1.0 Chapter Introduction

In this chapter, you will learn to use price index numbers to make the price adjustments necessary to analyze price and cost information collected over time.

Price Index Numbers. Price index numbers measure relative price changes from one time period to another. They are so widely used that discussions related to index numbers in contract pricing normally refers to price indexes. However, other index numbers could be used in contract pricing, particularly indexes that measure productivity.

Simple and Aggregate Price Index Numbers. Price index numbers can indicate price changes for one or several related supplies or services over a period of time.

- Simple index numbers calculate price changes for a single item over time. Index numbers are more accurate if they are constructed using actual prices paid for a single commodity, product or service rather than the more general aggregated index.
- Aggregate index numbers calculate price changes for a group of related items over time. Aggregate indexes permit analysis of price changes for the group of related products, such as price changes for apples, oranges, plywood, or nails. An example of an aggregate price index is the Producer Price Index (Bureau of Labor Statistics) that provides information the changes in the wholesale price of products sold in the United States over a given period of time.

1.1 Identifying Situations For Use

Situations for Use. You can use price index numbers to:

- Inflate/deflate prices or costs for direct comparison. You can use price index numbers to estimate/analyze product price/cost today using the price/cost of the same or a similar product in the past.
- Inflate/deflate prices or costs to facilitate trend analysis. You can use index numbers to facilitate trend or time series analysis of prices/costs by eliminating or reducing the effects of inflation so that the analysis can be made in constant-year dollars (dollars free of changes related to inflation/deflation).

- Estimate project price or cost over the period of contract performance. Prices/costs of future performance are not certain. One effect that you must consider is the changing value of the dollar. You can use index numbers to estimate and negotiate future costs and prices.
- Adjust contract price or cost for inflation/deflation. When price/cost changes are particularly volatile, you may need to include an economic price adjustment clause in the contract. The use of index numbers is one of the most popular methods used to identify and define price changes for economic price adjustment.

1.2 Constructing Price Index Number

Steps in Price Index Number Development. If your activity repeatedly buys the same types of services or supplies, consider developing your own price indices to track trends in price over time. This section will demonstrate the procedures for developing a simple price index. To develop an aggregate index, follow the same basic steps using data from the various products selected for index development.
There are four steps to developing a simple price index number:
Step 1. Collect data for each period.
Step 2. Select an appropriate base period.
Step 3. Divide each period price by the base-period price.
Step 4. Multiply by 100 to produce an index number.
Example of Price Index Number Development.
Step 1. Collect Data for Each Period. For each index period, collect average price data for the product, commodity, or service. For example, assume the following average yearly prices for a hoist:

Year	19X4	19X5	19X6	19X7	19X8
Price	$84.12	$90.84	$95.06	$101.97	$107.32

Step 2. Select an Appropriate Base Period. Select a base period appropriate for the data available. In this case, we will use the 19X4 price, $84.12.

Select Base Period		
A	B	C
Year	Average Annual Price	19X4 Base Price
19X4	$84.12	$84.12
19X5	$90.84	$84.12
19X6	$95.06	$84.12
19X7	$101.97	$84.12

19X8	$107.32	$84.12

Step 3. Divide each period price by the base-period price. Divide each period price (Column B) by the base-period price (Column C). The result is a price relative (Column E). A price relative is the relationship of the price in any period to the base period price. For example, the table below shows that the price in 19X6 is 1.13 times the price in 19X4.

Calculate Price Index				
A	B	C	D	E
Year	Average Annual Price	19X4 Base Price	Price Relative Calculation	Price Relative
19X4	$84.12	$84.12	$\frac{\$84.12}{\$84.12}$	1.000
19X5	$90.84	$84.12	$\frac{\$90.84}{\$84.12}$	1.080
19X6	$95.06	$84.12	$\frac{\$95.06}{\$84.12}$	1.130
19X7	$101.97	$84.12	$\frac{\$101.97}{\$84.12}$	1.212
19X8	$107.32	$84.12	$\frac{\$107.32}{\$84.12}$	1.276

Step 4. Convert to an Index Number. Convert to an index number (Column F) by multiplying each price relative (Column E) by 100. Normally, you should round index numbers to the nearest tenth.

Calculate Price Index					
A	B	C	D	E	F
Year	Average Annual Price	19X4 Base Price	Price Relative Calculation	Price Relative	Index Number
19X4	$84.12	$84.12	$\frac{\$84.12}{\$84.12}$	1.000	100.0
19X5	$90.84	$84.12	$\frac{\$90.84}{\$84.12}$	1.080	108.0
19X6	$95.06	$84.12	$\frac{\$95.06}{\$84.12}$	1.130	113.0

19X7	$101.97	$84.12	$\frac{\$101.97}{\$84.12}$	1.212	121.2
19X8	$107.32	$84.12	$\frac{\$107.32}{\$84.12}$	1.276	127.6

1.3 Selecting A Price Index For Analysis

Points to Consider in Index Selection. Use published indexes carefully, because a published index will usually not exactly fit the pattern of price changes for the product or service that you are analyzing. The data are usually not from a specific contractor or location, but represent national or regional averages. Nevertheless, preconstructed index numbers offer a practical alternative to the costly and time-consuming task of developing index numbers from basic cost data.

When you use published indexes, choose the index series that best fits your specific analysis effort. Usually, the closer the chosen index series relates to the item that you are pricing, the more useful the number will be in your analysis.

If you are buying a finished good, indices representing raw materials and purchased components may not necessarily provide an accurate basis for projecting prices. The finished good price may also be strongly influenced by trends in direct labor, cost of capital, etc. Accuracy can be improved through use of a weighted average index which represents changes in both labor and material elements of price. Many contracting organizations develop weighted average indexes for major products or major groups of products.

Sources of Published Indexes. You may not have the time or data required to construct the price indexes that you need for price or cost analysis. Fortunately, there are many sources of previously constructed price indexes that you can use to estimate price changes. These sources include:

- Bureau of Labor Statistics;
- Other Government agencies;
- Government contracting organizations;
- Commercial forecasting firms;
- Industry or trade publications; and
- Newspapers.

Indexes from the Bureau of Labor Statistics. The Government collects and publishes vast amounts of data on prices. Four of the best known sources of index numbers are published by the Bureau of Labor Statistics (BLS):

- Producer Price Index Detailed Report. Probably the best known and most frequently used source of price index numbers for material pricing is the Producer Price Index (PPI) Detailed Report published monthly by the U.S. Department of Labor, Bureau of Labor Statistics (BLS). The indexes report monthly price changes at the producer/wholesale level for 15 major commodity groups:

Producer Price Indexes Commodity Groups	
Commodity Code	Commodity Description
01	Farm Products
02	Processed Foods and Feeds
03	Textile Products and Apparel
04	Hides, Skins, Leather, and Related Products
05	Fuels and Related Products and Power
06	Chemicals and Allied Products
07	Rubber and Plastic Products
08	Lumber and Wood Products
09	Pulp, Paper, and Allied Products
10	Metals and Metal Products
11	Machinery and Equipment
12	Furniture and Household Durables
13	Nonmetallic Mineral Products
14	Transportation Equipment
15	Miscellaneous Products

- Consumer Price Index Detailed Report. The consumer price index (CPI), published monthly in the Consumer Price Index

Detailed Report, reports on changes in consumer prices for a fixed mix of goods selected from the following categories:
  - Food;
  - Clothing;
  - Shelter and fuels;
  - Transportation; and
  - Medical services.

You should normally not use the CPI in adjusting material prices because the CPI reflects retail rather than wholesale price changes. However, the CPI can be of value in pricing services when labor rate increases are linked to changes in the CPI.

- Monthly Labor Review. The Monthly Labor Review includes selected data from a number of Government indexes, including:
  - Employment Cost Index;
  - Consumer Price Index;
  - Producer Price Indexes;
  - Export Price Indexes; and
  - Import Price Indexes.

That data and other information presented in the publication can prove useful in analyzing the price of contracts, such as service contracts, where direct labor is a significant part of contract price.

- Employment Cost Index. The Employment Cost Index presents information on the changes in earnings index for various classes of labor. Like the Monthly Labor Review, the report can be very useful in pricing contracts in which direct labor is a significant part of the contract price.

Indexes from Other Government Agencies. Data on contract prices are also available from agencies other than the Bureau of Labor Statistics. The most notable are the Federal Reserve System and the Bureau of Economic Analysis.

- Federal Reserve System. The Board of Governors publishes the Federal Reserve Bulletin, which includes economic indexes and data on business, commodity prices, construction, labor, manufactures, and wholesale trade. Each bank in the system publishes information each month with special reference to its own Federal Reserve District.

- Bureau of Economic Analysis Publications. The Bureau of Economic Analysis, Department of Commerce, publishes the Survey of Current Business that provides general information on trends in industry and the business outlook. It furnishes economic indexes on business, construction, manufactures, and wholesale trade Indexes from Government Contracting Organizations. Many Government contracting organizations have teams of analysts who develop indexes that are particularly applicable to the organizations' specific contracting situations. These indexes may be developed from raw price data, or they may be developed as weighted averages of published indexes.

Indexes from Commercial Forecasting Firms. Numerous commercial indexes are available for use in contract price analysis. While most Government indexes only report historical price changes, many commercial indexes also forecast future price movement. In situations where forecasts are necessary, commercial indexes may prove particularly useful. Before using such indexes, examine their development and consult with auditors, technical personnel, and other contracting professionals to assure that they are applicable in your analysis situation.

Indexes from Industry or Trade Publications. Industry and trade publications frequently provide general forecasts of economic conditions and price changes anticipated in the industry. To identify which publications have economic information relevant to a particular product, ask Government technical personnel. Offerors can also assist you in the identification of appropriate publications. However, be sure to verify with Government personnel the appropriateness of sources of information recommended by offerors.

Indexes from Newspapers. Publications, such as local, national, and financial newspapers, provide valuable forecasts of price changes in specific industries. The information reported is normally data provided by the Government, economic forecasting firms, or industry groups.

1.4 Adjusting Price/Cost For Analysis

In this section, you will learn how to use price index numbers to adjust prices and costs for analysis.

1.4.1 – Adjusting Price/Cost for Pricing Comparisons

1.4.2 – Adjusting Price/Cost For Further Analysis

Compensating for Inflation or Deflation. The changing value of the dollar over time can complicate comparisons and other analysis using price or cost information collected over time. You can use price indexes to adjust prices/costs to compensate for inflation or deflation to facilitate direct comparisons and further analysis.

Calculate Relative Price Change Between Two Periods. Index numbers indicate the percentage change in price relative to the base year. For example, the table below shows that the average product price increased by 23.2 percent between 19X4 and 19X9.

$$\frac{\text{Index in 19X9}}{\text{Index in 19X6}} = \frac{123.2}{112.0} = 1.10$$

Year	Product Index
19X4	100.0
19X5	105.3
19X6	112.0
19X7	116.5
19X8	119.3
19X9	123.2

To adjust prices for inflation or deflation, you must be able to do more than determine how prices have changed relative to the base year. You must be able to determine how prices changed between any two time periods. For example, looking at the table above, how did prices change between 19X6 and 19X9? To calculate the percentage price change between any two time periods, you must follow the same procedure that you would follow if you had actual price data; you must divide.

$$\frac{\text{Index in 19X9}}{\text{Index in 19X6}} = \frac{123.2}{112.0} = 1.10$$

Based on the price index and this calculation, you could estimate that product prices in 19X9 were 1.10 times the prices in 19X6 or 10.0 percent more than the prices in 19X6.

Estimating Price/Cost Using Index Numbers. You can use index numbers to adjust prices or costs from any time period for inflation or deflation. For example, the calculation above demonstrated that product prices increased 10.0 percent between 19X6 and 19X9. If you knew that the price for an equipment item in 19X6 was $1,000, you could estimate that the price should be

$$\frac{I_2}{I_1} = \frac{P_2}{P_1}$$

10.0 percent higher in 19X9. That would result in a price estimate of $1,100 for 19X9.

These calculations can be formalized into a simple equation using either the Ratio Method or the Price Adjustment Formula Method described below.

- Ratio Method. The Ratio Method uses an equation in the form of a simple ratio to make the price adjustment.

$$\frac{I_2}{I_1} = \frac{P_2}{P_1}$$

Where:

I_1 = Index in Time Period 1 -- the index for the period for which you have historical cost/price information.

I_2 = Index in Time Period 2 -- the index for the period for which you are estimating.

P_1 = Price/cost in Time Period 1 -- historical cost/price information.

P_2 = Price/cost in Time Period 2 -- cost/price estimate.

Example: You purchased an item in 19X6 for $1,000 and you are trying to estimate the price in 19X9. The relevant index in 19X6 was 112.0. In 19X9, it is 123.2.

$$\frac{I_2}{I_1} = \frac{P_2}{P_1}$$

$$\frac{123.2}{112.0} = \frac{P_2}{\$1,000}$$

$$123.2 \times \$1,000 = 112.0 \times P_2$$

$$123,200 = 112.0 \times P_2$$

$$\frac{123,200}{112.0} = P_2$$

$$\$1,100 = P_2$$

- Price Adjustment Formula Method. The Price Adjustment Formula is a simplification of the Ratio Method described above.

$$P_2 = \frac{I_2}{I_1} \times P_1$$

Example: The calculations below use the same pricing information used above to demonstrate the ratio method.

$$P_2 = \frac{I_2}{I_1} \times P_1$$

$$= \frac{123.2}{112.0} \times \$1{,}000$$

$$= 1.10 \times \$1{,}000$$

$$= \$1{,}100$$

Adjustment Period Selection. When adjusting historical prices for inflation, take care in selecting the period of adjustment. There are two basic methods that you can use in adjusting costs/prices:

- Adjustment based on period between acquisition dates.
  - This is the method most commonly used to calculate the period of price adjustment, because acquisition dates are readily available.

For example: An item is being acquired in January 19X2 was last purchased in January 19X1. Using this method, the logical adjustment period would be January 19X1 to January 19X2 -- a year of inflation or deflation.

  - If delivery schedules are similar, this method should be satisfactory. However, if delivery schedules are significantly different, you may be over or under the adjustment required.

For example: If the January 19X1 acquisition provided for delivery in January 19X2 and the January 19X2 acquisition also provided for delivery in January 19X2, allowing for a year of

inflation or deflation would likely overestimate the adjustment required. The pricing of the first acquisition should have already considered the anticipated price changes between January 19X1 and January 19X2. Why make a second adjustment for the same price changes?

- Adjustment based on period between delivery dates.
  - This method for determining the appropriate period of adjustment is probably more accurate for the reasons described above. The problem with applying this method is the collection of accurate information on delivery dates. Application is further complicated by deliveries over an extended period of time.
  - For smaller dollar material purchases in periods of limited price changes, the differences between acquisition date to acquisition data and delivery date to delivery date adjustment may not be that significant. However, as contract costs/prices increase or cost/price changes become more volatile, selection of the proper adjustment period becomes more important.
  - Wage rates should always be estimated for the time period in which the work will be performed.

1.4.1 Adjusting Price/Cost For Pricing Comparisons

Should-Pay Estimates. You can use price indexes to develop should-pay estimates of current price or cost based on historical information. These should-pay estimates can be used for a variety of purposes including comparison with an offered price or cost as part of an evaluation of reasonableness.

Steps in Using Price Indexes to Analyze Price/Cost Reasonableness. To perform this analysis, follow the steps below:

Step 1. Collect available price/cost data.

Step 2. Select price indexes for adjusting price/cost data.

Step 3. Adjust price/cost for inflation/deflation.

Step 4. Use adjusted price/cost for pricing comparisons.

Example of Using Price Indexes to Analyze Price/Cost Reasonableness. Consider the problem of analyzing a contractor's

proposed price of $23,000 for a turret lathe to be delivered in 19X8.

Step 1. Collect Available Price/Cost Data. A procurement history file reveals that the same machine tool was purchased in 19X4 at a price of $18,500. Determine whether the 19X8 proposed price is reasonable.

Step 2. Select An Index Series For Adjusting Price/Cost Data. Select or construct an appropriate index series. In this case, you might select a Machinery and Equipment Index as a reasonable indicator of price movement for a turret lathe. You could extract the data from a Government publication (e.g., the PPI) or use a similar commercial index.

Year	Machinery and Equipment Index
19X2	100.0
19X3	103.3
19X4	106.0
19X6	110.8
19X7	115.0
19X8	121.9

Step 3. Adjust Price/Cost for Inflation/Deflation. After you have selected an index, you can adjust prices to a common dollar value level. In this case, you would normally adjust the historical 19X4 price to the 19X8 dollar value level. To make the adjustment, you simply use one of the methods already demonstrated.

Using the Ratio Method.

$$\frac{I_2}{I_1} = \frac{P_2}{P_1}$$

$$\frac{121.9}{106.0} = \frac{\text{Price Estimate for 19X8}}{\$18,500}$$

$$121.9 \times \$18,500 = 106.0 \times P_2$$

$$\$2,255,150 = 106.0 \times P_2$$

$$\frac{2,255,150}{106.0} = P_2$$

$21,275 = P_2

Using the Formula Adjustment Method.

$$P_2 = \frac{I_2}{I_1}$$

$$= \frac{121.9}{106.0} \times \$18,500$$

$$= 1.15 \times \$18,500$$

$$= \$21,275$$

Step 4. Make Direct Price Comparison. Once you have made the adjustment for inflation/deflation, you can compare the offered and historical prices in constant dollars. The offered price/cost is $23,000, but the adjusted historical price/cost is only $21,275. Thus, the offered price/cost is $1,725, or 8.1 percent higher than what you would expect, given the historical data and available price indexes.

If you look at the percentage price/cost change between the two acquisitions, the difference is even more pronounced. Using the price indexes, you projected an increase from $18,500 to $21,275, or about 15.0 percent. The offer increase was from $18,500 to $23,000, or about 24.3 percent. In this case, you might ask the offeror why the price/cost rose at a rate 62 percent higher than anticipated (24.3 is 62 percent larger than 15.0).

Do not attempt to determine whether a price or cost is reasonable based this type of analysis alone. You must consider the entire contracting situation, including any differences in quantity, quality, delivery requirements, or other contract terms that might significantly affect price. However, the above analysis does raise concern about the reasonableness of the offer.

Note that the analysis above is based on 4-year old data. You should generally place less reliance on a comparison based on 4-year old data than you place on a comparison based on more current data.

1.4.2 Adjusting Price/Cost For Further Analysis

Inflation/Deflation May Obscure Trend. Often you will make a series of similar acquisitions over a period of time. Pricing trends may develop but they may be obscured by inflation/deflation. Adjusting prices for inflation/deflation will make it possible to more accurately identify and track these trends.

Steps in Using Price Indexes to Analyze Price/Cost Reasonableness. Adjustment for further analysis follows four steps similar to those used for data adjustment that are applied in preparation for direct comparison. The major difference is that several elements of cost/price data must be adjusted to a single time period. After adjustment, data is said to be in constant-year dollars.

Step 1. Collect available price/cost data.

Step 2. Select price indexes for adjusting price/cost data.

Step 3. Adjust prices/costs for inflation/deflation.

Step 4. Apply appropriate analysis technique(s).

Example of Using Price Indexes to Adjust Prices/ Costs for Further Analysis. To illustrate this analysis, consider an offer of $22,500 each for five precision presses in 19X7.

Step 1. Collect Available Price/Cost Data. The organization has purchased five similar presses each year since 19X2. The historical unit prices are shown in Column D of the table below. While purchase quantity changes are not present in this situation, unit prices are used to limit the effect of quantity differences on trend analysis. In this case, the only apparent cost/price trend in the unadjusted data is increasing prices.

Step 2. Select Price Indexes For Adjusting Price/Cost Data. Again, the Machinery and Equipment Index will be used. Annual indexes are presented in Column B of the table below.

Step 3. Adjust Prices/Costs For Inflation/Deflation. The adjustment calculation is presented in Column C of the table below. Each historical price is adjusted to an equivalent price in 19X7 dollars.

Adjustment For Further Analysis				
A	B	C	D	E
Year	Machinery and Equipment Index	Index Adjustment Calculation	Historical Prices	Adjusted Prices

19X2	100.0	$\frac{121.9}{100.0}$	$17,391	$21,200*
19X3	103.3	$\frac{121.9}{103.3}$	$17,796	$21,000
19X4	106.0	$\frac{121.9}{106.0}$	$18,087	$20,800
19X5	110.8	$\frac{121.9}{110.8}$	$18,724	$20,600
19X6	115.0	$\frac{121.9}{115.0}$	$19,245	$20,400
19X7	121.9	$\frac{121.9}{121.9}$	--	?

Step 4. Apply appropriate analysis technique(s). After the historical unit prices are adjusted to 19X7 dollars, a trend becomes obvious. In 19X7 dollars, prices have been dropping $200 each year since 19X2. The obvious price estimate is $20,200 for the 19X7 acquisition. That projection is based on the continuation of the historical trend. However, as with direct comparison, analysis based on historical price trends must consider any changes in the contracting situation and their possible affect on contract price. There may also be questions as to what has caused the trend and whether those forces will continue to cause price changes.

Most trends are not so obvious, even after prices have been adjusted to constant-year dollars. However, you can often apply techniques such as regression analysis or improvement curve analysis to identify clear estimating relationships.

1.5 Identifying Issues And Concerns

Questions to Consider in Analysis. As you perform price/cost analysis, consider the issues and concerns identified in this section, whenever your analysis is based on data collected over time.

- Were prices/costs collected over time adjusted for inflation/deflation?

Inflation/deflation can mask underlying price changes. Price indexes should be used to compensate for the effect these general price changes.

- Is it reasonable to use the price index series selected?

The price index series selected for making the price/cost adjustment should be as closely related to the item being

considered as possible. For example, you should not use the Consumer Price
Index to adjust for changes in the price of complex industrial electronic equipment.

- Are adjustments calculated correctly?

Anyone can make a mistake in calculation. Assure that all adjustments are made correctly. This is particularly important when the adjustment is part of a contractor's offer or part of an analysis performed by other Government personnel.

- Is the time period for the adjustment reasonable?

When adjusting historical prices for inflation, take care in selecting the period of adjustment. There are two basic methods that are used in adjusting costs/prices, period between acquisition dates and the period between delivery dates. The period between acquisition dates is most commonly used because purchase dates are typically more readily available. However, be careful if delivery schedules are substantially different.

- Is more than one adjustment made for the same inflation/ deflation?

For example, it is common for offerors to adjust supplier quotes to consider inflation/deflation between the time when the quote was obtained and the date that the product will be required. This is acceptable unless the supplier already considered the inflation/deflation in making the quote.

- How far into the future can you forecast?

You can forecast any period into future as long as you have a reasonable index estimate. However, the price forecast risk increases as the risk of developing a reasonable index estimate increases. The farther into the future that you forecast, the greater the risk that the economic factors affecting the index will change.