

Investment Analysis

Chapter 9

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Chapter Outline

- The Time Value of Money
- Investment Analysis (a.k.a. Capital Budgeting)

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The Time Value of Money

- Compounding
- Discounting
- Present value of an annuity
- Amortization or Capital Recovery

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Compounding

- We know a present value but not a future value
- What will \$500 today be worth in 3 years?
- In one year, at 7% per year, we'll have \$535
 - $500 * 1.07 = 535$
- In two years, we'll have \$572.45
 - $535 * 1.07 = 572.45$
- In three years, we'll have \$612.52
 - $572.45 * 1.07 = 612.52$

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Compounding, cont.

Over three years:

- $\$500 * 1.07 * 1.07 * 1.07 = \612.52
- $\$500 * (1.07)^3 = \612.52
- $\$500 * 1.2250 = \612.52

Instead of multiplying, 1.2250 can be found in a table of compounding factors at the intersection of the row for 3 periods and the column for 7%.

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Discounting

- We know a future value but not a present value
- Discounting is the opposite of compounding
- If we know we will receive \$612.52 in 3 years, what is today's value at 7%?
- Dividing \$612.52 by 1.2250, the factor we calculated in the previous compounding example, we calculate \$500 for today's value.

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Discounting, cont.

- Discounting can be used to compare alternatives
- Suppose we have a choice between:
 - One investment that will provide a return of 12%
 - Another investment that will pay us \$800 in 4 years
- The present value of \$800 in 4 years can be found by multiplying \$800 by the discount factor for 12%:
 - $Pvf_{(4,12)} = 1 / (1.12)^4 = 0.6355$
 - $PV = 800 * 0.6355 = \$508.40$
- If the price of the second alternative is less than \$508.40, it will provide a return better than 12%.

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Instead of multiplying,

$$Pvf_{(4,12)} = 1 / (1.12)^4 = 0.6355$$

0.6355 can be found in a table of discount factors at the intersection of the row for 4 periods and the column for 12%.

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Discounting is used extensively in investment analysis when the future returns need to be compared to the initial cost of the investment.

Discounting helps compare the price of land or the cost of a new livestock building to the estimates of future income.

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Present Value of an Annuity

- An annuity is a stream of equal payments received on a regular basis over a period of time.
- Suppose we could choose to receive \$150 at the end of the next 3 years or another investment that paid 12%.
- In a table of annuity factors (at the intersection of the row for 3 periods and the column for 12%, we can find the annuity factor of 2.4018
- Thus, the present value of a 3 year annuity of \$150 is \$360.27

$$360.27 = 150 * 2.4018$$

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Amortization

- Loans with multiple payments are amortized over those payments.
- As shown in chapter 8, a loan of \$250,000 with an interest rate of 7% is amortized over 20 years and has an annual payment of \$23,600
- The amortization factor for 20 years, annual payments, and 7% can be calculated or found in a table of amortization factors at the intersection of the row for 20 periods and the column for 7%: 0.0944
- $PI_{(20,0.07)} = 250,000 * 0.0944 = \$23,600$

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Capital Recovery

- The same procedure used to amortize a loan over its terms can be used to spread the costs of an investment over its lifetime.
- For example, the annual capital cost of a tractor costing \$80,000 is estimated to be \$15,896 using a discount rate of 9% and a useful life of 7 years.

$$15,896 = 80,000 * 0.1987$$
- The capital recovery factor, 0.1987, is found in a table of amortization factors at the intersection of the row for 7 periods and the column for 9%
- This capital recovery process is used as a substitute for the alternative of calculating depreciation and interest costs.

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Investment Analysis (a.k.a. Capital Budgeting)

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Investment steps

1. Identify alternatives
2. Estimate future receipts and costs
3. Estimate economic profitability and financial feasibility
4. Perform sensitivity analysis
5. Select investment(s)

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Measuring Economic Profitability

- Payback period
- Net present value (NPV)
- Internal rate of return (IRR)

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Example investment of \$20,000

Year	After-tax net cash flow (undiscounted)
1	\$2,000
2	4,000
3	6,000
4	9,000
5	10,000
total	\$31,000

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Estimating the present value of future net cash flows

Year	After-tax net cash flow (undiscounted)	Present value of after-tax net cash flow (at 8% discount rate)
1	\$2,000	\$1,852
2	4,000	3,429
3	6,000	4,763
4	9,000	6,615
5	10,000	6,810
total	\$31,000	\$23,465

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Payback Period

The payback period is the number of years of after-tax net cash flow needed to pay back the initial investment.

In the example investment, the total of the first 3 years of after-tax net cash flow is \$12,000. So, \$8,000 of the \$9,000 projected for the 4th year is needed to pay back the initial investment of \$20,000.

Thus, the payback period = 3 + (8000 / 9000) = 3.89

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However, the payback period does not account for the time value of money. It uses the undiscounted after-tax net cash flows.

To overcome this problem, the present values of the after-tax net cash flows are used to estimate the discounted payback period.

Doing so we note that the discounted cash flows for first 4 years add up to \$16,659. So, \$3,341 of the \$6,810 in the 5th year is needed to pay back the initial \$20,000.

Thus, the discounted payback period

$$= 4 + (3341/6810) = 4.49$$

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Net Present Value

The net present value (NPV) is the sum of the present values of future net cash flows minus the initial investment.

In the example investment, a discount rate of 8% is chosen to estimate the present values of the future after-tax net cash flows.

For the 5 years of the investment, these present values total \$23,465. Subtracting the initial investment, the net present value is:

$$NPV = 23,465 - 20,000 = \$3,465$$

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Internal Rate of Return

The internal rate of return (IRR) is the discount rate that sets the net present value of the investment to zero.

For the example investment, a discount rate of approximately 13% sets the net present value of the investment to zero.

This can be calculated:

1. By trial and error
2. Graphically
3. Using a spreadsheet or business calculator

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Combine purchase, from Table 9.8

Year	Cash income	Cash expenses	Taxes	Salvage value	After-tax net cash flow
1	\$48,000	\$21,970	\$-1,795		\$27,825
2	50,400	23,069	181		27,150
3	52,920	24,222	2,165		26,533
4	55,566	25,433	3,652		26,481
5	58,344	26,705	4,074		27,565
6	61,262	28,040	4,517		28,705
7	64,325	29,442	4,982		29,901
8	67,541	30,914	7,861	37,837	66,603

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Combine purchase, from Table 9.8, cont.

Year	After-tax net cash flow (ANCF)	Present value factor at 8%	PV of ANCF
1	\$27,825	0.9259	\$25,763
2	27,150	0.8573	23,276
3	26,533	0.7938	21,062
4	26,481	0.7350	19,464
5	27,565	0.6806	18,761
6	28,705	0.6302	18,090
7	29,901	0.5835	17,447
8	66,603	0.5403	35,986
TOTAL			\$179,849

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Combine purchase, from Table 9.8, cont.

Present value of the net cash flows	\$179,849
Minus the initial cost of investment	-157,000
Net present value of the investment (NPV)	22,849
Internal rate of return (IRR)	11.3%
Payback period (undiscounted)	5.7
Discounted payback period	7.4

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Financial Feasibility of Combine, Table 9.9

Year	ANCF	Loan payment	Interest payment	Principal payment	Tax savings	After-tax payment	Surplus or deficit
1	27,825	30,273	10,598	19,675	2,967	27,306	519
2	27,150	30,273	8,827	21,446	2,471	27,802	-651
3	26,533	30,273	6,897	23,376	1,931	28,342	-1,809
4	26,481	30,273	4,793	25,480	1,342	28,931	-2,450
5	27,565	30,273	2,500	27,773	700	29,573	-2,008
6	28,705						28,705
7	29,901						29,901
8	66,603						66,603

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Table 9.10 PV of purchasing a tractor

Year	Cash outlay	Salvage value	Tax savings	After-tax cash outlay	pvf at 10%	PV of after-tax cash outlay
0	14,000		4,200	9,800	1.0000	9,800
1	18,858		4,897	13,961	0.9091	12,692
2	18,858		5,991	12,867	0.8264	10,633
3	18,858		5,136	13,722	0.7513	10,309
4	18,858		4,462	14,396	0.6830	9,832
5	18,858		4,192	14,667	0.6209	9,107
6	18,858		3,894	14,964	0.5645	8,447
7	6,000		3,567	2,433	0.5132	1,249
8	6,000	10,000	-176	-3,824	0.4665	-1,784
Present value of the after-tax cash outlay for purchasing						70,285

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Table 9.11 PV of leasing a tractor

Year	Cash outlay	Salvage value	Tax savings	After-tax cash outlay	pvf at 10%	PV of after-tax cash outlay
0	10,000		2,800	7,200	1.0000	7,200
1	18,500		5,180	13,320	0.9091	12,109
2	18,500		5,180	13,320	0.8264	11,008
3	18,500		5,180	13,320	0.7513	10,007
4	18,500		5,180	13,320	0.6830	9,098
5	18,500		5,180	13,320	0.6209	8,270
6	18,500		5,180	13,320	0.5645	7,519
7	18,500		5,180	13,320	0.5132	6,836
8	18,500	0	5,180	13,320	0.4665	6,214
Present value of the after-tax cash outlay for leasing						78,261

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