

# Chapter 6

## After-tax Economic Analysis

# LEARNING OBJECTIVES

- 1. Determining cash flows before taxes(CFBT) and after taxes (CFAT)**
- 2. Effects of depreciation on taxes**
- 3. Determining the Rate of Return**
- 4. Understanding value-added tax (VAT)**

# 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

$$\text{NOI} = \text{GI} - \text{OE} \quad (\text{only actual cash involved})$$

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

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Taxable income = gross revenue – operating expenses – depreciation

$$\text{TI} = \text{GI} - \text{OE} - \text{D} \quad (\text{involves noncash item})$$

**Note:** All terms and relations are calculated for each year  $t$ , but the subscript is often omitted for simplicity

# After Tax Cash Flow

**Once firms are able to calculate their taxes, then the taxes are incorporated into engineering economic analysis evaluations to determine the after-tax cash flow (ATCF).**

**After-tax cash flows are used when calculating the after-tax rate of return, net present worth, future worth, and equivalent uniform annual worth.**

**The calculations for solving for these values use the same equations introduced in the previous chapters, but taxes are subtracted from the revenue before any of the formulas are applied to calculate these values**

# After Tax Cash Flow

**Up until this chapter, all of the cash flow problems have been before-tax cash flows (BTCFs).**

**At this point, all of the cash flows become ATCFs since in the United States ATCFs are the accurate method for determining engineering economic values.**

# After Tax Cash Flow

The principal elements of ATCFs are the following

- ✓ Before-tax cash flow
- ✓ Depreciation
- ✓ Taxable income (Before-tax cash flow – Depreciation)
- ✓ Income taxes (Taxable income  $\times$  tax rate)
- ✓ After-tax cash flow (Before-tax cash flow – Income taxes)

These elements are usually arranged to form an after-tax cash flow table

# After Tax Cash Flow

Table 14.2 provides a spreadsheet format for tabulating the elements required for developing ATCFs.

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**TABLE 14.2**

## Before-Tax and After-Tax Cash Flow Format

Before-Tax Cash		Taxable Income		Income taxes	After-Tax Cash Flow
Year	Flow (BTCF)	Depreciation	(BTCF–Depreciation)	(Taxable Income × Tax Rate)	(BTCF–Income Taxes)

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# After Tax Cash Flow

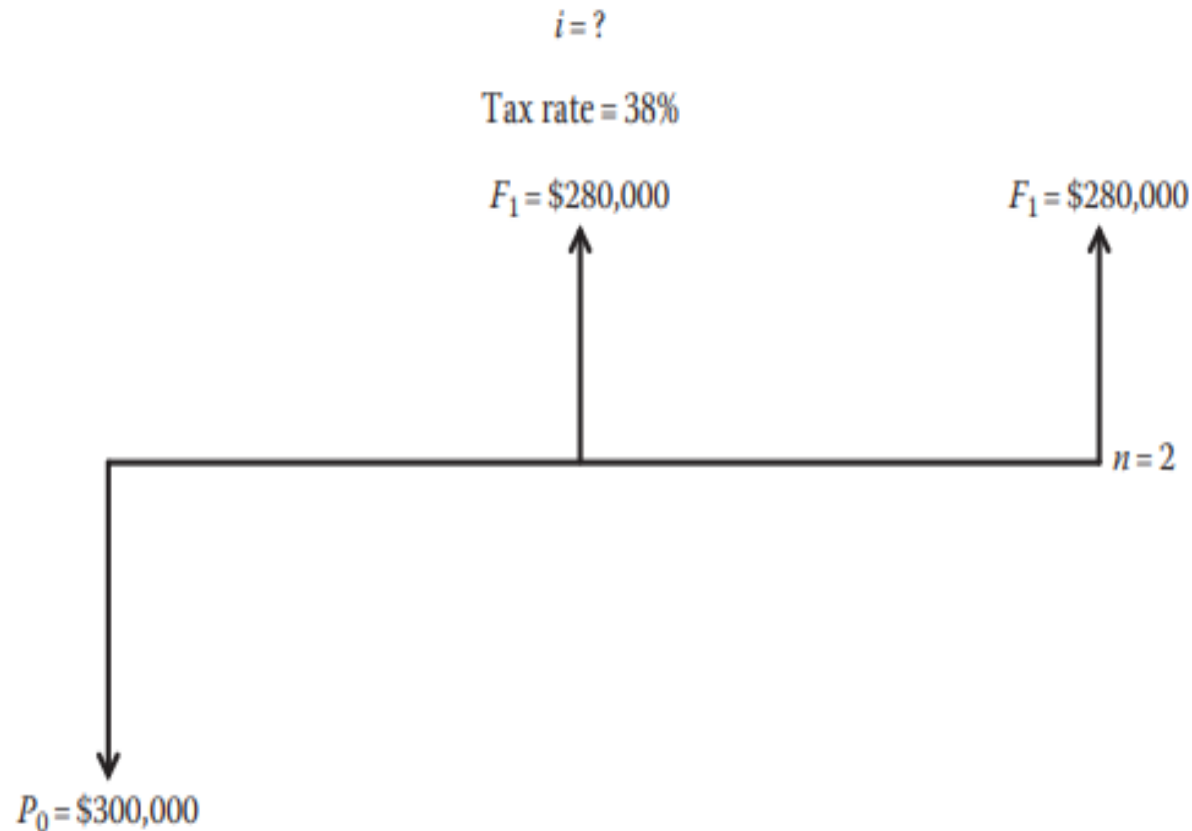
## Example

The owner of a chemical processing firm pays \$300,000.00 for a new piece of machinery. The firm is able to earn \$280,000.00 from the machinery in years one and two. The machinery will have a salvage value of \$75,000.00 at year five. Calculate the after-tax rate of return for years one and two using straight line depreciation and a corporate tax rate of 38%.

Figure 14.1 is the before tax cash flow diagram for the chemical processing machinery



# After Tax Cash Flow



**FIGURE 14.1** Before-tax cash flow diagram for the processing machinery in Example 14.4.

# After Tax Cash Flow

## Solution

First, calculate the straight line depreciation for years one and two using Equation 13.2:

$$\begin{aligned}\text{Straight line depreciation} &= \frac{P-F}{n} = \frac{\$300,000.00 - \$75,000.00}{5} = \frac{\$225,000.00}{5} \\ &= \$45,000.00\end{aligned}$$

Second, develop Table 14.3 using the format in Table 14.2 with before-tax cash flow, depreciation, taxable income, income taxes, and the after-tax cash flow for the first two years.

**TABLE 14.3**  
**Before-Tax and After-Tax Cash Flows for Example 14.4**

Year	BTCF	Straight Line Depreciation	Taxable Income (BTCF – Depreciation)	Income Taxes (Taxable Income × Tax Rate)	ATCF (BTCF – Income Taxes)
0	– \$300,000.00	—	—	—	– \$300,000.00
1	+ \$280,000.00	\$45,000.00	\$280,000.00 – \$45,000.00 = \$235,000.00	\$235,000.00 × 0.38 = \$89,300.00	\$280,000.00 – \$89,300.00 = \$190,700.00
2	+ \$280,000.00	\$45,000.00	\$280,000.00 – \$45,000.00 = \$235,000.00	\$235,000.00 × 0.38 = \$89,300.00	\$280,000.00 – \$89,300.00 = \$190,700.00

# After Tax Cash Flow

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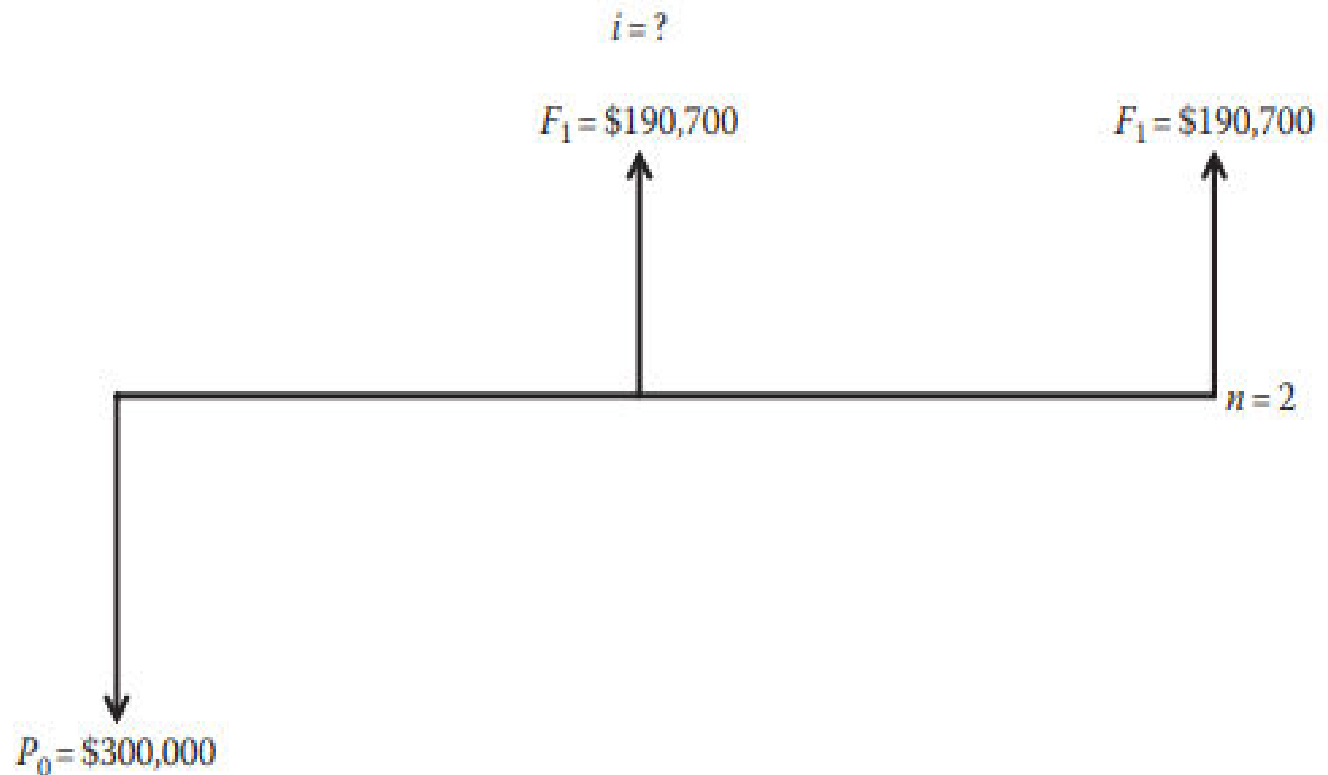
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Year	BTCF	Straight Line Depreciation	Taxable Income (BTCF – Depreciation)	Income Taxes (Taxable Income × Tax Rate)	ATCF (BTCF – Income Taxes)
0	– \$300,000.00	—	—	—	– \$300,000.00
1	+ \$280,000.00	\$45,000.00	\$280,000.00 – \$45,000.00 = \$235,000.00	\$235,000.00 × 0.38 = \$89,300.00	\$280,000.00 – \$89,300.00 = \$190,700.00
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# After Tax Cash Flow

Third, draw the after-tax cash flow diagram, as shown in Figure 14.2.



**FIGURE 14.2** After-tax cash flow diagram for the processing machinery in Example 14.4.

# After Tax Cash Flow

Fourth, develop the net present worth equation for the after-tax cash flow:

$$\begin{aligned} NPW &= P_0 + A(P/A, i, n) \\ &= -\$300,000.00 + \$190,700.00(P/A, i, 2) \end{aligned}$$

Fifth, use trial and error in the net present worth equation to calculate the unknown rate of return.

Try 15%:

$$\begin{aligned} &= -\$300,000.00 + \$190,700.00(1.6257) = -\$300,000.00 + \$310,020.99 \\ &= \$10,020.99 \end{aligned}$$

Try 20%:

$$\begin{aligned} &= -\$300,000.00 + \$190,700.00(1.5277) = -\$300,000.00 + \$291,332.39 \\ &= -\$8,667.61 \end{aligned}$$

# After Tax Cash Flow

Sixth, use interpolation and Table 14.4 to calculate the rate of return:

**TABLE 14.4**

**Table for Developing Interpolation Problem for Unknown Rate of Return with  $n = 2$  Years for Example 14.4**

	ROR		Net Present Worth	
$d$	15%		10,020.99	$a$
	Unknown ROR		0	
	20%		-8,667.61	
				$b$

# After Tax Cash Flow

$$\text{ROR} = c + \left( \frac{a}{b} \right) d$$

$$\text{ROR} = 15 + \left( \frac{10,020.99 - 0}{10,020.99 - (-8,667.61)} \right) \times (20 - 15)$$

$$= 15 + \left( \frac{10,020.99}{18,688.60} \right) \times 5$$

$$= 15 + (0.536209 \times 5)$$

$$= 15 + 2.6810$$

$$= 17.68\%$$

# After Tax Cash Flow

## Example

A medium-sized profitable corporation may buy a \$15,000 used pickup truck for use by the shipping and receiving department. During the truck's 5-year useful life, it is estimated the firm will save \$4000 per year after all the costs of owning and operating the truck have been paid. Truck salvage value is estimated at \$4500.

- (a) What is the before-tax rate of return?
- (a) What is the after-tax rate of return on this capital expenditure?  
Assume straight-line depreciation.



# After Tax Cash Flow

**TABLE 12-3 After-Tax Cash Flow Table for Example 12-5\***

Year	(a) Before-Tax Cash Flow	(b) Straight-Line Depreciation	(c) $\Delta(\text{Taxable Income})$ (a) – (b)	(d) 34% Income Taxes –0.34 (c)	(e) After-Tax Cash Flow (a) + (d) <sup>†</sup>
0	–\$15,000				–\$15,000
1	4000	\$2100	\$1900	–\$646	3354
2	4000	2100	1900	–646	3354
3	4000	2100	1900	–646	3354
4	4000	2100	1900	–646	3354
5	$\begin{cases} 4000 \\ 4500 \end{cases}$	2100	1900	–646	$\begin{cases} 3354 \\ 4500 \end{cases}$

IRR<sub>bt</sub> = 16.7% ; IRR<sub>at</sub> = 11.2%

# After Tax Cash Flow

Taxable income is the before-tax cash flow minus depreciation.

For this medium-sized profitable corporation, let's assume an incremental federal income tax rate of 34%.

Therefore income taxes are 34% of taxable income.

Finally, the after-tax cash flow equals the before-tax cash flow minus income taxes.

# Value-Added Tax (VAT)

VAT is an **indirect tax placed on goods and services**, not on people and corporations like an income tax. The VAT is charged sequentially throughout the process of manufacturing a good or providing a service. The VAT is also called **Goods and Service Tax (GST)**.

## **VAT CHARACTERISTICS**

A percent, e.g., 10%, of current value, of **unfinished** goods or service (G/S) is charged to the purchaser and sent to taxing entity by manufacturer or provider

VAT charged to buyer at purchase time whether buyer is an end user or intermediate business

As next transfer occurs, VAT previously paid on unfinished G/S is subtracted from VAT currently due

## **SALES TAX CHARACTERISTICS**

Charged only **once** at final product sale to the **end user or consumer**

Selling merchant sends tax to taxing entity

Businesses do not pay sales tax on raw materials or unfinished goods or service

Businesses do pay sales tax on items for which they are the end user

# Example: How a 10% VAT Could Work in the US

1. **Mining company** sells \$100,000 of iron ore to Steel company and charges Steel company 10% VAT, or \$10,000. **Mining company** sends \$10,000 to US Treasury.
2. Steel company sells steel for \$300,000 to **Refrigerator company** and charges Refrigerator company 10% VAT, or \$30,000. Steel company sends  $\$30,000 - 10,000 = \$20,000$  to US Treasury.
3. **Refrigerator company** sells refrigerators to **Retail company** for \$700,000 and charges Retailer 10% VAT, or \$70,000. **Refrigerator company** sends  $\$70,000 - 30,000 = \$40,000$  to US Treasury.
4. Finally, **Retailer** sells refrigerators to **end users/consumers** - for \$950,000 and collects 10% VAT, or \$95,000, from consumers. **Retailer** sends  $\$95,000 - 70,000 = \$25,000$  to US Treasury.

**Conclusion: US Treasury received  $\$25,000 + 40,000 + 20,000 + 10,000 = \$95,000$ , which is 10% of final sales price of \$950,000**

# Summary of Important Points

A medium-sized profitable corporation may buy a \$15,000 used pickup truck for use by the shipping and receiving department. During the truck's 5-year useful life, it is estimated the firm will save \$4000 per year after all the costs of owning and operating the truck have been paid. Truck salvage value is estimated at \$4500. a. What is the before-tax ROR? b. What is the after-tax ROR? Assume straight-line depreciation, 34% tax rate.