PRICE INDEX THEORY

Statistiska centralbyrån Statistics Sweden

Course lectures
at Stockholm University

Part 5

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Hedonic example 1

t = 1			t = 2			Price
Price	Size	Trait_A	Price	Size	Trait_A	relative
390	23	0	290	23	0	74,36
480	39	0	519	39	0	108,13
700	51	1	700	51	1	100,00
550	39	0	550	39	0	100,00
520	35	1	520	35	1	100,00
490	43	0	698	53	1	142,45

A replacement

Hedonic example 2

- **Regression equation (fitted for t = 1)**

$$\ln Price = 5.604 + $$

$$+ 0.0155 \times \text{Size} + 0.1331 \times \text{Trait\_A} + \varepsilon$$

- **Hedonic function**

$$Price = h(\text{Size}, \text{Trait\_A}) + r$$

$$= e^{5.604 + 0.0155 \times \text{Size} + 0.1331 \times \text{Trait\_A}} + r$$

Hedonic example 3

- **Quality change factor for replacement:**

$$g = \frac{h(\text{Size of replacement model, Trait\_A of replacement model})}{h(\text{Size of replaced model, Trait\_A of replaced model})}$$

$$= e^{0.0155\times(53-43) + 0.1331\times(1-0)} = 1.3339$$

Hedonic example 4

- **Index computation with hedonic quality adjustment:**

$$g = e^{0.0155\times(53-43) + 0.1331\times(1-0)} = 1.3339$$

$$I = \left(\frac{290}{390}\times\frac{519}{480}\times\frac{700}{700}\times\frac{550}{550}\times\frac{520}{520}\times\frac{698}{490\times 1.3339}\right)^{1/6}\times 100$$

$$= \mathbf{97.49}$$

Topics for consideration in applying hedonic methods

- Topic 1: Data needed
- Topic 2: Data editing/preparation
- Topic 3: Creating hedonic function
- Topic 4: Index calculation
- Topic 5: Refreshing hedonic function

Reference:
Handbook on the application of quality adjustment methods in the Harmonised Index of Consumer Prices, Destatis, 2009

https://www.destatis.de/DE/Publikationen/StatistikWissenschaft/Band13_Handbook1030813099004.pdf?__blob=publicationFile

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Hedonic equation (”model”)

- Example – ”semi-logarithmic” form:

$$\ln P = b_0 + b_1 z_1 + b_2 z_2 + \ldots + b_k z_k + \varepsilon$$

- Alternative – ”double-logarithmic” form uses logs also for regressors
- The regressor variables z are selected product characteristics – reflecting quality perceived by consumers, but not fasion or production cost as such

Hedonic Regression
obs. (n), # regressors (p)

- ***Heuristics***

$$\text{var}\ \hat{y}_i = \sigma^2 h_i$$

$$\text{where}\ \ h_i = x_i^T (X^T X)^{-1} x_i$$

Fact:

$$\frac{1}{n}\sum_{i=1}^{n} h_i = p/n$$

- ***Rule of thumb (?)***

Demand ≥20 obs. / regressor

(or so, effectively)

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Variants of hedonics

- **Time dummy variable method**
  - ↳ ***Much used in int'l academic work***
- **Price imputation method**
- **Characteristics price index method**
  - ↳ ***Used for Swedish real-estate index***
- **Hedonic re-pricing method**
  - ↳ ***Main method in official indices; works as in the preceding example***

A further use of hedonics

- **Hedonic re-pricing method is applicable also when replacements are not one-to-one**
  - **Then all prices are modified to the same standard characteristics values**
  - **They are thus multiplied by a quality adjustment factor**

$$g = \frac{h(\text{Standard set of characteristics})}{h(\text{Characteristics of actual model})}$$

Insurance: Adjustment for excess

- *Actuarial risk premium at excess b is*

$$r(0)\int_{b}^{\infty}(x-b)\,dF(x)$$

Rate of damages > 0

Damage distribution

- *If the excess is raised from b to c then the risk premium falls by*

$$r(b')\,(c-b), \qquad b \le b' \le c$$

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Insurance:
Gross vs net principle 1

	Gross premium
+	Premium supplements (yield on reserves)
–	Claims
–	Changes in actuarial provisions
=	Service charge (Net premium)

Insurance: Gross vs net principle 2

- Gross premium
  - *Adequate for compensation index*

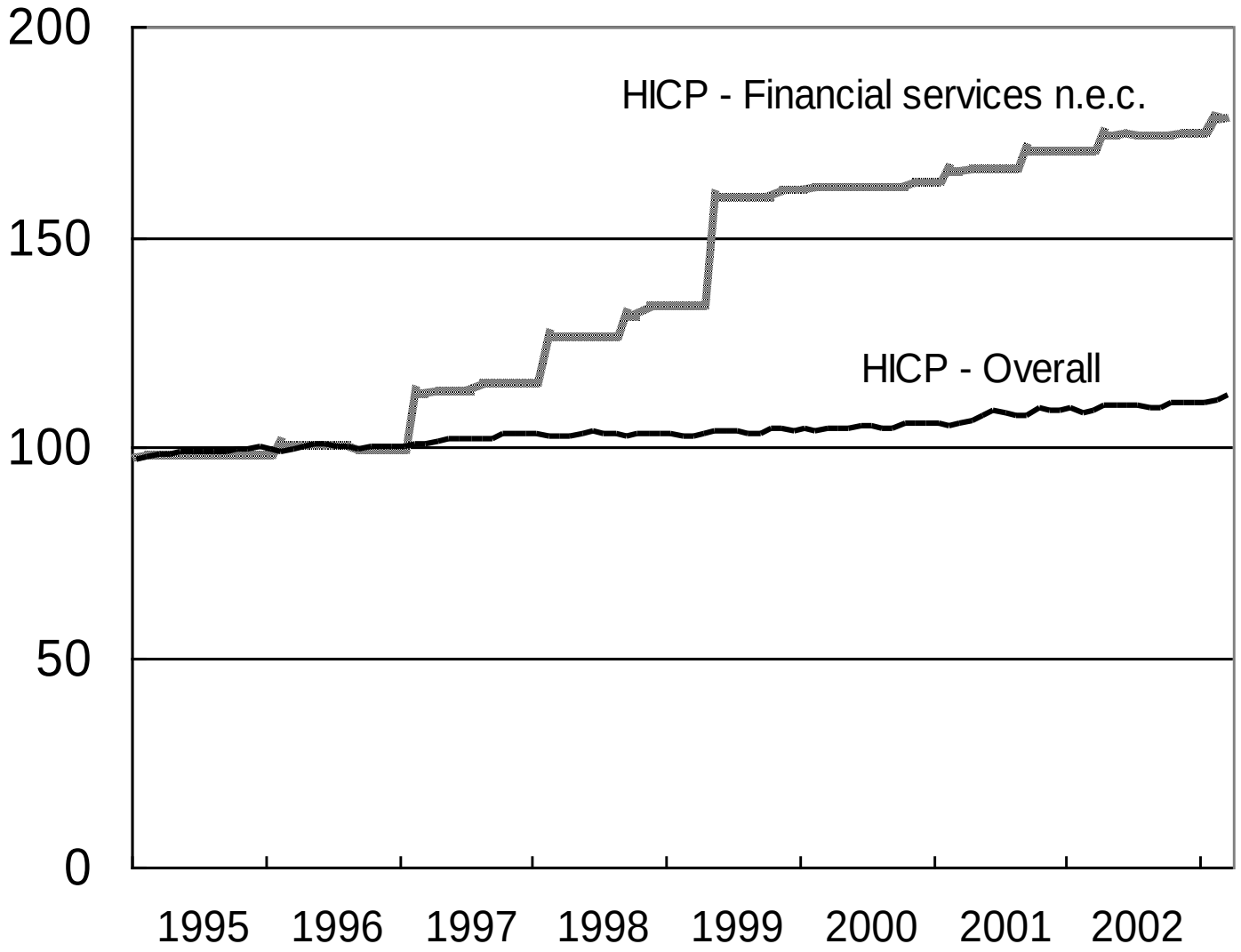
- Service charge (Net premium)
  - *Prescribed for NA & HICP*
  - *Can be used only for weights*
  - *Then acceptable proxy also for compensation index*

Banking services: Delineation of coverage

- Exclusion of FISIM (Financial Inter-mediation Services Indirectly Measured)
  - *Only part of price is seen*
  - *Could give artificial index changes*

- Currency exchange is implicitly charged
  - *Is FISIM by HICP rules*

Banking services: HICP outcome



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Owner Occupied Housing: Alternative approaches

- Exclusion of capital part (the house)
- (Net) Aquisition Approach
  - ↳ *”Houses like potatoes”*
- Rental Equivalent Approach
  - ↳ *Appealing, but depends on rents*
- User Cost Approach
  - ↳ *Variants: partial cost*
- Payment Approach

Owner Occupied Housing

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- ***Swedish CPI:***
  - Depreciation
  - Interest cost
  - Real estate tax
  - Site rent
  - Repairs
  - Insurance
  - Water, etc.
  - Oil, Electricity

- ***HICP – plan:***
  - Purchase of new houses
  - Repairs
  - Insurance
  - Water, etc.
  - Oil, Electricity

Interest cost

- **Interest on mortgage + equity**
  - ***On mortgage = Interest payment***
  - ***On equity = Opportunity cost***
- **Rates of interest on mortgages of different types**
- **Based on a capital equal to present owner's purchase price**
- **Interest cost deducted in underlying inflation**

Interest cost index

$$I = RS \cdot KS$$

Interest rate index

Capital stock index

$$RS_{01} = \frac{\sum_i w_i^{RS} \overline{R}_i^1}{\sum_i w_i^{RS} \overline{R}_i^0}$$

Average rate, mortgage type i