



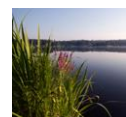
Meeting of the Group of Experts on Consumer
Price Indices

Sample Selection Bias in the Swedish CPI

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Sample Selection Bias

- KPI has been adjusting for sample selection bias in clothes and footwear since 1993
- Article:
 - Is a correction for sample selection bias necessary in other product groups?
 - Is there a better way of dealing with the problem?



CPI, Annual Linking

Around 25-30% of the outlets are replaced in the new link



Every year new product offers are introduced into the sample



Instructions to Price Collectors

- Good representation of consumer behavior
- Representative products = most sold
- All types of prices:

”Product varieties sold to a discount should still be picked if they are ‘most sold’. Price itself should not be a deciding factor in the choice of product variety. Sale items should not be left in the sample for too long since varieties are sold out and replaced by new varieties.”

(From instructions for price collectors)



Sample Selection

Price collectors dislike replacements since they are time consuming. They want product varieties that remain in the sample for a long time.



Price collectors prefer product varieties sold at regular price.



Price collectors **PURPOSELY** stay away from sale prices.



Sample Selection Bias

- Reference sample: it is possible for the price collector to avoid sale prices
- Following months: price collectors have to collect sale prices when they occur



Proportion of sale prices in the reference month is too low



Mean price in the reference months is too high



Downward bias in the KPI

~ 2 % for clothes

~ 0,1 % for total CPI





- Regular prices
- Sale prices

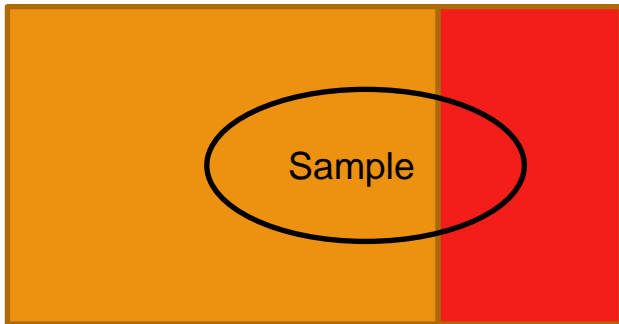
Statistiska centralbyrån
Statistics Sweden

December 2013

Reference month, 2014

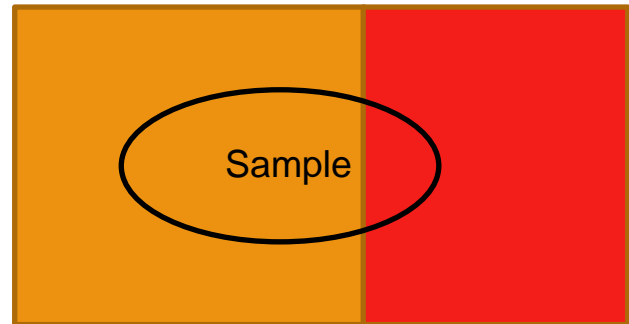


Final month, 2013

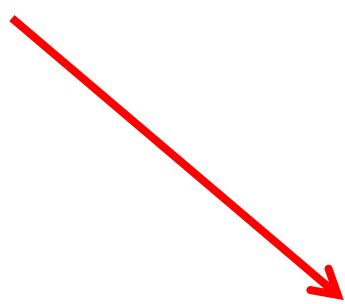
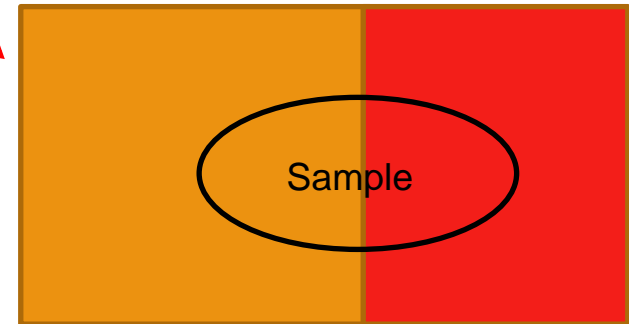


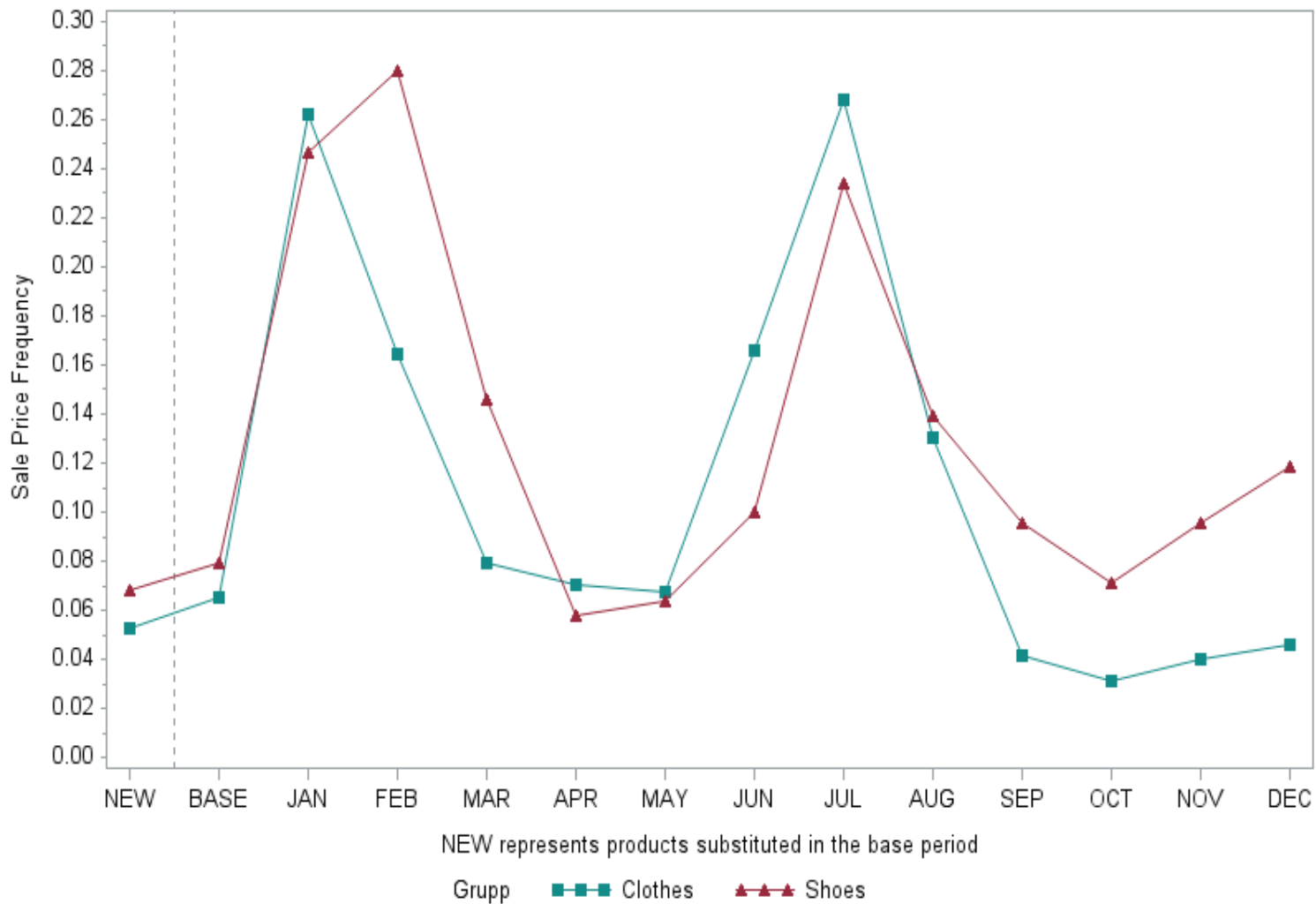
December 2014

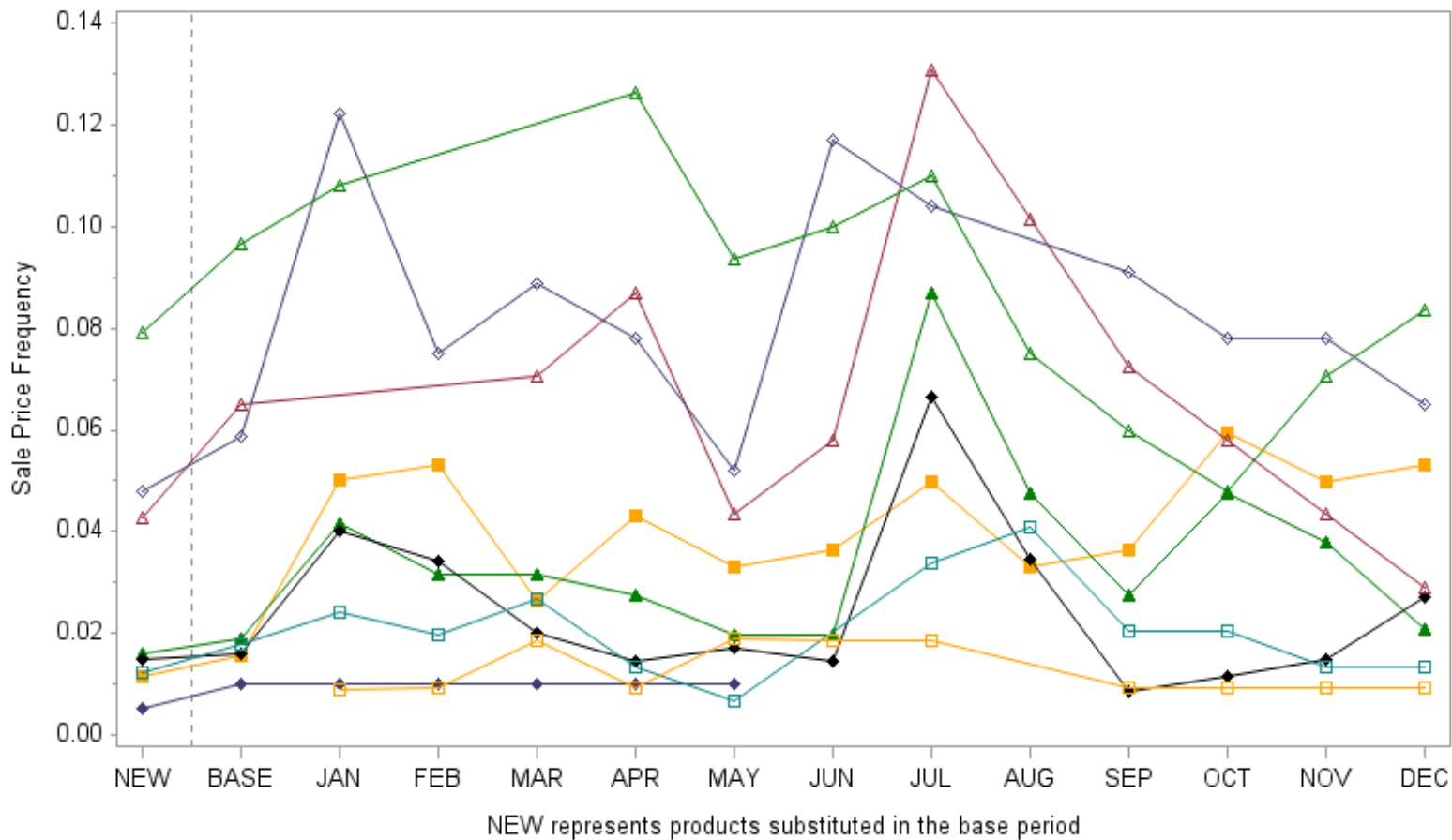
Reference month, 2015



Final month, 2014







- Grupp
- ◆ Car Accessoires
 - Furniture
 - ▲ High-Tech Products
 - ◆ Household Equipmen
 - Household Goods
 - ▲ Household Textiles
 - ◆ Other Personal Goo
 - Personal Hygiene
 - ▲ Toys and Sport Art



Solutions

1. Hinder the bias to occur

- a) Further instructions to price collectors –
probably not a possible solution
- b) Draw the new sample in September
 - Start price collection in September
 - Allow the proportion of sale prices in the sample to increase until it (hopefully) mirrors that of the population
- c) Change linkage month to September



1 b) New Sample in September

Pros

- Fewer price activities in September than in December
- Improvement of work environment for price collectors and personnel at SCB
- Training period for price collectors (and stores)

Cons

- Expensive
- Possibly a bad impact on morals of price collectors if they learn that collected prices are not used
- Is this enough?



1 c) Change the Linkage Month

Pros

- Fewer price activities in September than in December
- Improvement of work environment for price collectors and personnel at SCB
- Fewer price activities → smaller variance and bias

Cons

- Index calculations will be more complicated



1 c) Change the Linkage Month

Year-to-month link

$$I_{y-2;g}^{y,m} = \frac{I_{y-3,Dec;g}^{y-2,Dec}}{\frac{1}{12} \sum_{m=1}^{12} I_{y-3,Dec;g}^{y-2,m}} \cdot I_{y-2,Dec;g}^{y-1,Dec} \cdot I_{y-1,Dec;g}^{y,m}$$

For the months after September (October), the last piece will be calculated as:

$$I_{y-1,Dec;g}^{y,m} = I_{y-1,Dec;g}^{y,Sept} \cdot I_{y,Sept,g}^{y,m}$$



Solutions

2. Correcting for the Bias

- An adjustment method is used for clothes and footwear in the Swedish CPI today
- Estimate the effect of sales prices in the old sample
- Estimate the effect of sales prices in the new (biased) sample
- Compare the effects



2) Correcting for the Bias

- Index link for elementary aggregates from December year $y - 1$ to current month year y

- $$I_{y-1,Dec;g}^{y,m} = \frac{(\prod_k w_k p_k^{y,m})^{\frac{1}{n}}}{(\prod_k w_k p_k^{y-1,Dec})^{\frac{1}{n}}}$$

- Use *observed prices* and *regular prices* in stead of year and reference year

- $$S_{y-1,12,obs}^{y-1,12,obs} = \frac{(\prod_k w_k p_{k,obs}^{y-1,12})^{\frac{1}{n}}}{(\prod_k w_k p_{k,reg}^{y-1,12})^{\frac{1}{n}}}$$

$$S_{y,0,reg}^{y,0,obs} = \frac{(\prod_k w_k p_{k,obs}^{y,0})^{\frac{1}{n}}}{(\prod_k w_k p_{k,reg}^{y,0})^{\frac{1}{n}}}$$



2) Correcting for the Bias

- The bias for the prices in the reference period is estimated by

$$BIAS_g = \frac{S_{y,0,obs}}{S_{y,0,reg;g}}$$
$$S_{y-1,12,obs}$$
$$S_{y-1,12,reg;g}$$



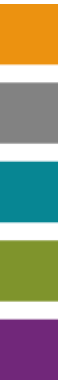
2) Correcting for the Bias

Objections

- a) Reverse bias in the beginning of the year
- The corrections will adjust evenly over all months in the new year. However, it will take a few months for the proportion of sale prices in the sample to mirror that of the population. The result is a reverse bias in the beginning of the year.

Counter argument:

- We believe that the effect is negligible compared to the long term effect of the correction



2) Correcting for the Bias

Objection

b) Quality of regular prices

- What is a "regular price?"
- Do stores change regular prices before a sale as a pricing strategy

Counter argument:

- Analysis of collected regular prices show no suspicious pattern
- Regular prices are already used for quality adjustments in the CPI
- In our opinion, regular prices are of high enough quality to use in our calculations (in Sweden)



2) Correcting for the Bias

Objection

c) Variability of the correction factor

- Products with few observed prices can have a great impact on the calculations of the correction factor

Counter argument:

- Negative covariance between the estimated correction for year y and the index link between December year $y - 2$ and December year $y - 1$
- Long term, the variance of the index will be reduced



Suggestions

- Bias should primarily be avoided
 - New sample in September, for retail outlets
 - After discussions in the Swedish CPI Advisory Board we agreed that this is the best solution
- Remaining bias
 - Adjust according to the above described method if still necessary



Hi-Tech Products

09.1 Audiovisual and photographic equipment and computers

7105	Television set, small
7106	CD/cassette player
7108	Stereo
7111	Camcorder
7112	Television set, big
7115	DVD player
7117	Home theatre
7118	MP3 player
7206	Digital camera



Household Goods

05.4 Household Goods

5403	Plate	5502	Paint
5404	Coffee cup	5513	Paper towels
5405	Drinking glass	5514	Wall paper
5407	Utensils	5518	Kitchen scales
5408	Pot	5524	Detergent
5416	Kitchen knife	5525	Dish soap
---		5526	Cleaning products
		5527	Cleaning equipment
		5528	Other consumables
		5530	Plastic jars
		5531	Salad bowl

