Balancing the Swedish CPI

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Anders Norberg
Can Tongur

Statistics Sweden

SCB Sveriges officiella statistik

Outline

- The Swedish CPI (Konsumentprisindex)
- Variance estimation
- Divisions of CPI in this study
- Methodology
- Results
- Conclusions

The Konsumentprisindex

- **Sampling of companies, outlets, products, product offers, time**
  - Rotated by PRN (20%)
  - Multistage: outlets – product offers
  - Two-phase: areas – outlets (many price collectors, historically)
  - Order πps, srs, judgemental
  - Two-dimensional; outlet/product in daily necessities (sort of)

- **”Old” and new data sources**
  - Conventional price collection; field, online, telephone
  - Regional price collectors, central CPI-staff
  - New collection methods in broad usage and ongoing transition: internet, web scraping, transaction data
  - Mixed and adapted methodology ↔ Swedish CPI Board

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Variance estimation for the CPI

- **Complex statistical measure with ”derivatives”**

  Central for the analysis: *short-term link*, *inflation*, *change in inflation*

  One/two baskets, different weights, within-year patterns & business cycles

- **Variance assessments**
  1) Design based
  2) Model based
  3) Randomisation

  Notable work by Dalén & Ohlsson (1995) and Norberg (2004) for KPI
  Model approaches by Shoemaker (1999,+,+) and Bialek (2020)

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The Quality Declaration (2022)

- Official statistics provided with QD
- Relies partly on previous studies, partly on simple variance estimates
- Many components in CPI surveys contribute to the final estimate, and the variance
- Does QD improve interpretation for important users?

Table 1 Estimated sampling inaccuracy, length of 95% confidence interval 2021

Statistics	Length of 95% confidence interval	Comments
Monthly change	±0.14	Somewhat shorter for April, May, June and November
Annual change (inflation rate)	±0.23	Somewhat shorter for December*
Monthly change in inflation rate	±0.20	Somewhat shorter for April, May, June, November and December, somewhat longer for other months

* The change from December to December is based on one and the same sample.

CPI divisions in the study

- COICOP 01 and 02.2 (Food, non-alcoholic beverages, tobacco + non-food)
- COICOP 03 Clothing and footwear (=*Apparel)*
- COICOP 05.1 Furniture
- COICOP 07.1 Domestic and international air travel
- COICOP 11 Restaurants

- Domains compare with previous assessments
  Varying data sources and quality adjustment methods

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Bootstrap resampling method

- Select *B* samples from the original data by srs-wr, thus obtaining the same distributions in all samples. Compute the estimates $\hat{\theta}^*(b)$.

$$\hat{V}(\hat{\theta}) = \sum_{b=1}^{B}(\hat{\theta}^*(b) - \bar{\hat{\theta}}^*)^2/(B-1)$$

- The formulation allows for setting up most estimators
  Specifically, the twelve-month change from two baskets can be explicitly estimated

- Challenge to mimic the underlying design, many moving parts also between years (=not so simple in practice)

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Food/daily necessities

- Two-dimensional sampling

- Transaction Data
  - Outlets cheap
  - Products expensive due to market analysis, replacements and manual quantity adjustments

- Correlations between outlets (in general)
  - Very high in multi-store companies
  - High for chains

- Very high design effect, simple variance estimator not appropriate

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Food/daily necessities

Table 5.1 *01 & 02.2 Food and non-alcoholic beverages, Tobacco, and non-food*

Subpopulation (Aspects 1-4)	Measure	Variance (avg.)	V(I) / V(S)	+/- 2 std. errors
1. Food	Short-term	0.043		0.414
B=400	Inflation	0.058	1.360	0.482
	Δ(Inflation)	0.053		0.460
2. Food: products	Short-term	0.028		0.337
B=400	Inflation	0.037	1.315	0.386
	Δ (Inflation)	0.038		0.388
3. Food: outlets	Short-term	0.014		0.235
B=400	Inflation	0.017	1.229	0.260
	Δ(Inflation)	0.012		0.216
(1-2-3) Food: Interaction	Short-term	0.001		
	Inflation	0.004		
B=400	Δ(Inflation)	0.003		

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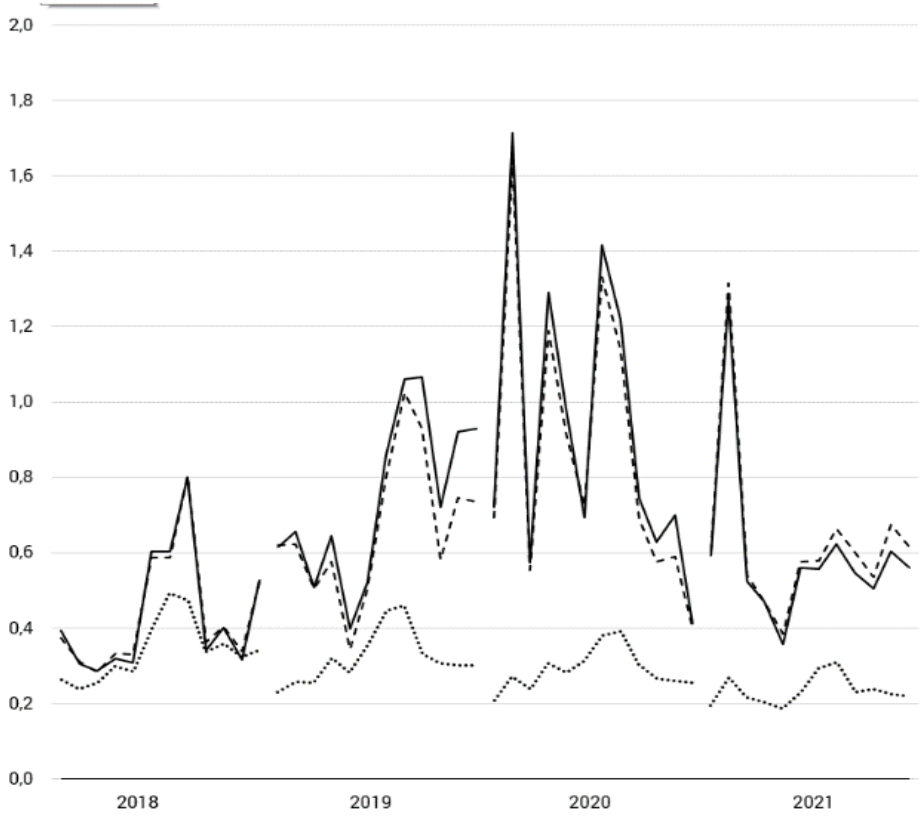
Clothing and footwear

- Manual price collection, on-site and online
- Outlet sampling; central, register
  - Big multi-store companies form strata of their own
- Product offer selection; locally by collector
- Extreme volatility from campaigns/discounts, season sales
- Hedonic quality adjustments
  - No reduction of variance

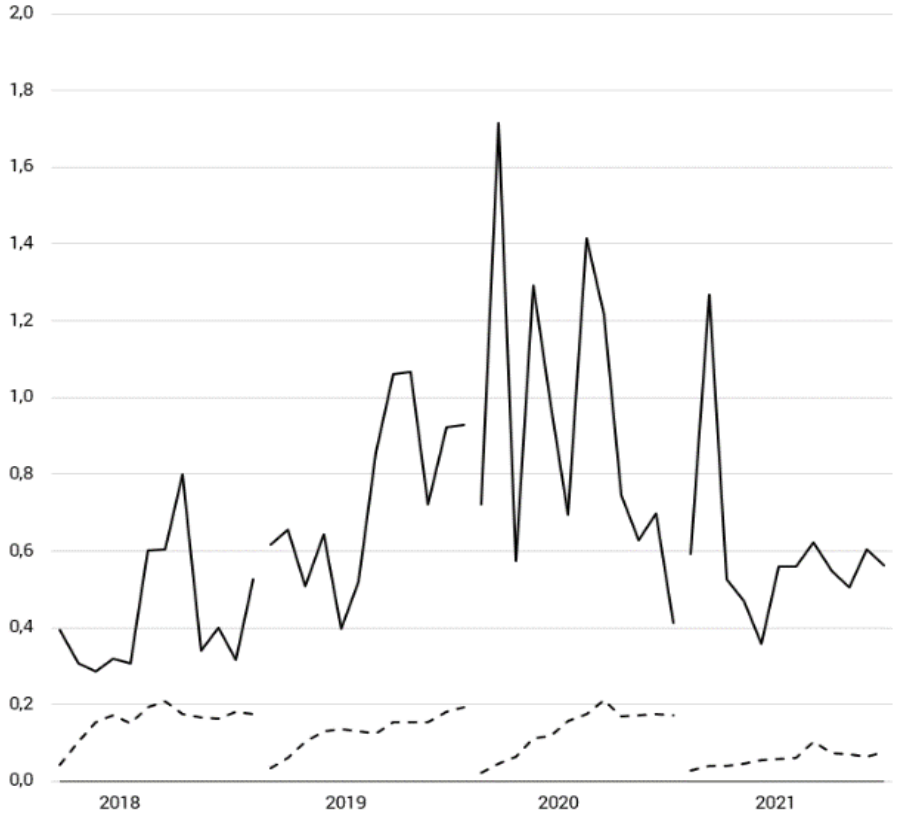
Additional information: IQI close to 100% in last 10 years

Clothing: variance in actual & regular price

- **Figure 5.2.1** Clothing and footwear**:** Short-term index link variance from actual prices, without quality adjustment (dashed) and simple variance (dotted)



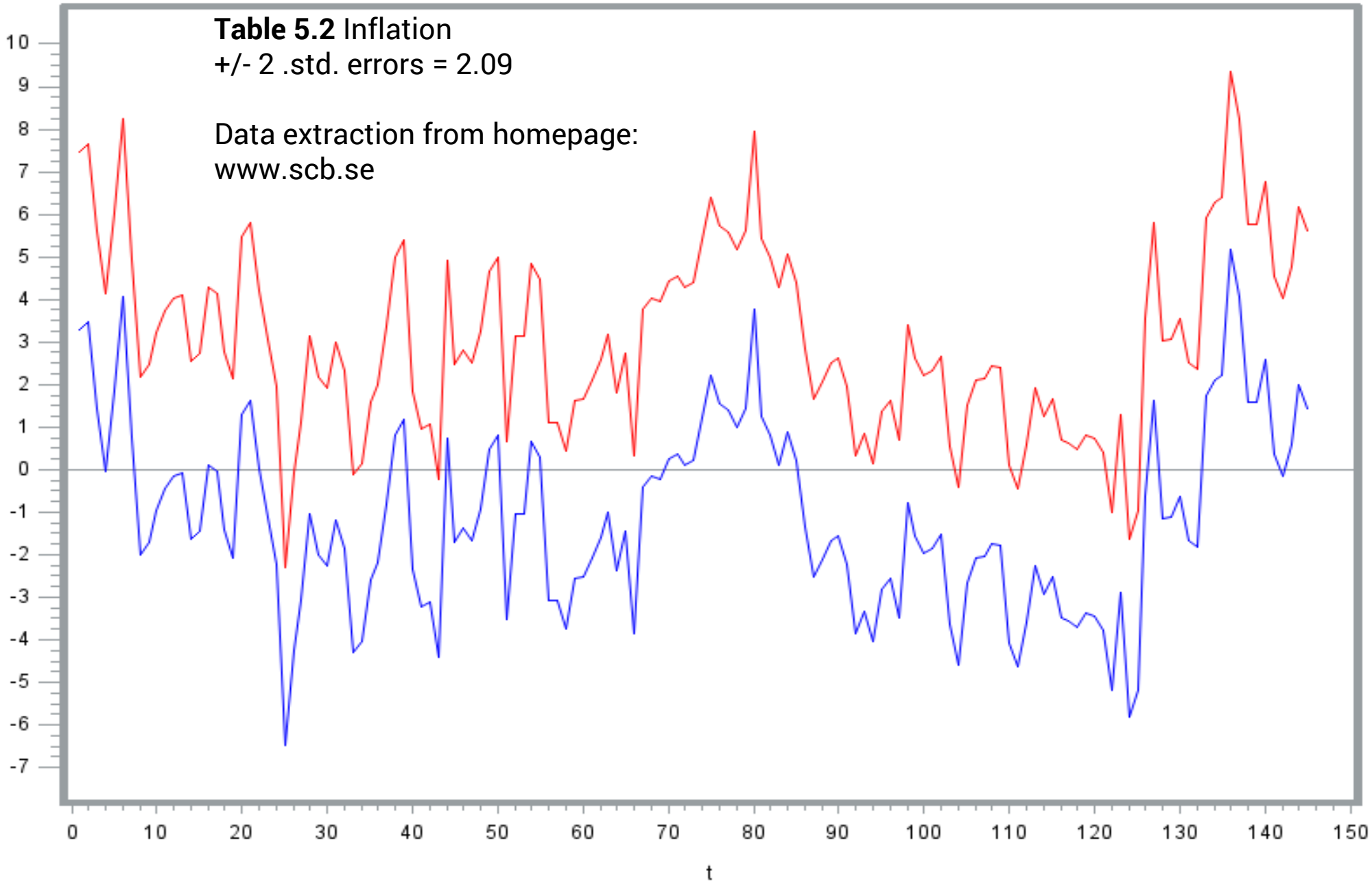
- **Figure 5.2.2** Clothing and footwear: Short-term index link variance from actual prices and regular prices variance (dashed)



CPI Clothing & Shoes: Inflation 2010-2021

Table 5.2 Inflation
+/- 2 .std. errors = 2.09

Data extraction from homepage:
www.scb.se



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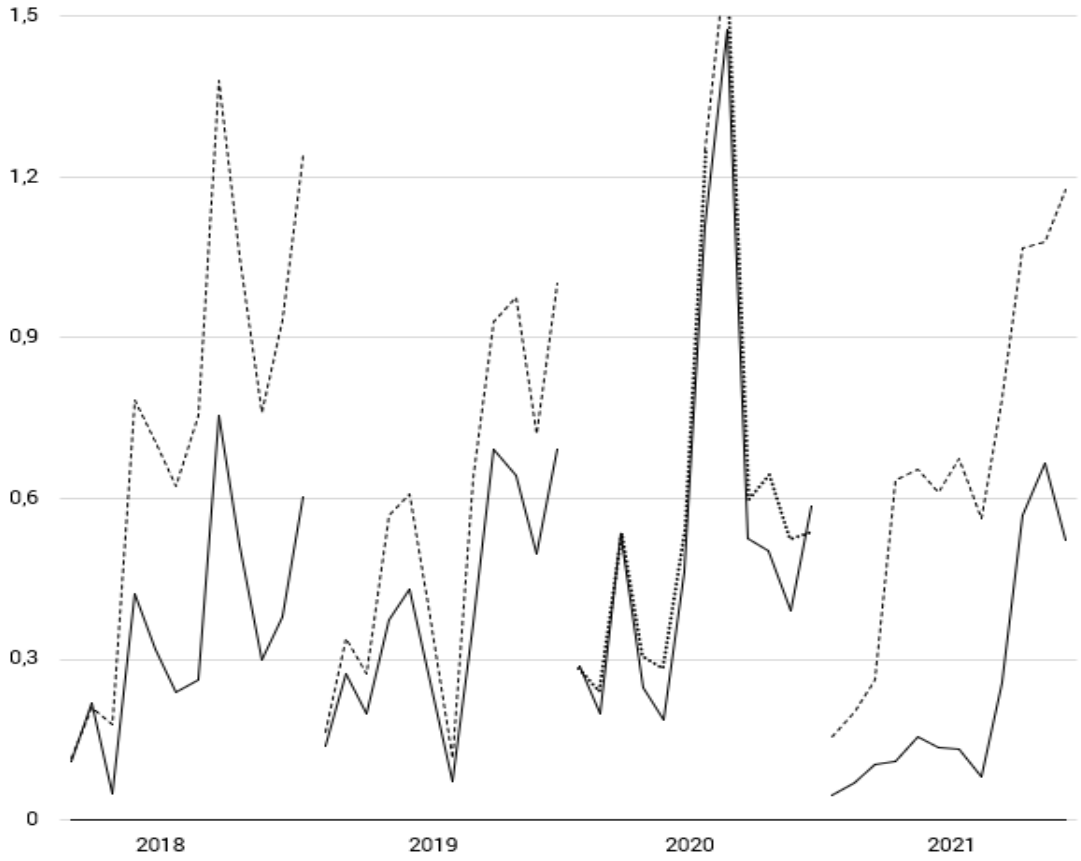
Furniture

- On-site, internet, web scraping
- Judgemental quality adjustments halves the variance
- Simple variance estimates appropriate (=no clustring), unlike other cases in the study

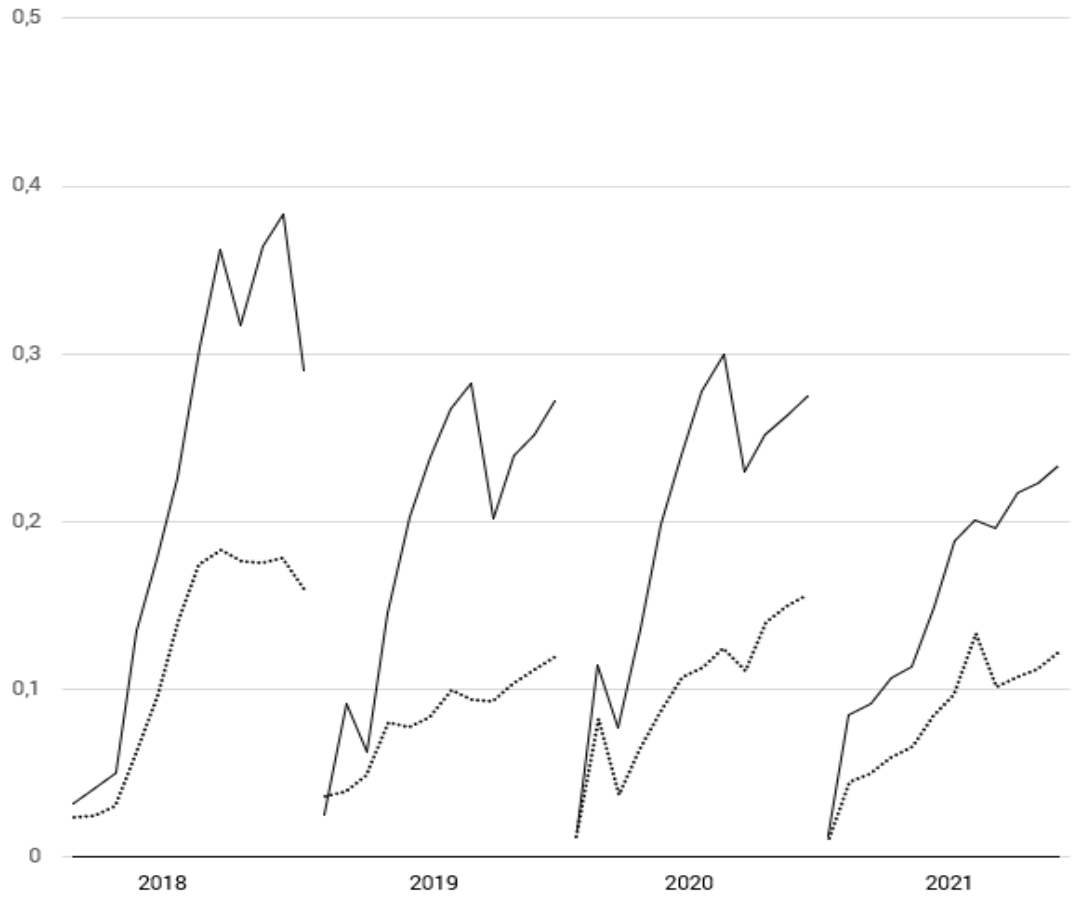
Figure 5.2.6 Furniture: Short-term index link variance, with quality adjustment and without (dashed)



Restaurants

- Telephone/internet
- Judgemental quality adjustments (minor issue)
- Establishment characteristics more distinct (cluster effect)

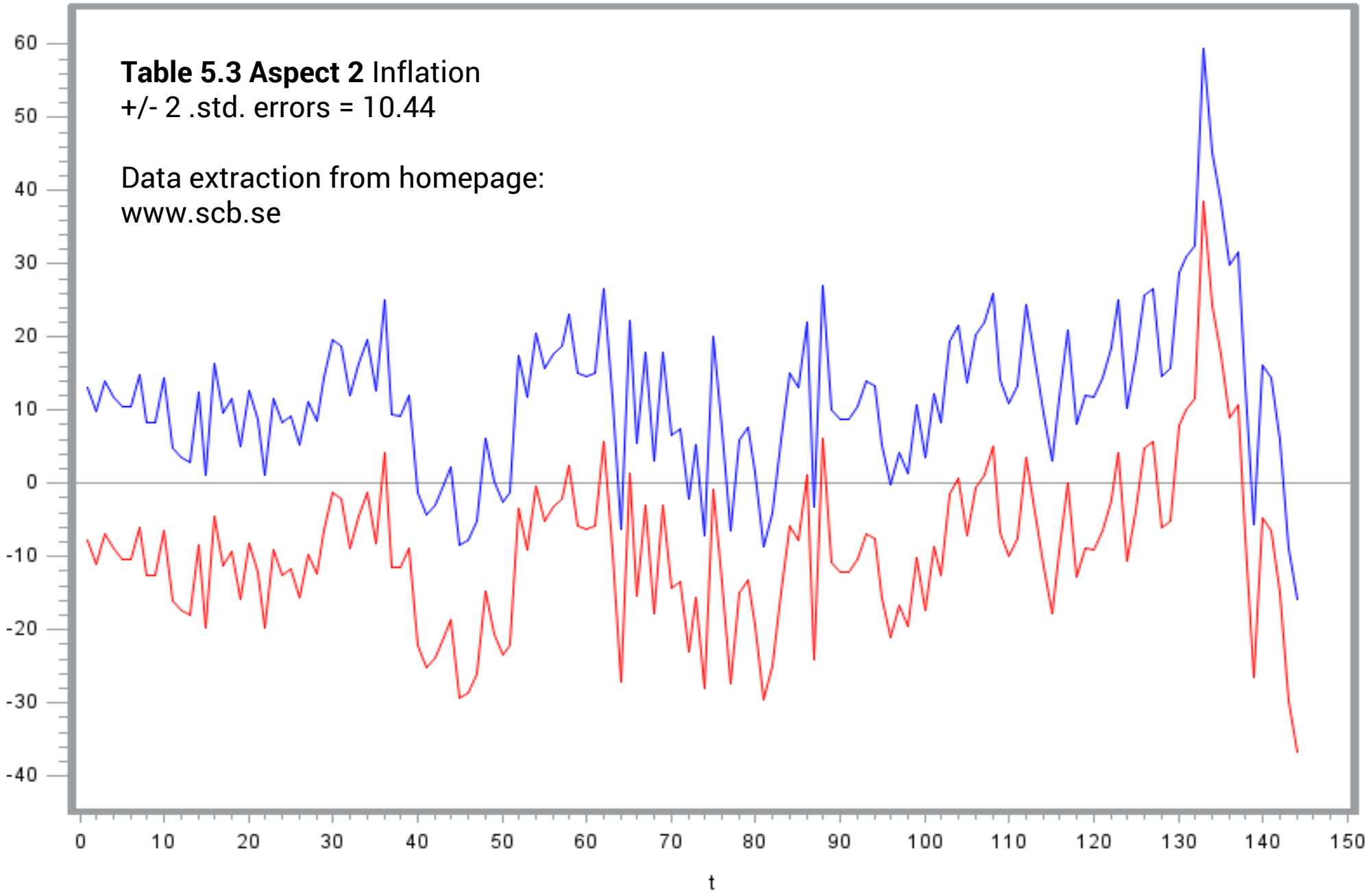
Figure 5.2.11 Restaurants: Short-term index link variance and simple variance (dotted)



Air travel

- Manual online collection → web scraping, schematic according to HICP
- Completely affected by Covid in weights and imputed prices
- Between-destination variance > within-destination variance
- ”The carrier issue” as variance driver?

CPI Air travel: Inflation 2010-2021



Conclusions

- Bootstrapping viable (when *n>1*) but tedious
  No single setup fits all surveys and years

- Changes in the CPI (basket/method/data source) appear to influence
  Less ”traditional” design orientation with new data sources

- Effective sample sizes potentially smaller than presumed
  Simple variance estimators downward biased:
  design effects significant, except in one situation (Furniture)

- Inflation variance/short term variance ratio observed: **1.36 - 1.77**
  (yearly averages, dec.-dec. smaller)

- Clothing & footwear disproportionately high variance despite survey costs

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