Overview of Lecture 8

- Stock Pricing
  - **P**resent **V**alue of **G**rowth **O**pportunities (PVGO)
  - PE ratios and what they tell us

- Alternative Measures of Value

(Lecture 6 in Reader book & Chpt. 5 in B&M textbook)

PVGO: Present Value of Growth Opportunities

- Consider this base case for XYZ firm:
  - $EPS_1 = 10$ and $DIV_1 = 10$, so plowback = 0, g =0.
  - If r = .10, then $P_0 = 10/.10 = 100$
- In addition, suppose XYZ invests $2 in year 1 on a project that returns 10% per year forever.
  - After year 1, it pays everything out as a dividends.
  - Cash flow result:
    - » $EPS_1 = 10$ $DIV_1 = 8$
    - » $EPS_2 = 10.2$ $DIV_2 = 10.2$
    - » $EPS_3 = 10.2$ $DIV_3 = 10.2$

PVGO: Example 1 Continued

$$P_0 = \frac{10-2}{1.1} + \frac{10+.2}{(1.1)^2} + \frac{10+.2}{(1.1)^3} + \ldots =$$

$$= \left(\frac{10}{1.1} + \frac{10}{1.1^2} + \frac{10}{1.1^3} + \ldots \right) + \left(\frac{-2}{1.1} + \frac{.2}{1.1^2} + \frac{.2}{1.1^3} + \ldots \right)$$

PV of No Growth Component = \$100

NPV of Growth Component = -2/1.1 + .2/.1(1.1) = \$0

PVGO: **P**resent **V**alue of **G**rowth **O**pportunities

- The investment did not alter the firm's value. Why?
- Because the NPV of the new investment is zero.

PVGO: Example 2

- Consider this alternative for XYZ:
  - XYZ invests \$2 in year 1 in a project that returns <u>20%</u> per year forever.
  - After year 1 all earnings are paid as dividends.
- Thus
  - $EPS_1 = 10$ $DIV_1 = 8$
  - $EPS_2 = 10.4$ $DIV_2 = 10.4$
  - $EPS_3 = 10.4$ $DIV_3 = 10.4$

PVGO: Example 2 Continued

$$P_0 = \frac{10-2}{1.1} + \frac{10+.4}{(1.1)^2} + \frac{10+.4}{(1.1)^3} + \ldots =$$

$$= \left(\frac{10}{1.1} + \frac{10}{(1.1)^2} + \frac{10}{(1.1)^3} + \ldots \right) + \left(\frac{-2}{(1.1)} + \frac{.4}{(1.1)^2} + \frac{.4}{(1.1)^3} + \ldots \right)$$

PV of No Growth Component = \$100

NPV of Growth Component = -2/1.1 + .4/.1(1.1) = \$1.818

Since the new investment ROE (20%) > r, the new project has NPV > 0.

PVGO: Summary

- A firm's stock price can always be represented as the sum of two components:
  - PV of the no growth component of the firm +
  - PV of the growth opportunities (PVGO)
- This formulation is very general. It holds when the interest rate, growth rates and other factors vary over time.

Earnings-Price Ratios: Formulation

- The PV of the no growth component is:
  $P_0 = EPS / r.$
  - This assumes the firm does not invest (DIV = EPS) and therefore it does not grow.
- The price of the firm can thus be written as:
  $P_0 = EPS/r + PVGO$
- Solving for the earnings-price ratio produces:

$$\frac{EPS}{P_0} = r\left[1 - \frac{PVGO}{P_0}\right].$$

Earnings-Price Ratios: Properties

$$\frac{EPS}{P_0} = r\left[1 - \frac{PVGO}{P_0}\right] \qquad \text{or} \qquad \frac{P_0}{EPS} = \left(\frac{1}{r}\right)\left[\frac{P_0}{P_0 - PVGO}\right].$$

- If PVGO = 0 the earnings-price ratio equals r. The earnings-price ratio then measures the capitalization rate.
- Generally, the earnings-price ratio will be lower than r.

Valuing a Business

- Value of firm's equity = PV of firm's dividends.
- Dividend = Cash left after investment
- But,

  Free Cash Flow = Operating cash flow

  - Investment

- So we can equivalently value a firm by calculating the present value of its Free Cash Flows.
  – This makes valuing a firm the same as valuing a project

Alternative Measures of Value

- The correct criterion for evaluating projects is NPV.
  - When NPV > 0, take the project.
  - When choosing among projects, start with highest NPV.
- In this section, we consider some alternative methods:
  - Some alternatives have benefit of simple computations.
- **Any method producing results that differ from NPV is WRONG. Use such methods with great care.**

Internal Rate of Return (IRR): Definition

- IRR is the most popular alternative method, since it is intuitive and usually gives the right result.
- A project's IRR is defined as the interest rate that sets the NPV of cash flows equal to zero. Given C_0, C_1, … C_t the IRR is the r solving the equation:

$$0 = C_0 + \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \frac{C_3}{(1+r)^3} + \ldots$$

Internal Rate of Return (IRR): Example

- Suppose: $C_0 = -100$, $C_1 = 50$, $C_2 = 55$, $C_3 = 10$

$$0 = -100 + \frac{50}{1+r} + \frac{55}{(1+r)^2} + \frac{10}{(1+r)^3}.$$

- HP–12C and Excel give answer $r = 8.92\%$.
  – The programs search for the r that makes NPV = 0.

- IRR decisions: Adopt projects if **IRR > hurdle rate**, where hurdle rate equals the cost of capital for that project.

NPV vs. IRR

	Calculation	Investment Decision
NPV	Taking discount rate as given (r), calculate NPV	Accept project if NPV > hurdle (zero)
IRR	Taking NPV as given (zero), calculate IRR.	Accept project if IRR > hurdle (r)

- Most of the time, these rules are equivalent
- But not always…

IRR Pitfall 1: Lending or Borrowing

- Projects A and B (from BM p. 101) each have an IRR of 50%. Are they equally desirable (at r = 10%)?

Date	Project A	Project B
0	-1000	1000
1	1500	-1500
IRR	50%	50%

- The NPV of A (r = 10%) is + $364; NPV of B is -$364
- In A, we are lending money at 50% (a good thing).
- In B, we are borrowing money at 50% (not so good…)

IRR Pitfall 2: Multiple IRR Values

- Example: $C_0 = -100$, $C_1 = 360$, $C_2 = -431$, $C_3 = 171.6$.

  Solve for r:

$$0 = -100 + \frac{360}{(1+r)} - \frac{431}{(1+r)^2} + \frac{171.6}{(1+r)^3}$$

Date	Computing Multiple IRRs				
0	-100	-100	-100	-100	
1	360	360	360	360	
2	-431	-431	-431	-431	
3	171.6	171.6	171.6	171.6	
Resulting IRR	10.00%	20.00%	30.00%	30.00%	
NPV	0.0000	0.0000	0.0000	0.0000	

With **multiple IRRs, you don't know which one to use!**

IRR Pitfall 3: Mutually Exclusive Projects

- Example: for simplicity, assume the discount rate is zero.

PROJECT	C_0	C_1	IRR	NPV
A	–1	2	100%	1
B	–100	110	10%	10

- Should you select project A or B?

IRR and Mutually Exclusive Projects, Continued

- You should select B, but A has a higher IRR.
- The problem is that IRR does not adjust for a project's scale.
- What are some reasons that projects might be mutually exclusive?

IRR Pitfall 4: Time Varying Interest Rates

- The IRR rule: accept project if IRR > hurdle rate.
- Example: Suppose 3-year IRR = 10.0%. Hurdle rates are: r_1 = 7%; r_2 = 10%; r_3 = 13%?
  What to do?
- The right answer is far from obvious. You must compute a complex weighted average (depending on the C_i) of the spot rates to compute the correct summary hurdle rate.
- A much simpler solution is just to compute the NPV!!

IRR Pitfall 5: No Real Solution Exists

- With problem 1 we had too many solutions. Now we consider a case where no real solution exists.

- Example: $C_0 = 4$, $C_1 = -8$, $C_2 = 104$

$$0 = 4 + \frac{-8}{(1+r)} + \frac{104}{(1+r)^2}$$

Date	
1	4
2	-8
3	104
IRR	#NUM!

- What r's solve this equation? $r = (-25)^{.5} = \pm 5i$.
- This is an imaginary interest rate! Excel says #NUM!

IRR Summary

- Why use IRR at all?
  - Lots of other people use it.
  - It works (it exists, is unique, and gives right decision) as long as:
    - » One discount rate for all periods
    - » One negative cash flow in period 0 followed by positive cash flows.
    - » We are only looking at one investment
  - It provides an intuitive measure of a project's rate of return.
- **However, given a choice, you should always use NPV**

Another Alternative to NPV: Payback Period

- Some firms require investment "payback period".
  - In the BM (p. 96) example, Project A maximizes NPV, but fails to meet a payback rule of 2 years.

Date	Project A	Project B	Project C
0	-2000	-2000	-2000
1	500	500	1800
2	500	1800	500
3	5000	0	0
Payback	3 years	2 years	2 years
NPV (10%)	$2,624	($58)	$50

Pitfall to Using NPV: Capital Rationing

So far, firm accepts all projects with NPV > 0.
But what if the firm faces **capital rationing**.
In this example (BM p. 109), capital = $10 million

Date	Cash Flows $ Millions		
	Project A	Project B	Project C
0	-10	-5	-5
1	30	5	5
2	5	20	15
NPV (10%)	$21	$16	$12

- In this case, best solution is Project B + Project C.
- More generally, programming solution (see BM 108-113.)

Overall Summary

- **Given a choice, you should always use NPV**
- **When you are asked or required not to use NPV, be sure to understand and adjust for built-in biases of technique being used.**