Chapter 12

Inflation Effects

Inflation can be scary! It doesn't have to be. If you are prepared for it, inflation can be your friend!

Systematic Economic Analysis Technique

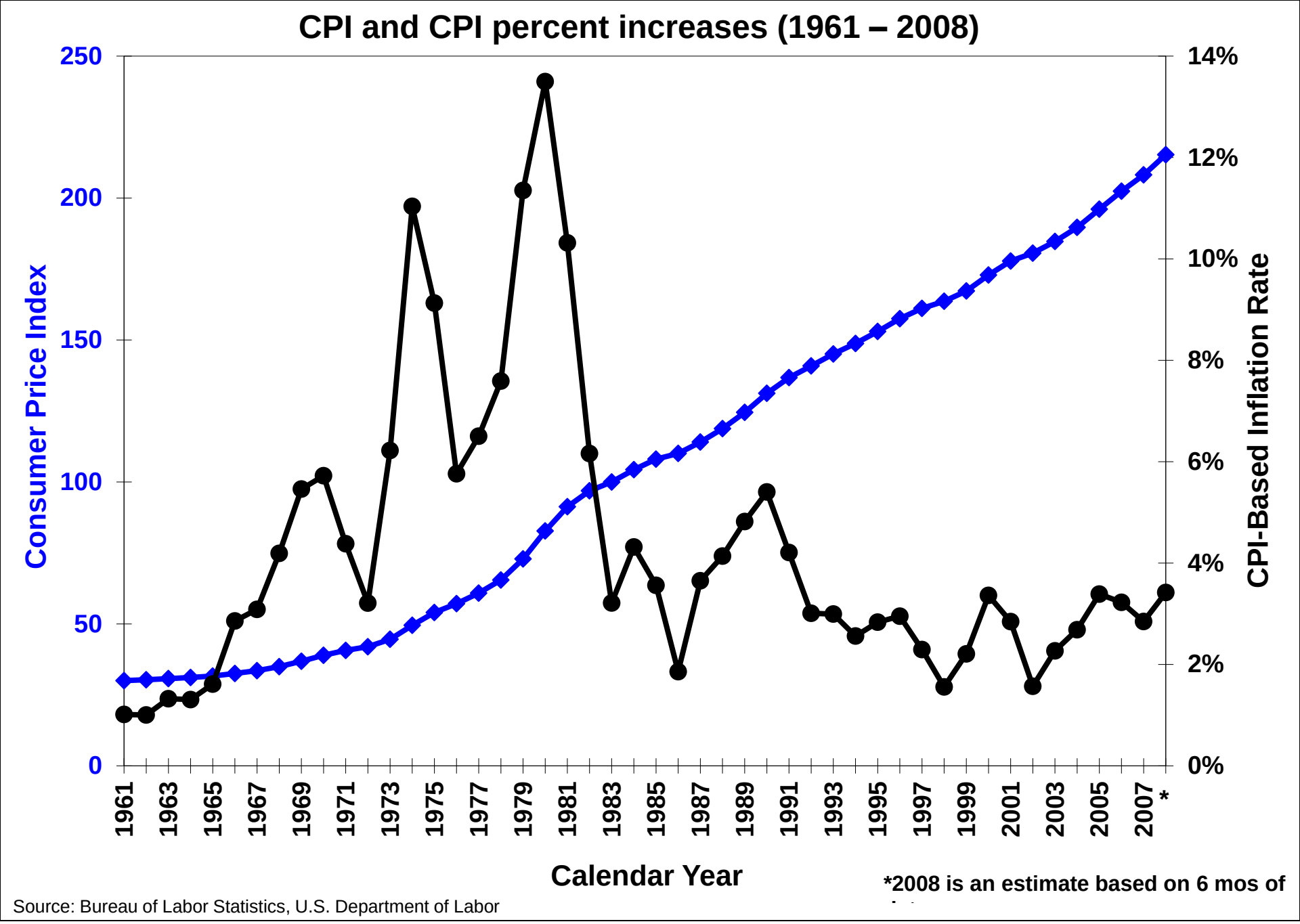
1. **Identify the investment alternatives**
2. **Define the planning horizon**
3. **Specify the discount rate**
4. **Estimate the cash flows**
5. **Compare the alternatives**
6. **Perform supplementary analyses**
7. **Select the preferred investment**

Inflation decreases the purchasing power of money

CPI Market Basket Categories

- Food and beverages
- Housing
- Apparel
- Transportation
- Medical care
- Recreation
- Education and communication
- Other goods and services

The CPI-U is the index most often cited in the U.S. and tends to be used to measure general inflation


CPI and CPI percent increases (1961 – 2008)
Consumer Price Index
CPI-Based Inflation Rate
Calendar Year
250
200
150
100
50
0
14%
12%
10%
8%
6%
4%
2%
0%
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
*
*2008 is an estimate based on 6 mos of
Source: Bureau of Labor Statistics, U.S. Department of Labor

CPI and CPI percent increases, 1961 to 2008

Year	CPI	1983 = 100.0	CPI %	Year	CPI	1983 = 100.0	CPI %
1961	29.9	30.0	1.0	1985	107.6	108.0	3.6
1962	30.2	30.3	1.0	1986	109.6	110.0	1.9
1963	30.6	30.7	1.3	1987	113.6	114.1	3.6
1964	31.0	31.1	1.3	1988	118.3	118.8	4.1
1965	31.5	31.6	1.6	1989	124.0	124.5	4.8
1966	32.4	32.5	2.9	1990	130.7	131.2	5.4
1967	33.4	33.5	3.1	1991	136.2	136.7	4.2
1968	34.8	34.9	4.2	1992	140.3	140.9	3.0
1969	36.7	36.8	5.5	1993	144.5	145.1	3.0
1970	38.8	39.0	5.7	1994	148.2	148.8	2.6
1971	40.5	40.7	4.4	1995	152.4	153.0	2.8
1972	41.8	42.0	3.2	1996	156.9	157.5	3.0
1973	44.4	44.6	6.2	1997	160.5	161.1	2.3
1974	49.3	49.5	11.0	1998	163.0	163.7	1.6
1975	53.8	54.0	9.1	1999	166.6	167.3	2.2
1976	56.9	57.1	5.8	2000	172.2	172.9	3.4
1977	60.6	60.8	6.5	2001	177.1	177.8	2.8
1978	65.2	65.5	7.6	2002	179.9	180.6	1.6
1979	72.6	72.9	11.3	2003	184.0	184.7	2.3
1980	82.4	82.7	13.5	2004	188.9	189.7	2.7
1981	90.9	91.3	10.3	2005	195.3	196.1	3.4
1982	96.5	96.9	6.2	2006	201.6	202.4	3.2
1983	99.6	100.0	3.2	2007	207.3	208.2	2.8
1984	103.9	104.3	4.3	2008*	214.4	215.3	3.4

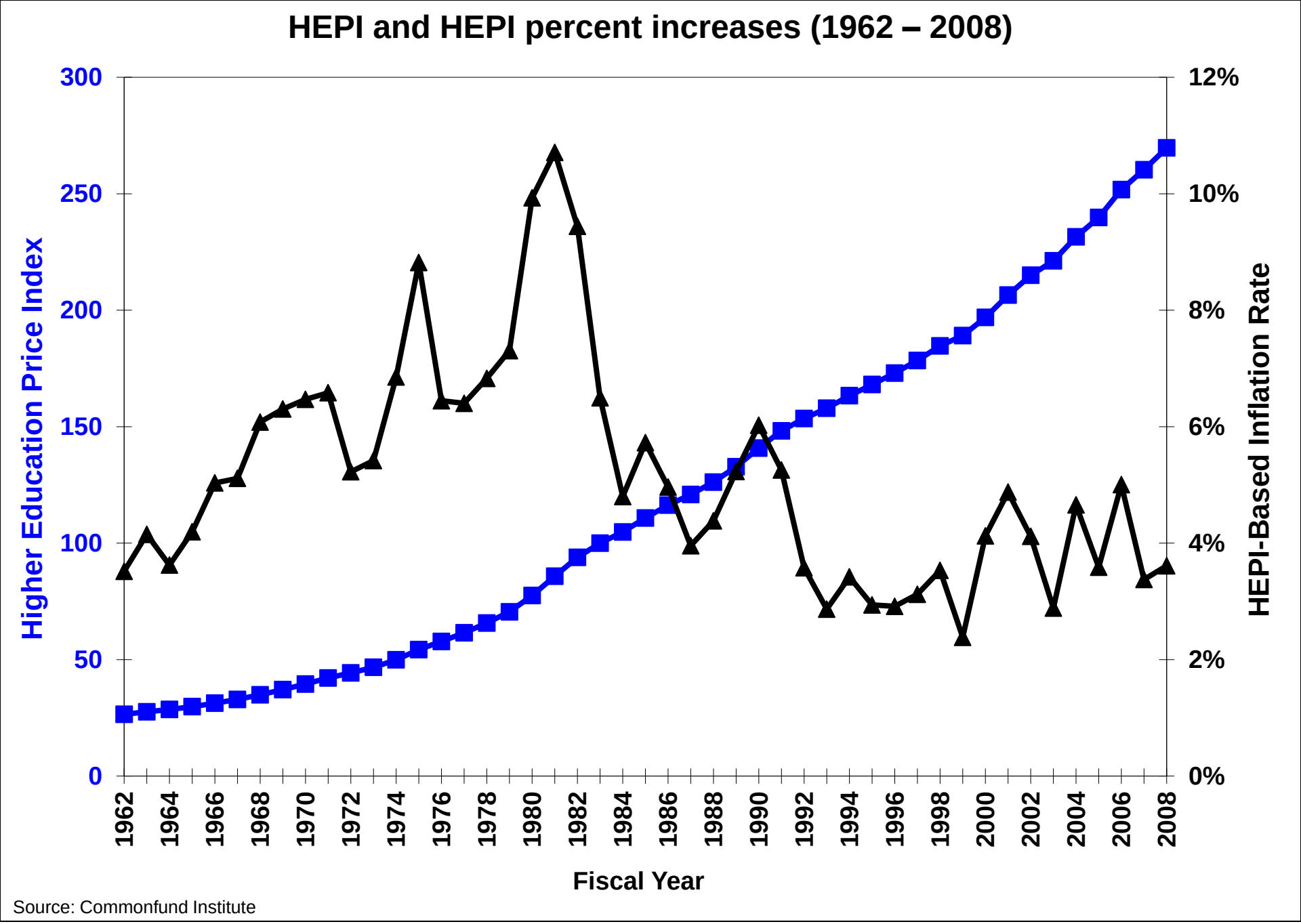
Source: U.S. Department of Labor, Bureau of Labor Statistics

* 2008 is estimated, based on 6 months of data

Other Indexes

Producers Price Index (PPI) – 10,000

Higher Education Price Index (HEPI)

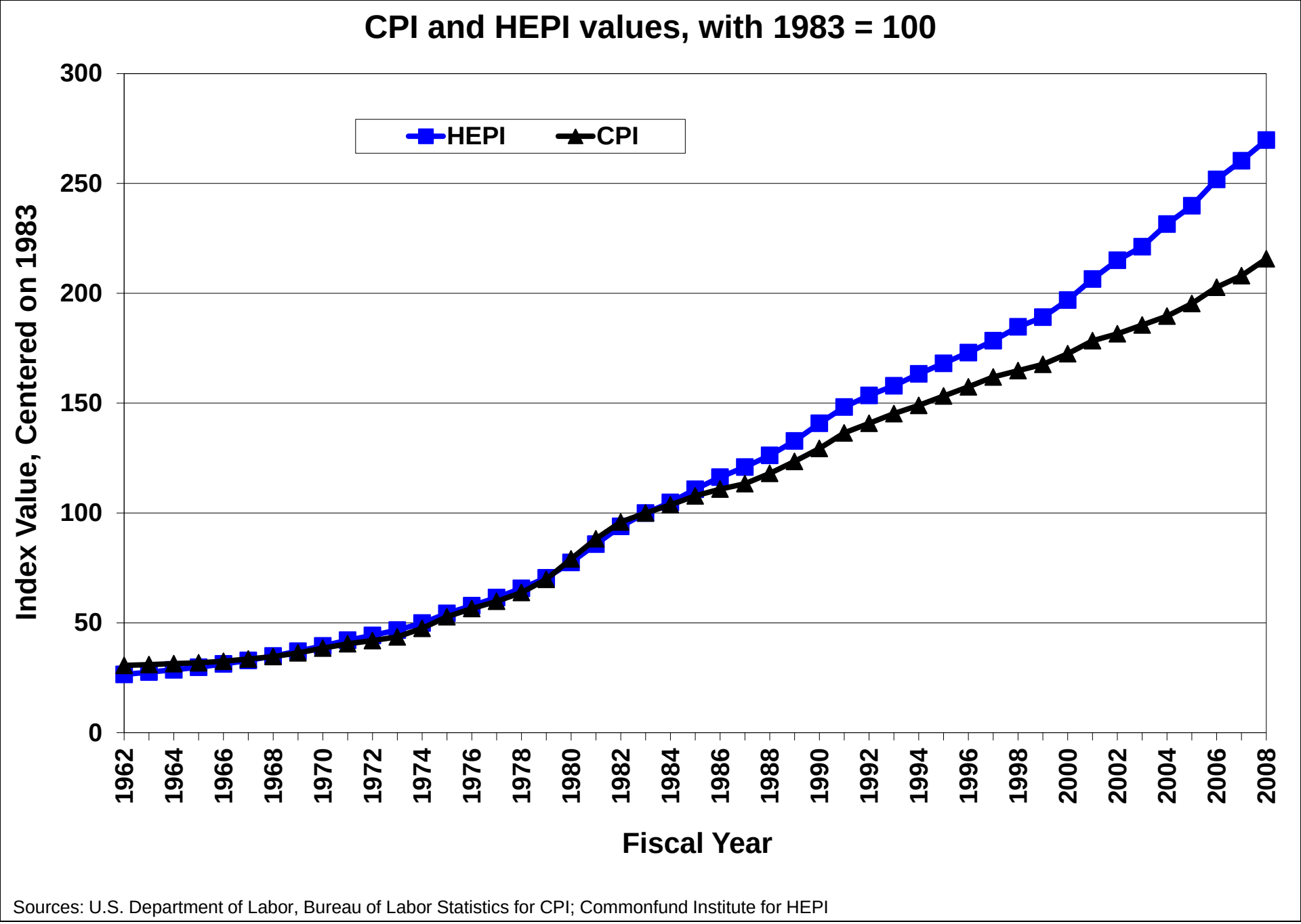


Source: Commonfund Institute

HEPI and HEPI percent increases, 1961 to 2008

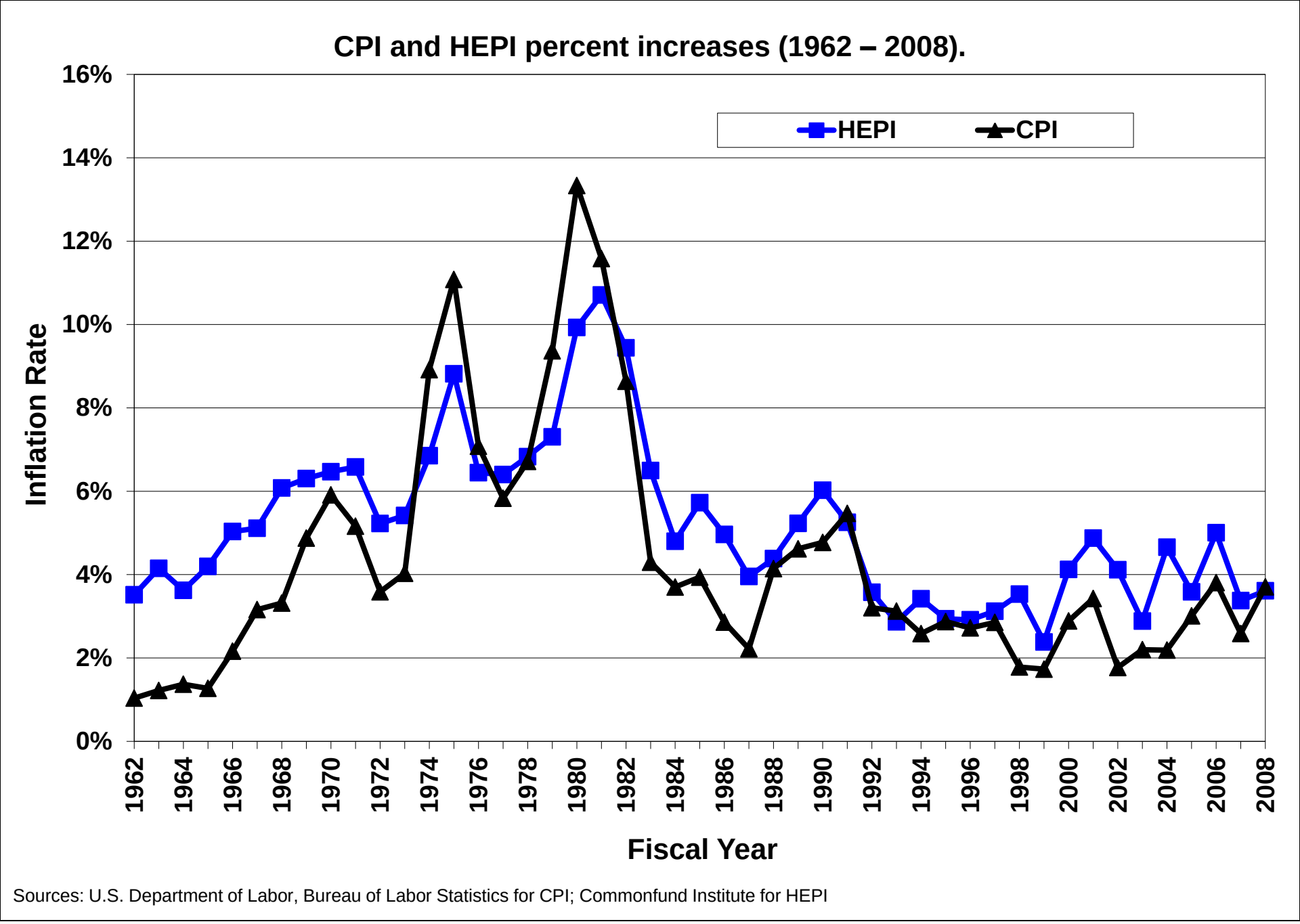
Year	1983 = 100 HEPI	% Change	Year	1983 = 100 HEPI	% Change
1961	25.6	---	1985	110.8	5.7%
1962	26.5	3.5%	1986	116.3	5.0%
1963	27.6	4.2%	1987	120.9	4.0%
1964	28.6	3.6%	1988	126.2	4.4%
1965	29.8	4.2%	1989	132.8	5.2%
1966	31.3	5.0%	1990	140.8	6.0%
1967	32.9	5.1%	1991	148.2	5.3%
1968	34.9	6.1%	1992	153.5	3.6%
1969	37.1	6.3%	1993	157.9	2.9%
1970	39.5	6.5%	1994	163.3	3.4%
1971	42.1	6.6%	1995	168.1	2.9%
1972	44.3	5.2%	1996	173.0	2.9%
1973	46.7	5.4%	1997	178.4	3.1%
1974	49.9	6.9%	1998	184.7	3.5%
1975	54.3	8.8%	1999	189.1	2.4%
1976	57.8	6.4%	2000	196.9	4.1%
1977	61.5	6.4%	2001	206.5	4.9%
1978	65.7	6.8%	2002	215.0	4.1%
1979	70.5	7.3%	2003	221.2	2.9%
1980	77.5	9.9%	2004	231.5	4.7%
1981	85.8	10.7%	2005	239.8	3.6%
1982	93.9	9.4%	2006	251.8	5.0%
1983	100.0	6.5%	2007	260.3	3.4%
1984	104.8	4.8%	2008	269.7	3.6%

Source: Commonfund Institute



Sources: U.S. Department of Labor, Bureau of Labor Statistics for CPI; Commonfund Institute for HEPI

The Higher Education Price Index (HEPI) reflects higher education inflation. It is less volatile than CPI, but its percent increases tend to be greater than those of CPI.



Sources: U.S. Department of Labor, Bureau of Labor Statistics for CPI; Commonfund Institute for HEPI

Price increases in one segment of the economy are generally felt in all segments of the economy

Inflation Effects

Before-Tax Analysis

Two *equivalent approaches* can be used to consider explicitly inflation in an economic justification—a *constant dollar* approach and a *then-current dollar* approach.

The *constant dollar* approach uses cash flows and a discount rate, both of which are inflation-free.

The *then-current* approach uses cash flows and a discount rate, both of which include inflation components.

Reminder

- **In performing economic analyses under inflation, either**
  - **use *constant dollars* with a discount rate that *does not* incorporate inflation**

  or
  - **use *inflated dollars* with a discount rate that *does* incorporate inflation**

Some Terminology

When inflation effects are not included, cash flows are given as *constant dollars*

When including inflation in cash flow estimates, they are called *then-current dollars*

Let

- **C_k = constant worth amount of cash flow at the end of year k**
- **T_k = then-current cash flow at the end of year k**

$$i_c = i_r + f + i_r(f)$$

The combined minimum attractive rate of return ($MARR_c$) equals the sum of the real minimum attractive rate of return ($MARR_r$), the inflation rate (f), and the product of the real minimum attractive rate of return ($MARR_r$) and the inflation rate (f).

Example 12.1

If inflation averages 3%/yr and you require an 8% real return on your investments, what inflation adjusted MARR should you use in performing economic justifications?

$$MARR_c = 0.03 + 0.08 + 0.03(0.08)$$
$$= 0.1124 \ (11.24\%)$$

$$i_r = (i_c - f)/(1 + f)$$

The real minimum attractive rate of return ($MARR_r$) equals the difference in the combined minimum attractive rate of return ($MARR_c$) and the inflation rate (f), divided by one plus the inflation rate (f)

Example 12.2

If inflation averages 4%/yr and your combined return on your investment is 10%, what is your real return on your investment?

i_r = (0.10 – 0.04)/(1 + 0.04)

= 0.057692 or 5.7692%

Example 12.3

Measured in today's dollars, a family anticipates spending $5,000 annually on groceries. If inflation averages 3%/yr, what will be the then-current cash flows for groceries over a 4-year period? (Assume end-of-year expenditures and the same quantities and items purchased each year.)

$$\$T_1 = \$5{,}000.00(1.03) = \$5{,}150.00$$

$$\$T_2 = \$5{,}150.00(1.03) = \$5{,}304.50$$

$$\$T_3 = \$5{,}304.50(1.03) = \$5{,}463.64$$

$$\$T_4 = \$5{,}463.64(1.03) = \$5{,}627.55$$

$$\$C_k = \$5{,}000 \qquad k = 1, \ldots, 4$$

Example 12.4

If the family wants to invest money today to cover the cost of groceries over the next 4 years, how much do they need to invest if they earn 6% compounded annually on their investments?

$$PW(6\%) = \$5{,}150.00(P|F\ 6\%,1) + \$5{,}304.50(P|F\ 6\%,2) + \$5{,}463.64(P|F\ 6\%,3) + \$5{,}627.55(P|F\ 6\%,4)$$

$$= \$18{,}624.42$$

=NPV(6%,FV(3%,1,,-5000),FV(3%,2,,-5000), FV(3%,3,,-5000),FV(3%,4,,-5000))

$$= \$18{,}624.39$$

$i_r = (0.06 - 0.03)/(1 + 0.03) = 0.029126 = 2.9126\%$ □

$$PW(2.9126\%) = \$5{,}000.00(P|A\ 2.9126\%,4)$$

$$= \$18{,}624.40$$

=PV((0.06-0.03)/1.03,4,-5000)

$$= \$18{,}624.39$$

Example 12.5

A stamping machine in a small manufacturing company requires maintenance at an increasing rate. This year, maintenance cost $2,500. Each of the next 5 years, it is expected maintenance will be required 8% more times than the previous year. Additionally, the costs of labor and parts required to maintain the machine are expected to increase, due to inflation, at a rate of 4%/yr. The company has a real required return on its investments of 9%/yr. Determine the PW of maintenance costs over the next 5 years.

In $C, maintenance cost will increase at a rate of 8%/yr; in $T, maintenance cost will increase at a rate of 8% + 4% + 8%(4), or 12.32%. Since $MARR_r$ = 9%, $MARR_c$ = 9% + 4% + 9%(4%), or 13.36%.

PW of $C & $T for Example 12.5.*

EOY	*$C*	*$T*
0	$2,500.00	$2,500.00
1	$2,700.00	$2,808.00
2	$2,916.00	$3,153.95
3	$3,149.28	$3,542.51
4	$3,401.22	$3,978.95
5	$3,673.32	$4,469.16
P =	$12,160.14	$12,160.14

***Note: PW does not include cash flows at EOY = 0; only years 1 thru 5 are included**

Reminder

- **In performing economic analyses under inflation, either**
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  or
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Approaches to Economic Justification in Inflationary Conditions.

	Then-Current Dollar ($T) Analysis	Constant Dollar ($C) Analysis
Cash Flows	Cash flows are in then-current dollars; therefore, they include inflation effects	Cash flows are in constant dollars; therefore, they are inflation-free
Discount rate used in *TVOM* calculations	Use a combined interest rate, i_c	Use a real interest rate, i_r

Pit Stop #12—Check Your Tires for Proper Inflation!

1. True or False: Inflation decreases the purchasing power of money.
2. True or False: The most commonly used measure of inflation is the relative change in the Consumer Price Index.
3. True or False: The Consumer Price Index typically increases faster than the Higher Education Price Index.
4. True or False: In performing engineering economic analyses in inflationary conditions, the after-tax present worth will always be less than it would be if inflation were negligible.
5. True or False: The two approaches used in considering inflation are the constant dollar and the then-current dollar approaches.
6. True or False: If the real minimum attractive rate of return is 8%, inflation is 4%, and the tax rate is 40%, then money should not be borrowed if the interest rate on the loan is greater than 18%.
7. True or False: if the real minimum attractive rate of return is 8%, inflation is 4%, the tax rate is 40%, and money can be borrowed at 16% annual compound interest, then the loan should be repaid using Method 4, i.e., don't pay anything until the end of the loan period.
8. True or False: If the real minimum attractive rate of return is 8%, inflation is 4%, the tax rate is 40%, and money can be borrowed at 12% annual compound interest, then the loan should be repaid using Method 1, i.e., pay interest annually and pay principal at the end of the loan period.
9. True or False: If the combined minimum attractive rate of return is 12% and inflation is 4%, then the real minimum attractive rate of return is approximately 7.7%.
10. True or False: When investing in capital equipment, inflation reduces the after-tax present worth because depreciation does not increase with inflation.

Pit Stop #12—Check Your Tires for Proper Inflation!

1. True or False: Inflation decreases the purchasing power of money. TRUE
2. True or False: The most commonly used measure of inflation is the relative change in the Consumer Price Index. TRUE
3. True or False: The Consumer Price Index typically increases faster than the Higher Education Price Index. FALSE
4. True or False: In performing engineering economic analyses in inflationary conditions, the after-tax present worth will always be less than it would be if inflation were negligible. FALSE
5. True or False: The two approaches used in considering inflation are the constant dollar and the then-current dollar approaches. TRUE
6. True or False: If the real minimum attractive rate of return is 8%, inflation is 4%, and the tax rate is 40%, then money should not be borrowed if the interest rate on the loan is greater than 18%. FALSE
7. True or False: if the real minimum attractive rate of return is 8%, inflation is 4%, the tax rate is 40%, and money can be borrowed at 16% annual compound interest, then the loan should be repaid using Method 4, i.e., don't pay anything until the end of the loan period. FALSE
8. True or False: If the real minimum attractive rate of return is 8%, inflation is 4%, the tax rate is 40%, and money can be borrowed at 12% annual compound interest, then the loan should be repaid using Method 1, i.e., pay interest annually and pay principal at the end of the loan period. FALSE
9. True or False: If the combined minimum attractive rate of return is 12% and inflation is 4%, then the real minimum attractive rate of return is approximately 7.7%. TRUE
10. True or False: When investing in capital equipment, inflation reduces the after-tax present worth because depreciation does not increase with inflation. TRUE