

Chapter 15

Investment, Time and Capital Markets

Stocks Versus Flows

- ()
 - Capital is a stock measurement.
 - The amount of plant and equipment a company owns at a point in time
- Flow
 - Variable inputs and outputs are flow measurements.
 - An amount needed or used per time period

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Stocks Versus Flows

- Profit is also a flow number
- Must know what the capital stock will allow the firm to earn as a flow of profit
 - Was the investment a sound decision
- Must be able to value *today* the expected profit flow over time
 - What is the flow of profit worth today?

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Present Discounted Value (PDV)

- Determining the value today of a future flow of income
 - The value of a future payment must be discounted for the time period and interest rate that could be earned.
 - Interest rate – rate at which one can borrow or lend money

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Present Discounted Value (PDV)

- () (FV)
 - One dollar invested today should yield $(1 + R)$ dollars a year from now
 - $(1 + R)$ is the future value of the dollar today
 - What is the value today of getting \$1 a year from now?
 - What is the present discounted value of the \$1?

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Present Discounted Value (PDV)

Future Dollar Value of \$1 invested today = $(1 + R)^n$
n = Number of year in future
PDV = Present dollar value of \$1 received in the future = $\frac{1}{(1 + R)^n}$; (how much would you have to invest today to have a dollar in the future)

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Present Discounted Value (PDV)

- The interest rate impacts the ()
- The lower the interest rate, the less you have to invest to reach your goal in the future
- We can see how different interest rates will give different future values

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PDV of \$1 Paid in the Future

R	1 YR	5 YR	10 YR	30 YR
1%	\$0.990	\$0.951	\$0.905	\$0.742
2%	\$0.980	\$0.906	\$0.820	\$0.552
5%	\$0.952	\$0.784	\$0.614	\$0.231
10%	\$0.909	\$0.621	\$0.386	\$0.057

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Valuing Payment Streams

- Can determine a stream of payments over time
- Choosing a payment stream depends upon the interest rate.
- Given two streams, we can compute and add the present values of each year's payment

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Two Payment Streams

	Today	1 Year	2 Years
Payment Stream A:	\$100	\$100	0
Payment Stream B:	\$20	\$100	\$100

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PDV of Payment Streams

	R = .05	R = .10	R = .15	R = .20
PDV of Stream A:	\$195.24	\$190.90	\$186.96	\$183.33
PDV of Stream B:	205.94	193.54	182.57	172.77

- Notice which stream is worth more depends on interest rate

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The Value of Lost Earnings

- PDV can be used to determine the value of lost income from a disability or death.
- Scenario
 - Harold Jennings died in an auto accident January 1, 1996 at 53 years of age.
 - Salary: \$85,000
 - Retirement Age: 60

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The Value of Lost Earnings

- What is the () of Jennings' lost income to his family?
 - Must adjust salary for predicted increase (g)
 - Assume an 8% average increase in salary for the past 10 years
 - Average rate of growth of airline pilot salary over time
 - Must adjust for the true probability of death (m) from other causes
 - Derived from mortality tables

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The Value of Lost Earnings

- Must adjust for the true probability of death (m) from other causes
 - Derived from mortality tables
- Assume R = 9% – The rate on government bonds

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The Value of Lost Earnings

$$\begin{aligned}
 \text{PDV} = & W_0 + \frac{W_0(1+g)(1-m_1)}{(1+R)} \\
 & + \frac{W_0(1+g)^2(1-m_2)}{(1+R)^2} + \dots \\
 & + \frac{W_0(1+g)^7(1-m_7)}{(1+R)^7}
 \end{aligned}$$

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Calculating Lost Wages

Year	$W_0(1+g)^t$	$(1-m_t)$	$1/(1+R)^t$	$W_0(1+g)^t(1-m_t)/(1+R)^t$
1996	\$ 85,000	.991	1.000	\$84,235
1997	91,800	.990	.917	83,339
1998	99,144	.989	.842	82,561
1999	107,076	.988	.772	81,671
2000	115,642	.987	.708	80,810
2001	124,893	.986	.650	80,044
2002	134,884	.985	.596	79,185
2003	145,675	.984	.547	78,409

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The Value of Lost Earnings

- Finding PDV
 - The summation of column 4 will give the PDV of lost wages – \$650,252
 - Jennings' family could recover this amount as partial compensation for his death.

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The Value of a Bond

- A () is a contract in which a borrower agrees to pay the bondholder (the lender) a stream of money
- Example: A bond issued by a company may make a "coupon" payment of \$100 per year for the next 10 years and a final payment of \$1000.
 - How much would you pay for this bond?
 - Present value of payment stream

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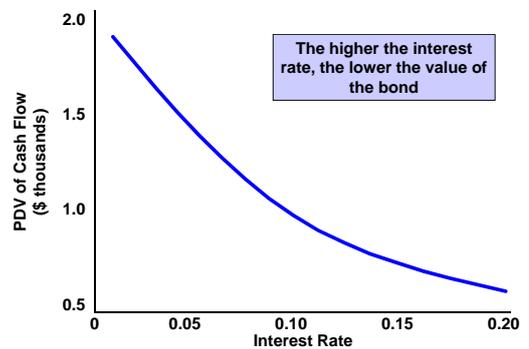
The Value of a Bond

- Determining the Price of a Bond
 - Coupon Payments = \$100/yr. for 10 yrs.
 - Principal Payment = \$1,000 in 10 yrs.

$$\text{PDV} = \frac{\$100}{(1+R)} + \frac{\$100}{(1+R)^2} + \dots + \frac{\$100}{(1+R)^{10}} + \frac{\$1000}{(1+R)^{10}}$$

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Present Value of the Cash Flow from a Bond



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The Value of a Bond

- Perpetuity is a bond that pays out a fixed amount of money each year forever.
- Present value of a perpetuity is an infinite summation
- Can express the value of a perpetuity by

$$\text{PDV} = \$100/R$$
- In general, $\text{PDV} = \text{payment}/R$

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The Net Present Value Criterion for Capital Investment Decisions

- Firms have to decide when and how much capital to invest in
- Comparing the present value (PV) of the cash flows from the investment to the cost of the investment can give firm information needed to make worthwhile decisions.

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The Net Present Value Criterion for Capital Investment Decisions

- () Criterion
 - Firms should invest if the present value of the expected future cash flows from an investment exceeds the cost of the investment.

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The Net Present Value Criterion for Capital Investment Decisions

- C = capital cost
 - π_n = profits for n years ($n = 10$)
 - $$\text{NPV} = -C + \frac{\pi_1}{(1+R)} + \frac{\pi_2}{(1+R)^2} + \frac{\pi_{10}}{(1+R)^{10}}$$
 - R = discount rate or opportunity cost of capital with a similar risk

Invest if $\text{NPV} > 0$

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The Net Present Value Criterion for Capital Investment Decisions

- Determining the ()
 - The firm must determine the opportunity cost of its money
 - The correct value of the discount rate should equal the rate that the firm could earn on a *similar* investment
 - We assume no risk for now so opportunity cost is what the firm could earn on a government bond

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The Net Present Value Criterion for Capital Investment Decisions

- The Electric Motor Factory (choosing to build a \$10 million factory)
 - 8,000 motors/ month for 20 yrs
 - Cost = \$42.50 each
 - Price = \$52.50/motor
 - Profit = \$10/motor or \$80,000/month
 - Factory life is 20 years with a scrap value of \$1 million
 - Should the company invest?

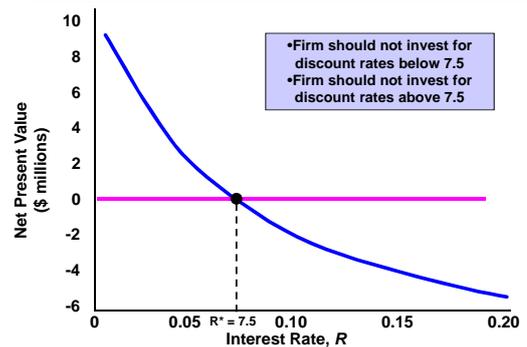
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The Net Present Value Criterion for Capital Investment Decisions

- Assume all information is certain (no risk)
 - R = government bond rate
- $$NPV = -10 + \frac{.96}{(1+R)} + \frac{.96}{(1+R)^2} + \dots + \frac{.96}{(1+R)^{20}} + \frac{1}{(1+R)^{20}}$$
- $R^* = 7.5\%$
- Discount rates below 7.5, NPV is positive
 - Discount rates above 7.5, NPV is negative

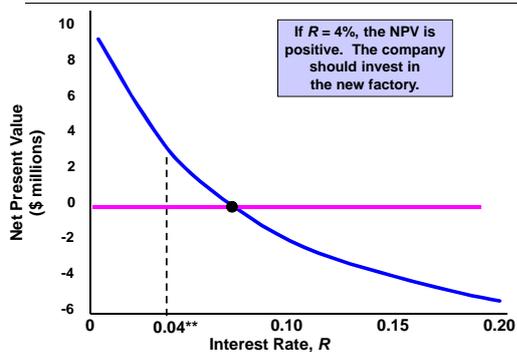
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Net Present Value of a Factory



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Net Present Value of a Factory



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The Net Present Value Criterion for Capital Investment Decisions

- Electric Motor Factory
 - Construction time is 1 year
 - \$5 million expenditure today
 - \$5 million expenditure next year
 - Expected to lose \$1 million the first year and \$0.5 million the second year
 - Profit is \$0.96 million/yr. until year 20
 - Scrap value is \$1 million

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The Net Present Value Criterion for Capital Investment Decisions

$$\begin{aligned} \text{NPV} = & -5 - \frac{5}{(1+R)} - \frac{1}{(1+R)^2} - \frac{.5}{(1+R)^3} \\ & + \frac{.96}{(1+R)^4} + \frac{.96}{(1+R)^5} + \dots \\ & + \frac{.96}{(1+R)^{20}} + \frac{1}{(1+R)^{20}} \end{aligned}$$

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Investments in Human Capital

- Individuals make choices on whether to invest in human capital
 - Do I finish college?
 - Do I go to graduate school?
- () is the knowledge, skills, and experience that make an individual more productive and thereby able to earn a higher income over a lifetime

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Investments in Human Capital

- Typically the investment in human capital pays off in the future in terms of higher pay, better promotions, and/or more job opportunities
- How does one decide to invest in human capital?
 - Can use the net present value rule from before

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Investments in Human Capital

- Suppose you are deciding to go to college for 4 years or skip college and go to work
 - Assume purely financial basis (ignore pleasure or pain from college)
 - Calculate net present value of costs and benefits of going to college

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Investments in Human Capital

- Major costs for college
 - Opportunity cost of lost wages – approximately \$20,000 per year
 - Costs for tuition, room and board, and related expenses – assume \$20,000 per year
 - Total economic costs of attending college are \$40,000 per year for 4 years

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Investments in Human Capital

- Benefits of college
 - Higher salary throughout working life
 - On average college grad earns \$20,000 higher than high school grad
 - Assume persists for 20 years
- Can now calculate net present value of investing in a college education

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Investments in Human Capital

$$NPV = -40 - \frac{40}{(1+R)} - \frac{40}{(1+R)^2} - \dots - \frac{40}{(1+R)^3} + \frac{20}{(1+R)^4} + \dots + \frac{20}{(1+R)^{23}}$$

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Investments in Human Capital

- What discount rate should be used?
 - We are ignoring inflation so should use a real discount rate
 - About 5% would reflect opportunity cost of money for many households
 - Return of investing in other assets
 - This gives a NPV of about \$66,000 therefore investing in college is a good idea

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Investments in Human Capital

- Although NPV is positive, it is not very large
- Almost free entry system to attend college
- Free entry markets tend to lead to zero economic profits

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Should you go to Business School?

- Getting an MBA often means a large increase in salary
- Can see the typical change in salary from getting an MBA from top business schools
- For US as a whole, average salary pre-MBA is about \$45,000 and obtaining the MBA increase by about \$30,000

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Should you go to Business School?

University	Base Salary: Mean	Pre-MBA Salaries
Harvard University	\$95,012	\$65,000
Stanford University	\$94,900	\$65,000
Columbia University	\$92,000	\$50,000
University of Pennsylvania (Wharton)	\$91,117	\$60,000
Dartmouth (Tuck)	\$89,661	\$50,000
University of Chicago	\$88,176	\$55,000
Northwestern University (Kellogg)	\$88,000	\$56,000
MIT (Sloan)	\$87,702	\$55,000
New York University (Stern)	\$85,531	\$45,000
Yale	\$85,368	\$45,000
University of Michigan	\$84,922	\$50,000
University of Virginia (Darden)	\$84,302	\$50,000

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Should you go to Business School?

University	Base Salary: Mean	Pre-MBA Salaries
UC Berkeley (Haas)	\$83,950	\$50,000
Cornell University (Johnson)	\$83,759	\$50,000
Duke University	\$83,575	\$49,000
UCLA (Anderson)	\$82,715	\$55,000
Georgetown University (McDonough)	\$82,000	\$45,000
Carnegie Mellon	\$80,299	\$45,000
Texas—Austin (McCombs)	\$79,175	\$45,000
UNC Chapel Hill (Kenan-Flagler)	\$79,076	\$48,000
Purdue University (Kranner)	\$79,000	\$35,000
Washington (Olin)	\$78,200	\$42,000
Rochester (Simon)	\$78,061	\$40,000
Indiana University (Kelley)	\$76,934	\$42,000
USC (Marshall)	\$75,000	\$45,000

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Should you go to Business School?

- Assuming the \$30,000 per year gain persists for 20 years
- Typical MBA takes 2 years and has expenses of about \$45,000
- Opportunity cost of forgone pre-MBA salary is also \$45,000 per year
- Total economic cost of getting MBA is \$90,000

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Should you go to Business School?

- Net present value of the investment is

$$NPV = -90 - \frac{90}{(1+R)} + \frac{30}{(1+R)^2} + \dots + \frac{30}{(1+R)^{21}}$$

- With real discount rate of 5%, NPV is about \$158,000

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Should you go to Business School?

- Why is payoff from MBA in table 15.6 so much greater than from 4-year undergrad degree?
 - Entry into many MBA programs, especially those listed in table, is highly selective and difficult

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Should you go to Business School?

- Financial decision is easy
 - Although costly, return is very high
 - But some find it more fun than others
 - Many do not have undergraduate grades and test scores to go to business school
 - May find career you like better such as teaching or law

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