills are quoted in units of 100.

Q: Treasury Quote

Assume the Treasury quote is indeed 95. If you invest $1, how much will you receive in 6 months? 95%?

Present Value

– Arguably, present value is the most important concept in (corporate) finance.

Q: Present Value

If you will receive $7 next year, and the prevailing interest rate (= [opportunity] *cost of capital*) for investing in this type of project is 40%, what do you value this "$7 next year" as of today?

Q: What was your formula?

And how does it relate to the basic rate of return formula?

Q: Application

If you will receive $7 in two years, and the prevailing (alternative) interest rate [or cost of capital] is 40%/year, what do you value this $7 as of today?

What is the General PV formula?

The present value of cash CF_t at time t is

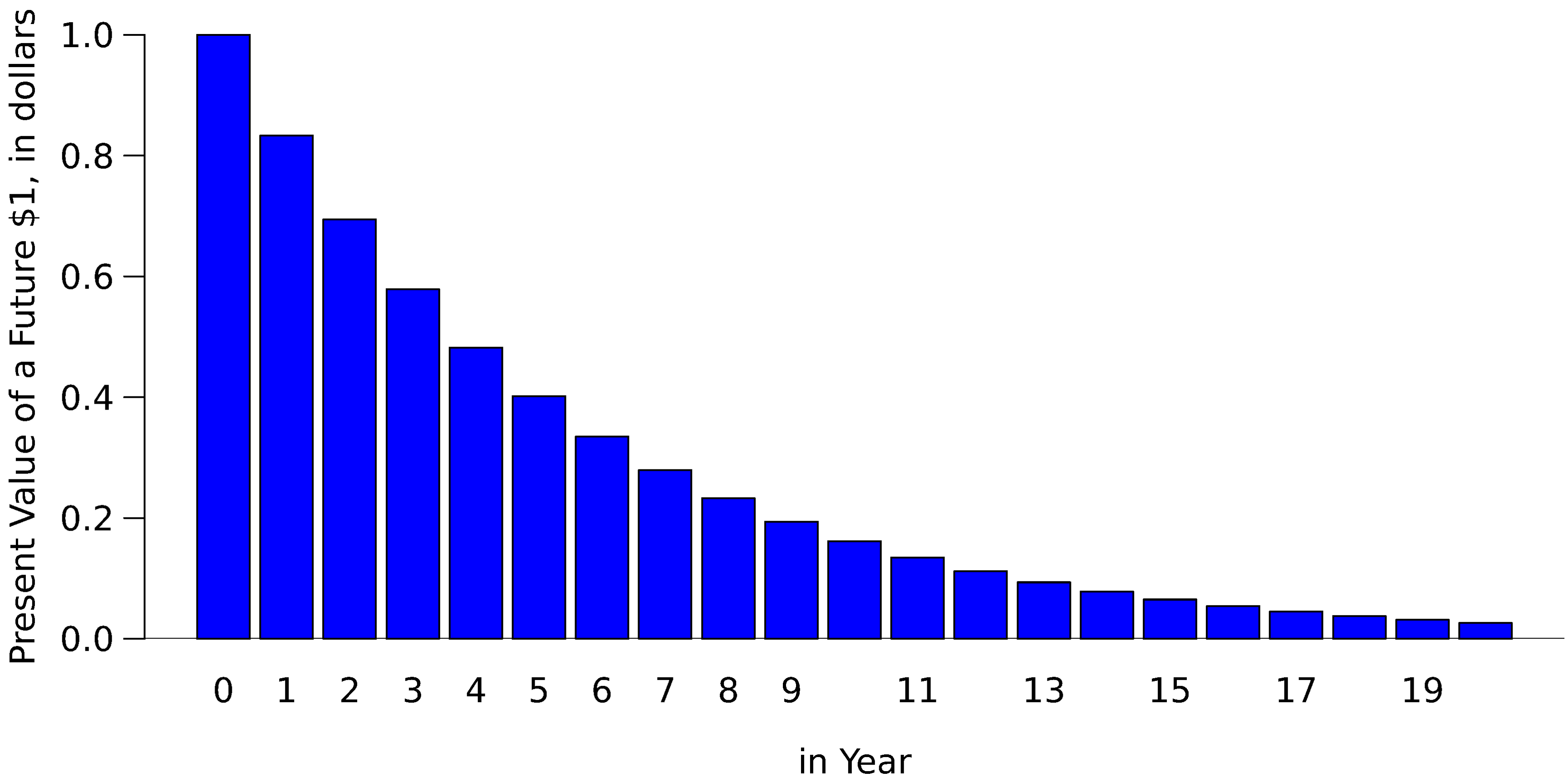
$$PV = CF_0 = \frac{CF_t}{(1 + r_{0,t})} \ .$$

- **Discount factor**: $1/(1 + r_{0,t})$
  - this is multiplied to a future cash flow in order to obtain the future cash flow's current value
- **DIscount rate**: $r_{0,t}$
  - this is the interest rate that is used to obtain the discout factor

(What is the General PV formula?)

- Discount rate is often called the **(opportunity) cost of capital**
  - You should think of it either representing your alternative investment opportunities (if you have money) or your cost of borrowing (if you need money)
  - In our perfect market, the two are the same. That is, in our financial markets, you can invest into infinitely many alternatives for a rate of return that is exactly to your cost of borrowing.
- NPV simply means include the time-0 cash flow, often a cost (negative).

Discounting at 20% Per Year



Discounting $1

Q: Interest Rates & Bond Prices

How does the price of a bond change if the economy-wide interest rate changes (up)?

Q: Prevailing Interest Rate

If you will receive $7 next year and another $7 in two years, and the prevailing (alternative) interest rate [or cost of capital] is 40%, do you have the equivalent of $14?

Q: Prevailing interest rate

If you will receive $7 next year and another $7 in two years, and the prevailing (alternative) interest rate [or cost of capital] is 40% per year, what would you value this project as of today? What formula are you using?

Q: Capital Budgeting

If this project costs $8, should you take this project?

Q: Capital Budgeting

If the cost of capital were 80%/year, should you take this project?

NPV Capital Budgeting

The net present value is

$$NPV = CF_0 + \frac{CF_1}{(1 + r_{0,1})} + \frac{CF_2}{(1 + r_{0,2})} + \ldots$$

$$= \sum_{t=0}^{\infty} \frac{CF_t}{(1 + r_{0,t})} \; .$$

- "Net" because the CF_0 is often negative.
- In a perfect world, take all positive NPV projects.
- This is called the **NPV capital budgeting rule**.

The Logical Foundation

Here is how a perfect world w/o uncertainty must work:

- The NPV rule is correct and optimal
    - Other rules *may* leave money on the table
- and positive NPV projects must be scarce.
    - Otherwise, money would compete to bid up r

(The Logical Foundation)

The proof is trivial. For example, presume that, in our perfect market, you can borrow or lend money at 8% anywhere today. The NPV formula says you will not make money on projects that cost \$1 today and yield \$1.08 next year. It says you should take all projects that yield more than \$1.08 next year. Now, presume that you have (infinitely) many investment opportunities that cost \$0.99 and yield \$1.08. (The NPV is positive.)

How would you get rich? Borrow \$0.99 and use it to buy the project. Tomorrow, you pay \$1.07, and receive \$1.08. You earn \$0.01. If you prefer money today, borrow against the \$0.01, or borrow \$1.00 to begin with.

(The Logical Foundation)

If such projects are in limited supply, you (and everyone else) would buy up all such projects, until the project's equilibrium price has increased to make the project zero NPV.

(If you can short projects, and you have willing buyers for negative NPV projects, you can just sell them and thereby invert the argument.)

Q: Good/bad investment

Is a good stock or good firm a good investment? Is a bad stock or bad firm a bad investment?

Good firm could mean growing. Bad firm could mean shrinking.

Fast vs. Slow Growing Firms

- In a perfect market, neither is a better investment because both firms should be priced fairly
- In the real world, the question is whether the price is appropriate or not
  - if price of either is too high, they are both bad invesments
  - if price of either is too low, they are both good investments
- Stupid investors may think growing firms are better and drive the price too high by piling in