

# PRICE INDEX THEORY

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Course lectures  
at Stockholm University


Part 1

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# Fixed basket price index 1


$$I = \frac{\sum_{i=1}^n q_i p_{1,i}}{\sum_{i=1}^n q_i p_{0,i}} = \frac{q_1 p_{1,1} + q_2 p_{1,2} + \dots + q_n p_{1,n}}{q_1 p_{0,1} + q_2 p_{0,2} + \dots + q_n p_{0,n}}$$

## ► Variables

$q$  = quantity (volume)

$p$  = price

## ► Objects and times

$i$  = Product (good/service from given seller)

0 = Base period (alias: reference period)

1 = Current period



# Fixed basket price index 2

$$I = \frac{\sum_{i=1}^n q_i p_{1,i}}{\sum_{i=1}^n q_i p_{0,i}} = \frac{q_1 p_{1,1} + q_2 p_{1,2} + \dots + q_n p_{1,n}}{q_1 p_{0,1} + q_2 p_{0,2} + \dots + q_n p_{0,n}}$$

Exempel

$$I = \frac{50 \times 98 + 100 \times 49 + 20 \times 195}{50 \times 88 + 100 \times 48 + 20 \times 195} \times 100 = 104.6$$

# Laspeyres price index

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$$I = \frac{\sum_i q_{0,i} p_{1,i}}{\sum_i q_{0,i} p_{0,i}}$$

- It uses a basket reflecting the observed consumption in the base period
- It is the basic idea of most price indices used in practice

# Laspeyres in practice

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➤ *Index as a weighted average of sub-indices:*

$$I = \sum_i w_i \cdot I_i, \quad \text{with weights } w_i, \quad \sum_i w_i = 1$$

➤ *Explanation:*

$$I = \frac{\sum_i q_{0,i} p_{1,i}}{\sum_i q_{0,i} p_{0,i}} = \sum_i \frac{q_{0,i} p_{0,i}}{\sum_k q_{0,k} p_{0,k}} \cdot \frac{p_{1,i}}{p_{0,i}} = \sum_i w_i \cdot \frac{p_{1,i}}{p_{0,i}}$$

with  $w_i = \frac{q_{0,i} p_{0,i}}{\sum_k q_{0,k} p_{0,k}}$

*Price  
relative  $I_i$*



# Two kinds of weighting

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- *Prices* are weighted together with *quantities*  $q$  – in numerator and denominator of the Laspeyres formula:

$$I = \frac{\sum_i q_{0,i} p_{1,i}}{\sum_i q_{0,i} p_{0,i}}$$

- *Indices* are weighted together with *value shares*  $w$  – in the alternative formula:

$$I = \sum_i w_i \cdot I_i$$

# Price and volume indices



## Price index

$$I = \frac{\sum_i q_{0,i} p_{1,i}}{\sum_i q_{0,i} p_{0,i}}$$

**Laspeyres**

## Volume index

$$I = \frac{\sum_i q_{1,i} p_{0,i}}{\sum_i q_{0,i} p_{0,i}}$$

**Laspeyres**

$$I = \frac{\sum_i q_{1,i} p_{1,i}}{\sum_i q_{1,i} p_{0,i}}$$

**Paasche**

$$I = \frac{\sum_i q_{1,i} p_{1,i}}{\sum_i q_{0,i} p_{1,i}}$$

**Paasche**

# Factors of a value index

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$$\frac{\sum_i q_{1,i} p_{0,i}}{\sum_i q_{0,i} p_{0,i}} \cdot \frac{\sum_i q_{1,i} p_{1,i}}{\sum_i q_{1,i} p_{0,i}} = \frac{\sum_i q_{1,i} p_{1,i}}{\sum_i q_{0,i} p_{0,i}} = \frac{\text{Total value (1)}}{\text{Total value (0)}}$$

Volume index  $\times$  Price index = Value index

Laspeyres Paasche

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$$\frac{\sum_i q_{1,i} p_{1,i}}{\sum_i q_{0,i} p_{1,i}} \cdot \frac{\sum_i q_{0,i} p_{1,i}}{\sum_i q_{0,i} p_{0,i}} = \frac{\sum_i q_{1,i} p_{1,i}}{\sum_i q_{0,i} p_{0,i}} = \frac{\text{Total value (1)}}{\text{Total value (0)}}$$

Paasche Laspeyres



# Practical uses

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- ▶ *Deflating* is to compute

$$\text{Volume index} = \frac{\text{Value index}}{\text{Price index}}$$

⇒ *Eliminates price change*

- ▶ *Implicit price index* is computed as

$$\text{Price index} = \frac{\text{Value index}}{\text{Volume index}}$$

# 'Laspeyres type' (Lowe index)

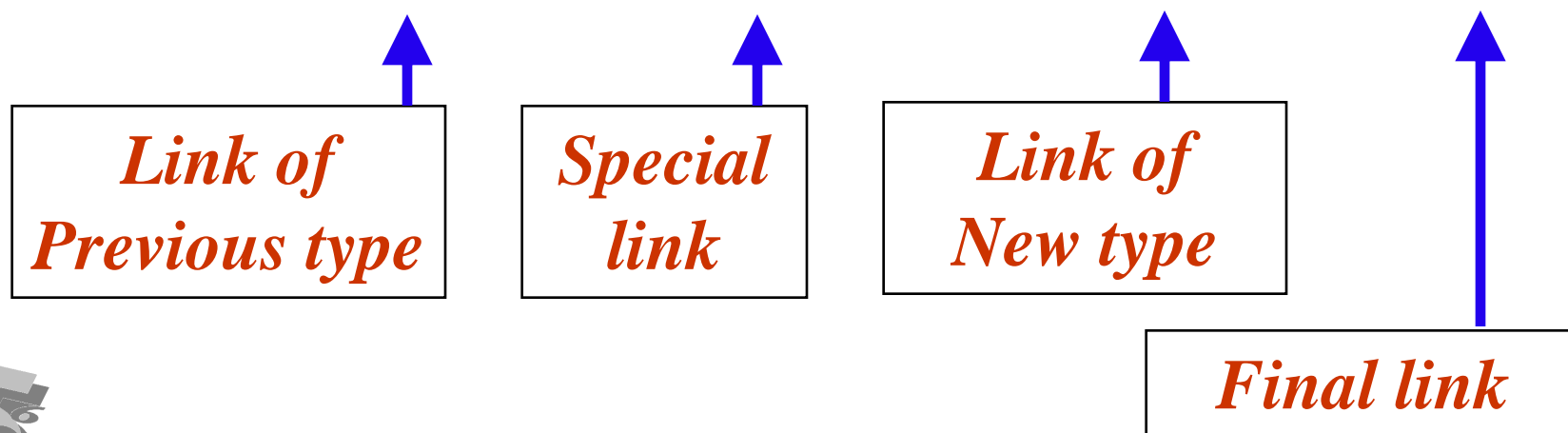
$$I_{2006, \text{Dec}}^{2007, \text{April}} = \frac{\sum_i q_{2005,i} p_{2007, \text{April}, i}}{\sum_i q_{2005,i} p_{2006, \text{Dec}, i}}$$

- A useful generalisation of Laspeyres index
- Example: Annual link in HICP  
(Harmonised index of consumer prices)
- Price base period = Dec 2006
- Weight base period = entire year 2005

# Chaining in Swedish CPI

$$I_{1980}^{2007, \text{Jan}} = I_{1980}^{1980, \text{Dec}} \times I_{1980, \text{Dec}}^{1981, \text{Dec}} \times I_{1981, \text{Dec}}^{1982, \text{Dec}} \times \dots$$

$$\dots \times I_{2002, \text{Dec}}^{2003, \text{Dec}} \times I_{2003, \text{Dec}}^{2004} \times I_{2004}^{2005} \times I_{2005}^{2007, \text{Jan}}$$



# Price indices (in Sweden) 1

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- ▶ **CPI** – *Consumer Price Index*  
**KPI** – **Konsumентprisindex**
- ▶ **HICP** – *Harmonised Index for*  
**HIKP** *Consumer Prices*
- ▶ **NPI** – *Net Price Index*
- ▶ **KPIX** – *Underlying Inflation*  
*(Core Inflation)*



# Price indices (in Sweden) 2

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- ▶ **PPI** – *Producer Price Index (goods)*
- ▶ **SPPI** – *Producer Price Index for Services*
- TPI** – *Tjänsteprisindex*
- ▶ **BPI** – *Building Price Index*
- ▶ *Real Estate Price Index*
- ▶ **CCI** – *Construction Cost Index for*  
**E84** *Buildings*  
*(building materials, labour)*



# International classification standards for breakdown

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- **COICOP – Classification of Individual Consumption by Purpose – *in CPI***
- **NACE – Industry classification standard / Nomenclature statistique des Activités économiques dans la Communauté Européenne – *in PPI, SPPI***

# Classification levels in CPI

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- **00**      **CPI overall (all items index)**
- **01**      **Food and non-alcoholic beverages**
- **01.1**    **Food**
- **01.1.8** **Sugar, jam, chocolate etc.**
- **1819**    **Ice cream**
- **1819-80** **Ice cream brand X, type Y**

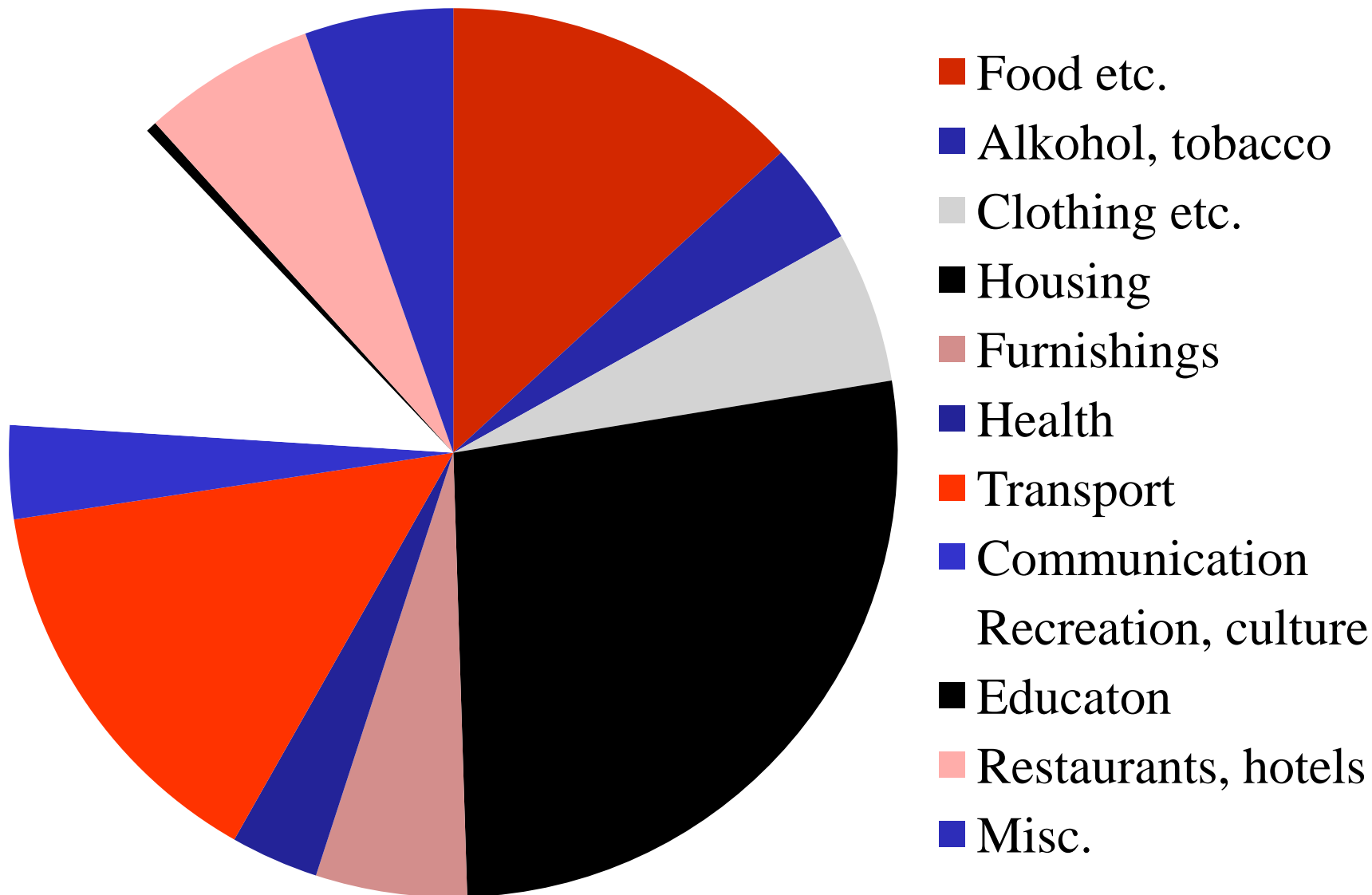


# Swedish CPI basket in 2010



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# Producer and Import Price Indices (PPI)

- ▶ **PPI** – Producer Price Index
- ▶ **ITPI** – Price Index for Domestic Supply
- ▶ **EXPI** – Export Price Index
- ▶ **IMPI** – Import Price Index
- ▶ **HMPI** – Producer Price Index of Home Sales

<b>PPI</b>			
<b>ITPI</b>			
<b>EXPI</b>			
<b>IMPI</b>			
<b>HMPI</b>			

# Actual prices: CPI

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## CPI follows:

- Price on price tag (shown to consumer)
- After any sales deduction
- After deduction of general discounts
- But before deduction of individual discounts, loyalty rebates etc.
  - ↳ *Not quite ideal, e.g. for cars*
- Including VAT and other indirect taxes
- After deduction of subventions

# Actual prices: PPI, SPPI

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PPI, SPPI follow:

- Invoiced price – transaction (ideally)
- After deduction of any discounts
- Excluding taxes, VAT
- List price rather not, maybe as ”proxy”
- Ex. *chargeout rate* (charged hour rate) for consultant services in SPPI – not ideal but practically feasible solution

# Development in price collection for CPI

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- ▶ *Traditional price collection for CPI:*  
Uses observation of price tags or advertising
- ▶ *New alternative – “Scanner Data”:*  
Uses individual purchase records from cashiers’ “scanning” of bar codes
  - ↪ *Yields prices actually paid*
  - ↪ *Offers plenty of data, incl. quantity*
  - ↪ *Comparability issues on discounts*
  - ↪ *Needs cleaning etc.*

# Problems with fixed baskets

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- ▶ Laspeyres > Paasche price index

- ↳ *True almost always*

- *due to altered consumption pattern*

- ▶ Fixed basket gets out of date – at new prices, new choices give better value for money

- ↳ *Products with larger price rises are “substituted away” by buyers*

- Ex.: Petrol price up → car use down**

# Indices – aims – targets

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- ▶ **CPI** – Main aim is compensation  
Target is Cost Of Living Index
- ▶ **HICP**– Main aim is monetary politics  
Target is Laspeyres type (?)
- ▶ **SPPI** – Main aim is deflating  
Ideal target is Paasche
  - ↪ *Deflating with Paasche price index yields volume index series i base period prices*
  - ➔ *But take Laspeyres in practice*

# **International CPI Manual**

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**Consumer Price Index Manual: Theory and Practice (2004), ILO/IMF/OECD/Eurostat/UNECE/World Bank**

► **Available at**

**<http://www.ilo.org/public/english/bureau/stat/guides/cpi/index.htm>**

► **Links to PPI Manual etc. are also available there**

# Levels of aggregation in the Swedish CPI

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SCB

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*Full-year  
base,  
Walsh index*

*December  
base,  
Jevons index*



**Overall index**

**Coicop classes**

**350 Product groups**

**Elementary aggregates**

