Corporate Income Taxes - Part 1

Overview

- Types of taxes
- Focus on corporate income taxes
- Operating income definition
- Graduated tax structure
- Formula-based computation

How many ways to tax?

- Asset based, % of asset value
- Head count, $ per person
- Excise tax, $ per unit produced/sold
- Sales tax, % on $ sales
- Capital gain tax, % on the increase in value of an asset when sold
- Income tax, % on the difference between revenues and expenses

Definition

$ Operating income = Revenues - Expenses$

What is revenue?

Revenue includes income from:
- Sales of goods and services
- Rents
- License fees
- Interest earned on accounts
- Dividends received from another company

What types of expenses?

Expenses allowed as deductions from revenue include:
- Salaries and wages
- Commissions
- Materials and components
- Rent and lease payments
- Interest paid on loans
- Advertising
- Insurance
- etc.
Corporate Income Taxes - Part 1

**How much is the tax?**

Operating income in the range

- \([1 - 50,000]\) 15%
- \([50,001 - 75,000]\) 25%
- \([75,001 - 100,000]\) 34%
- \([100,001 - 335,000]\) 39%
- \([335,001 - 10,000,000]\) 34%
- \([10,000,001 - 15,000,000]\) 35%
- \([15,000,001 - 18,333,333]\) 38%
- \([18,333,334 - \text{no limit}]\) 35%

Corporate Income Taxes - Part 1

**For larger firms?**

<table>
<thead>
<tr>
<th>Operating income (000s)</th>
<th>Federal tax (000s)</th>
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**Example 1**

Revenue $450,000
Cash optg. expenses
- Labor $120,000
- Materials $35,000
- Rent $22,000
- Insurance $15,000
Total expenses $192,000
Operating income $258,000
Federal income tax $83,870
Profit after tax $174,130

**Explanation of tax**

<table>
<thead>
<tr>
<th>Rate</th>
<th>Amount</th>
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<td>Total</td>
<td>$83,870</td>
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</table>

**An easier way**

<table>
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<th>% on increment</th>
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Note correction
Corporate Income Taxes - Part 1

**An easier way - Example 1**

Income tax =
\[
22,250 \text{ [ranges 1 - 3] } \\
+ (0.39)(258,000 - 100,000) \text{ [range 4] }
\]
= $83,870

Formula-based approach

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**Summary**

- Many types of taxes
  - Focus on corporate income tax
- Operating income definition
  - Revenues minus expenses
- Graduated tax structure
  - 8 ranges, not monotonic
  - Formula-based approach

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**Corporate Income Taxes - Part 2**

**Overview**

- Graduated tax structure
- Definitions of tax rate
- Special cases for large corporations

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**Graduated tax structure**

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<td>35</td>
</tr>
</tbody>
</table>

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**Example 1**

Revenue $450,000
Cash optg. expenses
  - Labor 120,000
  - Materials 35,000
  - Rent 22,000
  - Insurance 15,000
Total expenses 192,000
Operating income 258,000
Federal income tax $83,870
Profit after tax $174,130
Example 1

Income tax = 
\[22,250 \quad \text{[ranges 1 - 3]} \]
\[+ (0.39)(258,000 - 100,000) \quad \text{[range 4]} \]
\[= \$ 83,870 \]

Formula-based approach

Definition

Effective (average) tax rate = \[\frac{\text{tax}}{\text{taxable income}}\]

Example 1

Effective (average) tax rate = \[
\frac{\$ 83,870}{\$ 258,000} = 0.325 = 32.5\% \]

Definition

Marginal tax rate, \(t_m\) = \[\frac{\text{tax on next dollar}}{\text{of taxable income}}\]

Example 1: \(t_m = 39\%\)

[Slope of graph]

Example 2

Slope = marginal tax rate

Revenue $ 460,000
Cash optg. expenses
Labor $ 120,000
Materials $ 35,000
Rent $ 22,000
Insurance $ 15,000
Total expenses $ 192,000
Operating income $ 268,000
Federal income tax $ 87,770
Profit after tax $ 180,230
Example 2

Income tax = 22,250 \[\text{ranges 1 - 3}\] + (0.39)(268,000 - 100,000) \[\text{range 4}\] = $87,770

Formula-based approach

Observation

Change in profit after tax from Ex. 1 to Ex. 2 is

\[10,000*(1 - t_m)\]

= $6,100

Example 3, special case

Taxable income in the range $335,000 - $10,000,000

Example: Taxable income = $335,000

Income tax = 0.34 = 34%

= $113,900

Explanation of tax

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<tr>
<td>34%</td>
<td>8,500</td>
</tr>
</tbody>
</table>

Total $113,900

$113,900/335,000 = 0.34

Example 4

Existing operation is expected to have taxable income of $335,000

New project is expected to have additional taxable income of $120,000

Income tax for new project is

\[(0.34)(120,000)\]

= $40,800
Corporate Income Taxes - Part 2

Example 5, special case

Taxable income in the range above $18,333,333

Example: taxable income
  = $18,333,333

Income tax = 0.35 = 35%  
  = $6,416,667

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Corporate Income Taxes - Part 2

Example 6

Existing operation is expected to have taxable income of $40,000,000

New project is expected to have additional taxable income of $3,000,000

Income tax for new project is
  (0.35)(3,000,000)  
  = $1,050,000

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Corporate Income Taxes - Part 2

Example 7

Existing operation is expected to have taxable income of $40,000,000

New project is expected to have additional taxable income of $– 3,000,000  [Loss]

Income tax for new project is
  (0.35)(– 3,000,000)  
  = $– 1,050,000  [tax credit]

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Corporate Income Taxes - Part 2

Example 8

Example: taxable income, originally
  = $25,000,000

Federal income tax = 0.35

State income tax = 0.06

State tax is a deductible item for federal tax purpose

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Example 8

State income tax
(0.06)(25,000,000) = $ 1,500,000

Federal taxable income
$ 25,000,000 – 1,500,000
= $ 23,500,000

Federal income tax
(0.35)(23,500,000)
= $ 8,225,000

Total income taxes
1,500,000 + 8,225,000
= $ 9,725,000

Combined tax rate
= $ 9,725,000
$ 25,000,000
= 0.389

Definition

Combined tax rate:
The average rate of both federal and state taxes combined, on the original taxable income

Example 8:
Combined tax rate = 0.35 + (1 – 0.35)(0.06) = 0.389

Summary

- Graduated tax structure
  - 8 ranges, not monotonic
  - Formula-based approach

- Definitions of tax rates
  - Effective (average) rate
  - Marginal rate
  - Special cases for U.S. after 1986
    - $335,000 - 10,000,000
    - above $18,333,333

- Combined tax rate for large firms

Overview

- Concepts of depreciation
- Examples, accounting
- Straight-line (SL) method
- Profit A/T versus Cash Flow A/T
Depreciation Accounting - Part 1

**Concept of depreciation**

Three concepts of loss in value of an asset:

- Physical deterioration
  
  **Loss in pump efficiency**

- Loss in market value
  
  Auto, horse, computer

- Decline in accounting value for income tax purposes

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**Ex. 1, rent equipment**

- Five-year project
  
  ➤ Revenue: $28,500 / year
  
  ➤ Labor & matsls. $5,000 / yr
  
  ➤ Equipment rent $3,500 / yr

- Income tax rate = 40 %

- Obtain Profit A/T

---

**Ex. 1, Profit A/T**

<table>
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<th>Rev.</th>
<th>Lab.&amp; Mtls.</th>
<th>Eqpt.</th>
<th>Rent</th>
<th>Tot.</th>
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<th>Profit</th>
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**Ex. 2, buy & expense 1st yr.**

- Similar to Example 1
  
  ➤ Revenue $28,500 / year
  
  ➤ Labor & materials $5,000 / yr

- Instead of renting equipment, buy equipment for $20,000, sell 5 years later for $5,000

- Income tax rate = 40 %

- Obtain Profit A/T

- Obtain Cash Flow A/T

---

**Ex. 2, Profit A/T**

<table>
<thead>
<tr>
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<th>Lab.&amp; Mtls.</th>
<th>Eqpt.</th>
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**Observation**

Allocating all of the equipment expense in the first year is generally **not allowed** in the U.S. and other industrialized countries, with some exceptions.
Depreciation Accounting - Part 1

Definition

Equipment depreciation expense:
A **systematic** allocation of the **loss in value** of an asset that is expected to provide service over several years.

- Allocation prescribed by tax law.
- Allocation doesn't necessarily follow true economic loss.

Factors

Factors in computing depreciation:
- Initial value (basis)
  - Usually installed cost (less trade-in value)
- Terminal value (expected salvage)
- Time period of allocation
  - “Depreciation life” or “class”
- Rate of decline in accounting value, “Book value”

Ex. 3, SL depreciation

- Similar to Example 2
  - Revenue $28,500 / year
  - Labor & mats. $5,000 / yr
- Allocate ($20,000 - 5,000) / 5 = $3,000 equipment depreciation each year (Straight-line method).
- Proceeds from sale of equipment, $5,000 at end of year 5, are not subject to taxes.

Ex. 3, SL method graph

Ex. 3, Profit A/T

<table>
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<tr>
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Assumptions

End-of-year cash flow convention

The time lags between **accounting expenses** and **cash flows** for them (labor, materials, interest, rent, etc.) at the end of the year are offset by the time lags at the beginning of the year.

“Boundary effects cancel each other”

Equipment expense is the exception
Depreciation Accounting - Part 1

**Ex. 2, Cash Flow A/T**

<table>
<thead>
<tr>
<th>t</th>
<th>Optg. Cash</th>
<th>Eqpt. Exp.</th>
<th>Tax. Inc.</th>
<th>40% Tax</th>
<th>Profit A/T</th>
<th>Cash A/T</th>
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Includes $5000 revenue from asset sale

**Ex. 3, Cash Flow A/T, SL**

<table>
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<tr>
<th>t</th>
<th>Optg. Cash</th>
<th>Eqpt. Dep.</th>
<th>Tax. Inc.</th>
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</table>

Depreciation Accounting - Part 1

**Observation**

A quick estimate of the Cash Flow A/T is to add Depreciation Expense to Profit A/T (when there is no loan involved)

Depreciation Accounting - Part 1

**Comparison of Exs. 2 and 3**

<table>
<thead>
<tr>
<th>t</th>
<th>Ex. 2 Cash Exp. A/T</th>
<th>Ex. 3 Cash Eqpt. Flow Dep. A/T</th>
<th>Diff. 2 - 3</th>
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Depreciation Accounting - Part 1

**Summary**

- Concepts of depreciation
  - Decline in acctg. value
- Examples, accounting
  - Rent
  - Buy & expense 1st yr.
  - Buy & allocate loss in value
- Straight-line (SL) method

- Profit A/T versus
  - Cash Flow A/T
  - Sums equal for Exs. 2 and 3
  - Timing depends on equipment expenses
- Estimate of Cash Flow A/T
  - Profit A/T + Depreciation

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Depreciation Accounting - Part 2

Overview

- Classical depreciation methods, used before 1981 in U.S.
- Examples, compare Cash Flows A/T

Why study the classics?

- Classical depreciation methods must continue to be used on assets acquired before 1981
- Classical methods form the basis of modern methods
- Classical methods may be used in other countries

Three methods

- Straight-line (SL)
- Sum of the years-digits (SYD)
- Declining balance (DB)
  - Double declining balance (DDB or 200%DB)
  - 150% declining balance (150%DB)

Examples 3 - 5

- Five-year project
  - Revenue $28,500 / year
  - Labor & matls. $5,000 / yr
- Allocate ($20,000 - 5,000) = $15,000 equipment depreciation by 3 methods.
- Income tax rate = 40%
- Obtain Profit A/T, Obtain Cash Flow A/T

Straight line method

Basis: installed cost of asset \( B_0 \) including taxes, freight (assumes no trade-in)
Depreciation life: \( N_d \) from tax agency guidelines
Estimated salvage value: \( S_d \) based on past data, or at 10% of \( B_0 \)
Depreciation per year
\[ = \left( B_0 - S_d \right) / N_d \]
### Depreciation Accounting - Part 2

#### Ex. 3, SL method graph
- **Installed cost (basis)**: $20,000
- **Depreciation**: 3,000/year
- **Estim. salvage**: 5,000
- **Book value**
  - Year 1: $17,000
  - Year 2: $14,000
  - Year 3: $11,000
  - Year 4: $8,000
  - Year 5: $5,000

#### Ex. 3, Cash Flow A/T, SL

<table>
<thead>
<tr>
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<th>Dep.</th>
<th>Inc.</th>
<th>Tax</th>
<th>A/T</th>
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<td>61500</td>
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</table>

### Depreciation Accounting - Part 2

#### Ex. 3, SYD method graph
- **Installed cost (basis)**: $20,000
- **Depreciation**: Varies
- **Estim. salvage**: 5,000

#### Ex. 4, SYD method

- **Basis**, $B_0 = $20,000
- **Estimated salvage**, $S_d = $5,000
- **Depreciation life**, $N_d = 5$

**Method**:
1. Obtain $\sum = \sum_{1:N_d} n$
2. Apply fractions $\left(\frac{n}{\sum}\right)$ to $(B_0 - S_d)$ in reverse order

**Example Calculations**
- **Year 1**
  - $D_1 = \frac{5}{15}(20,000 - 5,000) = 5,000$
- **Year 2**
  - $D_2 = \frac{4}{15}(15,000) = 4,000$
- **Year 5**
  - $D_5 = \frac{1}{15}(15,000) = 1,000$

#### Ex. 4, Cash Flow A/T, SYD

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<th>Dep.</th>
<th>Inc.</th>
<th>Tax</th>
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<th>Cash</th>
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</tbody>
</table>
Depreciation Accounting - Part 2

Declining balance method

Accelerated method
Basis, Estimated salvage, Depreciation life: same as SL
Method: Obtain multiplier \( m \) based on tax law: 2.0, 1.5
Obtain rate \[ a = \frac{100\% m}{N_d} \]
Apply rate to Book values year by year, avoid \( B_N < S_d \)

Ex. 5, DDB method

Multiplier \( m = 2.0 \)
Rate \[ a = \frac{200\%}{5} = 0.4 \]
\[ D_1 = (0.4)(20,000) = 8,000 \]
\[ B_1 = 20,000 - 8,000 = 12,000 \]
\[ D_2 = (0.4)(12,000) = 4,800 \]
\[ B_2 = 12,000 - 4,800 = 7,200 \]
\[ D_3 = (0.4)(7,200) = 2,880 \]
\[ B_3 = 7,200 - 2,880 = 4,320 \]

Ex. 5, DDB method graph

Ex. 5, Cash Flow A/T, DDB

Optg. Eqpt. Tax. 40\% Profit Cash
\( t \) Cash Dep. Inc. Tax A/T A/T
0 -20000
1 23500 8000 15500 6200 9300 17300
2 23500 4800 18700 7480 11220 16020
3 23500 2200 21300 8520 12780 14980
4 23500 0 23500 9400 14100 14100
5 23500 0 23500 9400 14100 14100
Sum 117500 15000 102500 41000 61500 61500

Comparison of Exs. 3 - 5

Ex. 3 Cash Flow Ex. 4 Cash Flow Ex. 5 Cash Flow
\( t \) Dep. A/T Dep. A/T Dep. A/T
0 -20000 -20000 0 -20000
1 3000 15300 5000 16100 8000 17300
2 3000 15300 4000 15700 4800 16020
3 3000 15300 3000 15300 2200 14980
4 3000 15300 2000 14900 0 14100
5 3000 15300 1000 14500 0 14100
5 3000 15300 5000 5000 5000
Sum 15000 61500 15000 61500 15000 61500
### Comparison of Exs. 3 - 5

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<td>930</td>
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<td>1047</td>
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<tr>
<td>Δ(930)(0.4)</td>
<td>372</td>
<td>(1047)(0.4)</td>
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</table>

NPV changes in Cash Flow A/T can be traced back to changes in depreciation pattern.

\[ \Delta \text{NPV of Cash Flow A/T} = \{\Delta \text{NPV of Depreciation}\}(t_m) \]

### Summary

- Classical depreciation methods, used before 1981 in U.S.
  - SL, SYD, DB
- Examples, compare Cash Flows A/T
  - Effect on Taxable Income
  - Effect on Cash Flow A/T

### Overview

- Switching of depreciation methods, before 1981
- MACRS method, after 1986
- Half-year convention

### Example 6

- Five-year project
  - Revenue $28,500 / year
  - Labor & matls. $5,000 / yr.
- Buy equipment for $20,000, Estimated salvage is zero
- Apply DDB depreciation
- Income tax rate = 40%
- Obtain Profit A/T
  - Obtain Cash Flow A/T
Depreciation Accounting - Part 3

Ex. 6, DDB method

Multiplier \( m = 2.0 \)
Rate \( a = 200\% / 5 = 0.4 \)

\[ D_1 = (0.4)(20,000) = 8,000 \]
\[ B_1 = 20,000 - 8,000 = 12,000 \]
\[ D_2 = (0.4)(12,000) = 4,800 \]
\[ B_2 = 12,000 - 4,800 = 7,200 \]
\[ D_3 = (0.4)(7,200) = 2,880 \]
\[ B_3 = 7,200 - 2,880 = 4,320 \]

\[ D_4 = (0.4)(4,320) = 1,728 \]
\[ B_4 = 4,320 - 1,728 = 2,592 \]
\[ D_5 = (0.4)(2,592) = 1,037 \]
\[ B_5 = 2,592 - 1,037 = 1,555 \]

But we want \( B_5 = 0 \)
With SL or SYD this problem would not occur.

Switching to SL

With any of the accelerated methods it is possible to switch to SL to reach a target Salvage value.

If we switch after year \( N \):
The depreciation per year

\[ = \frac{(B_N - S_d)}{(N_d - N)} \]

for the remaining years.

Switch after year 3:

\[ B_3 = 4,320, \quad S_d = 0 \]
\[ N_d - N = 5 - 3 = 2 \]
\[ D_4 = D_5 = \frac{4,320}{2} = 2,160 \]
\[ B_4 = 4,320 - 2,160 = 2,160 \]
\[ B_5 = 2,160 - 2,160 = 0 \]
## Ex. 6, Cash Flow A/T

<table>
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<th>Time (t)</th>
<th>Cash (t)</th>
<th>Dep. Inc.</th>
<th>Tax</th>
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<th>Cash A/T</th>
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## Modern methods in U.S.

- Modified Accelerated Cost Recovery System (MACRS) used after 1986 in U.S.
- Two general options
  - Specified percentages
  - DB with switching, and SL
- Alternate MACRS (SL)
  - $S_d = 0$ for $D_H$ computation
  - Half-year convention
  - Rely heavily on tables

## Half-year convention, SL

### Example for 5-year property class

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<th>Dep. Inc.</th>
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<th>Cash A/T</th>
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<td>39000</td>
<td>58500</td>
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### Half-year convention, %

#### Example for 5-year property class with specified percentages

Method is DDB switch to SL

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<td>39000</td>
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### Examples 7 - 8

- Six-year project
  - Operating Revenue varies
- Allocate $10,000 equipment depreciation by 2 methods:
  - Alternative MACRS (SL)
  - MACRS specified percentages
    - (Estimated salvage value = 0)
- Income tax rate = 35%
- Obtain Profit A/T, Cash Flow A/T
Depreciation Accounting - Part 3
Exs. 7-8, MACRS graphs

Depreciation Accounting - Part 3
Ex. 7, Altern. MACRS (SL)

Optg.   E   t.   Tax.     35%  Profit   Cash
Cash Dep. Inc. Tax A/T A/T
0 - 10000 - 10000 0
1 6000 1000 5000 1750 3250 4250
2 7000 2000 5000 1750 3250 5250
3 7500 2000 5500 1925 3575 5575
4 7800 2000 5800 2030 3770 5770
5 8000 2000 6000 2100 3900 5900
6 5000 1000 4000 1400 2600 3600
Sum 41300 10000 31300 10955 20345 20345

Depreciation Accounting - Part 3
Ex. 8, MACRS Specified %

Optg.   E   t.   Tax.     35%  Profit   Cash
Cash Dep. Inc. Tax A/T A/T
0 - 10000 - 10000 0
1 6000 2000 4000 1400 2600 4600
2 7000 3200 3800 1330 2470 5670
3 7500 1920 5580 1953 3627 5547
4 7800 1152 6648 2327 4321 5473
5 8000 1152 6848 2397 4451 5603
6 5000 576 4424 1548 2876 3452
Sum 41300 10000 31300 10955 20345 20345

Depreciation Accounting - Part 3
Comparison of Exs. 7 and 8

Ex. 7 Cash  Ex. 8 Cash  Diff.
Cash Dep. A/T  Cash Dep. A/T 8 - 7
0 - 10000 - 10000 0
1 1000 4250 2000 4600  350
2 2000 5250 3200 5670  420
3 2000 5575 1920 5547  -28
4 2000 5770 1152 5473  -297
5 2000 5900 1152 5603  -297
6 1000 3600 576 3452  -148
Sum 10000 20345 10000 20345  0

Depreciation Accounting - Part 3
MACRS %, 10-year class

Depreciation Accounting - Part 3
Summary

Switching of depreciation methods, before 1981
DB switch to SL
MACRS method, after 1986
Specified percentages
Alternate MACRS (SL)
Half-year convention
Rely on tables
Sale of an Asset

Overview

- Salvage value received when selling an asset may lead to taxable gain or loss
- Treatment of assets used in production, distribution, or transportation (PDT)
- Capital gains

---

Example 1

- Four-year project
  - Operating Revenue varies
- Allocate $30,000 equipment depreciation by MACRS specified percentages using the 5-year class
- Estimated salvage value after 4 years = $7,500
- Income tax rate = 38%
- Obtain Profit A/T, Cash Flow A/T

---

Example 1

<table>
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<td>.0576</td>
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Due to premature sale, only half the usual depreciation is allowed.

---

Example 1

- Dep. in yr. 4 is half the usual amount
- Book and Salvage values differ

---

A closer look, Ex. 1

- Dep. in yr. 4
  - Book and Salvage values differ
  - BV at end of yr. 4 if not sold

---
Sale of an Asset

**Example 1**

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<th>Cash B/T</th>
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<td>3765</td>
<td>5493</td>
</tr>
<tr>
<td>4</td>
<td>588</td>
<td>588</td>
<td>223</td>
<td>365</td>
<td>365</td>
<td></td>
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<tr>
<td>4</td>
<td>6912</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum</td>
<td>48888</td>
<td>23088</td>
<td>25800</td>
<td>9809</td>
<td>15991</td>
<td>15991</td>
</tr>
</tbody>
</table>

**Gain on sale**

**BV part of sale**

**Sum**

**Sale of an Asset**

**Example 2**

- Similar to Example 1, except:
  - Estimated salvage value after 4 years = $3,000
  - Income tax rate = 38%
  - Obtain Profit A/T, Obtain Cash Flow A/T

<table>
<thead>
<tr>
<th>$t$</th>
<th>Cash B/T</th>
<th>Eqpt. Dep.</th>
<th>Tax Inc.</th>
<th>38%</th>
<th>Profit A/T</th>
<th>Cash A/T</th>
</tr>
</thead>
<tbody>
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<td>-30000</td>
<td>-30000</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>6000</td>
<td>7000</td>
<td>2666</td>
<td>4334</td>
<td>10334</td>
</tr>
<tr>
<td>2</td>
<td>14000</td>
<td>9600</td>
<td>4400</td>
<td>1672</td>
<td>2728</td>
<td>12328</td>
</tr>
<tr>
<td>3</td>
<td>13500</td>
<td>5760</td>
<td>7740</td>
<td>2941</td>
<td>4799</td>
<td>10559</td>
</tr>
<tr>
<td>4</td>
<td>7800</td>
<td>1728</td>
<td>6072</td>
<td>2307</td>
<td>3765</td>
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<td>-3912</td>
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<td>6912</td>
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<td></td>
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<tr>
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<td>23088</td>
<td>21300</td>
<td>8099</td>
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</tr>
</tbody>
</table>

**Gain (loss) on sale**

**BV part of sale**

**Sale of an Asset**

**Observation**

Usually for assets used in production, distribution, or transportation (PDT), the salvage value of the asset will be less than the installed cost (basis). In that case the gain is called depreciation recapture and it is subject to ordinary income tax rates.

**Sale of an Asset**

**Definition: Capital gain**

In rare cases involving assets used in production, distribution, or transportation, the asset salvage value may exceed the installed cost (basis). The part of the gain in excess of the basis is called a capital gain, and it may be taxed at a lower, capital gain tax rate.

**Sale of an Asset**

**Example 3**

Same as Ex. 2, but $S_a = 32,000$

Since $B_a = 6,912$

Depreciation Recapture $= 30,000 - 6,912 = 23,088$

Capital gain $= 32,000 - 30,000 = 2,000$

The 23,088 gain is added to operating income. The 2,000 Capital gain may be taxed at a lower rate, e.g. 20%
Sale of an Asset

Example 3

<table>
<thead>
<tr>
<th>Time (t)</th>
<th>Asset Book Value</th>
<th>Depreciation Recapture</th>
<th>Capital Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$30,000</td>
<td>$6,912</td>
<td>$32,000 - 30,000</td>
</tr>
<tr>
<td>1</td>
<td>$24,000</td>
<td>$14,400</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>$15,000</td>
<td>$8,640</td>
<td></td>
</tr>
</tbody>
</table>

Sale of an Asset (error!)

Example 3

<table>
<thead>
<tr>
<th>t</th>
<th>Cash B/T</th>
<th>Eqpt. Dep.</th>
<th>Tax.</th>
<th>Profit A/T</th>
<th>Cash A/T</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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<tr>
<td>1</td>
<td>13000</td>
<td>6000</td>
<td>7000</td>
<td>2666</td>
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<td>14000</td>
<td>9600</td>
<td>4400</td>
<td>1672</td>
<td>2728</td>
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<tr>
<td>3</td>
<td>13500</td>
<td>5760</td>
<td>7740</td>
<td>2941</td>
<td>4799</td>
</tr>
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<td>8000</td>
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<td>2307</td>
<td>3765</td>
</tr>
<tr>
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<td>3088</td>
<td></td>
<td>23088</td>
<td>8773</td>
<td>14315</td>
</tr>
<tr>
<td>6</td>
<td>2000</td>
<td></td>
<td>2000</td>
<td>400</td>
<td>1600</td>
</tr>
</tbody>
</table>

Sum: $73388 - 30000 - 18759 = $24629

Summary

- Salvage value received when selling an asset may lead to taxable gain or loss
- Depreciation recapture common situation positive/negative
- Capital gain rare situation

Financing With a Loan

Overview

- Comprehensive examples including loan financing
- Premature sale of asset
- Salvage value of asset differs from book value
- Premature termination of loan
- Small firm, use tax table

Example 1

- Six-year project, estimated
- Operating Revenue varies
- Allocate $300,000 eqpt. dep.
- MACRS spec. %, 5-year class
- Zero estimated salvage value
- Loan for $200,000, to be repaid over 5 years with 12% interest, equal principal repayments
- Small firm, use tax table
- Obtain Profit A/T, Cash Flow A/T
Financing With a Loan

**Example 1**

- Project revenues not as expected, project terminated after 3 years
- Actual salvage value of $180,000
- Loan balance remaining after 3 years was paid
- Obtain entire cash flow over life of project

---

### Example 1, Depreciation

<table>
<thead>
<tr>
<th>Spec. Dep.</th>
<th>Book</th>
<th>Book</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>300000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>.2000</td>
<td>60000</td>
<td>240000</td>
</tr>
<tr>
<td>2</td>
<td>.3200</td>
<td>96000</td>
<td>144000</td>
</tr>
<tr>
<td>3</td>
<td>.1920</td>
<td>57600</td>
<td>86400</td>
</tr>
<tr>
<td>3</td>
<td>.0960</td>
<td>28800</td>
<td>115200</td>
</tr>
</tbody>
</table>

Half the usual depreciation recapture of 180000 - 115200 = 64800

---

### Example 1, Loan

<table>
<thead>
<tr>
<th>Interest</th>
<th>Princ.</th>
<th>Loan</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>t</td>
<td>pmt.</td>
<td>pmt.</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>200000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>24000</td>
<td>40000</td>
<td>160000</td>
</tr>
<tr>
<td>2</td>
<td>19200</td>
<td>40000</td>
<td>120000</td>
</tr>
<tr>
<td>3</td>
<td>14400</td>
<td>40000</td>
<td>80000</td>
</tr>
<tr>
<td>3</td>
<td>80000</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Remaining loan balance, paid at time 3

---

### Example 1, Taxes

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>230,000</td>
<td>60,000</td>
<td>24,000</td>
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</tr>
<tr>
<td>2</td>
<td>230,000</td>
<td>96,000</td>
<td>19,200</td>
<td>114,800</td>
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<tr>
<td>3a</td>
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<td>28,800</td>
<td>14,400</td>
<td>186,800</td>
</tr>
<tr>
<td>3b</td>
<td></td>
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<td></td>
<td>64,800</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>251,600</td>
</tr>
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</table>

Sum 690,000 184,800 57,600 512,400 149,586 362,814

---

### Example 1, Cash Flow

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>- 300,000</td>
<td>200,000</td>
<td>- 100,000</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>105,810</td>
<td>60,000</td>
<td>- 40,000</td>
<td>125,810</td>
</tr>
<tr>
<td>2</td>
<td>86,778</td>
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<td>- 40,000</td>
<td>142,778</td>
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<td>3a</td>
<td>170,226</td>
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<tr>
<td>3b</td>
<td>115,200</td>
<td>80,000</td>
<td>- 80,000</td>
<td>35,200</td>
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<td>3</td>
<td></td>
<td></td>
<td></td>
<td>194,226</td>
</tr>
</tbody>
</table>

Sum 362,814 184,800 - 184,800 0 362,814
Financing With a Loan

Example 2

Same as Example 1, but loan is repaid with equal total payments (principal and interest):

\[ A = \$200,000 \times (A/P, 12\%, 5) \]
\[ = \$200,000 \times 0.277410 \]
\[ = \$55,482 \]

Financing With a Loan

Example 2, Loan

<table>
<thead>
<tr>
<th>t</th>
<th>Total pmt.</th>
<th>Interest pmt.</th>
<th>Principal pmt.</th>
<th>Loan balance</th>
</tr>
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<tbody>
<tr>
<td>0</td>
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<td></td>
<td></td>
<td>200,000</td>
</tr>
<tr>
<td>1</td>
<td>55,482</td>
<td>24,000</td>
<td>31,482</td>
<td>168,518</td>
</tr>
<tr>
<td>2</td>
<td>55,482</td>
<td>20,222</td>
<td>35,260</td>
<td>133,258</td>
</tr>
<tr>
<td>3</td>
<td>55,482</td>
<td>15,991</td>
<td>39,491</td>
<td>93,767</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>93,767</td>
<td>0</td>
</tr>
</tbody>
</table>

Tax-deductible portion of loan payments
Remaining loan balance, paid at time 3

Financing With a Loan

Example 2, Taxes

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>t</td>
<td>Cash</td>
<td>Dep.</td>
<td>Pmt.</td>
<td>Inc.</td>
<td>Tax</td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>--------</td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>230,000</td>
<td>60,000</td>
<td>24,000</td>
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<td>40,190</td>
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<td>20,222</td>
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<td>15,991</td>
<td>185,209</td>
<td></td>
</tr>
<tr>
<td>3b</td>
<td></td>
<td></td>
<td>64,800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>250,009</td>
<td>80,754</td>
<td>199,256</td>
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<tr>
<td>Sum</td>
<td>690,000</td>
<td>184,800</td>
<td>60,213</td>
<td>509,787</td>
<td>148,567</td>
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</table>

Financing With a Loan

Example 2, Cash Flow

<table>
<thead>
<tr>
<th>Profit</th>
<th>Eqpt.</th>
<th>Asset</th>
<th>Loan</th>
<th>Cash</th>
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</thead>
<tbody>
<tr>
<td>t</td>
<td>A/T</td>
<td>Dep.</td>
<td>Invest.</td>
<td>Princ.</td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
<td>-------</td>
<td>--------</td>
<td>-------</td>
</tr>
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<td></td>
<td></td>
<td>-300,000</td>
<td>200,000</td>
</tr>
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<td>105,810</td>
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<td>86,154</td>
<td>96,000</td>
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<td>146,894</td>
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<td>158,565</td>
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<tr>
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<td></td>
<td></td>
<td>179,998</td>
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<tr>
<td>Sum</td>
<td>361,220</td>
<td>184,800</td>
<td>184,800</td>
<td>361,220</td>
</tr>
</tbody>
</table>

Financing With a Loan

Example 3

Same as Example 1, but without loan.

Question:
Will the Cash Flow A/T be larger, the same, or smaller than in Example 1?

Financing With a Loan

Example 3, Taxes

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>t</td>
<td>Cash</td>
<td>Dep.</td>
<td>Inc.</td>
<td>Tax</td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
<td>------</td>
<td>------</td>
<td>------------</td>
</tr>
<tr>
<td>0</td>
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<td></td>
<td></td>
</tr>
<tr>
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<tr>
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<td></td>
<td>266,000</td>
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<td>690,000</td>
<td>184,800</td>
<td>570,000</td>
<td>172,050</td>
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</table>
Financing With a Loan

**Example 3, Cash Flow**

<table>
<thead>
<tr>
<th>t</th>
<th>A/T</th>
<th>Dep.</th>
<th>Invest.</th>
<th>Cash Flow</th>
</tr>
</thead>
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<td>-300,000</td>
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<tr>
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<td>60,000</td>
<td>180,450</td>
<td></td>
</tr>
<tr>
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<td>98,490</td>
<td>96,000</td>
<td>194,490</td>
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</tr>
<tr>
<td>3a</td>
<td>179,010</td>
<td>28,800</td>
<td>207,810</td>
<td></td>
</tr>
<tr>
<td>3b</td>
<td>115,200</td>
<td>115,200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
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<td></td>
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<tr>
<td>Sum</td>
<td>397,950</td>
<td>184,800</td>
<td>397,950</td>
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</table>

Financing With a Loan

**Comparison of Exs. 1 - 3**

<table>
<thead>
<tr>
<th>t</th>
<th>Ex. 1</th>
<th>Ex. 2</th>
<th>Ex. 3</th>
</tr>
</thead>
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<td>-100,000</td>
<td>-300,000</td>
</tr>
<tr>
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<td>125,810</td>
<td>134,328</td>
<td>180,450</td>
</tr>
<tr>
<td>2</td>
<td>142,778</td>
<td>146,894</td>
<td>194,490</td>
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<tr>
<td>3</td>
<td>194,226</td>
<td>179,998</td>
<td>323,010</td>
</tr>
<tr>
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<td>362,814</td>
<td>361,220</td>
<td>397,950</td>
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<tr>
<td>NPV</td>
<td>245,067</td>
<td>246,232</td>
<td>216,360</td>
</tr>
</tbody>
</table>

Financing With a Loan

**Observation 2**

For the general case, to estimate Cash Flow A/T:

- Profit A/T
- + Depreciation expense
- – Asset investment
- + Tax-sheltered part of asset salvage value
- ± Loan principal cash flow

Financing With a Loan

**Observation 3**

In many situations financing with a loan can improve the Cash Flow A/T so that we obtain a greater NPV

The conditions for this are:

- NPV without loan > 0
- MARR > $i(1 − t_m)$

Financing With a Loan

**Summary**

- Only interest payments are tax-deductible, must separate loan interest payments from principal repayments
- Premature project termination may cause $\frac{1}{2}$ depreciation, depreciation recapture
- Loan financing often improves NPV of Cash Flow A/T

ISyE 3025 Engineering Economy

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