

## 1 CHAPTER OVERVIEW

Your visual roadmap through the chapter

### Index Numbers

Base periods, price/quantity/value indices

1

### Unweighted & Weighted Indices

Simple, Laspeyre, Paasche & Fisher methods

2

### Inflation, Purchasing Power & Wages

CPI, inflation rate, real vs nominal values

3

#### WHAT IT'S ABOUT

Index numbers are statistical devices used to measure changes in price, quantity or value over time, relative to a chosen base period.

#### WHY IT MATTERS FOR QAB

Indices (like the CPI) drive real-world decisions on inflation, wages, purchasing power and government economic policy.

#### EXAM SKILLS REQUIRED

Construct simple, Laspeyre, Paasche and Fisher indices; calculate CPI, inflation rate, purchasing power, and real vs nominal wages/GDP.

## 2 KEY DEFINITIONS

Source-based terminology, exam-ready

### Index Number

A statistical device used to express the relationship between quantitative variables, often as a measure of fluctuation in the economy.

**Key word:** relative measure

### Base Period

The reference period (usually given a value of 100 or 1,000) against which all other periods are compared.

**Key word:** reference = 100

### Price / Quantity / Value Index

Price: change in price of goods/services. Quantity: change in volume. Value: change in total value (price x quantity).

**Key word:** price, volume, or both

### Unweighted vs Weighted Index

Unweighted: equal importance to each item. Weighted: relative importance/significance of each item is factored in.

**Key word:** equal vs relative importance

### Consumer Price Index (CPI)

Measures the cost of a "typical" consumer basket of goods/services at a point in time, compared to the base year.

**Key word:** cost of living

### Inflation / Deflation

Inflation: general increase in prices (money buys less). Deflation: general decrease in prices (money buys more).

**Key word:** prices up/down

### Purchasing Power

The reciprocal of the CPI ( $\times 100$ ); the real value of money given current prices. Inversely related to the CPI.

**Key word:**  $1/\text{CPI} \times 100$

### Nominal vs Real Wages

Nominal (money) wage: amount earned in current rupees, ignoring inflation. Real wage: what that money can actually buy after inflation.

**Key word:** earned vs buying power

### 3 CORE CONCEPT

Explained in exam-oriented language

#### CONCEPT → Index Numbers

##### MEANING

A base value (usually 100) against which every other period's value is compared.

##### PURPOSE

Judge past changes and forecast future values for price, quantity or value.

##### APPLICATION

CPI, stock market indices, GDP deflators, wage/salary adjustments.

#### CONCEPT → Weighting (Laspeyres vs Paasche)

##### MEANING

Different items matter differently; weighting reflects each item's real importance in the basket.

##### PURPOSE

Avoid distortion from treating all items as equally significant.

##### APPLICATION

Laspeyres uses base-year quantities; Paasche uses current-year quantities as weights.

### 4 KEY RULES & PRINCIPLES

Every source rule, exam-ready

#### RULE 1 Selecting the base period

- Should not be too far in the past
- Should reflect stability within the variables (free from abnormalities like earthquakes, lockouts)

#### RULE 2 Fixed base vs Chain base method

- Fixed base: one base year stays unchanged throughout
- Chain base: base period moves year to year; results are "link relatives", later converted back to a fixed base to give the chain index

#### RULE 3 Rebasing an index

- Divide the existing index number in each year by the index number of the new base year, then  $\times 100$
- Rebasing never changes the underlying story — only how it's expressed

#### RULE 4 Laspeyres vs Paasche bias

- Laspeyres tends to OVERSTATE inflation (ignores consumers buying less of items that got pricier)
- Paasche tends to UNDERSTATE inflation (biased to cheaper substitute items)
- Laspeyres needs less new data each year, so it's used more in practice

#### RULE 5 Fisher's ideal index

- Fisher index = geometric mean of the Laspeyres and Paasche indices
- Balances both indices' baskets (base period AND current period)

#### RULE 6 CPI, inflation & purchasing power links

- CPI rises  $\rightarrow$  inflation; CPI falls  $\rightarrow$  deflation
- Purchasing power is inversely proportional to the CPI
- GDP deflator (Nominal GDP  $\div$  Real GDP) is a broader measure of inflation than CPI

## 5 FORMULA ZONE — SIMPLE (UNWEIGHTED) INDICES

Every formula supported by the source text

### SIMPLE PRICE INDEX & SIMPLE QUANTITY INDEX

$$\text{Price Index} = (p_1 \div p_0) \times 100 \quad | \quad \text{Quantity Index} = (q_1 \div q_0) \times 100$$

$p_0/q_0$ =base period price/quantity,  $p_1/q_1$ =current period. For a single item only.

### SIMPLE AGGREGATE PRICE INDEX

$$\text{Simple Aggregate Price Index} = (\sum p_1 \div \sum p_0) \times 100$$

Sum of current-period prices ÷ sum of base-period prices, for a group of items. Ignores relative importance of items.

### AVERAGE OF PRICE RELATIVES

$$P = \sum \{ (p_1 \div p_0) \times 100 \} \div K$$

$K$ =number of commodities. Changes in measuring units do not affect this index's value.

### Composite Price Index — the two families

**Unweighted:** Simple Aggregative Method; Average of Relatives Method.

**Weighted:** Weighted Aggregative Method (Laspeyre/Paasche/Fisher); Average of Weighted Relatives Method.

## 5 FORMULA ZONE — WEIGHTED PRICE INDICES

Every formula supported by the source text

### LASPEYRE PRICE INDEX

$$\sum (p_1 \times q_0) \div \sum (p_0 \times q_0) \times 100$$

Uses BASE year quantities ( $q_0$ ) as weights. The usual/default weighted price index.

### PAASCHE PRICE INDEX

$$\sum (p_1 \times q_1) \div \sum (p_0 \times q_1) \times 100$$

Uses CURRENT year quantities ( $q_1$ ) as weights — must be recollected every year.

### FISHER PRICE INDEX (IDEAL INDEX)

$$\text{Fisher} = \sqrt{(\text{Laspeyre} \times \text{Paasche})}$$

The geometric mean of the Laspeyre and Paasche price indices.

### AVERAGE OF WEIGHTED RELATIVES

$$\text{Index} = \sum Pw \div \sum w$$

$P$ =price relative ( $p_1/p_0 \times 100$ ),  $w$ =weight assigned,  $Pw = P \times w$  for each item.

## 5 FORMULA ZONE — QUANTITY INDICES

Every formula supported by the source text

### LASPEYRE QUANTITY INDEX

$$\frac{\sum(p_0 \times q_1)}{\sum(p_0 \times q_0)} \times 100$$

Uses BASE year price levels ( $p_0$ ) as weights.

### PAASCHE QUANTITY INDEX

$$\frac{\sum(p_1 \times q_1)}{\sum(p_1 \times q_0)} \times 100$$

Uses CURRENT price levels ( $p_1$ ) as weights.

### FISHER QUANTITY INDEX (IDEAL INDEX)

$$\text{Fisher} = \sqrt{\text{Laspeyre Qty} \times \text{Paasche Qty}}$$

The geometric mean of the Laspeyre and Paasche quantity indices.

### CHAIN INDEX

$$\text{Chain Index} = \frac{(\text{Relative Index}_{\text{current}} \times \text{Chain Index}_{\text{previous}})}{100}$$

Link Relative = (value in current period ÷ value in previous period) × 100. Used to monitor and forecast trends.

## 5 FORMULA ZONE — CPI, INFLATION, PURCHASING POWER & WAGES

Every formula supported by the source text

### CONSUMER PRICE INDEX (CPI)

$$\text{CPI} = \frac{(\text{Cost of basket, current year} \div \text{Cost of basket, base year}) \times 100$$

Other methods: Family Budget Method ( $\sum Pw/w$ ); Expenditure Method ( $\sum(p_1q_0)/\sum(p_0q_0) \times 100$ ).

### INFLATION RATE

$$\text{Inflation Rate} = \frac{[(\text{CPI}_2 - \text{CPI}_1) \div \text{CPI}_1] \times 100$$

CPI rising = inflation; CPI falling = deflation.

### PURCHASING POWER

$$\text{PP} = (1 \div \text{CPI}) \times 100$$

Inversely related to the CPI — as CPI rises, purchasing power falls.

### REAL GDP & GDP DEFLATOR

$$\begin{aligned} \text{Real GDP} &= \text{current-year quantity} \times \text{base-year price} \\ \text{GDP Deflator} &= \text{Nominal GDP} \div \text{Real GDP} \end{aligned}$$

GDP deflator is a broader measure of inflation than the CPI.

### REAL WAGE EQUIVALENCE

$$\text{Wage}_{\text{base}} \div \text{CPI}_{\text{base}} = \text{Wage}_{\text{current}} \div \text{CPI}_{\text{current}}$$

Used to find the equivalent (inflation-adjusted) wage needed in the current period, e.g. for a dearness allowance.

## 6 CALCULATION ROADMAP

General path for any index question

### 1- Read Question

Identify base & current period data

### 2- Identify Index Type

Simple, Laspeyre, Paasche, Fisher, CPI...?

### 3- Select Formula

Match weights (q0 or q1; p0 or p1)

### 4- Substitute

Put known values into the formula

### 5- Calculate & Interpret

Solve, state % change, final answer

## 7 STEP-BY-STEP METHODS

Kept separate — do not mix methods

### METHOD A · Simple/Aggregate Price Index

- 1 Identify base-period and current-period prices
- 2 Single item: divide current by base,  $\times 100$
- 3 Multiple items (unweighted): sum current prices, sum base prices, divide,  $\times 100$
- 4 State the % change from the index value

### METHOD D · Chain Index

- 1 Calculate each year's link relative vs the PREVIOUS year
- 2 Year 1's chain index = its relative index (base = 100)
- 3 Each subsequent chain index = (this year's relative  $\times$  last year's chain index)  $\div 100$
- 4 Continue year by year to build the full chain series

### METHOD B · Laspeyre / Paasche Index

- 1 Tabulate p0, q0, p1, q1 for every item
- 2 Laspeyre: compute  $p1 \times q0$  and  $p0 \times q0$  columns
- 3 Paasche: compute  $p1 \times q1$  and  $p0 \times q1$  columns instead
- 4 Sum each column, divide,  $\times 100$

### METHOD E · CPI & Inflation Rate

- 1 Total the basket's cost in the base year and in each other year
- 2  $CPI = (\text{current basket cost} \div \text{base basket cost}) \times 100$  for each year
- 3 Inflation rate =  $(CPI_2 - CPI_1) \div CPI_1 \times 100$  between any two years
- 4 Positive = inflation; negative = deflation

### METHOD C · Fisher Index

- 1 Calculate the Laspeyre index for the same data
- 2 Calculate the Paasche index for the same data
- 3 Multiply the two index values together
- 4 Take the square root for the Fisher (ideal) index

### METHOD F · Purchasing Power / Real Wage / Real GDP

- 1 Purchasing power: substitute the CPI into  $PP = (1/CPI) \times 100$
- 2 Real wage: solve  $Wage_{base}/CPI_{base} = Wage_{current}/CPI_{current}$  for the unknown
- 3 Real GDP: multiply current-year quantities by BASE-year prices
- 4 GDP deflator = Nominal GDP  $\div$  Real GDP; convert to an index/% for inflation

## 8 DIFFERENT CASES / SCENARIOS

Recognise what's given, pick the right index

**IF only one item/commodity is involved**

→ USE a **simple price/quantity index**

**IF multiple items, all treated as equally important**

→ USE the **simple aggregative** or **average of relatives** method

**IF weights are BASE-year quantities**

→ USE the **Laspeyre** index

**IF weights are CURRENT-year quantities**

→ USE the **Paasche** index

**IF asked for the "ideal" index balancing both periods**

→ USE the **Fisher** index ( $\sqrt{\text{Laspeyre} \times \text{Paasche}}$ )

**IF the base period should move forward each year**

→ USE the **chain base method**

**IF measuring a household's cost of living over time**

→ USE the **CPI**

**IF asked what money can actually buy, or a wage's real value**

→ USE **purchasing power** or the **real wage formula**

## 9 COMPARISON TABLES

Don't confuse these!

|                              | Laspeyre Index                 | Paasche Index                 | Fisher Index                          |
|------------------------------|--------------------------------|-------------------------------|---------------------------------------|
| <b>Quantity weights used</b> | Base year (q0)                 | Current year (q1)             | Both (geometric mean)                 |
| <b>Inflation bias</b>        | Tends to overstate             | Tends to understate           | Balances both biases                  |
| <b>Data needed each year</b> | Only new prices                | New prices AND new quantities | Both indices' full data               |
| <b>Used in practice</b>      | Most common (less data needed) | Less common                   | Considered the "ideal" but data-heavy |

|                    | Fixed Base Method              | Chain Base Method                            |
|--------------------|--------------------------------|----------------------------------------------|
| <b>Base period</b> | One year, unchanged throughout | Moves year to year (previous year is base)   |
| <b>Result</b>      | Direct index number            | "Link relatives", converted to a chain index |

|              | Nominal Value                                 | Real Value                                       |
|--------------|-----------------------------------------------|--------------------------------------------------|
| <b>Wages</b> | Money actually earned (current Rs.)           | What that money can actually buy after inflation |
| <b>GDP</b>   | Current-year prices × current-year quantities | Base-year prices × current-year quantities       |

## 10 WORKED CALCULATION LOGIC

Method students must reproduce in the exam

### LASPEYRE PRICE INDEX: GIVEN → FORMULA → SUBSTITUTION → ANSWER

A basket of 4 materials:  $\Sigma(p_0 \times q_0) = 21.0$ ,  $\Sigma(p_1 \times q_0) = 25.0$ .

**GIVEN:**  $\Sigma(p_1 q_0) = 25.0$ ,  $\Sigma(p_0 q_0) = 21.0$

**FORMULA:** Laspeyre =  $\Sigma(p_1 q_0) / \Sigma(p_0 q_0) \times 100$

**SUBSTITUTION:** =  $25.0 / 21.0 \times 100$

**ANSWER:** Laspeyre index = **119.04** → prices have risen 19.04%

### PURCHASING POWER: GIVEN → FORMULA → SUBSTITUTION → ANSWER

The CPI in a given year is 140 (base year = 100). Find the purchasing power of the rupee.

**GIVEN:** CPI = 140

**FORMULA:** PP =  $(1 / \text{CPI}) \times 100$

**SUBSTITUTION:** PP =  $(1 / 140) \times 100$

**ANSWER:** PP = **0.71** → the rupee now buys only 71% of what it did in the base year

### REAL WAGE / DEARNESS ALLOWANCE: GIVEN → FORMULA → SUBSTITUTION → ANSWER

In 1980 an employee's wage was Rs. 1,200 when CPI was 180. CPI rose to 220 in 1982. Find the wage needed to keep the employee's purchasing power unchanged.

**GIVEN:** Wage<sub>1980</sub> = 1,200, CPI<sub>1980</sub> = 180, CPI<sub>1982</sub> = 220

**FORMULA:** Wage<sub>1980</sub> + CPI<sub>1980</sub> = Wage<sub>1982</sub> + CPI<sub>1982</sub>

**SUBSTITUTION:** Wage<sub>1982</sub> =  $1,200 \times 220 / 180 = 1,467$

**ANSWER:** Additional dearness allowance = **1,467 – 1,200 = Rs. 267**

### INFLATION RATE: GIVEN → FORMULA → SUBSTITUTION → ANSWER

CPI was 120.18 in one year and 112.79 the next. Find the rate of inflation/deflation.

**GIVEN:** CPI<sub>1</sub> = 120.18, CPI<sub>2</sub> = 112.79

**FORMULA:** Inflation Rate =  $[(\text{CPI}_2 - \text{CPI}_1) / \text{CPI}_1] \times 100$

**SUBSTITUTION:** =  $[(112.79 - 120.18) / 120.18] \times 100$

**ANSWER:** **-6.15%** → this is deflation (prices fell)

## 12 EXAM QUESTION PATTERNS

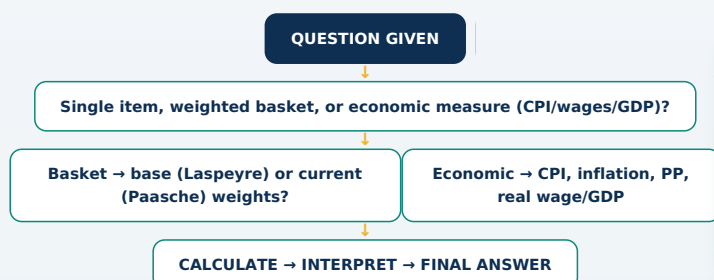
- **Simple index calculation** — single item, or unweighted aggregate
- **Laspeyre/Paasche/Fisher** — construct and compare weighted indices
- **Chain index** — building a series year by year
- **CPI & inflation rate** — direct calculation and interpretation
- **Purchasing power / real wage / real GDP** — adjusting for inflation
- **Conceptual** — uses/limitations of index numbers, base period selection

## 13 EXAM TRAPS

### ⚠ WATCH OUT

- ✗ **Laspeyre vs Paasche mix-up** — check whether q<sub>0</sub> (base) or q<sub>1</sub> (current) weights are used.
- ✗ **Forgetting the ×100** at the end of an index calculation.
- ✗ **CPI vs purchasing power direction** — they move inversely; don't apply the wrong formula.
- ✗ **Nominal vs real confusion** — always check whether inflation has been removed.
- ✗ **Chain index errors** — using the WRONG previous year's chain index in the next link.

## 14 QUICK DECISION TREE



### CHAPTER 9 IN 60 SECONDS

**Simple index:**  $p_1 / p_0 \times 100$

**Laspeyre:**  $\Sigma(p_1 q_0) / \Sigma(p_0 q_0) \times 100$

**Paasche:**  $\Sigma(p_1 q_1) / \Sigma(p_0 q_1) \times 100$

**Fisher:**  $\sqrt{(\text{Laspeyre} \times \text{Paasche})}$

**CPI:** current basket/base basket × 100

**Inflation:**  $(\text{CPI}_2 - \text{CPI}_1) / \text{CPI}_1 \times 100$

**PP** =  $(1 / \text{CPI}) \times 100$

**Trap:** Laspeyre overstates, Paasche understates inflation