



CHAPTER 11.

DEPRECIATION

Firms in most countries pay taxes, and depreciation is an important element of determining corporate income taxes. When firms purchase capital assets that last for several years, only parts of the cost can be depreciated each year. Depreciation rules and regulations can affect firm's decision making process.



1. HOW MUCH DID YOU MAKE LAST YEAR?

- This is a typical question to anyone who runs a business.
 - The measure of a business's success is its *profit*.
 - However, firms have to pay *taxes* which are levied on the percentage of *profit* (= revenue – expense).
 - Note that expenses are deducted from the tax base.
- How to calculate the *after-tax* profit?
 - Annual expenses (wages, materials, etc.) are deducted each year.
 - The cost of a *long-lived asset* (or capital), however, should be allocated over a number of periods.
 - The mechanism of allocating capital cost to the annual expense in each year is called “**depreciation**.”
 - Tax amount = tax rate \times (revenue – annual expense – depreciation)
 - After-tax profit = before-tax profit – tax amount

1.1. REASONS FOR DEPRECIATION

- What is depreciation?
 - Decrease in values (of capital assets).
- Why does depreciation occur?
- Deterioration
 - A machine is deteriorating or wearing out, and may no longer be performing its function.
 - It can be due to *use-related* physical loss (tire, engine, light bulb) or *time-related* physical loss (unused car).
- Obsolescence
 - A newer model makes an existing machine obsolete.
 - This loss is due to changes in *style*, *standard* or *technology*.
 - Introduction of computer has made calculator obsolete.
 - Introduction of DVD has made VHS tape obsolete in home video.

1.2. DEPRECIATION AND EXPENSES

- Business-related costs are either *expensed* or *depreciated*.
- **Expensed** items (or **operating expenses**)
 - They are “consumed” over short period of time, often within a year.
 - Examples: Labor, utilities, materials, insurance, etc.
 - Firms are able to *write off* the expenses when they occur (in a year).
- **Depreciation** (or **capital expenses**)
 - Capital assets (building, equipment, machine) lose value gradually over time.
 - They are not fully written off when they occur or within a year.
 - They must be depreciated over its *depreciable life*.

▪ Why depreciation analysis?

1.3. MORE ON DEPRECIATION

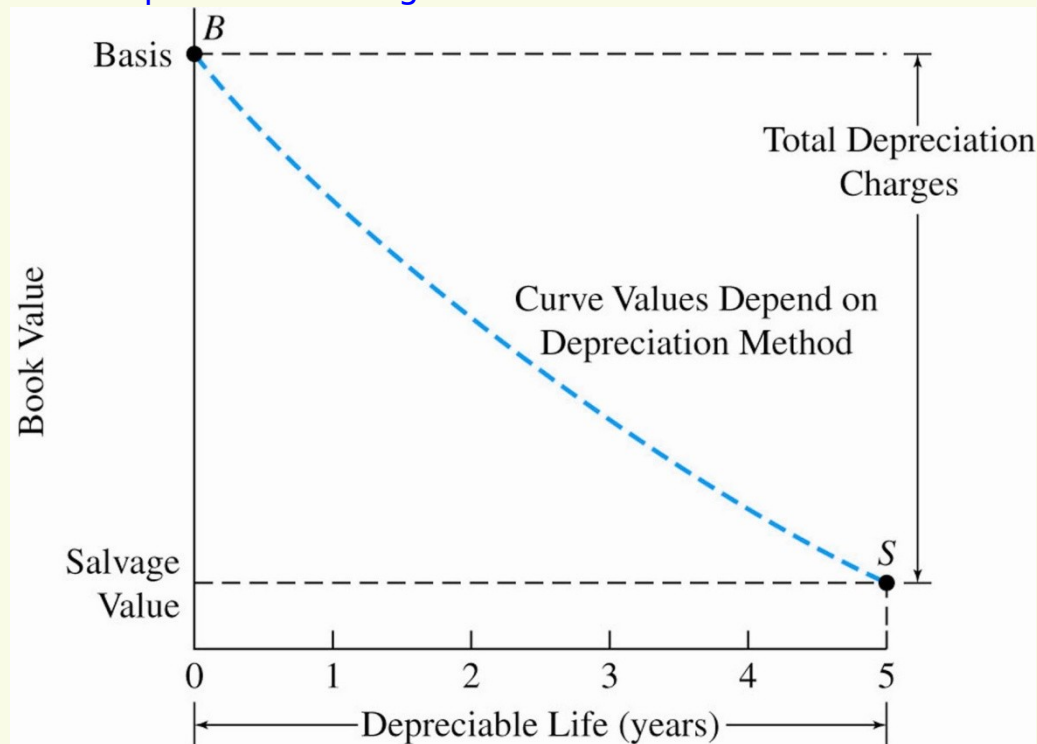
- *Depreciable life* is different from the asset's *economic life*.
 - It is determined by the depreciation method.
 - Government usually sets the depreciable life for each asset.
- Depreciation is a *non-cash* cost.
 - The depreciation expense in each year is not the actual cash flow.
 - The company has already paid for the assets up front.
 - Depreciation is simply a way to claim business expenses over time, mainly to reduce the taxable income and the amount of tax paid.
- Requirements for depreciation
 - The property must be used for *business purposes* to produce income.
 - The property must have a *useful life* which is longer than one year.
 - The property must be an asset that decays, wears out, become obsolete, or *lose value* to the owner from natural causes.

1.4. TYPES OF PROPERTY

- The rules for depreciation depend on the classification of business property.
- **Tangible property** (can be seen, touched, and felt)
 - Real property: land, buildings, or things attached to the land.
 - Personal property: equipment, vehicles, office machinery, and anything that is tangible excluding real estate property.
- **Intangible property** (cannot be directly seen or touched)
 - Examples are patents, copyrights, and trademarks.
- Most tangible property can be depreciated. Any counterexample?
 - *Land*: Land never depreciated, though its value may fluctuate.
 - *Antiques*: Some music instruments or cars appreciate!
 - *Landscaping* cannot be depreciated because it has no useful life.
 - *Leased property*: Only the owner may claim depreciation expenses.

1.5. FUNDAMENTALS OF DEPRECIATION CALCULATION

- Book value (BV_t) = Cost basis (B) - all depreciation ($\sum d_j$)
 - BV_t : Book value at the end of time t .
 - Cost basis (B): Base asset price (= purchase cost + other initial cost)
 - $\sum d_i$ = Accumulated depreciation charges from time 1 to t .



2. DEPRECIATION METHODS

- Firms may want to depreciate the assets in a way that minimizes the amount of tax paid (that is, a quick depreciation).
- However, for tax purposes, governments specify exactly how depreciation is to be calculated.
 - Canada: **Capital Cost Allowance (CCA) system**
 - United States: Modified Accelerated Cost Recovery System (MACRS)
 - Most of the current systems are based on the following four methods.
- General depreciation methods
 - Straight-line (SL) depreciation
 - Sum-of-years-digits (SOYD) depreciation
 - Declining-balance (DB) depreciation
 - Unit-of-production (UOP) depreciation

2.1. STRAIGHT-LINE DEPRECIATION

- Straight-line (SL) depreciation
 - The *amount* of loss in value of an asset (i.e., amount of depreciation) is constant over time.
 - This method is often used for depreciation of *intangible property*. (e.g., patent, copyright, etc.)
 - This method is easy to understand and calculate.
 - However, the book value is often too different from the *market value*.
- Annual depreciation charge

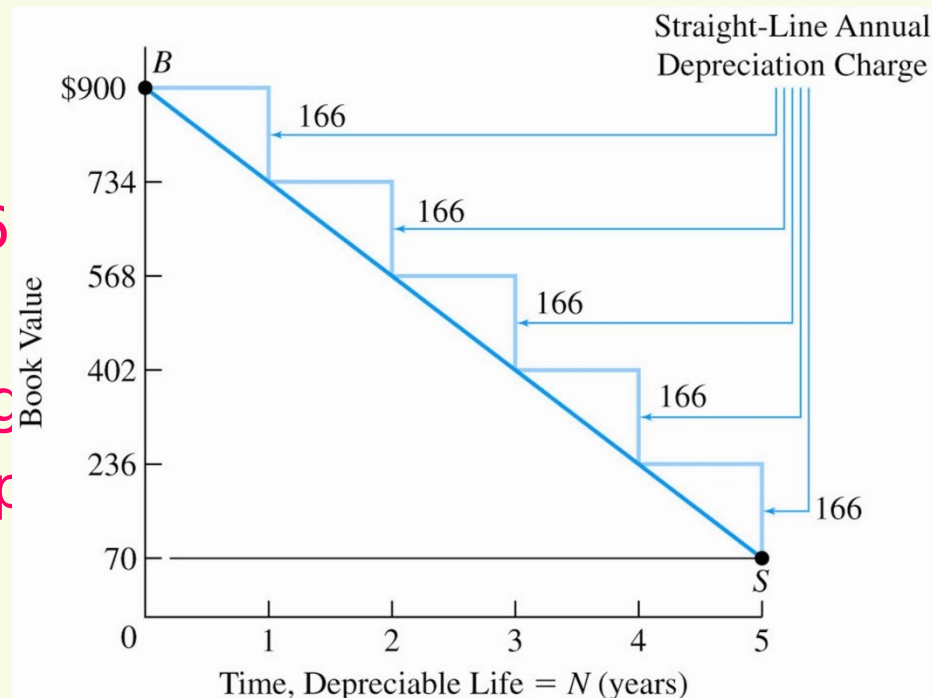
$$d_t = (B - S)/N$$

where d_t : Depreciation charge in year t
 B : Cost of the asset made ready for use (cost basis)
 S : Estimated salvage value after depreciable life
 N : Number of years in depreciable life

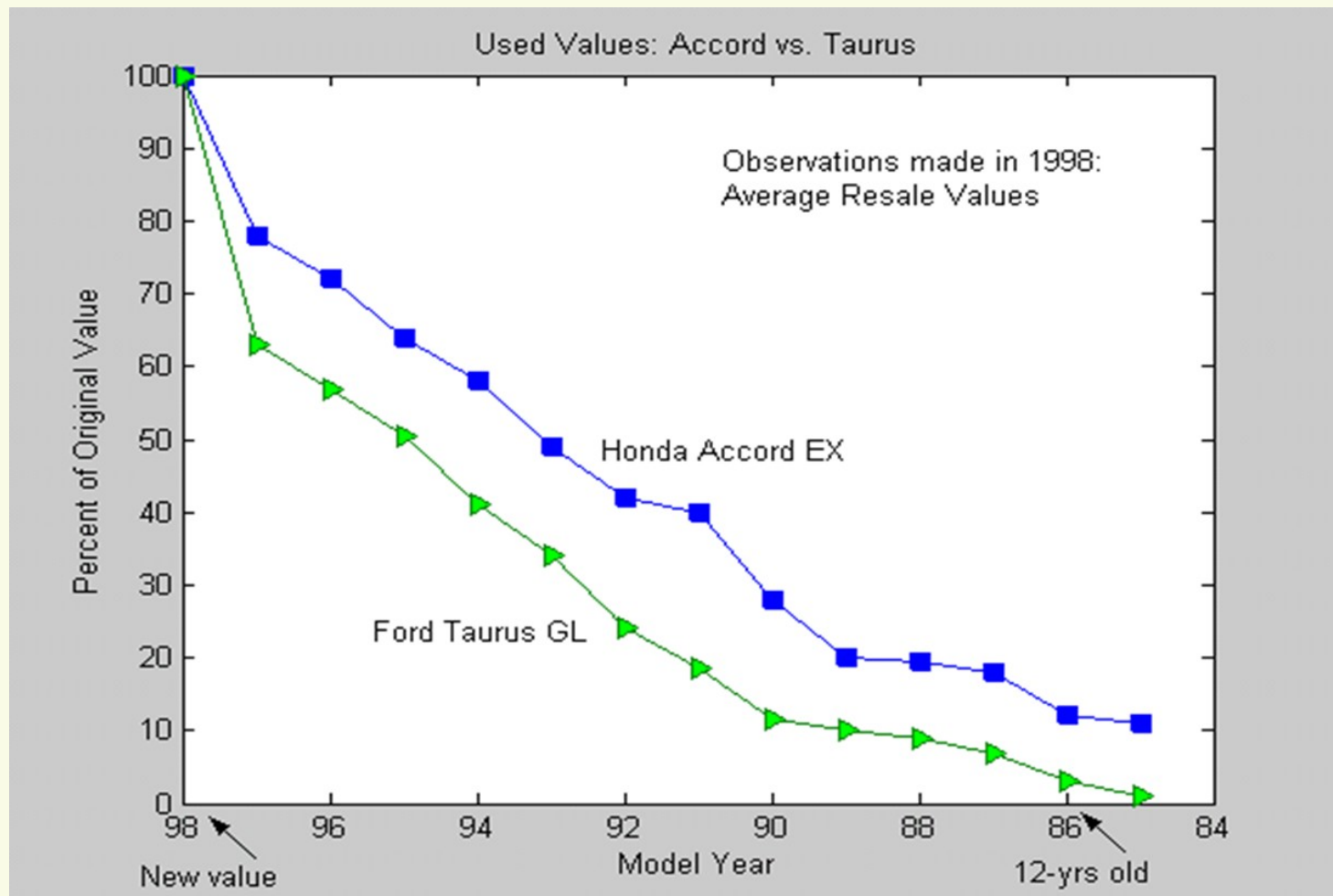
EXAMPLE 2-1. SL DEPRECIATION

- Consider the following costs.
 - Cost of the asset, $B = \$900$
 - Depreciable life in years, $N = 5$
 - Salvage value, $S = \$70$
- Compute the straight line depreciation schedule.

- $d = (B - S)/N$
 $= (900 - 70)/5 = \$166$
- d is constant at \$166.
- Each year, \$166 is charged as an annual capital expense



CASE 2-1. MARKET VALUE OF A USED CAR



2.2. SUM-OF-YEARS'-DIGITS DEPRECIATION

- Sum-of-years'-digit (SOYD) depreciation
 - It leads to larger-than the straight-line depreciation charges in early years, and smaller charges in later years.
 - The amount of depreciation in each year is decreasing.
 - The depreciation pattern is similar to the market value.
- Annual depreciation charge
 - Each year, the depreciation charge equals a fraction of the total amount to be depreciated ($B - S$).

$$d_t = [(N - t + 1)/\text{SOYD}](B - S)$$

where $\text{SOYD} = N(N + 1)/2$, sum of years' digits

- For $N = 5$, $\text{SOYD} = (5 \times 6)/2 = 15$.
- In the first year, 5/15 (or 33%) is depreciated, 4/15 (26%) in the second year, 3/15 (20%) in the third year, etc.

EXAMPLE 2-2. SOYD DEPRECIATION

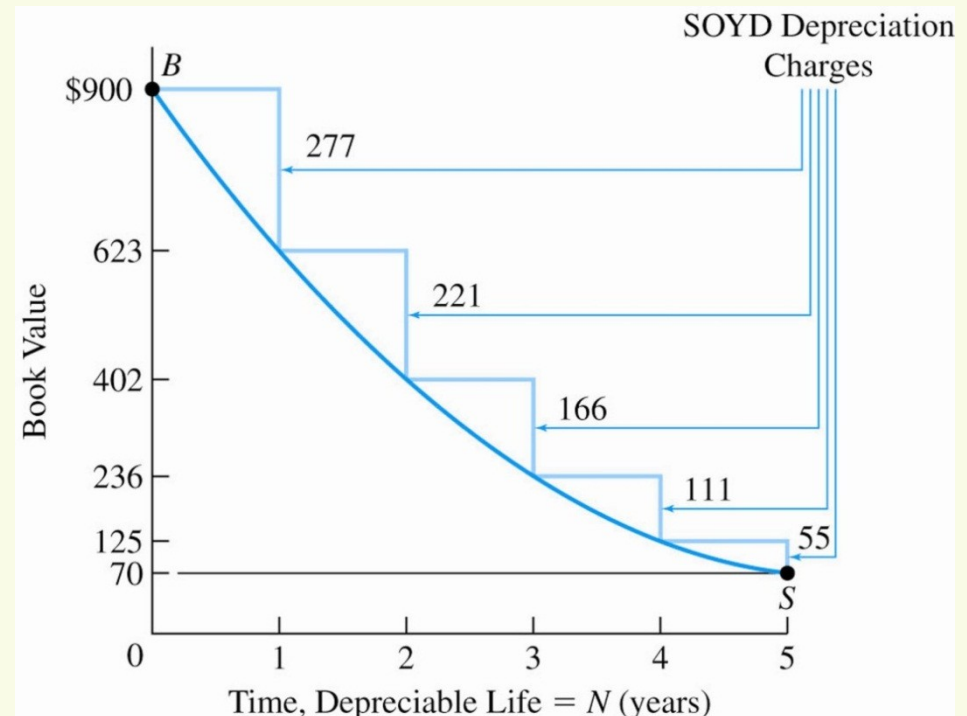
- Compute the SOYD depreciation schedule for the previous example: $B = \$900$, $N = 5$ and $S = \$70$.

$$\text{SOYD} = (5 \times 6)/2 = 15 \quad (= 1 + 2 + 3 + 4 + 5)$$

$$d_1 = 5/15 (900 - 70) = 277, d_2 = 4/15 (900 - 70) = 221, \dots$$

$$d_5 = 1/15 (900 - 70) = 55$$

	d_t	Σd_t	BV
0			900
1	277	277	623
2	221	498	402
3	166	664	236
4	111	775	125
5	55	830	70 (= S)



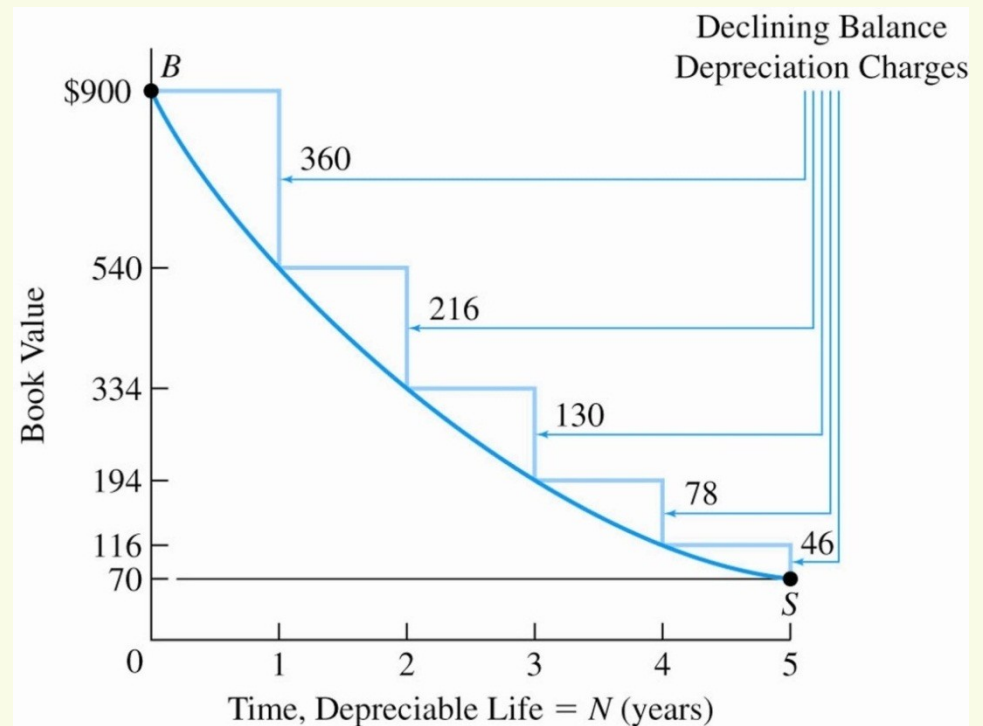
2.3. DECLINING-BALANCE DEPRECIATION

- Declining balance (DB) model
 - Depreciation is applied at a constant *depreciation rate* (D) to the property's declining book value.
 - Like SOYD, depreciation is faster in the earlier life of an asset.
 - It does not depreciate completely, so that straight line depreciation is used at the last year in the United States.
- Annual depreciation charge
 - $d_1 = D \cdot B$
 - $d_2 = D \cdot (B - d_1) = D \cdot B(1 - D)$
 - $d_3 = D \cdot (B - d_1 - d_2) = D \cdot B(1 - D)^2$
 - $d_t = D \cdot B(1 - D)^{t-1}$ where $BV_{t-1} = B(1 - D)^{t-1}$
 - *Double declining balance (DDB)*: The depreciation rate is $2/N$.
 - $d_t = (2/N)(BV_{t-1})$

EXAMPLE 2-3. DDB DEPRECIATION

- Compute the DDB depreciation schedule for the previous example: $B = \$900$, $D = 40\%$ and $S = \$70$.
 - The depreciation rate is $2/5$ ($= 40\%$): double-declining balance
 - $d_1 = 40\% \times 900 = 360$,
 - $d_2 = 40\% \times (900 - 360) = 216$

	d_t	Σd_t	BV
0			900
1	360	360	540
2	216	576	324
3	130	706	194
4	78	784	116
5	46	830	70 (= S)



2.4. UNIT-OF-PRODUCTION DEPRECIATION

- The three methods discussed up to now have considered depreciation based on the *years* of use.
- However, in some situations, depreciation may be based on the *use or amount of production*.
 - This method is useful for machinery that processes *natural resources*.
 - *Construction equipment* has very heavy use in some years and very light use in other years.
 - Thus, depreciation by production can be more appropriate than depreciation by time.
 - However, this approach is not an acceptable method for general use in depreciating industrial equipment.
- Unit-of-production (UOP) depreciation

$$\text{UOP} = (\text{Production} / \text{Total lifetime production})(B - S)$$

EXAMPLE 2-4. UOP DEPRECIATION

- An equipment costing \$900 has been purchased for use in a sand and gravel pit. The pit will operate for 5 years, and then sold for \$70. Compute the unit-of-production depreciation schedule if the construction schedule calls for 40 000 m³ of sand and gravel.

Year	Gravel required	UOP depreciation	d_t	BV_t
0				900
1	4,000	$(4,000/40,000)(900 - 70)$	83	817
2	8,000	$(8,000/40,000)(900 - 70)$	166	651
3	16,000	$(16,000/40,000)(900 - 70)$	332	319
4	8,000	$(8,000/40,000)(900 - 70)$	166	153
5	4,000	$(4,000/40,000)(900 - 70)$	83	70

2.5. QUICK VS. SLOW DEPRECIATION? (1)

- Does a firm want to depreciate its asset quickly or slowly?
 - It wants a quick depreciation. Why?
 - Tax saving in early periods can generate interest income in the future.
- Consider a capital depreciation structure of a firm.
 - It just purchased a \$20,000 machine with a service life of 5 years (with no salvage value).
 - Its annual revenue is \$20,000 and there is no operating expense.
 - Assume the tax rate is 40% and the interest rate is 10%.
- We can compare the net cash savings at the *end of 5 years* for the case of
 - Full depreciation in one year (quick depreciation)
 - Straight-line depreciation over five years (slow depreciation).

2.5. QUICK VS. SLOW DEPRECIATION? (2)

- We can compare the *future worth* at the end of year 5.

Yr	Revenue	<u>Full depreciation</u>			<u>Straight-line depreciation</u>		
		Dep.	Tax (40%)	Cash	Dep.	Tax (40%)	Cash
1	20,000	20,000	0	20,000	4,000	6,400	13,600
2	20,000	0	8,000	12,000	4,000	6,400	13,600
3	20,000	0	8,000	12,000	4,000	6,400	13,600
4	20,000	0	8,000	12,000	4,000	6,400	13,600
5	20,000	0	8,000	12,000	4,000	6,400	13,600

3. CAPITAL COST ALLOWANCE (CCA)

- The purpose of studying depreciation is to calculate the *amount of tax* to be paid in each year.
 - Canada Revenue Agency (CRA) is responsible for collecting income taxes, both from individuals and firms.
 - While tax laws are changing, the fundamental principle is the same.
- Business income tax in Canada
 - Most important rules in taxation are related to *capital expense*.
 - Most capital assets are depreciated by the **declining-balance model**, at a rate specified in the tax legislation.
 - Taxpayers have no option as to the depreciation method or the depreciation rate to be used.
 - The amount of allowable depreciation is called the **Capital Cost Allowance (CCA)** in Canada.

3.1. DETAILS OF CAPITAL COST ALLOWANCE

- Asset-class accounting
 - Assets are pooled by class and the government sets the depreciation rate for each class, called the **Capital Cost Allowance (CCA) rate**.
 - The CCA for any year is the *remaining balance* at the end of the year times the *capital cost allowance rate* for the class.
 - The company can choose anywhere between zero and the CCA rate. Which one will it choose?
- **Half-year rule**
 - Since 1981, the CCA of the *first year* is only half of the normal maximum CCA amount for the year.
 - However, the firm can claim the full CCA from the 2nd taxation year.
 - *Disposal* of assets during the year is first netted against *acquisitions* made in the same year.
 - This rule does not apply to the assets with 100% CCA rate.

3.1. ACCELERATED CCA

- The government often uses taxes as a means of encouraging specific behavior.
 - It may want to encourage manufacturing investment (Class 29).
 - It may want firms to focus more on *clean energy generation* (Class 43.2).
- Accelerated CCA
 - The government allows a more rapid charging of depreciation expense for some investments, freeing up money for today's operation.
 - This benefit can be very critical when a business is starting a new line or product.
 - 25-50-25 split: Depreciation is allowed for 25% in the first year, 50% in the second year, and 25% in the third year.

3.1. CAPITAL COST ALLOWANCE (CCA) RATE

TABLE 11-1 CCA Asset Classes


CCA classes of commonly used business assets

Class	Rate %	Description
1	4	Most buildings you bought after 1987 and the cost of certain additions or alterations made after 1987. The rate for eligible non-residential buildings acquired after March 18, 2007, used for the manufacturing and processing in Canada of goods for sale or lease includes an additional allowance of 6% (total 10%). For all other eligible non-residential buildings in this class, the rate includes an additional allowance of 2% (total 6%). To be eligible for the additional allowance, elections have to be filed. For more information, see "Class 1 (4%)," on page 34.
3	5	Most buildings acquired before 1988 (or 1990, subject to certain conditions). Also include the cost additions or alterations made after 1987. For more information, see "Class 3 (5%)," on page 35.
6	10	Frame, log stucco on frame, galvanized iron, or corrugated metal buildings that meet certain conditions. Class also includes certain fences and greenhouses. For more information, see "Class 6 (10%)," on page 35.
8	20	Property that you use in your business that is not included in another class. Also included is data network infrastructure equipment and systems software for that equipment acquired before March 23, 2004. See also Class 46. For more information, see "Class 8 (20%).," on page 35.
10	30	General-purpose electronic data processing equipment (commonly called computer hardware) and systems software for that equipment acquired before March 23, 2004, or after March 22, 2004, and before 2005 if you made an election. Motor vehicles and some passenger vehicles. Also see Class 10.1. For more information, see "Class 10 (30%)," on page 36.
10.1	30	A passenger vehicle not included in Class 10. For more information, see "Class 10.1 (30%)," on page 36.
12	100	Under proposed changes, the cost limit for access to Class 12 (100%) treatment will increase to \$500 from \$200 for tools acquired on or after May 2, 2006, and medical and dental instruments and kitchen utensils acquired on or after May 2, 2006. For more information, see "Class 12 (100%)," on page 36.

Continued

3.2. CALCULATION OF CAPITAL COST ALLOWANCE

- Firms should fill out **Schedule 8** to claim *capital cost allowance*.


 Canada Customs and Revenue Agency Agence des douanes et du revenu du Canada

SCHEDULE 8

CAPITAL COST ALLOWANCE (CCA) (1998 and later taxation years)

Name of corporation						Business Number		Taxation year end Year Month Day				
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For more information, see the section called "Capital Cost Allowance" in the *T2 Corporation Income Tax Guide*.

Is the corporation electing under regulation 1101(5q)? **101** 1 Yes ☐ 2 No ☐

1	2	3	4	5	6	7	8	9	10	11	12	13
Class number	Undepreciated capital cost at the beginning of the year (undepreciated capital cost at the end of the year from last year's CCA schedule)	Cost of acquisitions during the year (new property must be available for use) See note 1 below	Net adjustments (show negative amounts in brackets)	Proceeds of dispositions during the year (amount not to exceed the capital cost)	Undepreciated capital cost (column 2 plus column 3 plus or minus column 4 minus column 5)	50% rule (1/2 of the amount, if any, by which the net cost of acquisitions exceeds column 5) See note 2 below	Reduced undepreciated capital cost (column 6 minus column 7)	CCA rate %	Recapture of capital cost allowance	Terminal loss	Capital cost allowance (column 8 multiplied by column 9; or a lower amount) See note 3 below	Undepreciated capital cost at the end of the year (column 6 minus column 12)
200	201	203	205	207		211		212	213	215	217	220
1.												
2.												

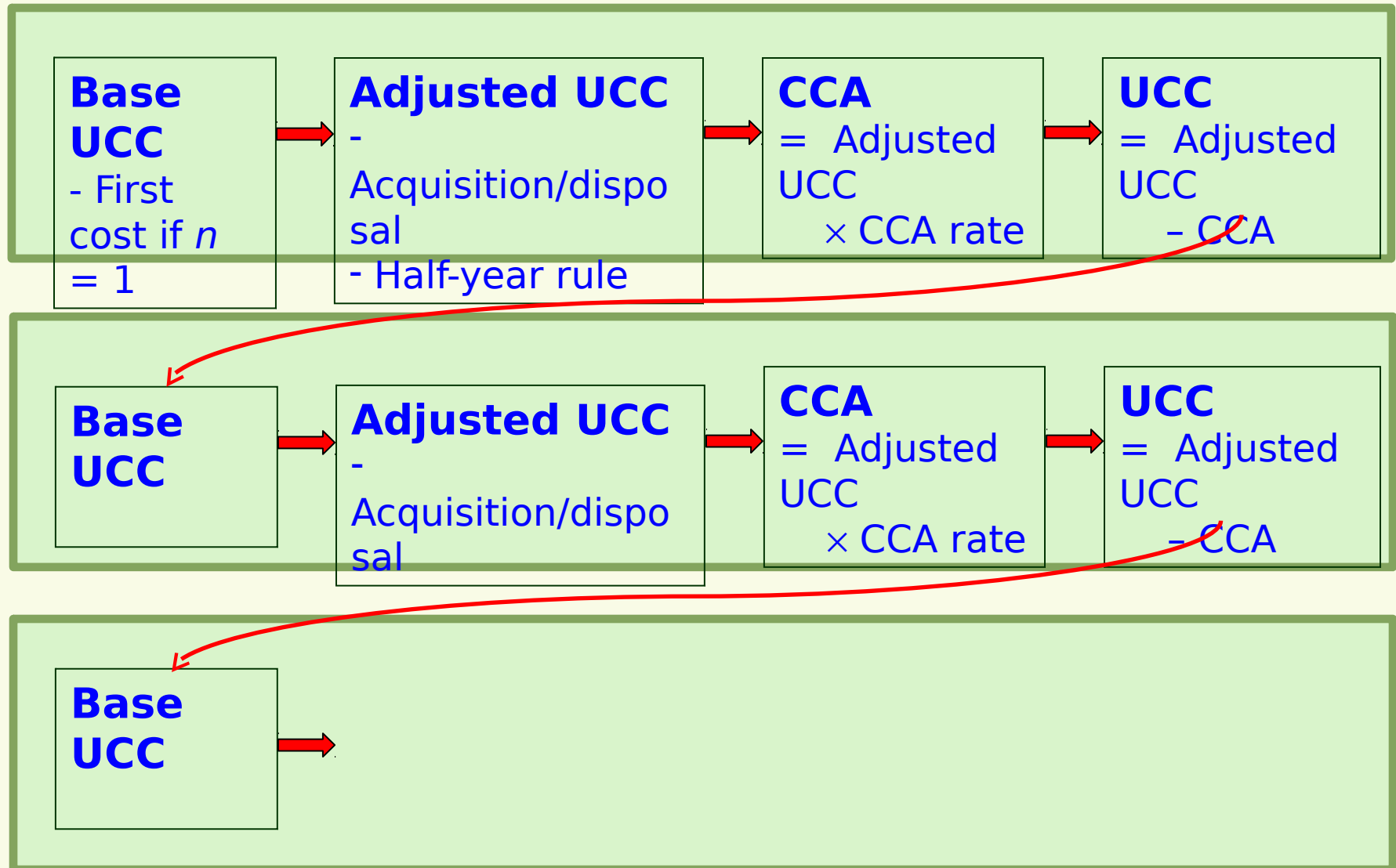
- Calculation of CCA
 - Undepreciated capital cost (UCC): The basis for calculating the capital expense in each year
 - Half-year rule* should be considered for any new acquisition.
 - Assets are pooled and one account of UCC is calculated for each class.

3.2. COMPARISONS OF SOME TERMS

- The terminologies in the *book depreciation* case can be slightly different from those in the *tax depreciation* case.
- The following table summarizes the correspondence between terms

Book Depreciation	Tax Depreciation
Asset	Property
Depreciation	Capital cost allowance (CCA)
Depreciation rate (in DB)	CCA rate
Cost basis	Capital cost
Book value	Undepreciated capital cost (UCC)
Salvage value	Proceeds from disposition

3.2. ALGORITHM OF CCA CALCULATION



EXAMPLE 3-1. CCA CALCULATION OF A MACHINE

- A company buys a new machine of Class 43 (30% CCA rate) for \$100,000. What would the CCA depreciation and UCC be in the *third* year?

EXAMPLE 3-2. CCA CALCULATION OF BUILDING

- On August 1, you purchased a home for your professional office for \$150,000. The appraisal is divided into \$30,000 for the land and \$120,000 for the building. In your *first year* of ownership, how much CCA can you deduct?

EXAMPLE 3-3. CCA CALCULATION (1)

- A firm currently has five vehicles whose information is as follows:

Age in years	Description	Book Value (UCC)
5	Chevy Van	\$22,465
2	Hyundai Sedan	\$31,620
3	Honda Accord	\$18,732
22	Ford Bronco	\$2,419
7	Dodge pick-up	\$11,563
Total book value		\$86,799

- Calculate the firm's cash flows, net of taxes, for the next 6 years.
 - Year 2: It sells the Honda Accord for \$20,000.
 - Year 3: It buys a Toyota Land Cruiser for \$26,000.
 - Year 5: It sells Bronco for \$850 and buys an equipment for \$25,000.
 - Year 6: It sells all the remaining vehicles for \$9,000.

EXAMPLE 3-3. CCA CALCULATION (2)

EXAMPLE 3-3. CCA CALCULATION (3)

Year	Adjustment	Adjusted UCC	CCA (rate = 30%)	UCC
0				86,799
1	-	-	26,040 (= 86,799 × 30%)	60,759 (= 86,799 - 26,040)
2	-20,000	40,759 (= 60,759 - 20,000)	12,228 (= 40,759 × 30%)	28,531 (= 40,759 - 12,228)
3	26,000	41,531 (= 28,531 + 13,000)	12,459 (= 41,531 × 30%)	42,072 (= 54,531 - 12,459)
4		42,072	12,622 (= 42,072 × 30%)	29,450 (= 42,072 - 12,622)
5	-850	41,525	12,458	41,142

EXAMPLE 3-4. COMPARISON OF METHODS (1)

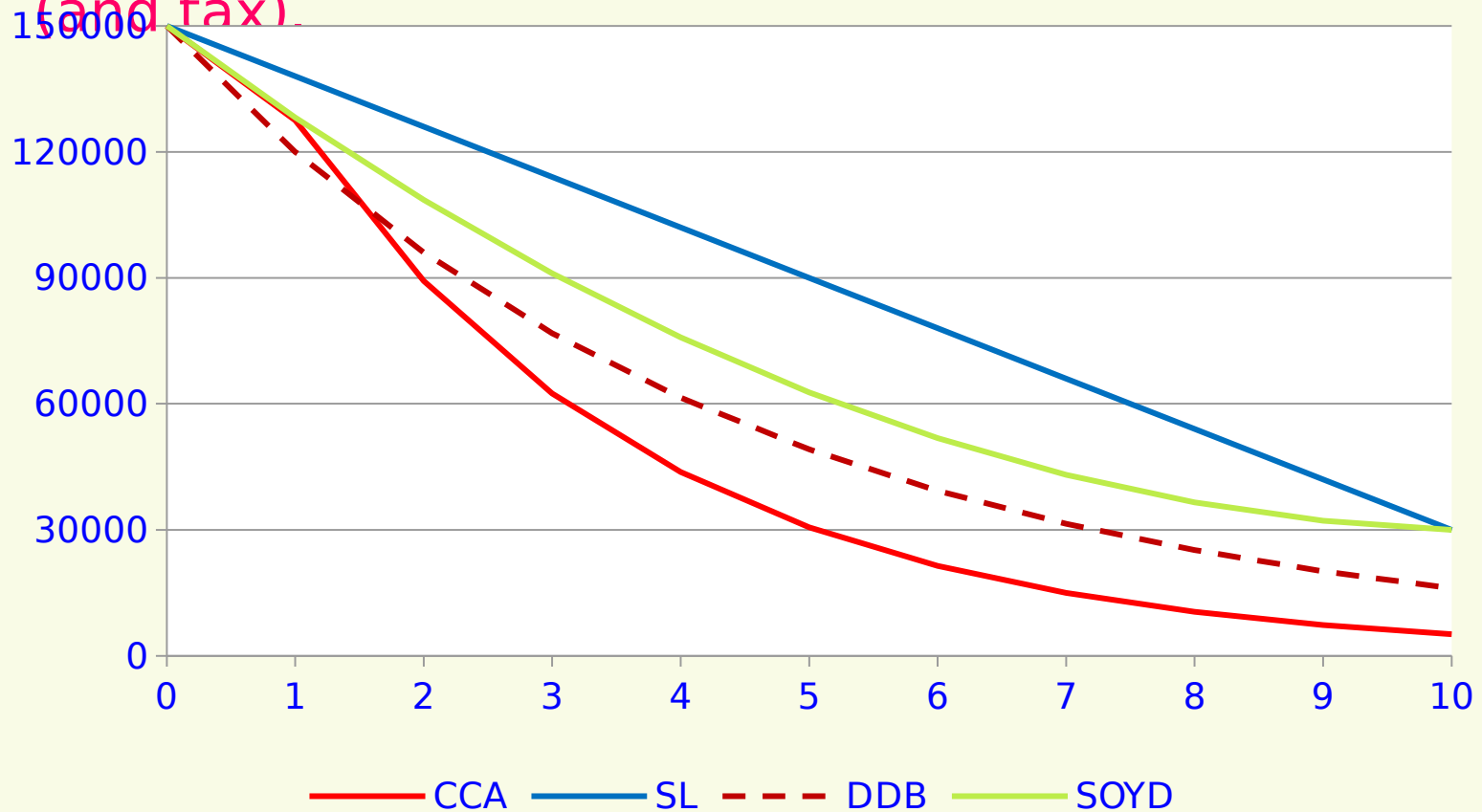
- A firm purchased office equipment (CCA rate = 30%) with \$150,000. The equipment is estimated to have a salvage value of \$30,000 after 10 years. Compute the depreciation schedules of CCA, Straight-line, SOYD, and Double declining-balance methods.

EXAMPLE 3-4. COMPARISON OF METHODS (2)

	CCA		SL		DDB		SOYD	
	d_t	BV_t	d_t	BV_t	d_t	BV_t	d_t	BV_t
1	22,500	127,500	12,000	138,000	30,000	120,000	21,818	128,182
2	38,250	89,250	12,000	126,000	24,000	96,000	19,636	108,545
3	26,775	62,475	12,000	114,000	19,200	76,800	17,455	91,091
4	18,743	43,733	12,000	102,000	15,360	61,440	15,273	75,818
5	13,120	30,613	12,000	90,000	12,288	49,152	13,091	62,727
6	9,184	21,429	12,000	78,000	9,830	39,322	10,909	51,818
7	6,429	15,000	12,000	66,000	7,864	31,457	8,727	43,091
8	4,500	10,500	12,000	54,000	6,291	25,166	6,545	36,545
9	3,150	7,350	12,000	42,000	5,033	20,133	4,364	32,182
10	2,205	5,145	12,000	30,000	4,027	16,106	2,182	30,000

EXAMPLE 3-4. COMPARISON OF METHODS (3)

- *CCA depreciation* is the most accelerated depreciation method.
- With depreciation, firms can reduce taxable income (and tax).



EXAMPLE 3-5. OVERHAUL AND DEPRECIATION (1)

- The Dow Ceramic Company purchased a glass molding machine in 2006 for \$150,000.
 - For the *book*, the company has been depreciating the machine by the *straight-line method* with a useful life of 10 years (with no salvage value).
 - For *tax* purpose, the company has been depreciating the machine by CCA with a Class 43 (30% CCA rate).
- At the beginning of 2009, Dow overhauled the machine at a cost of \$30,000. As a result of the overhaul, the useful life of the machine extends five years beyond the original estimate.

(A) Calculate the *book depreciation* amount and *book value* at the end of year 2012.

EXAMPLE 3-5. OVERHAUL AND DEPRECIATION (2)

EXAMPLE 3-5. OVERHAUL AND DEPRECIATION (3)

(B) Calculate the CCA for year 2012.

	Molding machine		Overhaul		
Year	CCA	UCC	CCA	UCC	Total CCA
		150,000			
2006	22,500	127,500			22,500
2007	38,250	89,250			38,250
2008	26,775	62,475		30,000	26,775
2009	18,743	43,733	4,500	25,500	23,243
2010	13,120	30,613	7,650	17,850	20,770
2011	9,184	21,429	5,355	12,495	14,539
2012	6,429	15,000	2,717	10,000	9,146

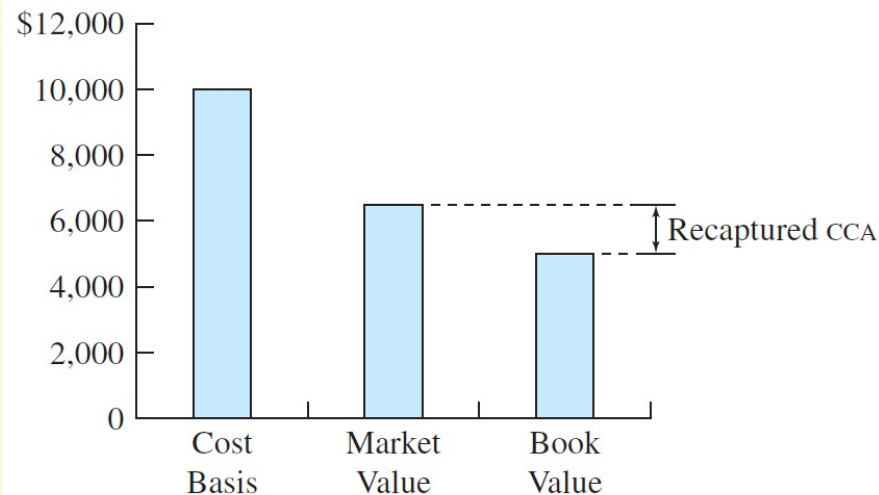
4. DEPRECIATION AND ASSET DISPOSAL

- Assets are bought and sold, and the government charges taxes if you make any gain from the transaction.
- When a depreciated asset is disposed of, a key question is whether the market value (MV) is larger than book value (BV).
 - What happens if a depreciated asset has a smaller book value?
 - This implies that the asset has depreciated too much, reducing the amount of taxes paid.
 - The firm should pay something back to the government.
- A few assumptions
 - The asset is disposed at the end of the year.
 - The asset is disposed after the depreciation for that year has been taken.
 - The adjustment is included in the calculation for that year.

4.1. RECAPTURED DEPRECIATION

- It occurs when an asset is sold for more than its current book value, but less than the original cost basis ($BV < MV < B$).
- There was excessive depreciation which is recaptured (

Cost basis	\$10,000
Market value	\$6,500
Book value	\$5,000



If Cost basis > Market value > Book value, there is Recaptured CCA.

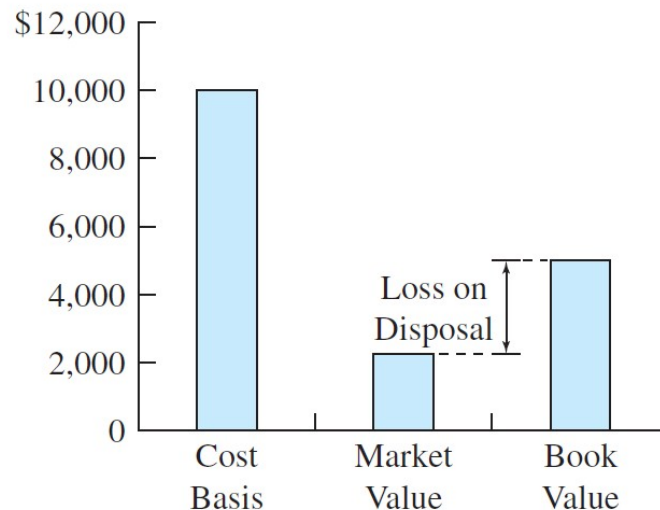
Recaptured CCA = Market value minus Book value = \$1,500

Figure 11-7 Recaptured cca.

4.2. LOSS ON DISPOSAL

- It occurs when an asset is sold for less than book value ($MV < BV$).
- The company has not claimed enough depreciation expense.
- The loss will

Cost basis	\$10,000
Market value	\$2,250
Book value	\$5,000



If Book value $>$ Market value, there is a *loss on disposal*.

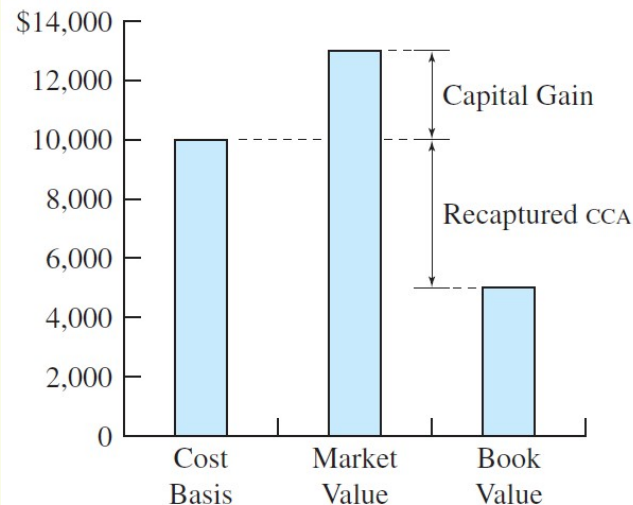
Loss on disposal = Book value minus Market value = \$2,750

Figure 11-8 Loss on disposal.

4.3. CAPITAL GAIN

- It occurs when an asset is sold for more than the basis ($MV > B$).
- The excess over the original cost is a “capital gain”.
- It is common for capital assets, real estates, etc.

Cost basis	\$10,000
Market value	\$13,000
Book value	\$5,000



If Market value $>$ Cost basis, there is a *capital gain* plus *recaptured depreciation*.

Capital gain = Market value minus Cost basis = \$3,000

Recaptured depreciation = Cost basis minus Book value = \$5,000

Figure 11-9 Capital gain.

EXAMPLE 4-1. ASSET DISPOSAL

- O'Leary Engineering Corp. has been depreciating a \$50,000 machine for the last 3 years. The asset was just sold for 60% of its first cost. What is the size of the recaptured CCA or loss at disposal if the CCA rate of the machine is 30%?

EXAMPLE 4-2. ASSET DISPOSAL

- A Class 8 asset (20%) with a cost basis of \$10,000 has been depreciated under the CCA. What is the gain or loss if the asset is disposed of after 4 years of operation, for \$6,000 and for 2,000?

SUMMARY OF CHAPTER 11

- Depreciation is useful for tax calculation
- Depreciation methods
 - Straight line depreciation
 - Sum of Years' digit depreciation
 - Declining balance depreciation
 - Unit of production depreciation
- Capital cost allowance (CCA): Canadian depreciation method
 - Half-year rule
 - Asset disposal
- Selective end-of-chapter problems
 - 7, 13, 21, 32, 36, 38, 40, 55, 59