LESSON 22 TAXES, DEPRECIATION AND INFLATION IN ECONOMIC ANALYSIS

Learning Objectives

After this presentation you will be able to:

- Define and compute depreciation for economic analysis
- Examine the affect of adding taxes to project economic analysis
- Include the effects of inflation in energy economic analysis
- Identify sources for financing energy projects
DEPRECIATION AND TAXES

Depreciation – the decrease in asset value over time due to use or depletion

Characteristics of a depreciable item

1.) must be held by business to produce income
2.) must wear out or be consumed over time
3.) must have life greater than one year

Examples:
- Business buildings
- Rental property
- Office furniture and fixtures
- Office furniture and fixtures
- Trucks and Cars
- Manufacturing tools

DEPRECIATION AND TAXES

Methods of computing depreciation

Straight-line – constant value each year

\[ d = \frac{P}{N} \]

Where:
- \( d \) = depreciation
- \( P \) = purchase cost
- \( N \) = economic life (years)

Sum of Year Digits – arithmetic gradient over life of asset

\[ d_t = \frac{2 \cdot (N - t + 1)}{N \cdot (N + 1)} (P - S) \]

Where:
- \( d_t \) = depreciation at year \( t \)
- \( P \) = purchase cost
- \( N \) = economic life (years)
- \( t \) = year
- \( S \) = salvage value
DEPRECIATION AND TAXES

Other methods of computing depreciation

Double Declining Balance – value reduced by constant rate on remaining un-amortized balance

\[ d_t = \frac{2 \cdot P}{N} \left( 1 - \frac{2}{N} \right)^{t-1} \]

Where:  
\( d_t \) = depreciation at year \( t \)  
\( P \) = purchase cost  
\( N \) = economic life (years)  
\( t \) = year

Note: Using this method the value of the asset is never zero.

DEPRECIATION METHODS COMPARED

<table>
<thead>
<tr>
<th>Depreciation Method</th>
<th>Total Deprecation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight Line</td>
<td>10,000</td>
</tr>
<tr>
<td>Sum of Year</td>
<td>12,000</td>
</tr>
<tr>
<td>Double Declining Balance</td>
<td>0</td>
</tr>
</tbody>
</table>

Diagram showing depreciation methods comparison over time.
DEPRECIATION AND TAXES

Other methods of computing depreciation

- Accelerated Cost Recovery System
- Modified Accelerated Cost Recovery System (MACRS)

Federal tax code defines property class as accounting life (depreciation) time

<table>
<thead>
<tr>
<th>Property Class</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 year property</td>
<td>Special manufacturing tools</td>
</tr>
<tr>
<td>5 year property</td>
<td>Cars, trucks computers</td>
</tr>
<tr>
<td>7 year property</td>
<td>Office furniture and fixtures</td>
</tr>
<tr>
<td>10 year property</td>
<td>Petroleum refining assets</td>
</tr>
<tr>
<td>15 year property</td>
<td>Telephone distribution equipment</td>
</tr>
<tr>
<td>20 year property</td>
<td>Utility transmission lines</td>
</tr>
</tbody>
</table>

Only six property classes allowed to use MACRS

<table>
<thead>
<tr>
<th>Recovery Year</th>
<th>3-year property</th>
<th>5-year property</th>
<th>7-year property</th>
<th>10-year property</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>33.33%</td>
<td>20.00%</td>
<td>14.29%</td>
<td>10.00%</td>
</tr>
<tr>
<td>2</td>
<td>44.45%</td>
<td>32.00%</td>
<td>24.49%</td>
<td>18.00%</td>
</tr>
<tr>
<td>3</td>
<td>14.81%</td>
<td>19.20%</td>
<td>17.49%</td>
<td>14.40%</td>
</tr>
<tr>
<td>4</td>
<td>7.41%</td>
<td>11.53%</td>
<td>12.49%</td>
<td>11.52%</td>
</tr>
<tr>
<td>5</td>
<td>11.52%</td>
<td>8.93%</td>
<td>9.22%</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>5.76%</td>
<td>8.92%</td>
<td>7.37%</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>8.93%</td>
<td>6.55%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>4.46%</td>
<td>6.55%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td>6.56%</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>6.55%</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td>3.28%</td>
<td></td>
</tr>
</tbody>
</table>
### DEPRECIATION - MACRS CALCULATION

Multiply MACRS rate for given year by cost basis to find depreciation in year

<table>
<thead>
<tr>
<th>Year</th>
<th>MACRS Rate</th>
<th>Depreciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20.00%</td>
<td>$2,000.00</td>
</tr>
<tr>
<td>2</td>
<td>32.00%</td>
<td>$3,200.00</td>
</tr>
<tr>
<td>3</td>
<td>19.20%</td>
<td>$1,920.00</td>
</tr>
<tr>
<td>4</td>
<td>11.52%</td>
<td>$1,152.00</td>
</tr>
<tr>
<td>5</td>
<td>11.52%</td>
<td>$1,152.00</td>
</tr>
<tr>
<td>6</td>
<td>5.76%</td>
<td>$576.00</td>
</tr>
</tbody>
</table>

\[
\text{Total} \quad (0.2)(\$10,000) = \$2,000
\]

### ECONOMIC ANALYSIS WITH TAXES

Some companies prefer to analyze project alternatives using after tax cash flows

Computing after tax cash flows (ATCFs)

Define Before tax cash flows (BTCFs)  
Taxable Income (TI)

Business allowed to subtract all expenses in doing business to find taxable income

- Taxable Income
- BTCFs
- Loan Interest LI
- Bond Interest BI
- Depreciation d
Computing after tax cash flows (ATCFs)

\[
\text{Taxes (T)} = \text{Tax rate (TR)} \times \text{Taxable Income (TI)}
\]

\[
\text{T} = TR \times TI
\]

Example: A firm is considering two conveyor systems. One system (A) will cost $30,000 but will require less energy to operate yielding an annual operating expense of $7,000. The other system (B) will cost $17,000 and consume more energy resulting in an annual operating expense cost of $13,000. The company uses straight line depreciation and has a tax rate of 35%. There is no salvage value for both choices. Compute the after tax rate of return on these alternatives.
### Example solution

#### Cash Flow Diagrams

**Choice A**
- $PC_A = -$30,000
- $EC_A = -$7,000
- $TR = 0.35$
- Depreciation: SLD

**Choice B**
- $PC_B = -$17,000
- $EC_B = -$13,000

#### Subtract Choice B from Choice A

<table>
<thead>
<tr>
<th>Economic Analysis with Taxes and Deprecation</th>
<th>7</th>
<th>35%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Life time</strong></td>
<td>7</td>
<td></td>
</tr>
<tr>
<td><strong>Purchase</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost A</td>
<td>-$30,000.00</td>
<td></td>
</tr>
<tr>
<td>Cost B</td>
<td>-$17,000.00</td>
<td></td>
</tr>
<tr>
<td><strong>Energy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost A</td>
<td>-$7,000.00</td>
<td></td>
</tr>
<tr>
<td>Cost B</td>
<td>-$13,000.00</td>
<td></td>
</tr>
<tr>
<td><strong>Deprecation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>-$4,285.71</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>-$2,428.57</td>
<td></td>
</tr>
<tr>
<td><strong>Subtract B from A</strong></td>
<td>-$13,000.00</td>
<td></td>
</tr>
<tr>
<td><strong>Account for Taxes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taxable Savings</td>
<td>$6,000.00</td>
<td></td>
</tr>
<tr>
<td>Less Deprecation</td>
<td>-$1,857.14</td>
<td></td>
</tr>
<tr>
<td><strong>BTCF</strong></td>
<td>$4,142.86</td>
<td></td>
</tr>
<tr>
<td><strong>Income Tax</strong></td>
<td>$1,450.00</td>
<td></td>
</tr>
<tr>
<td><strong>ATCF</strong></td>
<td>$2,692.86</td>
<td></td>
</tr>
</tbody>
</table>

\[
ATCF = BTCF - T = 4142.86 - 1450 = 2692.86
\]
Example solution

Find present worth of series of ATCFs.

Present value of a uniform series is:

$$PVS(n,i,A) = A \cdot \left( \frac{(1 + i)^n - 1}{i \cdot (1 + i)^n} \right)$$

$n=7$ $i=\ ?$

Equate present value of cost to present value of savings and solve for $i$ with $n=7$ years.

Example solution

Given

$$C_{AB} = 13,000$$

$$S = 6,000 \text{ (ATCF)}$$

$$C_{AB} = S \cdot \left( \frac{(1 + i)^n - 1}{i \cdot (1 + i)^n} \right)$$

$$\text{ROR} := \text{Find}(i)$$

$$\text{ROR} = 10.25\%$$ 

Answer

Solved using MathCAD find function.

Including taxes and depreciation can reduce economic viability of energy project.

Sensitivity analysis:

- $C_{AB} = 17,000 \ (\pm 5000) \ ROR=2.65\%$
- $S = 6,000 \ (\text{ATCF}) \ (C_{AB}=13,000) \ ROR = 42.24\%$
Constant Dollars – value that reflects the purchasing power of a cash flow.

Current Dollars – out-of-pocket dollars changing hands at the time of a sales transaction.

Inflation Rate – (f) government published rate (%) based on consumer price index.

Real Interest Rate – (j) real growth in monetary earning power. Inflation-free interest rate

Market Interest Rate – (i) earning rate of interest available in finance and business

Relationship between market interest rate and real interest rate

\[ i = f + j + f \cdot j \]

Where:  
\( i \) = market interest rate  
\( j \) = real interest rate  
\( f \) = inflation rate (know as escalation rate for energy sector)

What rate to use with what dollars

<table>
<thead>
<tr>
<th>Type of Dollars</th>
<th>Type of Interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current (actual)</td>
<td>i (market interest)</td>
</tr>
<tr>
<td>Constant Worth</td>
<td>j (real interest)</td>
</tr>
</tbody>
</table>
INFLATION

Discounting and compounding factors for inflation calculations

Relationships between current $ and constant $

\[
\begin{align*}
\text{constant$} &= \frac{(\text{current$})}{(1+f)^n} \\
\text{current$} &= (\text{constant$})(1+f)^n
\end{align*}
\]

Example: Gasoline currently costs $3.80/gal on the average. What would the constant dollar cost of gasoline be if we have experienced an annual average inflation rate of 4% over the last 30 years.

\[
\begin{align*}
\text{constant$} &= \frac{(\text{current$})}{(1+f)^n} \\
\text{constant$} &= \frac{$3.80}{(1 + 0.04)^{30}} = \frac{$3.80}{3.2434} = $1.17
\end{align*}
\]

Answer

INFLATION EXAMPLE

A company has constant dollar energy costs of $25,000 for 3 years. There is an energy escalation rate of 25% annually. The company’s real interest (discount rate) is 4%. Find the present worth of the three years of energy costs in a.) constant dollars and b.) current (actual) dollars

a.) constant dollars

Find present worth of constant dollars using discounting formula  \( j=0.04 \)

\[
\begin{align*}
PW &= \frac{S}{(1+i)^n} \\
PW_{\text{constant}} &= \frac{$25,000}{(1 + 0.04)^1} + \frac{$25,000}{(1 + 0.04)^2} + \frac{$25,000}{(1 + 0.04)^3} \\
PW_{\text{constant}} &= $25,000 + $25,000 + $25,000 \\
PW_{\text{constant}} &= \frac{1.04}{1.0816} + \frac{1.04}{1.1248} \\
PW_{\text{constant}} &= $24,038 + $23,114 + $22,225 = $69,377
\end{align*}
\]

Answer
INFLATION EXAMPLE

a.) current dollars

First increase the constant dollars using inflation to get current dollars then, using the market rate, find the present worth.

\[
\text{Current}\$ = \text{Constant}\$(1 + f)^n
\]

\[
\text{Current}\$1 = 25,000(1 + 0.25)^1 = 31,250
\]

\[
\text{Current}\$2 = 25,000(1 + 0.25)^2 = 39,063
\]

\[
\text{Current}\$3 = 25,000(1 + 0.25)^3 = 48,828
\]

\[
i = f + j(f)(j) = 0.25 + 0.04 + (0.25)(0.04) = 0.30
\]

\[
\text{PW}_{\text{current}} = \frac{31,250}{(1 + 0.30)^1} + \frac{39,063}{(1 + 0.30)^2} + \frac{48,828}{(1 + 0.30)^3}
\]

\[
\text{PW}_{\text{current}} = \frac{31,250}{1.30} + \frac{39,063}{1.69} + \frac{48,828}{2.197}
\]

\[
\text{PW}_{\text{current}} = 24,038 + 23,114 + 22,225 = 69,377
\]

Answer

ENERGY PROJECT FINANCING

Financing Options

In-House Capital – use profits from inside company to finance energy management projects. Most common method.

Utility Rebates/Incentives – Reduce initial cost of project through funds contributed by utility.

Rebates – utility reimburses customer for part of energy project cost. Typical $/item or $/kW load reduction. Example: Cash for installing high efficiency furnace.

Direct Assistance – utility pays project contractor directly for part/all of energy project cost.
ENERGY PROJECT FINANCING

Low Cost Loan Programs

**Commercial Loans** – secure capital from lending institution for all or part of project costs. Loan payments must be less than projected energy savings

**Government Loans/Bonds** – some states make low interest loans/bonds available to qualifying businesses. Must meet program requirements. (Number of employees, profits) Loan payment must be less than estimated energy savings.

PROJECT FINANCING

Energy Equipment Leases

**Capital Lease** - (Installment payments) Little or no initial cost to purchase equipment. Company owns equipment and claims tax benefits/deprecation. Offered by banks, leasing companies, equipment installers/suppliers

**Operating Lease** - Leaser owns equipment and takes tax benefits and depreciation. Charges company monthly fee for usage during contract period. Company can buy equipment at contract end, renew lease or remove equipment.
PROJECT FINANCING

Performance Contracts

Equipment/project paid for through energy cost savings. Requires careful analysis, monitoring of new equipment, quantifying savings.

Shared Savings- Portion of energy savings pays for project over time. Similar to operating lease. Requires detailed and exact analysis of EMO and economics of project. Contractor performs analysis, installs equipment collects percent savings for contract period (i.e. 10 years)

Performance Contracts - Energy services company (ESCO) contracts with customer to provide energy services (levels of heating, cooling, lighting) and equipment. ESCO takes over utility payment for contracted services.

END LESSON 22 TAXES, DEPRECIATION AND INFLATION IN ECONOMIC ANALYSIS