

Fifth: Weighted Aggregative Quantity Index Numbers

Quantity index numbers aim to measure the change in the level of production, consumption, or trade between two time periods.

1- Weighted quantity index using Laspeyres' formula

Idea:

- Prices of the base year are fixed.
- We compare quantities of the same basket in two periods.
- It shows the effect of quantity changes only

$$I_{LQ} = (c_1/c_0) * 100$$

$$c_0 = \sum q_0 p_0$$

$$c_1 = \sum q_1 p_0$$

$$I_{LQ} = (c_1/c_0) * 100 = \left(\frac{\sum q_1 p_0}{\sum q_0 p_0} \right) * 100$$

A factory produces three products:

| Product | (Q ₀) | (Q ₁) | (P ₀) |
|---------|-------------------|-------------------|-------------------|
| A | 100 | 140 | 5 |
| B | 80 | 60 | 10 |
| C | 50 | 90 | 20 |

$$c_0 = \sum q_0 p_0 = 100(5) + 80(10) + 50(20) = 500 + 800 + 1000 = 2300$$

$$c_1 = \sum q_1 p_0 = 140(5) + 60(10) + 90(20) = 700 + 600 + 1800 = 3100$$

$$I_{LQ} = \left(\frac{3100}{2300} \right) * 100 = 134.8\%$$

So, real production increased by 34.8%.

2- Weighted quantity index using Paasche formula

$$I_{PQ} = (c_1/c_0) * 100 = \left(\frac{\sum q_1 p_1}{\sum q_0 p_1} \right) * 100$$

- We fix current prices.

3-Weighted quantity index using Fisher formula

To balance the bias of Laspeyres and Paasche

$$I_{FQ} = \sqrt{I_{LQ} I_{PQ}}$$

Properties

Always

$$I_{LQ} \leq I_{FQ} \leq I_{PQ}$$

Fifth: Relative Weighted Average of Quantity Index Number

$$I_{PW} = \left(\frac{\sum \left(\frac{q_1}{q_0} \right) * (W)}{\sum W} \right) * 100$$

$$W = p_0 q_0$$

Paasche Weighted Quantity Index (Average of Relatives Form)

$$I_{PW} = \left(\frac{\sum \left(\frac{q_1}{q_0} \right) * (W)}{\sum W} \right) * 100$$

$$W = p_1 q_1$$

Statistical applications: The lecture 4
Weighted Aggregative Quantity Index Numbers
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EX:17

| Commodity | (Q ₀) | (Q ₁) | (P ₁) |
|---------------------------|-------------------|-------------------|-------------------|
| Wheat (ton) | 100 | 140 | 450 |
| Oil (ton) | 60 | 50 | 3,600 |
| Medicine (thousand packs) | 20 | 30 | 15,000 |

| |
|---------------------------|
| R=Q1/Q₀ |
| (140) |
| (83.3) |
| (150) |

| |
|--------------------------------------|
| (p₁*q₁) |
| (450*140=63000) |
| (3600*50=180000) |
| (15000*30=450000) |

$$\sum w = 693,000$$

| (w _i) | R=Q1/Q ₀ | (w _i *R) |
|-------------------|---------------------|---------------------|
| 63,000 | 140 | 8,820,000 |
| 180,000 | 83.3 | 14,994,000 |
| 450,000 | 150 | 67,500,000 |

$$\sum wR_{qi} = 91,314,000$$

$$I_{PW} = \left(\frac{91,314,000}{693,000} \right) * 100 = 131.7$$

Economic Interpretation

This means that the real quantity level, after being weighted by current-year values, increased by about:

$$131.7 - 100 = 31.7\%$$

In other words, real growth in quantities (using a current basket) is about **32%**.