Dynamic pricing as a challenge for Consumer Price Statistics

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Overview

- What is dynamic pricing?
- Goals of the analysis
- Price collection via internet for the German CPI/HICP
- Set-up of the study
- Results
- Implications for Consumer Price Statistics
- Outlook

What is dynamic pricing?

- Application of automatic algorithms to change prices in short intervals due to market conditions and parameters indicating consumers willingness to pay
- Possible parameters used to set prices
  - Calendar effects (holidays, time of the day)
  - Weather
  - Prices of competitors
  - Devices as indicator for the individual willingness to pay?
  - …
- Dynamic pricing: price changes in time
- Individualized pricing: different prices for different consumers

Goals of the analysis

- Dynamic pricing is analysed, individualized pricing not
  - To investigate the existence and the extent of individualized pricing would require more complex study designs (different consumer profiles)

- To which extent is dynamic pricing applied by online shops?
  - Identification of online shops applying dynamic pricing
  - Frequency and level of price changes for products relevant for CPI/HICP

Price collection via internet for CPI/HICP

- Centralized price collection for goods in online shops
  - Approx. 10.000 single prices per month
  - Share in whole basket: approx. 5%, increasing...
- Centralized price collection for services
  - Internet as data source
- Way of price collection
  - To a large extent done manually at one time per month
  - Automatized for certain fields (via web scraping)
    - passenger transport by railway, rental cars, long-distant coaches, online pharmacies

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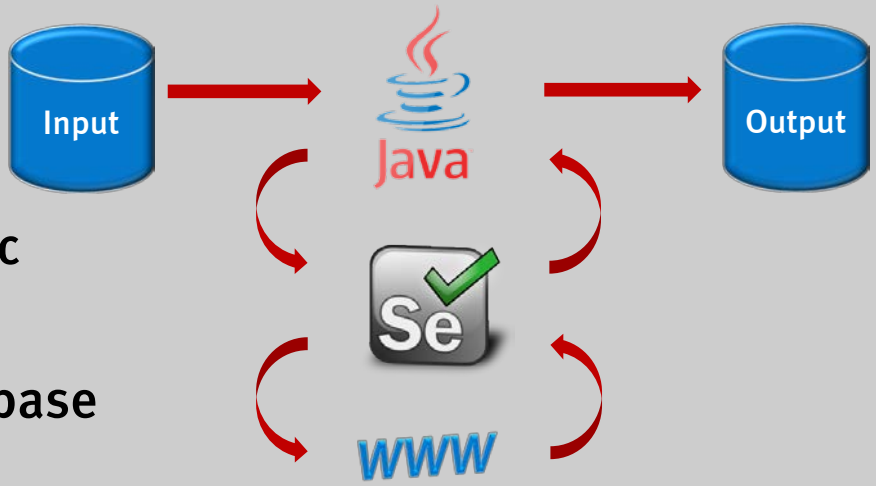
Price collection via internet for CPI/HICP

- Sample design
  - 2,680 products out of the sample of CPI/HICP
  - Different product groups
  - 14 online shops
- Automatized price collection via web scraping
- Hourly collection of prices at constant times
- Observed period: 3 months (09.12.2016 - 06.03.2017)
- Overall: 2097 prices per product, 5,559,933 single prices

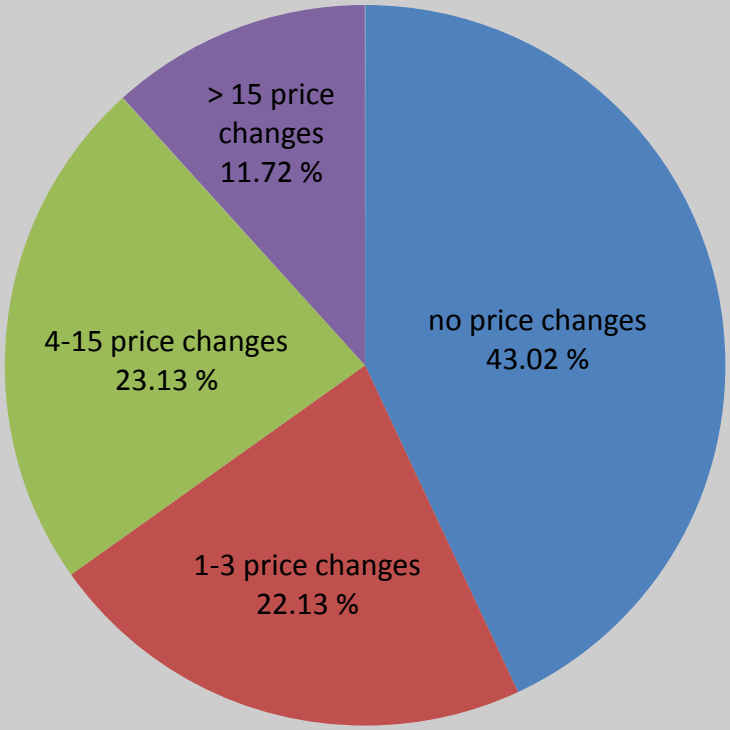
Set-up of the study



- Java
  - Realization of program logic
  - Data cleaning
  - Read/Store data from database
- Selenium
  - Extraction of information
  - XPaths are used to find information on respective website
  - Plug-in for common internet browsers
- MySQL database is used for input data and to store extracted data
- Windows Scheduled Tasks is used to start the automation at a certain time

Results (1)

Price changes per product (observed period of 3 months)



Results (2)

Shop	Share of price series with ... price changes				number price series overall
	0	1 - 3	4 - 15	› 15	
Shop 1	7.91%	9.30%	35.35%	47.44%	215
Shop 2	47.94%	19.50%	20.39%	12.16%	559
Shop 3	50.72%	26.09%	21.26%	1.93%	207
Shop 7	54.39%	19.59%	16.33%	9.68%	888
Shop 9	4.88%	29.27%	48.78%	17.07%	123
Shop 13	68.81%	30.28%	0.92%	0.00%	109
Shop 14	17.86%	30.71%	47.86%	3.57%	140
other	39.64%	28.25%	25.74%	6.38%	439
all	**43.02%**	**22.13%**	**23.13%**	**11.72%**	**2680**

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Results (3)

Shop	variation coefficient (price series with › 3 changes)				share on price series overall
	‹ 0,05	0,05 - ‹0,1	0,1 - ‹0,25	› 0,25	
Shop 1	99	46	27	6	82.8%
Shop 2	67	44	52	19	32.6%
Shop 3	26	19	2	1	23.2%
Shop 7	75	40	67	49	26.0%
Shop 9	47	24	9	1	65.9%
Shop 13	0	0	1	0	0.9%
Shop 14	5	6	57	4	51.4%
other	75	44	18	4	32.1%
all	**394**	**223**	**233**	**84**	**34.9%**

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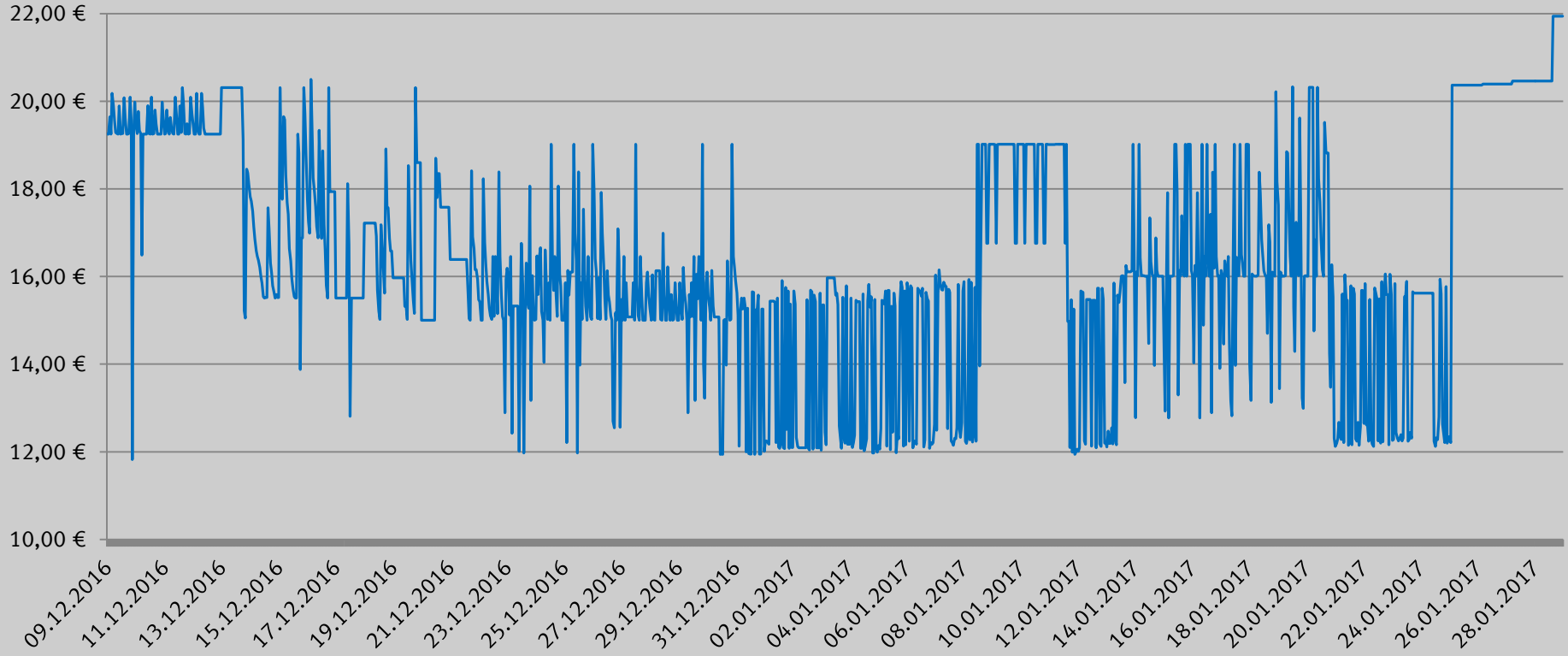
Results (4)

Example of extreme frequent price changes: aftershave



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Results (5)

- Summarized results
  - Differences in price setting behavior among shops, not among product categories
  - Dynamic pricing is applied by few online shops in a remarkable extent
  - Volatility of prices is critical in some of these shops
  - Time of price changes: more in the first third of the day probably for technical reasons and to hide price changes

Implications for Consumer Price Statistics

- Information about online shops and their price setting behavior can be used to manage resources for price collection
  - Concentrate on online shops with high frequency of price changes and high volatility of prices
    - More frequent dates of price collection, additional checks
    - Use of new tools for price collection (web scraping) as soon as possible

Outlook – web scraping

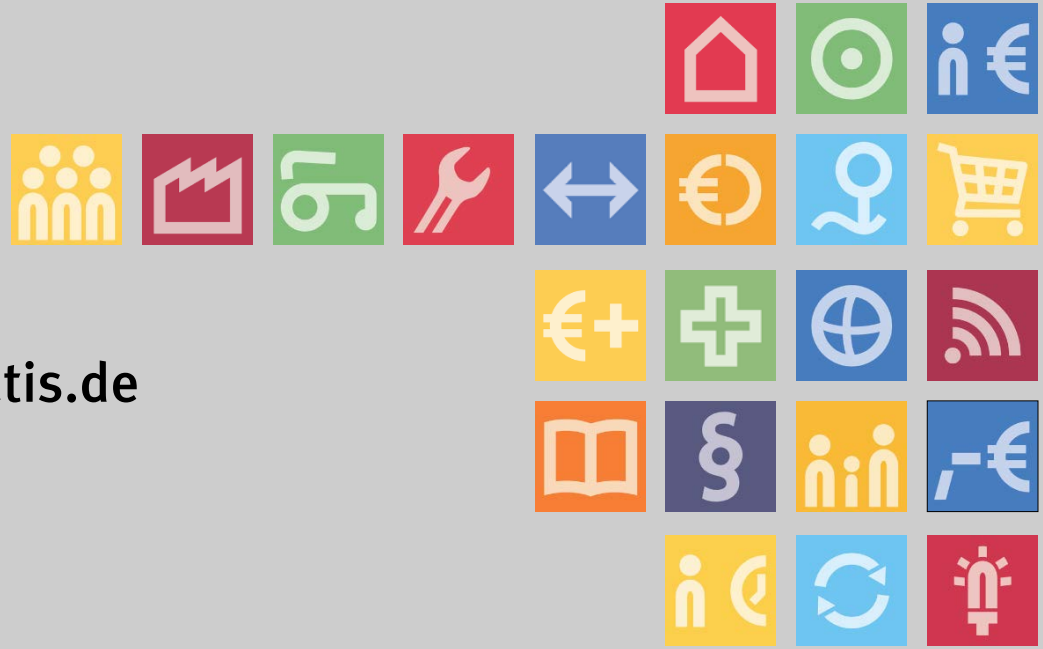
- Automatized price collection (web scraping)
  - Is applied in some fields and will be applied on a broader basis
  - Will be further developed technically, project with IT
- Methodological challenges
  - How to deal with replacements and quality adjustments?
  - How to calculate average prices?
- Legal basis for the access to websites does not exist currently

Outlook – transaction data

- Dynamic pricing in physical shops?
  - Introduction of electronic price signs
- Traditional price collection will no longer be sufficient
- Use of transaction data (scanner data) necessary
  - Project on scanner data has just started

Digitale Preise: Die Zukunft des Bezahlens © dpa

THANK YOU FOR YOUR ATTENTION!



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