EM600 - Engineering Economics and Cost Analysis

Lecture 08: *Inflation*

- References:
  - Park, Chan S. Contemporary Engineering Economics. New Jersey: Pearson Prentice Hall, 2006 (Chapter 11)
  - Ganguly, A. Engineering Economics Using Excel. New Jersey: SSE, 2008

After completing this module you should understand the following:

- Introduction to Inflation
- Measuring / assessing inflation
- Equivalence calculation under inflation (real, constant, actual dollars)
- Impact of inflation on capital projects

- Key Definitions: (Chan S. Park)
  - Inflation:
    - *The rate at which the general level of prices and goods and services is rising and subsequently, purchasing power is falling.*
  - Deflation:
    - *Opposite to inflation.*
    - *Gain in purchasing power.*
    - *Not covered in this lecture, inflation is far more realistic to our every day lives.*

- Key Definitions: (Chan S. Park)
  - Measuring Inflation:
    - Consumer Price Index (CPI):
      - *Is an inflationary indicator that measures the change in the cost of a fixed basket of products and services.*
      - *The CPI compares the cost of a sample "market basket" of goods and services in a specific period relative to the cost of the same "market basket" in an earlier reference period. This reference period is known as the base period.*
    - Producer Price Index (PPI):
      - *Is an inflationary indicator published by the U.S. Bureau of Labor Statistics to evaluate wholesale price levels in the economy.*

- Key Definitions: (Chan S. Park)
  - Measuring Inflation:
    - Average Inflation Rate (f):
      - *a single rate that accounts for the effect of varying yearly inflation rates over a period of several years.*
    - General Inflation Rate ($\overline{f}$)
      - *the **average** inflation rate calculated based on the CPI for all items in the market basket. The market interest rate is expected to respond to this inflation rate.*
    - Specific Inflation Rate (f_j)
      - *This rate is based on the CPI specific to segment j of the economy. Focuses on the future cost estimation of a particular item e.g. labor.*

- Average inflation rate (f)
  - Example 1:
    - Calculate the average inflation for a 5 year period with the following details:
      - Base price (year 1), P = $150
      - Inflation rates:
        - » Year 1 = 2.90%
        - » Year 2 = 3.76%
        - » Year 3 = 5.91%
        - » Year 4 = 2.78%
        - » Year 5 = 6.38%

- Average inflation rate (f)
  - Example 1:
    - Step 1: Calculate the price at the end of the 5th year, F
      - Use the compounding method

$$F = P(1+i)^N = P(1+f)^N \qquad \text{. . . . . eqn (1)}$$

$$F = P(F/P,i,N) = P(F/P,f,N) \qquad \text{. . . . . eqn (2)}$$

where, i = interest rate; f = average inflation rate

In this case f varies each year, therefore,

$$F = P(1+f_1)(1+f_2)(1+f_3)(1+f_4)(1+f_5)$$

$$F = \$100(1+0.029)(1+0.0376)(1+0.0591)(1+0.0278)(1+0.0638)$$

$$F = \$185.46$$

- Average inflation rate (f)
  - Example 1:
    - Step 2: Calculate the overall average inflation rate, f
      - Use the compounding method

$$F = P(1+i)^N = P(1+f)^N \qquad \text{. . . . . eqn (1)}$$

$$F = P(F/P,i,N) = P(F/P,f,N) \qquad \text{. . . . . eqn (2)}$$

where, i = interest rate; f = average inflation rate for N periods

Rearranging eqn (1) yields,

$$f = \left(\frac{F}{P}\right)^{1/N} - 1$$

$$f = \left(\frac{\$185.46}{\$150}\right)^{1/5} - 1 = 4.34\%$$

- General inflation rate ($\overline{f}$)
  - In terms of the CPI, the general inflation rate can be defined as follows:

$$\overline{f} = \left[\frac{CPI_n}{CPI_0}\right]^{1/n} - 1$$

where,

$\overline{f}$ = general inflation rate

CPI_n = consumer price index at the end of period n

CPI_0 = consumer price index for the base period

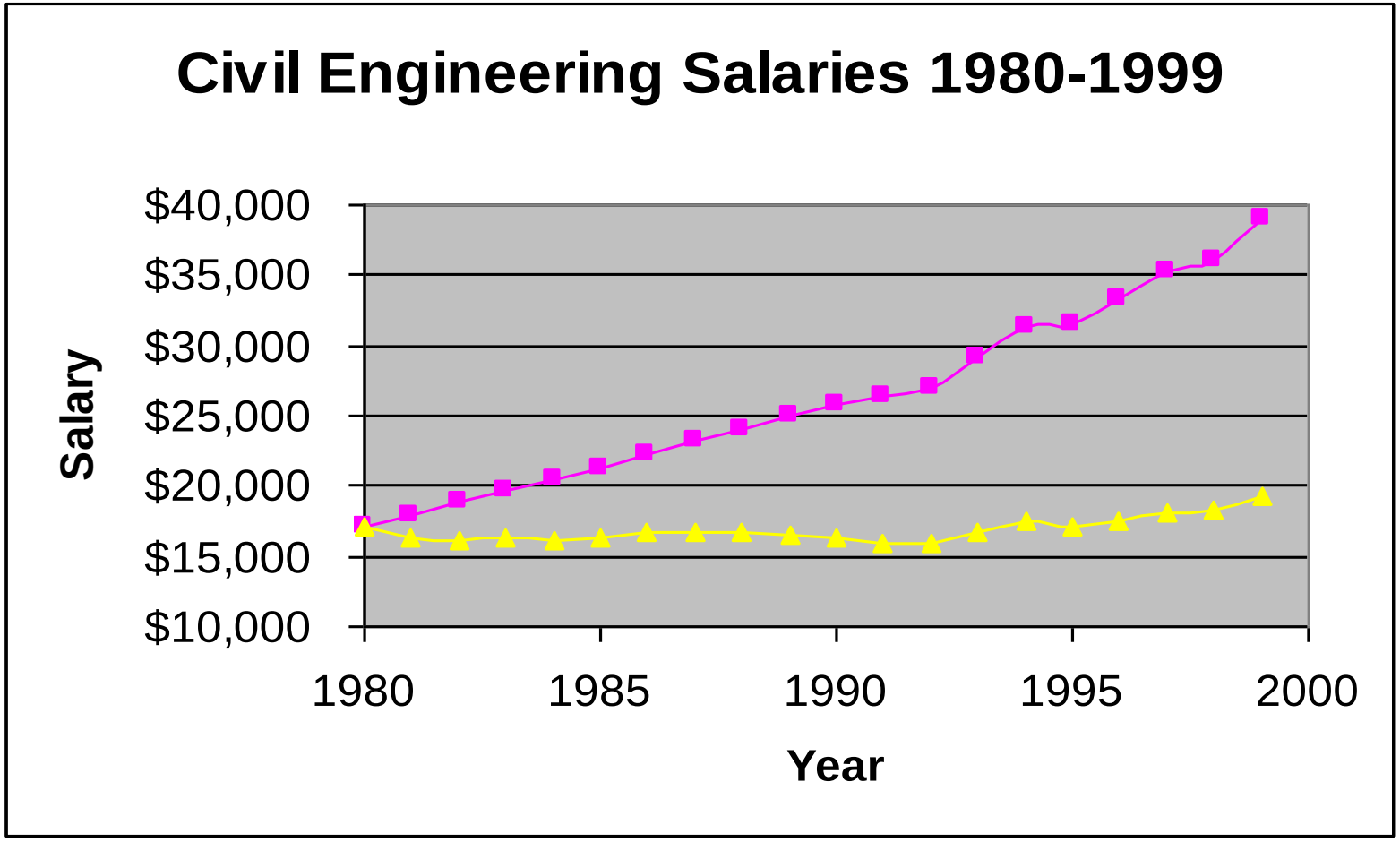
  - Knowing the CPI values for 2 consecutive years, the annual general inflation rate is:

$$\overline{f_n} = \frac{CPI_n - CPI_{n-1}}{CPI_{n-1}} = \text{general inflation rate for period n}$$

- Actual versus Constant Dollars
  - Definitions: (Chan S. Park)
    - Actual Dollars (A_n)
      - *The cash flow measured in terms of dollars at the time of the transaction.*
      - *Out-of-pocket dollars paid at the time of purchasing goods and services.*
      - *Estimates of future cash flows for year n that take into account any anticipated changes in amounts caused by the effects of inflation or deflation.*
      - *Also known as: Current dollars.*

- Actual versus Constant Dollars
  - Definitions: (Chan S. Park)
    - Constant Dollars (A'_n)
      - *Represents constant purchasing power that is independent of the passage of time.*
      - *Used to adjust for the effects of inflation.*
      - *Also known as: Base-year, Nominal or Real dollars.*

- Actual versus Constant Dollars



- Actual versus Constant Dollars
  - Conversion equations:
    - ***Constant to Actual Dollars***

$$A_n = A_n^{'}\left(1+\overline{f}\right)^n = A_n^{'}\left(F/P,\overline{f},n\right)$$

    - ***Actual to Constant Dollars***

$$A_n^{'} = \frac{A_n}{\left(1+\overline{f}\right)^n} = A_n\left(P/F,\overline{f},n\right)$$

    - ***where,***

A_n = Actual-dollar expression for the cash flow at the end of year n

$A_n^{'}$ = Constant-dollar expression for the cash flow at the end of year n

$\overline{f}$ = General inflation rate

Note:

If the future price of a specific cash flow element (j) is not expected to follow the general inflation rate ($\overline{f}$), the average inflation rate (f_j) applicable to that cash flow element shoud be used instead.

- Equivalence Calculations under Inflation
  - Two different interest rates involved
    - Inflation free interest rate, i'
    - Market interest rate, i
  - Two methods of analysis
    - Constant-dollar analysis (Inflation free interest rate, i')
    - Actual-dollar analysis (Market interest rate, i)
  - Three common cases for the nature of project cash flows
    - Case 1: All cash flow elements are estimated in constant dollars
    - Case 2: All cash flow elements are estimated in actual dollars
    - Case 3: Some cash flow elements estimated in constant dollars, others in actual dollars

- Market & Inflation-Free Interest Rates
  - Inflation-free interest rate (i')
    - *Estimate of the true earning power of money when the inflation effects have been removed.*
    - *Also known as: Real Interest Rate or MARR without inflation.*
  - Market interest rate (i)
    - *Takes into account the combined effects of earning power (earning value of capital) and purchasing power (inflation and deflation).*
    - *Also known as: Inflation Adjusted MARR or MARR with inflation.*
    - *Used to evaluate investment projects.*
    - *In the absence of inflation, $i = i'$*

- Case 1: Constant-Dollar Analysis
  - All cash flow elements in constant dollars
  - Use i' as the interest rate to find the equivalent worth.

$$P_n = \frac{A'_n}{(1+i')^n} = A'_n(P/F, i', n)$$

where,

P_n = the present worth equivalent of the constant dollar amount (A'_n) at i', occuring in year n

- Case 1: Constant-Dollar Analysis
  - Constant dollar analysis is common in the evaluation of many long-term public projects, because government do not pay income taxes.
  - For private sector, income taxes are levied based on the taxable income in actual dollars, the actual dollar analysis is more common.

- Case 1: Constant-Dollar Analysis
  - Example 2:
    - Assume the following cash flow data for JoeRx, a manufacturer of an anti-inflammatory drug for their first 5 years in business:

Period, n	Net Cash Flow in Constant Dollars
0	-$350,000
1	$125,000
2	$145,000
3	$160,000
4	$185,000
5	$172,500

    - With a 15% inflation-free rate of return (i') calculate the present worth of the cash flow series in constant dollars.

- Case 1: Constant-Dollar Analysis
  - Example 2:

Period, n	Net Cash Flow in Constant Dollars	(P/F, 15%, n)
0	-$350,000	-
1	$125,000	0.8696
2	$145,000	0.7561
3	$160,000	0.6575
4	$185,000	0.5718
5	$172,500	0.4972

$$PW = -P + \sum_{n=1}^{N} A_n^{'}\left(P/F, i^{'}, n\right)$$

$$PW = -\$350{,}000 + \$125{,}000\left(P/F, 15\%, 1\right) + \$145{,}000\left(P/F, 15\%, 2\right)$$
$$+\$160{,}000\left(P/F, 15\%, 3\right) + \$185{,}000\left(P/F, 15\%, 4\right) + \$172{,}500\left(P/F, 15\%, 5\right)$$

$$PW = -\$350{,}000 + \$125{,}000\left(0.8696\right) + \$145{,}000\left(0.7561\right)$$
$$+\$160{,}000\left(0.6575\right) + \$185{,}000\left(0.5718\right) + \$172{,}500\left(0.4972\right)$$

$$PW = \$165{,}085$$

- Case 2: Actual-Dollar Analysis
  - All cash flow elements in actual dollars
  - Use i as the interest rate to find the equivalent worth.
  - Two Methods:
    - Deflation Method:
      - 1. Convert actual dollars into equivalent constant dollars by discounting by the general inflation rate (common purchasing power)
      - 2. Use i' to find the equivalent present worth (consider the earning power)
    - Adjusted Discount Method:
      - Combines steps 1 and 2 of the deflation method.
      - Performs deflation and discounting in one step using the market interest rate (i).

- Case 2: Actual-Dollar Analysis
  - Deflation Method
    - Example 3:
      - Assume the following cash flow data:

Period, n	Net Cash Flow in Actual Dollars
0	-$95,000
1	$39,000
2	$41,500
3	$27,250
4	$33,750
5	$61,000

      - Calculate the equivalent constant dollars if the general inflation rate ($\bar{f}$) is 4% per year.
      - With a 12% inflation-free rate of return (i') calculate the present worth of the cash flow series in constant dollars.

- Case 2: Actual-Dollar Analysis
  - Deflation Method
    - Example 3:
      - Calculate the equivalent constant dollars if the general inflation rate ($\bar{f}$) is 4% per year.

Period, n	Net Cash Flow in Actual Dollars	(P/F,4%,n)	Net Cash Flow in Constant Dollars
0	-$95,000	-	-$95,000
1	$39,000	0.9615	$37,499
2	$41,500	0.9246	$38,371
3	$27,250	0.8890	$24,225
4	$33,750	0.8548	$28,850
5	$61,000	0.8219	$50,136

- Case 2: Actual-Dollar Analysis
  - Deflation Method
    - Example 3:
      - With a 12% inflation-free rate of return (i') calculate the present worth of the cash flow series.

Period, n	Net Cash Flow in Constant Dollars	(P/F, 12%, n)
0	-$95,000	-
1	$37,499	0.8929
2	$38,371	0.7972
3	$24,225	0.7118
4	$28,850	0.6355
5	$50,136	0.5674

$$PW = -P + \sum_{n=1}^{N} A_n' \left(P/F, i', n\right)$$

$$PW = -\$95{,}000 + \$37{,}499\left(P/F, 12\%, 1\right) + \ldots\ldots + \$50{,}136\left(P/F, 12\%, 5\right)$$

$$PW = -\$95{,}000 + \$37{,}499\left(0.8929\right) + \ldots\ldots + \$50{,}136\left(0.5674\right)$$

$$PW = \$33{,}096$$

- Case 2: Actual-Dollar Analysis
  - Adjusted Discount Method
    - The market interest rate (i) reflects both the earning power and the purchasing power.
    - The market interest rate (i) is therefore a function of:

      $\overline{f}$, general inflation rate

      i', inflation - free interest rate

      and can be expressed as:

      $i = i' + \overline{f} + i'\overline{f}$

- Case 2: Actual-Dollar Analysis
  - Adjusted Discount Method
    - Since the market rate (i) reflects both the earning power and the purchasing power,

$$P_n = \frac{A_n}{(1+i)^n} = A_n(P/F,i,n)$$

where,

P_n = the present worth equivalent of the constant dollar amount (A_n) at i, occuring in year n

- Case 2: Actual-Dollar Analysis
  - Adjusted Discount Method
    - Example 4:
      - Assume the same cash flow data for example 3:

Period, n	Net Cash Flow in Actual Dollars
0	-$95,000
1	$39,000
2	$41,500
3	$27,250
4	$33,750
5	$61,000

      - With a general inflation rate ($\overline{f}$) of 4% per year and a 12% inflation-free rate of return (i') calculate the present worth of the cash flow series.

- Case 2: Actual-Dollar Analysis
  - Adjusted Discount Method
    - Example 4:
      - Calculate the market interest rate (i) with,
        - » general inflation rate ($\bar{f}$) of 4%
        - » inflation-free rate of return (i') of 12%

$$i = i' + \bar{f} + i'\bar{f}$$

$$i = 12\% + 4\% + (12\% \times 4\%)$$

$$i = 16.48\%$$

- Case 2: Actual-Dollar Analysis
  - Adjusted Discount Method
    - Example 4:
      - With a 16.48% market interest rate of return (i) calculate the present worth of the cash flow series.

Period, n	Net Cash Flow in Actual Dollars	(P/F, 16.48%, n)
0	-$95,000	-
1	$39,000	0.8585
2	$41,500	0.7371
3	$27,250	0.6328
4	$33,750	0.5432
5	$61,000	0.4664

$$PW = -P + \sum_{n=1}^{N} A_n (P/F, i, n)$$

$$PW = -\$95{,}000 + \$39{,}000(P/F, 16.48\%, 1) + \ldots.. + \$61{,}000(P/F, 16.48\%, 5)$$

$$PW = -\$95{,}000 + \$39{,}000(0.8585) + \ldots.. + \$61{,}000(0.4664)$$

$$PW = \$33{,}097$$

- Case 3: Mixed-Dollar Analysis
  - All cash flow elements should be converted into the same dollar units
    - Converted to ***constant*** dollars = use the inflation-free interest rate (i') when calculating the equivalent present worth.
    - Converted to ***actual*** dollars = use the market interest rate (i) when calculating the equivalent present worth.

- ***Effects of Inflation on Project Cash Flows:***
  - Two areas of focus:
    - Depreciation expenses
    - Interest expenses
  - Why focus on these areas?
    - Always given in actual dollars (with inflation), therefore, they are essentially immune to the effects of inflation.

- ***Effects of Inflation on Projects with Depreciable Assets***
  - Example 5: (Chan S. Park, example 11.8)
    - Refer to example 1, Lecture 7
    - Project: Installation of a new computer system
    - Financial Data:
      - Investment: $125,000
      - Project life: 5 years
      - Salvage value: $50,000
      - Annual labor savings (Annual Revenues): $100,000
      - Annual manufacturing costs:
        - » Labor: $20,000
        - » Materials: $12,000
        - » Overhead: $8,000
      - Depreciation method: 7-year MACRS
      - Income tax rate: 40%
      - Inflation-free interest rate (i'): 15%

- ***Effects of Inflation on Projects with Depreciable Assets***
  - Example 5: (Chan S. Park, example 11.8)
    - PW in the absence of inflation: $43,153
    - Using the deflation method:
      - Determine the PW of the project if the general inflation rate ($\bar{f}$) during the next 5 years is expected to increase by 5% annually.

- ***Effects of Inflation on Projects with Depreciable Assets***
  - Example 5: (Chan S. Park, example 11.8)
    - Identify the items in the Income Statement and Cash Flow Statement that are impacted by the general inflation rate:
      - Income Statement:
        - » Revenues
        - » Expenses
          - » Labor
          - » Material
          - » Overhead
      - Cash Flow Statement:
        - » Salvage
          - » Will also have an impact on the gains tax

- ***Effects of Inflation on Projects with Depreciable Assets***
  - Example 5: (Chan S. Park, example 11.8)
    - Notes:
      - The items identified in the previous slide are all the cash flow elements assumed to be in constant dollars.
        - » These need to be converted to actual dollars
        - » Depreciation expenses are not included
      - The Net Cash Flows (operating activities and investment activities) are in actual dollars.
        - » These need to be converted to constant dollars before the PW can be calculated.
      - General inflation rate of 5% is assumed to apply to each of the identified cash flow elements on the previous slide starting in year 1

- **Example 5: (Chan S. Park, example 11.8)**
  - **Income Statement**

YEAR:	$\overline{f}$	1	2	3	4	5
Revenues	**5%**	$105,000	$110,250	$115,763	$121,551	$127,628
Expenses:						
Labor	**5%**	$21,000	$22,050	$23,153	$24,310	$25,526
Material	**5%**	$12,600	$13,230	$13,892	$14,586	$15,315
Overhead	**5%**	$8,400	$8,820	$9,261	$9,724	$10,210
Depreciation		$17,863	$30,613	$21,863	$15,613	$5,581
Taxable Income		$45,137	$35,537	$47,595	$57,317	$70,996
Income Taxes (40%)		$18,055	$14,215	$19,038	$22,927	$28,398
Net Income		$27,082	$21,322	$28,557	$34,390	$42,598

- **Example 5: (Chan S. Park, example 11.8)**
  - **Cash Flow Statement**

YEAR:	$\overline{f}$	0	1	2	3	4	5
Operating Activities:							
Net Income			$27,082	$21,322	$28,557	$34,390	$42,598
Depreciation			$17,863	$30,613	$21,863	$15,613	$5,581
Investment Activities:							
Investment		-$125,000					
Salvage	5%						$63,814
Gains Tax							-$12,138
Net Cash Flow (Actual Dollars)		-$125,000	$44,945	$51,935	$50,419	$50,003	$99,855

- **Example 5: (Chan S. Park, example 11.8)**
  - **Income Statement Notes**
    1. Revenues = \$100,000 x $(1 + 5\%)^n$
    2. Labor = \$20,000 x $(1 + 5\%)^n$
    3. Material = \$12,000 x $(1 + 5\%)^n$
    4. Overhead = \$8,000 x $(1 + 5\%)^n$
  - **Cash Flow Statement Notes**
    1. Salvage Value = \$50,000 x $(1 + 5\%)^n$
    2. Gains tax increases as salvage value has increased due to conversion to actual dollars from constant dollars.

- **Example 5: (Chan S. Park, example 11.8)**

Period, n	Net Cash Flow in Actual Dollars	(P/F, 5%, n)	Net Cash Flow in Constant Dollars	(P/F, 15%, n)
0	-$125,000	-	-$125,000	-
1	$44,945	0.8658	$42,804	0.8696
2	$51,935	0.7496	$47,106	0.7561
3	$50,419	0.6490	$43,554	0.6575
4	$50,003	0.5619	$41,138	0.5718
5	$99,855	0.4865	$78,239	0.4972

$$PW = -P + \sum_{n=1}^{N} A_n'(P/F, i', n)$$

$$PW = -\$125{,}000 + \$42{,}804(P/F, 15\%, 1) + \ldots.. + \$78{,}239(P/F, 12\%, 5)$$

$$PW = -\$125{,}000 + \$42{,}804(0.8696) + \ldots.. + \$78{,}239(0.4972)$$

$$PW = \$38{,}899$$

- **Note:** The adjusted-discount method can also be used here.

- ***Effects of Multiple Inflation Rates on Project Cash Flows***
  - Methodology:
    - Apply the same methodology as in example 5.
    - In this case, where inflation rates are given for specific elements, apply them to those elements.
    - Use the general rate of inflation and the inflation-free interest rates to calculate the PW using either,
      - The deflation method, or
      - The adjusted-discount method

      as previously shown
  - Refer to Chan S. Park, example 11.9

- ***Effects of Borrowed Funds under Inflation***
  - Notes:
    - Loan repayment is based on a historical contract amount.
    - Debt payment size ***does not*** change with inflation.
    - Future payments are calculated based on year-0 dollars.
    - Under the effect of inflation, the constant-dollar costs of both interest and principal repayments on a debt are reduced.
  - Summary:
    - Borrowers repay historical loan amounts with dollars of decreased purchasing power, reducing the debt-financing cost.

- ***Effects of Borrowed Funds under Inflation***
  - Example 6: (Chan S. Park, example 11.10)
    - Recall example 5
    - Assume a debt ratio of 0.5.
      - $62,500 borrowed
    - Debt borrowed at an annual interest rate of 15.5%.
    - General Inflation Rate ($\bar{f}$) = 5%
    - Calculate the loan repayment schedule
      - In actual dollars
      - In constant dollars
    - What is the borrowers gain in constant dollars?

- ***Effects of Borrowed Funds under Inflation***
  - Example 6: (Chan S. Park, example 11.10)
    - Calculate annual loan repayment in actual dollars:

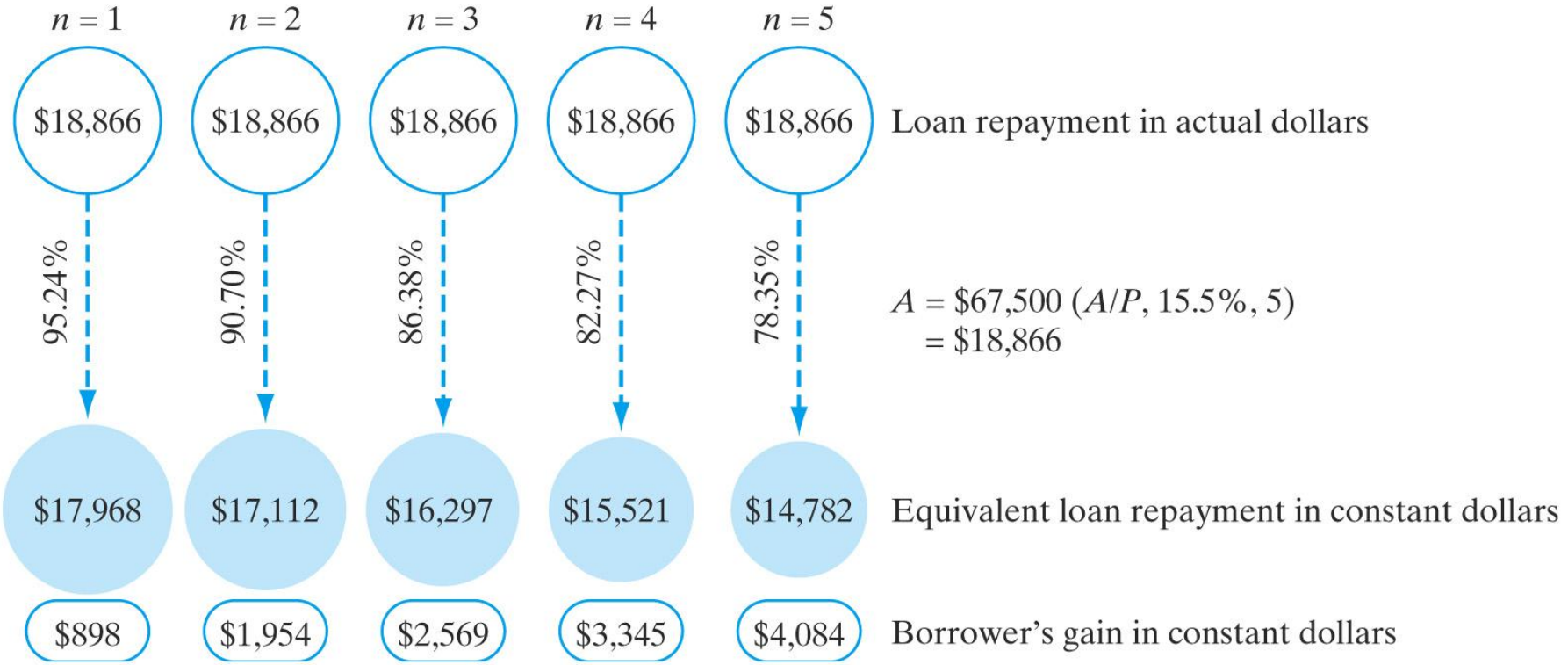
	A	B
1	P, amount borrowed	$62,500
2	i	15.50%
3	N	5
4	AE	$18,866

	A	B
1	P, amount borrowed	$62,500
2	i	15.50%
3	N	5
4		=PMT(B2,B3,-B1,,)

    - Loan repayment breakdown:

Year	Beginning Balance	Interest Payment	Principal Payment	Ending Balance
1	$62,500	$9,688	$9,178	$53,322
2	$53,322	$8,265	$10,601	$42,720
3	$42,720	$6,622	$12,244	$30,476
4	$30,476	$4,724	$14,142	$16,334
5	$16,334	$2,532	$16,334	$0

- ***Effects of Borrowed Funds under Inflation***
  - Example 6: (Chan S. Park, example 11.10)



Equivalent Loan repayment cash flows measured in year-0 dollars and borrowers gain over the life of the loan (Chan S. Park, Figure 11.3)

- ***Effects of Inflation on Return on Investment***
  - Notes:
    - Unless revenues are sufficiently increased to keep pace with inflation, tax effects and/or a working capital drain result in lower rate of return or lower NPW.
    - Under inflation, true (real) rate of return should be based on constant dollars.
    - Under inflation, if the rate of return is calculated based on actual dollars, the real rate of return can be calculated as: $i' = \frac{1+i}{1+\bar{f}} - 1$ where,

      i' = the real rate of return based on constant dollars

      i = the market rate of return based on actual dollars

      $\bar{f}$ = general rate of inflation

- ***Effects of Inflation on Return on Investment: No Inflation***

MARR = 20%

IRR' = 21.88%

The investment is acceptable.

	0	1	2	3	4
Income statement:					
Revenues		$ 24,500	$ 24,500	$ 24,500	$ 24,500
Expenses					
O&M		10,000	10,000	10,000	10,000
Depreciation		10,000	13,333	4,445	2,222
Taxable income		4,500	1,167	10,055	12,278
Income taxes (40%)		1,800	467	4,022	4,911
Net income		$ 2,700	$ 700	$ 6,033	$ 7,367
Cash flow statement:					
Operating activities					
Net income		2,700	700	6,033	7,367
Depreciation		10,000	13,333	4,445	2,222
Investment activities					
Machine center	$ (30,000)				
Salvage					0
Gains tax					0
Net cash flow (in actual dollars)	$ (30,000)	$ 12,700	$ 14,033	$ 10,478	$ 9,589

Example 11.11 (Chan S. Park, Table 11.5)

- ***Effects of Inflation on Return on Investment: Inflation***

MARR = 20%

IRR' = 19.40%

The investment is no longer acceptable.

	0	1	2	3	4
Income statement:					
Revenues		$26,950	$29,645	$32,610	$35,870
Expenses					
O&M		11,000	12,100	13,310	14,641
Depreciation		10,000	13,333	4,445	2,222
Taxable income		5,950	4,212	14,855	19,007
Income taxes (40%)		2,380	1,685	5,942	7,603
Net income		$ 3,570	$ 2,527	$ 8,913	$11,404
Cash flow statement:					
Operating activities					
Net income		3,570	2,527	8,913	11,404
Depreciation		10,000	13,333	4,445	2,222
Investment activities					
Machine center	$(30,000)				
Salvage					0
Gains tax					0
Net cash flow (in actual dollars)	$(30,000)	$13,570	$15,860	$13,358	$13,626
Net cash flow (in constant dollars)	$(30,000)	$12,336	$13,108	$10,036	$ 9,307

Note: PW(20%) = $(321); IRR (actual dollars) = 31.34%; IRR′ (constant dollars) = 19.40%.

Example 11.11 (Chan S. Park, Table 11.6)

- ***Effects of Inflation on Working Capital***
  - Notes:
    - Known as working capital drain, the cost of working capital increases in an inflationary environment.
    - Additional cash must be invested to maintain new price levels.
    - Additional working capital requirements can significantly reduce a project's rate of return.

- ***Effects of Inflation on Working Capital: No Inflation***

MARR = 20%

IRR' = 20.88%

The investment is acceptable.

Case 1: Without Inflation	0	1	2	3	4
Income statement:					
Revenue		$ 24,500	$ 24,500	$ 24,500	$ 24,500
Expenses					
O&M		10,000	10,000	10,000	10,000
Depreciation		10,000	13,333	4,445	2,222
Taxable income		4,500	1,167	10,055	12,278
Income taxes (40%)		1,800	467	4,022	4,911
Net income		$ 2,700	$ 700	$ 6,033	$ 7,367
Cash flow statement:					
Operating activities					
Net income		2,700	700	6,033	7,367
Depreciation		10,000	13,333	4,445	2,222
Investment activities					
Machine center	$ (30,000)				
Working capital	(1,000)				1,000
Salvage					0
Gains tax					0
Net cash flow (in actual dollars)	$ (31,000)	$ 12,700	$ 14,033	$ 10,478	$ 10,589

Note: PW(20%) = $499; IRR′ = 20.88%.

Example 11.12 (Chan S. Park, Table 11.7)

- ***Effects of Inflation on Working Capital: Inflation***

MARR = 20%

IRR' = 18.09%

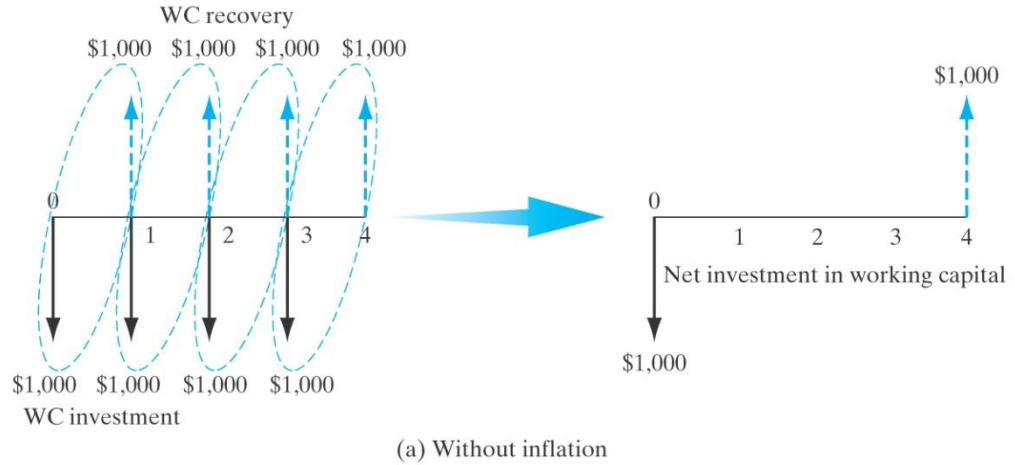
The investment is no longer acceptable.

Case 2: With Inflation (10%)	0	1	2	3	4
Income statement:					
Revenue		$ 26,950	$ 29,645	$ 32,610	$ 35,870
Expenses					
O&M		11,000	12,100	13,310	14,641
Depreciation		10,000	13,333	4,445	2,222
Taxable income		5,950	4,212	14,855	19,007
Income taxes (40%)		2,380	1,685	5,942	7,603
Net income		$ 3,570	$ 2,527	$ 8,913	$ 11,404
Cash flow statement:					
Operating activities					
Net income		3,570	2,527	8,913	11,404
Depreciation		10,000	13,333	4,445	2,222
Investment activities					
Machine center	$ (30,000)				
Working capital	(1,000)	(100)	(110)	(121)	$ 1,331
Salvage					0
Gains tax					0
Net cash flow (in actual dollars)	$ (31,000)	$ 13,470	$ 15,750	$ 13,237	$ 14,957
Net cash flow (in constant dollars)	$ (31,000)	$ 12,245	$ 13,017	$ 9,945	$ 10,216

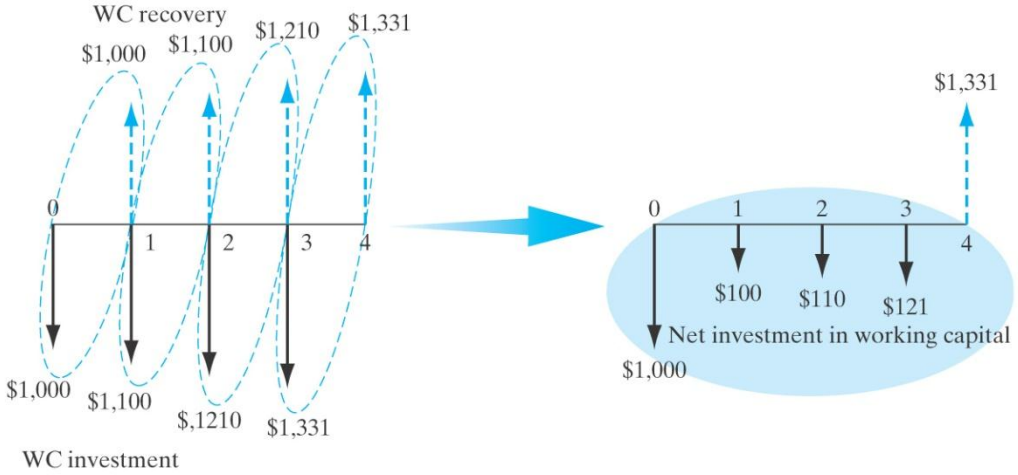
Note: PW(20%) = $(1,074); IRR (actual dollars) = 29.89%; IRR′ (constant dollars) = 18.09%.

Example 11.12 (Chan S. Park, Table 11.7)

- ***Effects of Inflation on Working Capital:***



(a) Without inflation



(b) With inflation

Working Capital Requirements under inflation (Chan S. Park, example 11.12; figure 11.4)

Questions?