

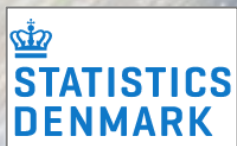


Statistics Sweden and Örebro University Summer School 2026

**Quality Change
and Quality Adjustment**

20th August 2026

Rohan Draper





Quality Change

The concept of quality

**Quality of
questionnaire
design?**

**Quality of
Contract Management?**

**Quality of
dissemination?**

**Quality of
Frame?**

**In price statistics and the national
accounts, *Quality* is a reserved
word with a unique meaning and
application**

**Quality of
Business Processes?**

**Quality of
user consultation?**

**Quality of
sample?**

What is a price?

Transaction

- The value placed on a product at the point of *transaction*
 - Must be (or represent) a mutually agreed price of an actual transaction (change of ownership)





What is a price?

Price, Quantity and Value

$$P^t Q^t = V^t$$

$$\Delta Q^t = \frac{\Delta V^t}{\Delta P^t}$$

$$GDP(P^t I^t E^t)$$



The Price Index Concept

Comparison

- Price indexes allow for the comparison of two (or more) sets of prices for a group of products
- To compare sets of prices
 - One set needs to be the “reference set” and another the “comparison set”
 - The price index for the reference set is usually given a index value of 100.0
- Comparison of prices can occur between:
 - differences in prices between time periods (temporal) – changes in prices over time
 - different regions (spatial) – difference in prices between geographic areas

The Price Index Concept

Comparison (example)

- Analysis of differences in economic development between counties
- Temporal index (e.g. CPI) measuring changes in prices over time
- Spatial price index measuring comparative price levels between different counties



[Link to CPI Australia](#) – regional CPI example



The Price Index Concept

Why measure price change?

- Households may want to compare the cost of their groceries to see if they can afford the same or more than the previous year
- A manufacturer may be interested in comparing prices between different markets to determine where to sell or manufacture their products
- A manufacturer might be interested in comparing the cost of inputs today compared with those of five years ago
- An employer might need to know how much labour has increased in price
- Many freighting companies set their contract prices based on the road freight transport index fluctuation.
- Economists need to compare prices between countries to assess and forecast a country's economic performance

The Price Index Concept

Many types of price indexes sharing the same fundamentals

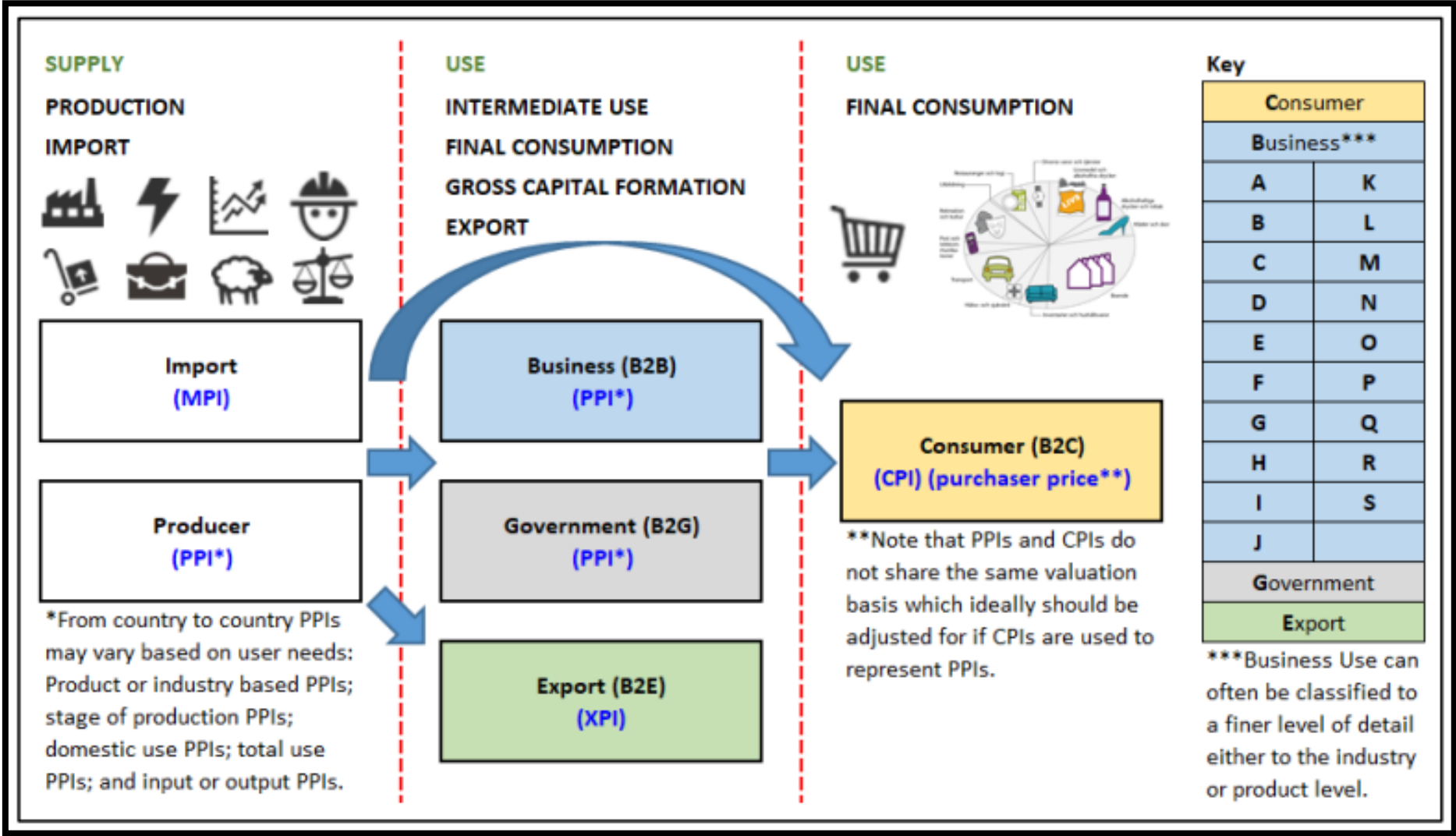


Diagram originates from R.Draper and M.Fridén (Statistics Sweden, 2019) – “SPPIs by customer sector - “the Swedish experience” (34th Voorburg Meeting).

The Price Index Concept

Four main uses of price indexes

- 1) indicator of inflationary trends
- 2) deflators used in the compilation of national accounts
- 3) indexation (contract escalation)
- 4) economic monitoring and analysis



The Price Index Concept

Fixed Basket vs. Fixed Price

Price index

Laspeyres

$$I_{LAS}^{0,t} \equiv \frac{\sum_{i=1}^n p_i^t q_i^0}{\sum_{i=1}^n p_i^0 q_i^0}$$

Fixed basket of products

Varying prices

Volume index

Laspeyres

$$I_{LAS}^{0,t} \equiv \frac{\sum_{i=1}^n p_i^0 q_i^t}{\sum_{i=1}^n p_i^0 q_i^0}$$

Fixed price

Varying quantities





Quality Change

The concept of quality

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In price statistics and the national accounts, ***Quality*** is a reserved word with a unique meaning and application

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Quality Change

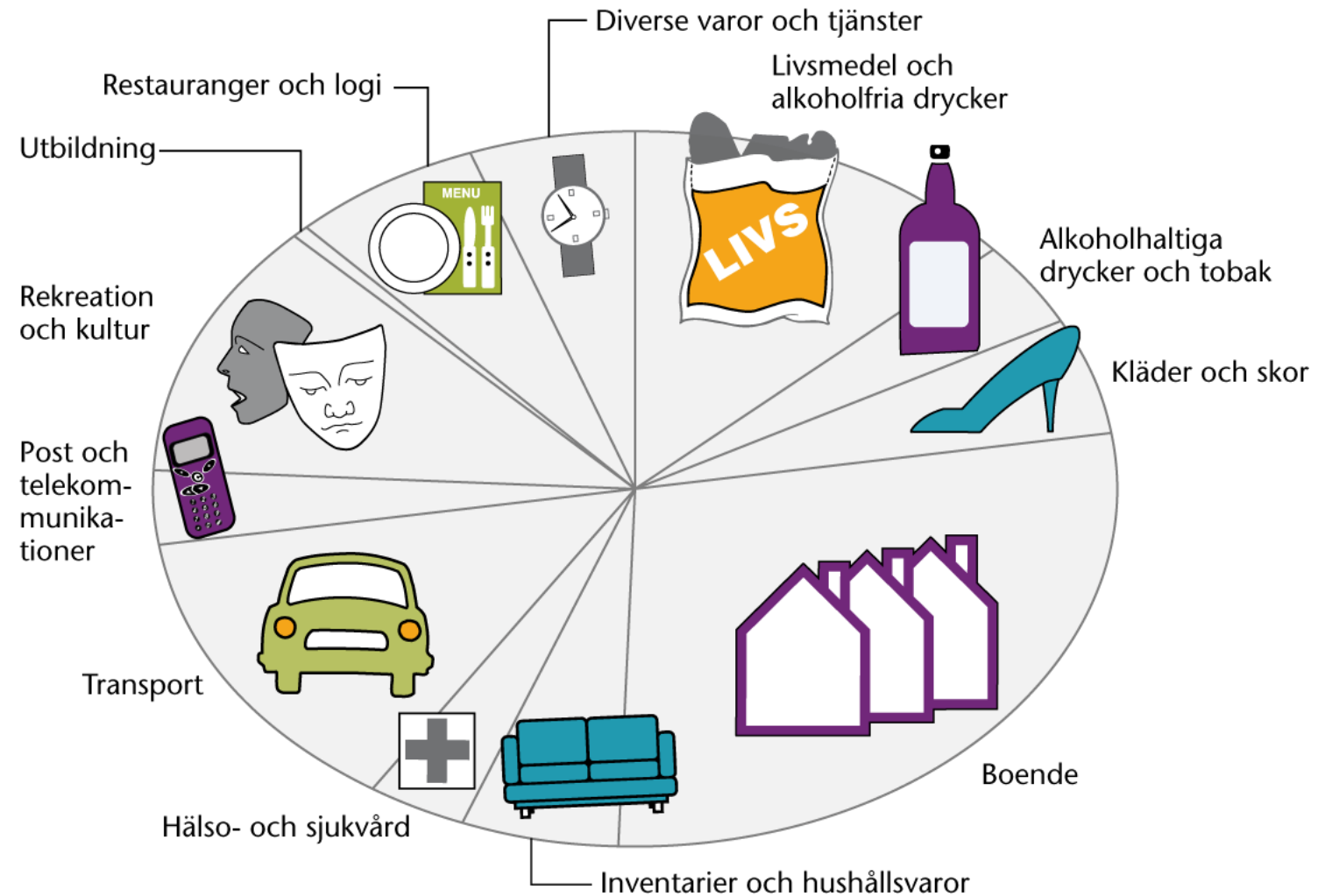
Fixed Basket

Quality at a broader level – where do our item level quality changes and adjustments take their reference from?

- The term **Fixed** means two things:
 - The type of goods & services remains the same from period to period
 - The quantity of the goods & services remains the same from period to period
- The term **Basket** represents the actual products included in the index, together with their quantities

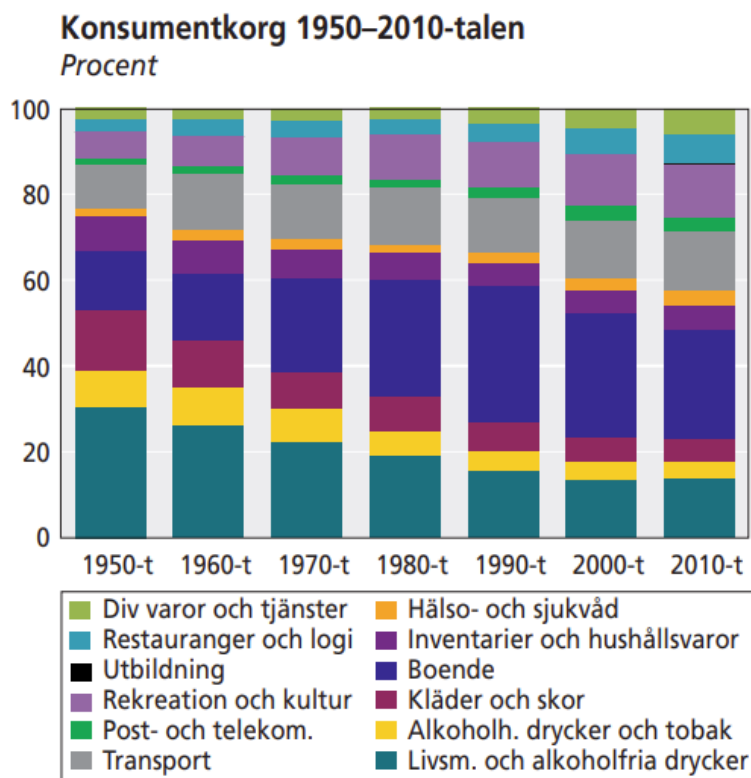
Quality Change

Fixed Basket – Example: Former Swedish CPI Basket



Quality Change

Fixed Basket – Example: Former Swedish CPI Basket



Källa: Konsumentprisindex

The following selection of products were added to the **consumer basket** during the 1950s and 1960s:

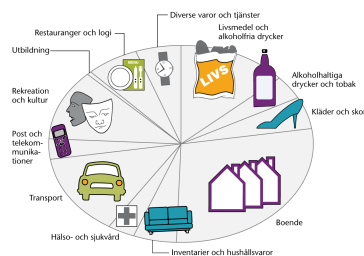
- Cinnamon bun
- Snus (tobacco)
- Washing machine
- Mazarin (almond tart)
- Laundry detergent
- Ice skates
- Marie biscuits
- Motor vehicles
- Ice hockey skates
- Crisp bread
- Garage costs
- Stay at a mountain hotel
- Blood pudding
- Gramophone record
- Hotel room
- Falukorv
- Camera
- Photocopying
- Lingonberry jam
- Colour film
- Perfume products
- Ice cream
- Transistor radio
- Hairspray
- Baby food
- Colour television
- Toothpaste

Quality Change

Fixed Basket - Laspeyres and Paasche

- The Laspeyres and Paasche indexes answer two different questions...

Basket (2010)



How much would I have to pay for the items I bought in July 2010 if I bought them in March 2015?

Laspeyres

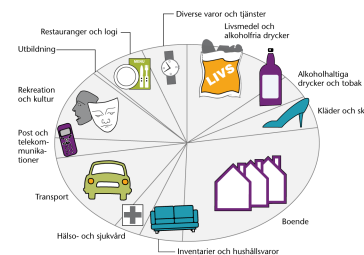
$$I_{Laspeyres}^{0:t} = \frac{\sum_{i=1}^n p_i^t q_i^0}{\sum_{i=1}^n p_i^0 q_i^0} \times 100$$

Paasche

$$I_{Paasche}^{0:t} = \frac{\sum_{i=1}^n p_i^t q_i^t}{\sum_{i=1}^n p_i^0 q_i^t}$$

How much would I have had to pay for the items I bought in March 2015 if I bought them in July 2010?

Basket (2015)



Quality Change

Example – Fixing the basket

BEER PRICES AND QUANTITIES

	Period 0			Period t		
	Price	Quantity	Value (\$)	Price	Quantity	Value (\$)
	(\$ per can)	440ml Cans	Price x Quantity	(\$ per can)	440ml Cans	Price x Quantity
Heineken	2.1	16	33.6	2.1	20	42
AngKor	2.4	22	52.8	2.5	22	55
Carlsberg	2	17	34	2.2	14	30.8

Quality Change

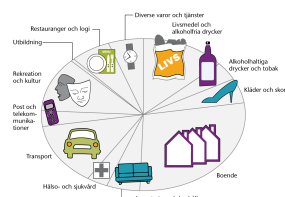
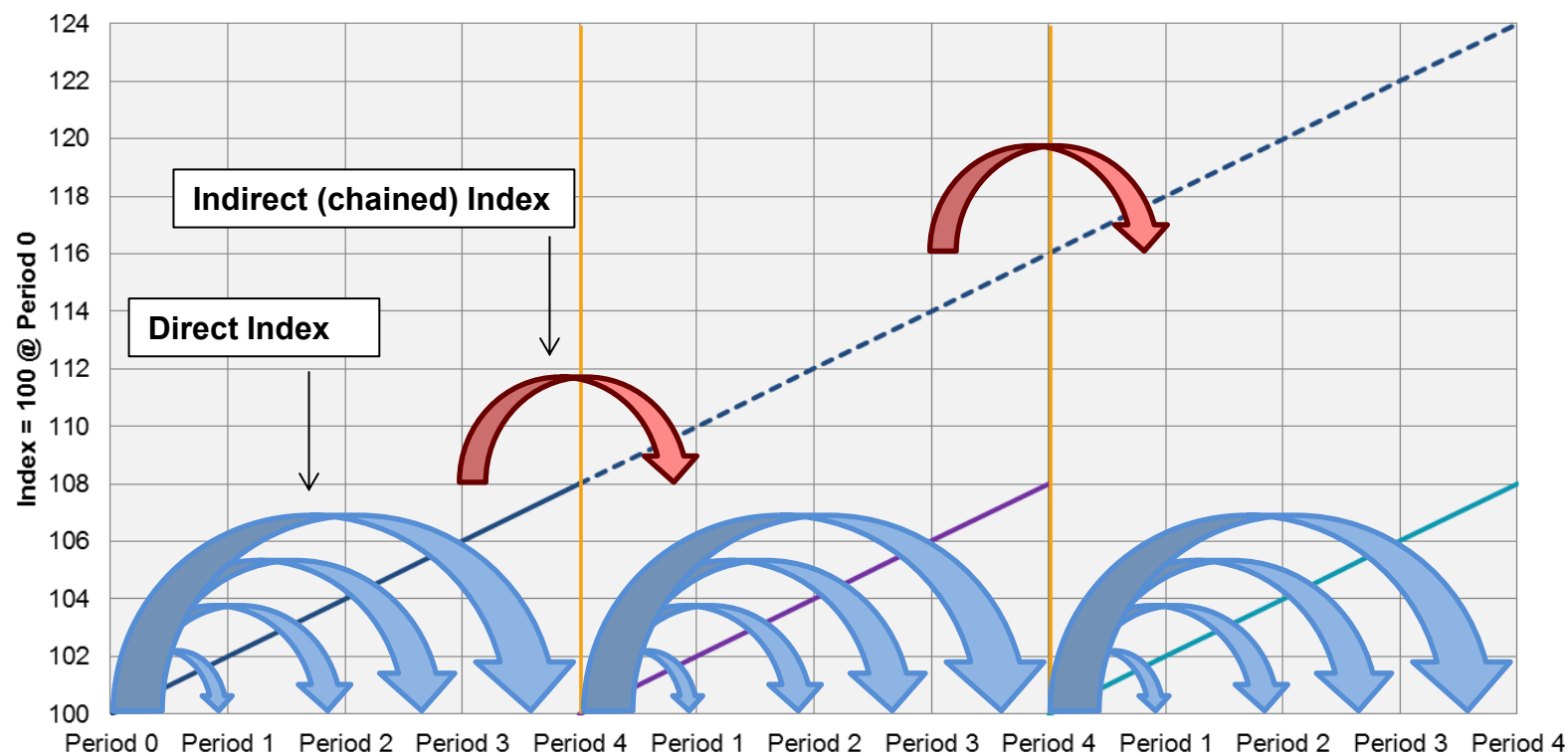
Example – Fixing the basket at period 0 (Laspeyres)

	Period 0		Period 0 Quantities at Period 0 Prices	Period t		Period 0 Quantities at Period t Prices
	Price	Quantity		Price	Quantity	
	\$ per can	440ml Cans	\$	\$ per can	440ml Cans	\$
Heineken	2.1	16	33.6	2.1	16	33.6
Angkor	2.4	22	52.8	2.5	22	55
ABC	2	17	34	2.2	17	37.4
Total Value	120.4			126		
Laspeyres Index	126/120.4 x 100 = 104.7					

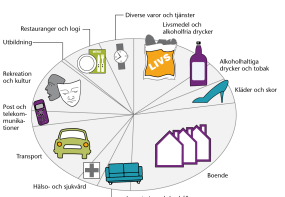
Quality Change

Example – Laspeyres Index (LTPR)

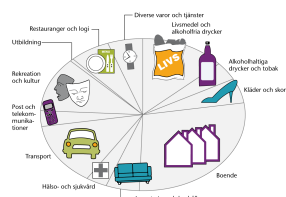
Example (1) - Fixed Basket & Index Construction



Basket (1)



Basket (2)



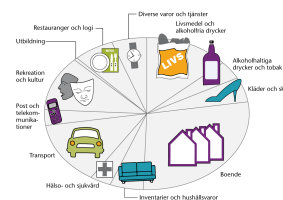
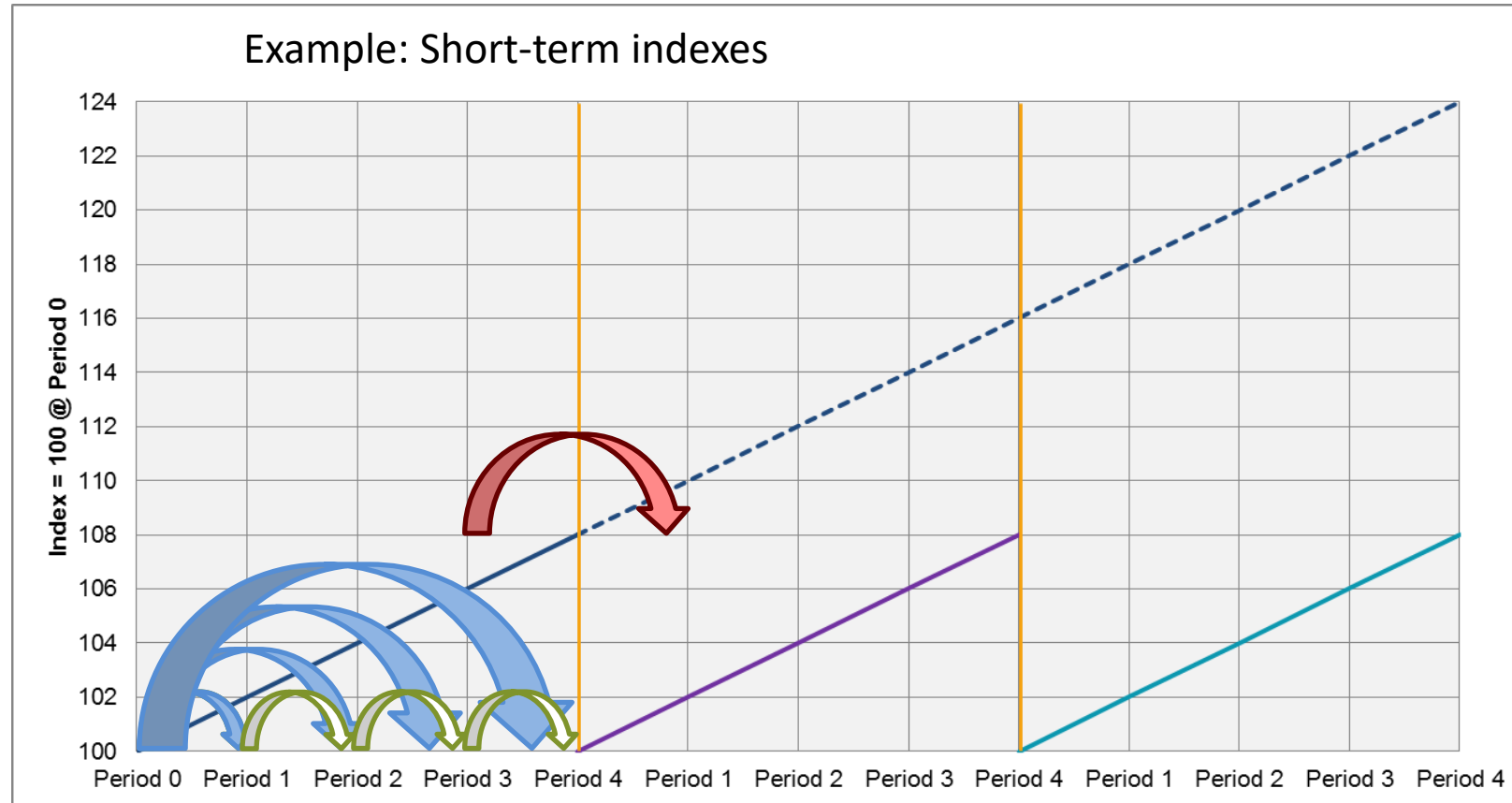
Basket (3)



Long Term Price Relative (LTPR)

Quality Change

Example – Laspeyres Index (STPR)



Basket (2)



Short Term Price Relative (STPR)

Long Term Price Relative (LTPR)



Quality Change

At the item level

- Just as price change differs when viewed from different perspectives; likewise, the concept of quality differs when viewed from different perspectives
- Change in utility for consumers
 - Quality change is represented as the (monetary) value of the additional satisfaction or utility that is derived from the new quality
- Change in production value for producers
 - Evaluation of quality change is an estimate of the per-unit change in revenue that a producer will receive for the new characteristics possessed
- ***Quality change is not price change***



Quality Change

At the item level

- The issue is then
 - to identify characteristics that purchasers value (in the case of CPI)
 - to make an estimate of that value
 - to measure change in value when characteristics change
- Some are obvious
 - freshness or otherwise of fresh produce
 - strength of materials & stitching in a garment
 - leather versus vinyl shoes



Quality Change

At the item level

- Others perhaps less so ...
 - location (such as goods delivered to Stockholm vs. Örebro)
 - model options (such as with or without leather interior)
 - timing (such as electricity supply: off-peak vs. peak)
 - conditions of sale (such as a good sold with after service care)
- And others less obvious still ...
 - The same goods or services sold by different kinds of retailers, such as local shops, specialist shops, department stores or supermarkets have to be treated as different qualities.



Quality Change

Pricing to constant quality

- Need to ***price like with like***
- Failure to price to constant quality means a price index no longer measures pure price change
- Why is this important?
 - Failure to price to constant quality means we overestimate (or underestimate) price change
 - Decisions based on price indexes are then misinformed
 - Payments, contracts, monetary policy, national accounts



Quality Change

Pricing to constant quality – National Accounts

- Different qualities reflect different use values
 - Or different production values
- Different qualities are therefore economically different from each other
- Changes in quality ***must*** appear in the national accounts as changes in volume (never as changes in price)



Quality Adjustment

What is the goal?

- Mechanism to ensure price indexes measure pure price change
- Need to make an assessment (valuation) of difference of quality and incorporate this difference into the price index calculation
- Aim: Ensure the measurement of pure price change.



Quality Adjustment

Which price should we adjust? $P(t)$ or $P(o)$?

- We need to measure pure price change from period 0 to period t
- Do we adjust the new p^t price to make comparisons on the old quality?
- Or do we adjust the old p^0 price to make comparisons on the new quality?



Quality Adjustment

Which price should we adjust? $P(t)$ or $P(o)$?

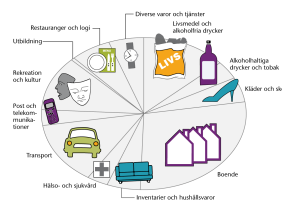
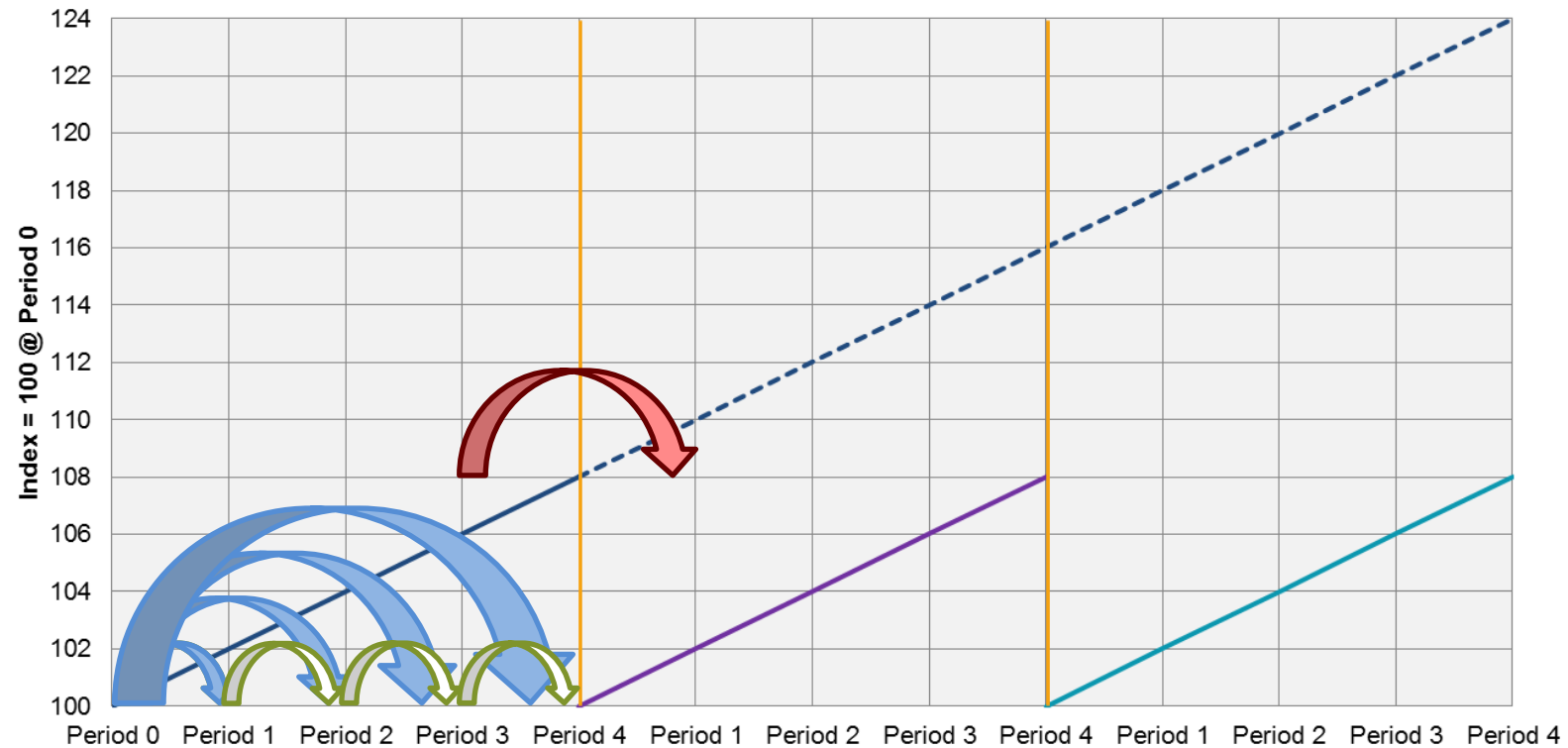
- If we adjust the new period t price so it is valued at the same quality as in period 0 we need to do this again, every subsequent period $t+1$, $t+2$, $t+3$, ...
- But if we adjust the period 0 price so it is valued at the same quality as in period t , we can carry this price forward into future periods

Adjust the period 0 price to reflect the new quality

Quality Adjustment

Which price should we adjust? $P(t)$ or $P(o)$?

Example: Short-term indexes



Basket (2)



Short Term Price Relative (STPR)

Long Term Price Relative (LTPR)



Quality Adjustment

“adjustment factor – g ”

- If the OLD quality is replaced by an equivalent item on the NEW quality, our aim is to estimate a period 0 price for the NEW quality
- We need to determine some adjustment factor g such that

$$\hat{p}_{i,NEW}^0 = g \times p_{i,OLD}^0$$



Quality Adjustment

How to estimate the quality adjustment factor?

Explicit methods:

"Evaluation of changes in product characteristics"

- Direct Comparison
- Quantity Adjustment (package size adjustment)
- Option Pricing
- Production Cost (resource cost)
- Expert Judgement
- Hedonic Regression

Implicit methods:

"Using observed price differences between similar product offers available at the same time"

- Overlap
- Bridged Overlap (simple overlap)
- Hedonic Regression

Quality Adjustment - Explicit

Direct comparison

- Value of the quality change is assessed as zero

Period 0



Period 1



$$g = 1$$

- Requires tight product specifications to work



Quality Adjustment - Explicit

Direct comparison

Also called :

- unadjusted price comparison
- essentially equivalent
- directly equivalent

The value of the quality difference is assessed at zero:

- The two qualities are essentially equivalent
- The entire difference in observed prices is due to pure price change ($g=1$)

$$\hat{p}_{i,NEW}^0 = p_{i,OLD}^0$$



Quality Adjustment - Explicit

Quantity Adjustment (package size adjustment)

- Linear relationship between quantities for OLD and NEW
- Assume ratios between NEW and OLD quantities gives difference in period 0 prices

$$g = \frac{u_{NEW}}{u_{OLD}}$$

$$\begin{aligned}\hat{p}_{NEW}^0 &= g \times p_{OLD}^0 \\ &= \frac{u^{NEW}}{u^{OLD}} \times p_{OLD}^0\end{aligned}$$

g = quality adjustment factor

$p(o)OLD$ = base price of the old specification

$p(o)NEW$ = base price of the new specification

u (new) = units of the current specification

u (old) = units of the old specification

Quality Adjustment - Explicit

Quantity Adjustment (package size adjustment)

- Value is assessed proportional to change in package size/ quantity (consumer value of the product is proportional to quantity size).

Period 0
200g



Period 1
134g



Quality factor (g)

$$g = 134/200$$
$$= 0.67 \text{ (quality drop of 33\%)}$$

Quality Adjustment - Explicit

Quantity Adjustment (package size adjustment)

Period 0
200g



Period 1
134g



If we did not apply a quality adjustment the index would incorrectly show that there was no price change for that collection period.

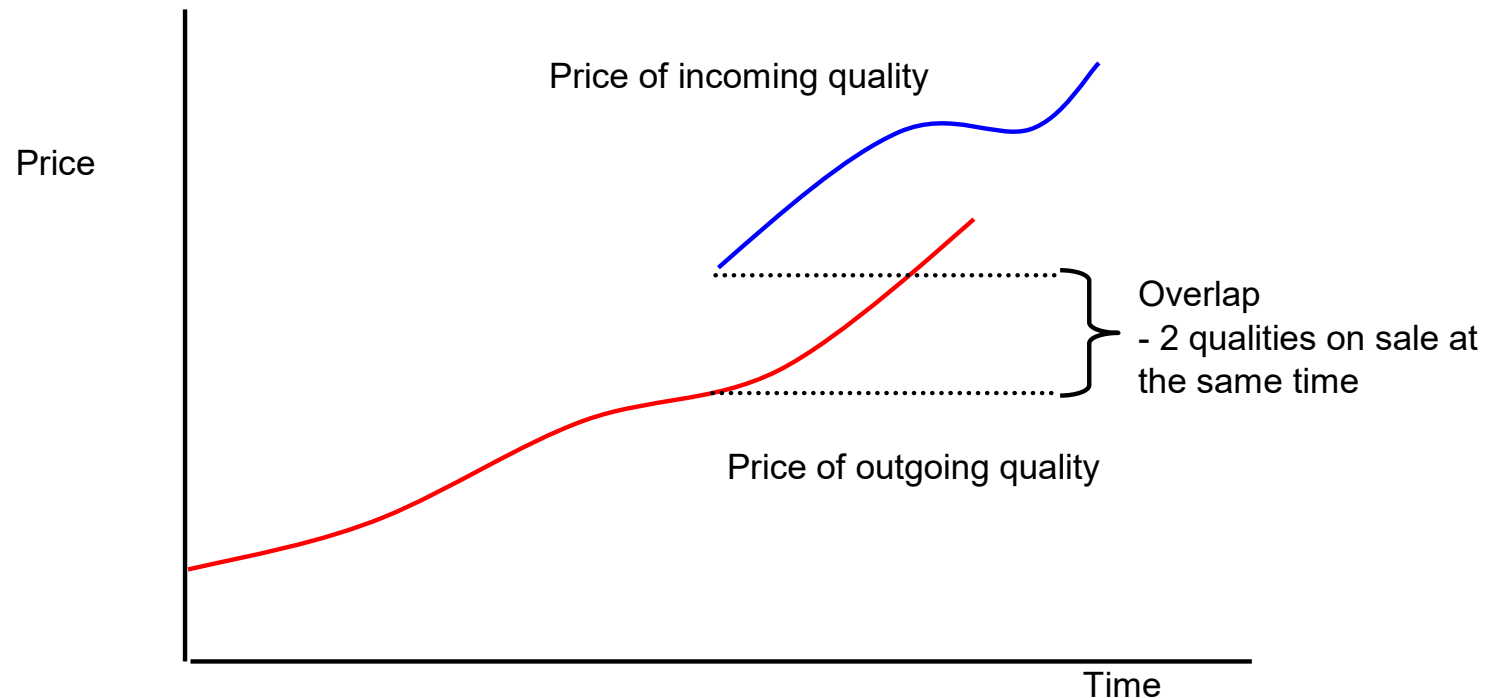
	Reference Period	Comparison Period
Quantity	200 g	134 g
Observed price	40 SEK	40 SEK
Quantity-adjusted price (t)	40 SEK	59.70 SEK
Quantity-adjusted price (o)	26.80 SEK	40 SEK
Index (no quality adjustment)	100.00	100.00
Index (with quality adjustment)	100.00	149.25

Quality Adjustment - Implicit

Overlap

“Overlapping pricing typically arises where a particular item (brand, model, etc.), being priced is no longer available in the market place from one period to the next, however there is another similar item which has been, and continues to be, available in the same market as the initial product and is expected to be a substitute once it is discontinued”

The out-going and incoming products (prices) are chained together utilising overlapping price data.





Quality Adjustment - Implicit

Bridged Overlap

- Also referred to as “*overall mean imputation*” or “*class mean imputation*”
- Assumption that contemporary movement of price sample gives best measure of price change for replacement items
- Derive period 0 price for NEW quality based on observed NEW price and consecutive period movement of the remainder of the price sample ($t-1$ to t)
- Bridged overlap gives same price movement of the full price sample ($t-1$ to t) as would be observed if the replacement item was omitted entirely
- Note the difference between “overall” where all of the sample is used and “class” where a sub-sample is used
 - examples in the manual



Quality Adjustment – Implicit/Explicit

Hedonics

- Applied where a product can be seen as a bundle of separately measurable components
 - High tech goods
- Applied when products change so rapidly that other mechanisms don't work
 - High tech goods
- Highly regarded for strong scientific basis and accuracy
- Requires a lot of resources to keep hedonic models updated
- Handbook on Hedonic Indexes and Quality Adjustments in Price Indexes, Triplett J (2006)

Questions?

