INDE 301
Engineering Economy

Tax Analysis

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LEARNING OBJECTIVES

1. Terminology and rates; marginal tax tables
2. Determining cash flows before taxes(CFBT) and after taxes (CFAT)
3. Effects of depreciation on taxes
4. Depreciation recapture and capital gains
5. Performing an after-tax analysis

Income Tax Terms and Relations (Corporations)

Income taxes are real cash flow payments to governments levied against income and profits. The (noncash) allowance of asset depreciation is used in income tax computations.

Two fundamental relations: NOI and TI

Net operating income = gross revenue – operating expenses

$$NOI = GI - OE$$ *(only actual cash involved)*

NOI is also call EBIT (earnings before interest and taxes)

Taxable income = gross revenue – operating expenses – depreciation

$$TI = GI - OE - D \Leftarrow$$ *(involves noncash item)*

Tax Terms and Relations - Corporations

- **Gross Income *GI* or operating revenue *R*** -- Total income for the tax year realized from all revenue producing sources

- **Operating expenses *OE*** -- All annual operating costs (AOC) and maintenance & operating (M&O) costs incurred in transacting business; these are tax deductible; depreciation not included here

- **Income Taxes and tax rate *T*** -- Taxes due annually are based on taxable income *TI* and tax rates, which are commonly graduated (or progressive) by TI level.

$$\text{Taxes} = \text{tax rate} \times \text{taxable income}$$
$$= T \times (\text{GI} - \text{OE} - \text{D})$$

- **Net operating profit after taxes *NOPAT*** – Money remaining as a result of capital invested during the year; amount left after taxes are paid.

$$\text{NOPAT} = \text{taxable income} - \text{taxes} = \text{TI} - T \times (\text{TI})$$
$$= \text{TI} \times (1 - T)$$

US Corporate Federal Tax Rates - 2010

If Taxable Income (TI) is:			
Over, $	But not over, $	Tax is, $ and %	Of the amount over, $
0	50,000	15%	0
50,000	75,000	7,500 + 25%	50,000
75,000	100,000	13,750 + 34%	75,000
100,000	335,000	22,250 + 39%	100,000
335,000	10,000,000	113,900 + 34%	335,000
10,000,000	15,000,000	3,400,000 + 35%	10,000,000
15,000,000	18,333,333	5,150,000 + 38%	15,000,000
18,333,333	No limit	35%	0

- US rates provide a slight tax advantage for small businesses
- Rates are an effective 34% for TI > $335,000 and flat at 35% for TI > $18.33 M

- Income tax rates are ***graduated*** or ***progressive*** as TI increases
- Each rate bracket is the ***marginal tax rate*** for the TI range

Average and Effective Tax Rates

Marginal tax rates change as TI increases. Calculate an average tax rate using:

$$\text{Average tax rate} = \frac{\text{total taxes paid}}{\text{taxable income}} = \frac{\text{taxes}}{\text{TI}}$$

To approximate a single-figure tax rate that combines local (e.g., state) and federal rates calculate the effective tax rate T_e

$$T_e = \text{local rates} + (1 - \text{local rates}) \times \text{federal rate}$$

$$\text{Taxes} = T_e \times TI$$

Example: Income Tax Calculations

Annual operating revenue is $1.2 million with expenses of $0.4 million and $350,000 depreciation on assets. The state imposes a flat rate of 5% of all TI. Determine (a) actual taxes and (b) approximate taxes using T_e.

Solution:

(a) TI = GI – OE – D = 1.20 - 0.40 – 0.35 = $0.45 (in $ million)

Use TI bracket $335,000 to $10 million; T = 0.34

Federal taxes = 113,900 + 0.34(450,000 – 335,000) = $153,000

State + federal taxes = 0.05(450,000) + 153,000 = $175,500

(b) Effective federal rate for TI bracket is 34%

T_e = 0.05 + (1 – 0.05)(0.34) = 0.373

Taxes = 0.373 (450,000) = $167,850

Approximation underestimates actual by 4.4%

Income Taxes for Individuals

Compare relations for individuals with corporations

- **Gross Income** (corporation: GI = all revenues)

  GI = salaries + wages + interest and dividends + other income

- **Taxable Income** (corporation: TI = GI – OE - D)

  TI = GI – personal exemption – standard or itemized deductions

- **Taxes** (Individual and corporate rates are graduated by TI)

  Taxes = taxable income × tax rate = TI × *T*

Cash Flow After Taxes (CFAT)

- NCF is cash inflows – cash outflows. Now, consider taxes and deductions, such as depreciation
- Cash Flow Before Taxes (CFBT)

  CFBT = gross income – expenses – initial investment + salvage value

  = GI – OE – P + S
- Cash Flow After Taxes (CFAT)

  CFAT = CFBT – taxes

  = GI – OE – P + S – (GI – OE – D)(T_e)

Effects on Taxes of Depreciation Method and Recovery Period

Goal is to **minimize PW of taxes,** which is equivalent to **maximizing PW of depreciation**

DEPRECIATION METHOD

All methods have the same amount of total taxes due

Accelerated depreciation methods result in lower PW_{taxes}

General observation for SL, DDB and MACRS methods:

$MACRS\ PW_{taxes} < SL\ PW_{taxes} < DDB\ PW_{taxes}$

(Note: with same single tax rate, recovery period and salvage value)

RECOVERY PERIOD

All lengths have the same amount of total taxes due

Shorter recovery periods result in lower PW_{taxes}

General goal: use shortest (MACRS) recovery period allowed

(Note: with same single tax rate, depreciation method and salvage value)

Depreciation Recapture (DR) and Capital Gain (CG)

DR, also called ordinary gain, in year t occurs when an asset is sold for more than its BV_t

$$DR = \text{selling price} - \text{book value} = SP - BV_t$$

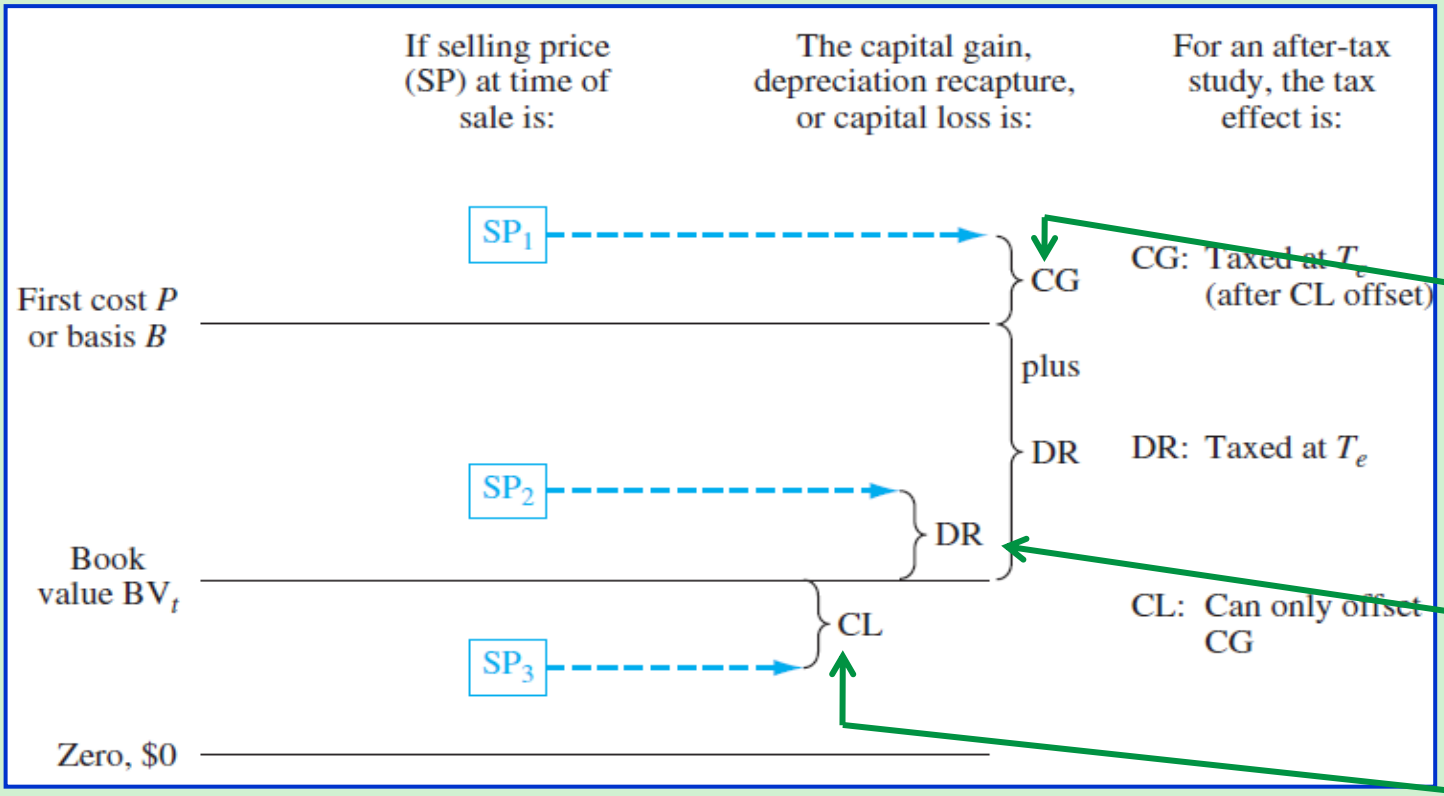
CG occurs when an asset is sold for more than its unadjusted basis *B* (or first cost *P*)

$$CG = \text{selling price} - \text{basis} = SP - B$$

CL occurs when an asset is sold for less than its current BV_t

$$CL = \text{book value} - \text{selling price} = BV_t - SP$$

Effects of DR, CG and CL on TI and Taxes



CG = SP_1 - B

DR = SP_2 - BV

CL = BV – SP

Update of TI relation: TI = GI – OE – D + DR + net CG – net CL

Example: Depreciation Recapture

A laser-based system installed for B = $150,000 three years ago can be sold for SP = $180,000 now. Based on 5-year MACRS recovery, BV_3 = $43,200. GI for year is $800,000 and annual operating expenses average $50,000. Determine TI and taxes if T_e = 34% and the system is sold now.

Solution: **Depreciation recapture and capital gain are present**

DR = 180,000 – 43,200 = $136,800
CG = 180,000 – 150,000 = $30,000
MACRS D_3 = 0.192(150,000) = $28,800

$$TI = GI - OE - D + DR + CG$$
$$= 800,000 - 50,000 - 28,800 + 136,800 + 30,000$$
$$= \$888,000$$

$$Taxes = TI \times T_e = 888,000 \times 0.34 = \$301,920$$

Note: If not sold now, taxes = (800,000 – 50,000 – 28,800) × (0.34) = $245,208

After-Tax Evaluation

- ✓ Use CFAT values to calculate PW, AW, FW, ROR, B/C or other measure of worth using after-tax MARR
- ✓ Same guidelines as before-tax; e.g., using PW at after-tax MARR:
  - One project: PW ≥ 0, project is viable
  - Two or more alternatives: select one ME alternative with best (numerically largest) PW value
- ✓ For costs-only CFAT values, use + sign for OE, D, and other savings and use same guidelines
- ✓ Remember: equal-service requirement for PW-based analysis
- ✓ ROR analysis is same as before taxes, except use CFAT values:
  - One project: if i* ≥ after-tax MARR, project is viable
  - Two alternatives: select ME alternative with Δi^* ≥ after-tax MARR for incremental CFAT series

Approximating After-Tax ROR Value

To adjust a before-tax ROR without details of after-tax analysis, an approximating relation is:

$$\text{After-tax ROR} \approx \text{before-tax ROR} \times (1 - T_e)$$

Example: P = $-50,000 GI – OE = $20,000/year

n = 5 years D = $10,000/year T_e = 0.40

Estimate after-tax ROR from before-tax ROR analysis

Solution: Set up before-tax PW relation and solve for i*

$$0 = -50{,}000 + 20{,}000(P/A,i^*\%,5)$$

$$i^* = 28.65\%$$

$$\text{After-tax ROR} \approx 28.65\% \times (1 - 0.40) = 17.19\%$$

(Note: Actual after-tax analysis results in i* = 18.03%)

Example: After-Tax Analysis

Asset: B = \$90,000 S = 0 n = 5 years

Per year: R = \$65,000 OE = \$18,500 D = \$18,000

Effective tax rate: $T_e = 0.184$

Find ROR (a) before-taxes, (b) after-taxes actual and (c) approximation

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	A	B	C	D	E	F	G	H	I
1		Revenue,	Operating	Basis, B and		Depreciation,	Taxable	Taxes	
2	Year	R	Expenses, OE	Salvage, S	CFBT	D	Income, TI	at $T_e = 0.184$	CFAT
3	0			90,000	-90,000				-90,000
4	1	65,000	18,500		46,500	18,000	28,500	5,244	41,256
5	2	65,000	18,500		46,500	18,000	28,500	5,244	41,256
6	3	65,000	18,500		46,500	18,000	28,500	5,244	41,256
7	4	65,000	18,500		46,500	18,000	28,500	5,244	41,256
8	5	65,000	18,500	0	46,500	18,000	28,500	5,244	41,256
9									
10			(a) Before-tax ROR:		43%		(b) After-tax ROR:		36%

(c) By approximation: after-tax ROR = 43% × (1 – 0.1840) = 35%