Chapter 14 – Effects of Inflation

Impact of Inflation

- **Inflation** is a fall in the purchasing power of money. This is equivalent to a sustained increase in the general level of prices.
- Inflation occurs because the value of the currency has gone down over time.
- The change in $ value over time needs to be considered to compare purchasing power over time.

Causes of Inflation

Causes that are generally agreed upon by economists are:

- **Money supply**: Too much currency in the system tends to devalue them
- **Exchange rates**: Domestic prices may be raised by international companies to compensate for profits reduced in other markets if the $ weakens in some outside markets

Causes of Inflation – contd.

- **Cost-Push Inflation**: Producers of goods and services “push” increasing operating costs along to the customers through higher prices
- **Demand-Pull Inflation**: If demand for goods and services well exceeds supply (“free spending” by customers), the prices will rise.

Deflation – Opposite of Inflation

- **Deflation**: when the value of the currency increases over time and produces increased value;
- In the future, smaller amounts of the currency can purchase the same amount of goods and services than it can presently.
- When deflation occurs nationally and for longer periods of time, money becomes less available (tighter). It has a very negative effect on the economy.

The Inflation rate

- The inflation rate, \( f \) is a measure of the rate of change in the value of the currency
- Expressed as a percent per time period, similar to interest rates
- Example: If \( f = 5.0\% \) per year inflation, $100 today, requires $105 to buy the same amount next year.
### The Basic Inflation Relationship

- Let \( n \) represent the number of periods (same period over which \( f \) is expressed) between today and a future time.
- \( 1 \) Future Dollar = \( 1 \) Dollar today\((1+f)^n \)
- Today's Dollars are also called:
  - CVD: Constant-value dollars (constant purchasing power)
  - Represent purchasing power today, inflation-free dollars
- Dollars at a future time are called:
  - FD: Future dollars
  - Actual $ that we normally think of, these inflated dollars as inflation is always present and has reduced their worth when compared to the same amount today.

### Example of Inflation

- Assume a firm desires to purchase an asset that costs $209,000 in today's dollars.
- Assume a reasonable inflation rate of, say, 4\% per year.
- In 10 years, that same piece of equipment would cost:
  - \( $209,000(1.04)^{10} = $309,371 \)
- Does not count an interest rate or rate of return consideration.

### Inflation can be Significant

- From the previous example we see that even at a modest 4\% rate of inflation, the future impact on cost is significant!
- The previous example does not consider the time value of money.
- A proper engineering economy analysis should consider both inflation and the time value of money.

### Importance of Inflation Impacts

- Most countries – inflation is from 2\% to 8\% per year;
- Some countries with weak currencies, political instability, wars, unchecked increase in paper money can have hyperinflation (as high as 100\% per year).

### Three Important Rates

- Real interest rate
  - \( i \)
- Market interest rate
  - \( i_f \)
- Inflation rate
  - \( f \)

### Market Interest Rate - \( i_f \)

- Rate that has been adjusted to take inflation into account.
- This rate is a combination (function) of \( i \) and \( f \).
- Also known as the inflated interest rate.
- This the rate that you are normally quoted:
  - Represents how money will accumulate in your account, but not how your purchasing power increased as inflation effect is always present.
Real or Inflation-free Interest Rate - \( i \)

- Effects of any inflation have been removed
- Represents the actual or real gain in purchasing power received/charged on investments or borrowed funds

Inflation Rate - \( f \)

- The inflation rate \( f \) is a measure of the rate of change in the value of the currency
  - As defined before ...

Present Worth Calculations Adjusted for Inflation

- In prior chapters, present worth was calculated assuming that all cash flows were in constant value dollars (CVD)
- Consider Table 14-1 for an example of $5,000 inflated at 4% per year with a discount rate of 10% per year.

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost of X in Future $</th>
<th>Future cost in CVD at ( f = 4% )</th>
<th>PW of CVD at ( i = 10% )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$5000</td>
<td>$5000</td>
<td>$5000</td>
</tr>
<tr>
<td>1</td>
<td>$5200</td>
<td>( 5200/(1.04)^1 ) = $5000</td>
<td>( 5000(P/F,i,1) ) = $4545</td>
</tr>
<tr>
<td>2</td>
<td>$5408</td>
<td>( 5408/(1.04)^2 ) = $5000</td>
<td>( 5000(P/F,i,2) ) = $4132</td>
</tr>
<tr>
<td>3</td>
<td>$5624</td>
<td>( 5624/(1.04)^3 ) = $5000</td>
<td>( 5000(P/F,i,3) ) = $3757</td>
</tr>
<tr>
<td>4</td>
<td>$5849</td>
<td>( 5849/(1.04)^4 ) = $5000</td>
<td>( 5000(P/F,i,4) ) = $3415</td>
</tr>
</tbody>
</table>

Comparison of $$ Values from Table 14-1

Derivation of a Combined Interest Rate

- We now derive \( i_e \) – the inflation-adjusted interest rate given \( i \) - the real interest rate and \( F \) - the inflated future amount
- \( F/(1 + f)^n \) gives the today’s dollar value (constant-value dollar) of that \( F \)
- The PW calculations use constant-value dollar of \( F \)…
Derivation of \(i_f\) - continued

\[
P = \frac{F}{(1 + f)^n} (P / F, i, n)
\]

\[
P = \frac{F}{(1 + f)^n} \frac{1}{(1 + i)^n}
\]

\[
P = F \frac{1}{(1 + i + f + if)^n}
\]

Defining \(i_f\)

1. \(i_f\) is equal to:

\[
i_f = (i + f + if)
\]

Then,

\[
P = F \frac{1}{(1 + i_f)^n} = F(P / F, i_f, n)
\]

Present Worth Factors

1. From the derivation for \(i_f\):
   - P/A, P/G, P can also use \(i_f\) instead of \(i\) if the cash-flow series is expressed in FD to obtain PW in CVD
   - Alternately, net cash flow in every year can be converted to CVD from FD and the PW in CVD can be found using \(i\)

Future Worth – Four Cases

1. Actual amount accumulated (FW at market rate \(i_f\))
   - \(F = P(F/P, i_f, n)\)
2. Purchasing power of FW stated in CVD
   - \(F = P(F/P, i_f, n) / (1+f)^n = P(1+i)^n\)
3. FD of a CVD (No interest)
   - \(F = P(F/P, i, n)\)
4. FW at inflated MARR
   - \(F = P(F/P, MARR_f, n)\)
   - \(MARR_f = MARR + f + (MARR)(f)\)
   - \(MARR = WACC + Risk + Return\)

The REAL Interest Rate

1. Given a market rate of interest and the inflation rate, find the real interest rate
   \[
i = \frac{i_f - f}{1 + f}
\]
   - The real rate is the rate at which current $$ expand with their same purchasing power, into equivalent future $$.

Capital Recovery Calculations Adjusted for Inflation

1. \(A = P(A/P, i_f, n) \ldots > P(A/P, i, n)\)
   - More dollars per year (compared to real rate) will be required to recover today’s P under inflation
   - \(A\) in FD (in each year)
2. \(A = F(A/F, i_f, n) \ldots < F(A/F, i, n)\)
   - You can invest less dollars per year (compared to real rate) to accumulate to a F in the future
   - \(A\) and \(F\) in FD
Chapter Summary

- Inflation makes the cost of the same product or service increase over time.
- This is due to the decreasing purchasing power of the currency when inflation is in effect.
- Terms:
  - Today’s dollars or constant-value dollars (CVD)
  - Future dollars (FD)
- Inflated interest rate: $i_r = i + f + if$
  - $i$: real interest rate
  - $f$: inflation rate