
CHAPTER TEN

INDEX NUMBERS

SPECIFIC OBJECTIVES

At the end of this topic the trainee should be able to:

- Define index numbers;
- Differentiate between the types of index numbers
- Explain the uses of index numbers
- List the limitations of index numbers.

INTRODUCTION

An index number is a device which shows by its variation the changes in a magnitude which is not capable of accurate measurement in itself or of direct valuation in practice. An index number may be described as a specialized average designed to measure the level of a phenomenon with respect to time geographic location or other characteristics such as income.

Uses of index numbers

- They help in framing suitable policies
- They reveal trends and tendencies
- Index numbers are very useful in deflating

Classification of index numbers.

Index numbers may be classified in terms of what they measure. In economics and business the classification is;

- Price
- Quantity
- Value
- Special purpose

Problems in the constructing of index numbers

Before constructing index numbers a careful thought must be given to the following problems.

- i) The purpose of the index; as the very outset the purpose of constructing the must be very clearly decided.
- ii) Availability and comparability of data; it is needless to say that it is impossible to make appropriate comparison unless the necessary statistical data can be obtained
- iii) Selection of base period; whenever index number are constructs, a reference is made to some base period ,safe period should be normal , it should not be too distant.
- iv) Selection of number of items; every item cannot be included while constructing an index number and hence one has to select a sample.

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- v) Price quotation; after the commodities have been selected the next problem is to obtain price quotation for these commodities pricing vary from place to place and even from shop to shop.
 - vi) Choice of an average; since index numbers are specific average a decision has to be made as to which particular average (i.e. arithmetic mean, median , mode , geometric mean)
 - vii) Selection of appropriate weight; the problem of selecting suitable weights are quite important and at the same time quite difficult to decide.
 - viii) Selection of appropriate formula; a large number of formula have been devised for often constructing the index numbers. The problem very often is that in selecting the most appropriate formula.

An index number is an attempt to summarize a whole mass of data into one figure. The single figure shows how one year differs from another year. It is a statistical devise used to measure the change in the level of prices, wages output and other variables at given times, relative to their level at an earlier time which is taken as the base for comparison purposes

A simple price index = $\frac{\sum P_n}{\sum P_o} \times 100$ (an unweighted price index)

A simple quantity index = $\frac{\sum Q_n}{\sum Q_o} \times 100$ (an unweighted quantity index)

Where p_n is the price of a commodity in the current year (the year for which the price index to be calculated)

Where p_o is the price of the same commodity in the base year (the year for comparison purposes)

Similarly Q_n and Q_o are defined in the same way

Methods of constructing index numbers

- a) unweighed indices
- b) weighed indices

In the unweighted indices weight are not expressively assigned whereas in the weighed indices weights are assigned to the various items. Each of these types may further be divided under two heads.

- i) simple aggregate
- ii) simple average of price relations

Unweighted index numbers

i) simple aggregate method

This is the simplest method of constructing index numbers. When this method is used to construct a price index number, the total of current year prices for the various commodities is divided by total of base year and quotient is multiplied by 100.

$$P_{01} = \frac{\sum p_1}{\sum p_0} \times 100$$

Where $\sum p_1$ = total current price for various commodities

$\sum p_0$ = total of base year price for various commodities

Limitation of the method

- The units in which prices of commodities are given affect the price index.
- No consideration is given to the relative importance of the commodities.

ii) simple average of relative method

When this method is used to construct a price index, price relative are obtained for the various items include intercontinental he index and then an average of these relative

$$P_{01} = \frac{\sum p_1}{\sum p_0} \times 100 / N$$

Where N= refers to the number of items

Merits

- Extreme items do not influence the index
- The index is not influenced by the units in which prices are quoted.

Limitations

- Difficulty is faced with regard to the selection of an appropriate average.
- The relatives are assumed to have equal importance.

Weighed index numbers

Weighed index numbers are of two types

- i) weighed aggregate index numbers
- ii) weighed average of relative index numbers

Weighed aggregate method

An index is called a weighed aggregate index when it is constructed fro an aggregate of items (price) that have been weighed.

Some important formulae of construction a weighed aggregate index are

- i) Laspeyres Method
- ii) Paasche Method
- iii) Fishers Ideal Method
- iv) Marshall - Edgeworth

Laspeyres method

In this method the base year's quantities are taken as weights. The formula for constructing index is

$$P_{01} = \frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$$

$$\Sigma p_0q_0$$

Paasche method

In this method the current year quantities are taken as the formula for constructing index is

$$P_{01} = \frac{\Sigma p_1q_1}{\Sigma p_0q_1} \times 100$$

Fischer's ideal method

Prof Fischer has given a number of formulas for constructing index numbers

$$P_{01} = \sqrt{\left[\frac{\Sigma p_1q_0}{\Sigma p_0q_0} \times \frac{\Sigma p_1q_1}{\Sigma p_0q_1} \times 100 \right]} \quad \text{or}$$

$$p_{01} = \sqrt{(L \cdot P)}$$

Marshall Edge Worth Method

In this method also the current year as well as base year and quantities are considered

$$P_{01} = \frac{\Sigma (q_0 + q_1) p_1}{\Sigma (q_0 + q_1) p_0} \times 100$$

INDEX NUMBERS APPLICATION

The index of industrial production

It is a quantity index compiled by the government. It measures changes in the volume of production in major industries. The index is a good indication of the state of national economy.

It covers the following major industries in the UK

- i. Mining and quarrying
- ii. Manufacturing such as food, drinks and tobacco, chemicals, metal manufacture, engineering e.t.c
- iii. Textile

- iv. Construction
- v. Gas electricity, water e.t.c

It excludes agriculture, fishing, trade, transport, finance and other such industries.

Each industries order is given a weighting. The weighting is based on average monthly production in each industry in a fixed base year. It gives each item its relative importance amongst all other items and thus gives a better estimate of the index for comparison purposes.

The Geometric Index (Industrial Share index)

This index is an index of 30 selected top industrial companies. It is calculated by taking an unweighted geometric mean of the price relatives of the selected shares.

Example

The share prices of ordinary shares of four companies on 1st January 1990 and 1st January 1991 were as follows.

Share	Price on 1.1.1990	Price on 1.1.1991
Company A	Shs 10	Shs 12
Company B	Shs 12	Shs 15
Company C	Shs 20	Shs 25
Company D	Shs 5	Shs 6

Using an unweighted geometric index, calculate the index of share prices at 1.1.1991 if 1.1.1990 is the base date, index 100

Solution

$$\left(\frac{12}{10} \times \frac{15}{12} \times \frac{25}{20} \times \frac{6}{5} \right)^{\frac{1}{4}} = \left(\frac{27000}{12000} \right)^{\frac{1}{4}} = (2.25)^{\frac{1}{4}}$$

$$= 1.225$$

$$\text{Percentage increase} = 22.5\% \quad \text{index} = 122.5$$

Inflation

The inflation rate for a given period can be calculated using the following formula;

$$\text{Inflation} = \frac{\text{Current retail price index}}{\text{Retail price index in the base year}} \times 100$$

Marshal Hedge Worth Index

$$\text{Marshal Hedge worth index} = \frac{\sum p_n (p_o + q_n)}{\sum p_o (q_o + q_n)} \times 100$$

Tests for an Ideal Index Number

1. Factor Reversal Test

This test indicates that when the price index is multiplied with a quantity index i.e. factors are reversed), it should result in the value index.

2. The time reversal test

If we reverse the time subscripts of a price or quantity index, the result should be reciprocal of the original index.

PRACTICE QUESTION

QUESTION FIVE

Prodco PLC manufactures an item of domestic equipment which requires a number of components which have varied as various modifications of the model have been used. The following table shows the number of components required together with the price over the last three years of production.

COMPONENT	1981		1982		1983	
	Prices	Quantity	Prices	Quantity	Prices	Quantity
A	3.63	3	4.00	2	4.49	2
B	2.11	4	3.10	5	3.26	6
C	10.03	1	10.36	1	12.05	1
D	4.01	7	5.23	6	5.21	5

Required:

- a) Establish the base weighted price indices for 1982 and 1983 based on 1981 for the item of equipment. (8 marks)
- b) Establish the current weighted price indices for 1982 and 1983 based on 1981 for the item of equipment. (8 marks)
- c) Using the results of (a) and (b) as illustrations, compare and contrast Laspeyre's and Paasche price index numbers. (4 marks)

(Total: 20 marks)

QUESTION SIX

- a) A company manufacturing a product known as 257 uses five components in its assembly.

The quantities and prices of the components used to produce a unit of K257 in 1982, 1983 and 1984 are tabulated as follows:

COMPONENT	1982		1983		1984	
	Quantity	Prices	Quantity	Prices	Quantity	Prices
A	10	3.12	12	3.17	14	3.20
B	6	11.49	7	11.58	5	11.67
C	5	1.40	8	1.35	9	1.31
D	9	2.15	9	2.14	10	2.63
E	50	0.32	53	0.32	57	0.32

Required:

- Calculate Laspyere's type price index number for the cost of one unit of K257 for 1983 and 1984 based on 1982. (6 marks)
- Calculate Paasche type price index numbers for the cost of one unit of K257 for 1983 and 1984 based on 1982. (6 marks)
- Compare and contrast the Laspeyre and Paasche price-index numbers you have obtained in (i) and (ii) (3 marks)

A number of employers manufacturing plastic components used in plumbing have formed themselves into an association for the purpose of negotiating with the trade union for this industrial sector.

The negotiations cover pay and contributions in this sector.

Required:

Explain the usefulness of an index of Industrial Production and an index of retail prices to both sides in a series of pay negotiations.

(5 marks)

(Total: 20marks)