

Statistics 2

Chapter 12

Index Numbers

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Chapter 12

Index Numbers

GOALS

When you have completed this chapter, you will be able to:

ONE

Describe what is meant by an index.

TWO

Understand the difference between a weighted price index and an unweighted price index.

THREE

Be able to construct and interpret a Laspeyres Price index.

FOUR

Be able to construct and interpret a Paasche Price index.

Chapter 12 *continued*

Index Numbers

GOALS

When you have completed this chapter, you will be able to:

FIVE

Be able to construct and interpret a Value Index.

SIX

Explain how the Consumer Price index is constructed and used.

Index Numbers

- ◉ An **index number** is a number that measures the relative change in price, quantity, value, or some other item of interest from one time period to another.
- ◉ A **simple index number** is an index number that is used to measure the relative change in just one variable. It is the ratio of two values of the variable expressed as a percentage.

EXAMPLE 1

- Mr. Wagner owns stock in three companies. Shown below is the price per share at the end of 1991 and 1998 for the three stocks and the quantities he owned in 1991 and 1998.

Stock	1991 Price	1991 Shares	1998 Price	1998 Shares
N W S	\$ 1	3 0	\$ 2	5 0
N P C	\$ 5	1 5	\$ 4	3 0
G A C	\$ 6	4 0	\$ 6	2 0

EXAMPLE 1 *continued*

- Compute a simple price index for each stock. Use 1991 as the base year (1991=100).
 - > The simple price indexes are: $(2/1)(100)=200$; $(4/5)(100)=80$; and $(6/6)(100)=100$
- Compute a simple index for the number of shares owned for each stock. Use 1991 as the base year.
 - > The shares indexes are: $(50/30)(100)=166.67$; $(30/15)(100)=200$; and $(20/40)(100)=50$

Why Convert Data to Indexes?

- Reasons for computing indexes:
 - > Indexes facilitate a comparison of unlike series.
 - > An index is a convenient way to express the change in the total of a heterogeneous group of items.
 - > A percent change is often easier to comprehend than actual numbers, especially when the numbers are extremely large.

Types of Index Numbers

- ◉ An index can be classified as a *price index*, a *quantity index*, a *value index*, or a *special-purpose index*.
- ◉ A *price index* measures the changes in prices from a selected base period to another period.
- ◉ **EXAMPLE:** *Producer Price Index* - measures the average change in prices received in the primary markets of the United States by producers of commodities in all stages of processing (1982=100).

Types of Index Numbers

- A **quantity index** measures the changes in quantity consumed from the base period to another period.
- **EXAMPLE:** Federal Reserve Board indexes of quantity output.
- A **value index** measures the change in the value of one or more items from the base period to the given period. The values for the base period and the given periods are found by $P \times Q$.
- **EXAMPLE:** the index of department store sales.

Types of Index Numbers

- A **special-purpose index** combines and weights a heterogeneous group of series to arrive at an overall index showing the change in business activity from the base period to the present.
- **EXAMPLE:** The federal government puts out an index of leading economic indicators

Construction of Index Numbers

- Simple Price Index, P : Let p_0 be the base period price, and p_t be the price at the selected or given period. Thus, the simple price index is given by:

$$P = \frac{p_t}{p_0} (100)$$

Construction of Index Numbers

- A **weighted index** considers both the price and the quantities of items. There are two methods of computing the price index: *Laspeyres* method and *Paasche* method.
- Laspeyres Weighted Price Index, P:** This method uses the base period quantities q_0 as weights. Let p_t be the current price, p_0 be the price in the base period, and q_0 be the quantity consumed in the base period

$$P = \frac{\sum p_t q_0}{\sum p_0 q_0} (100)$$

Construction of Index Numbers

- Paasche Weighted Price index, P : Here the present year weights are substituted for the original base period weights. Let q_t be the current quantity consumed, p_0 be the price in the base period, and p_t be the current price.

$$P = \frac{\sum p_t q_t}{\sum p_0 q_t} (100)$$

Value Index

- Value index, V : Here both the price and quantity change from the base period to the given period. A value index reflects changes in both price and quantity.

$$V = \frac{\sum p_t q_t}{\sum p_0 q_0} (100)$$

Consumer Price Index

- ◉ In 1978 two consumer price indexes were published. One was designed for urban wage earners and clerical workers. It covers about one third of the population. Another was designed for all urban households. It covers about 80% of the population.
- ◉ Millions of employees in automobile, steel, and other industries have their wages adjusted upward when the

Consumer Price Index

○ Uses of the CPI:

- > It allows consumers to determine the effect of price increases on their purchasing power.
- > It is a yardstick for revising wages, pensions, alimony payments, etc.
- > It is an economic indicator of the rate of inflation in the United States.
- > It computes real income: $\text{real income} = \text{money income} / \text{CPI} (100)$

Consumer Price Index

Deflating Sales:

$$\text{Deflated sales} = \frac{\text{Actual sales}}{\text{An approximate index}} (100)$$

Determining the purchasing power of the dollar compared with its value for the base period:

$$\text{Purchasing power of dollar} = \frac{\$1}{CPI} (100)$$

Consumer Price Index

- ◉ Shifting the base:
 - > When two or more series of index numbers are to be compared, it is necessary they do not have the same base period.
 - > First select a common base period for all series. Then use the respective base numbers as the denominators and convert each series to the new base period.

EXAMPLE 2

- ◉ From the information given in **EXAMPLE 1**, perform the following operations:
 - > Compute a simple aggregate price index for the three stocks. $(12/12)=1$
 - > Compute the price index using the Laspeyres method. $P = [2(30)+4(15)+6(40)] / [1(30)+5(15)+6(40)](100) = [360/345](100) = 104.35$

EXAMPLE 2 *continued*

- > Compute the price index using the Paasche method. $P = [2(50) + 4(30) + 6(20)] / [1(50) + 5(30) + 6(20)] (100) = [340 / 320] (100) = 106.25$
- > Develop a value index.
 $V = [2(50) + 4(30) + 6(20)] / [1(30) + 5(15) + 6(40)] (100) = (360 / 345) (100) = 98.55$