

Property price indices

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Statistics Sweden and Örebro University Summer School 2026

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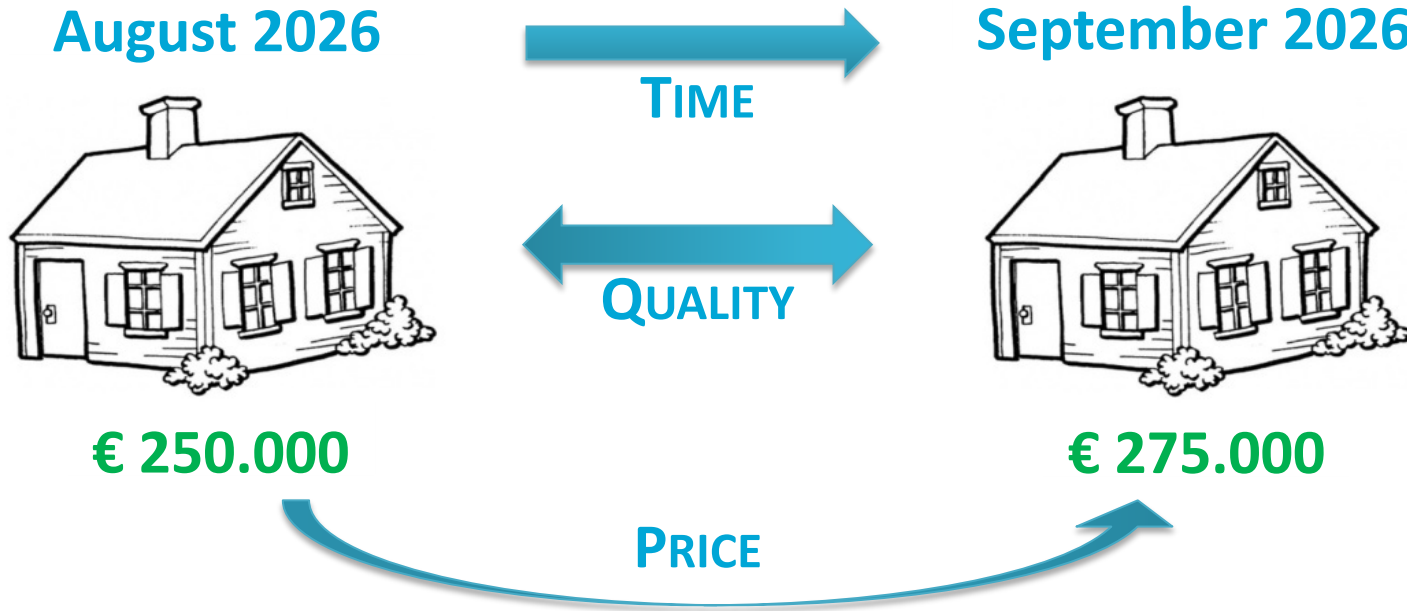
Today's content

- **What** exactly are we talking about?
Why do property price indices matter?
- **How** can we compile property price indices?
 - Challenges
 - Methods
- **Current challenges** in this domain

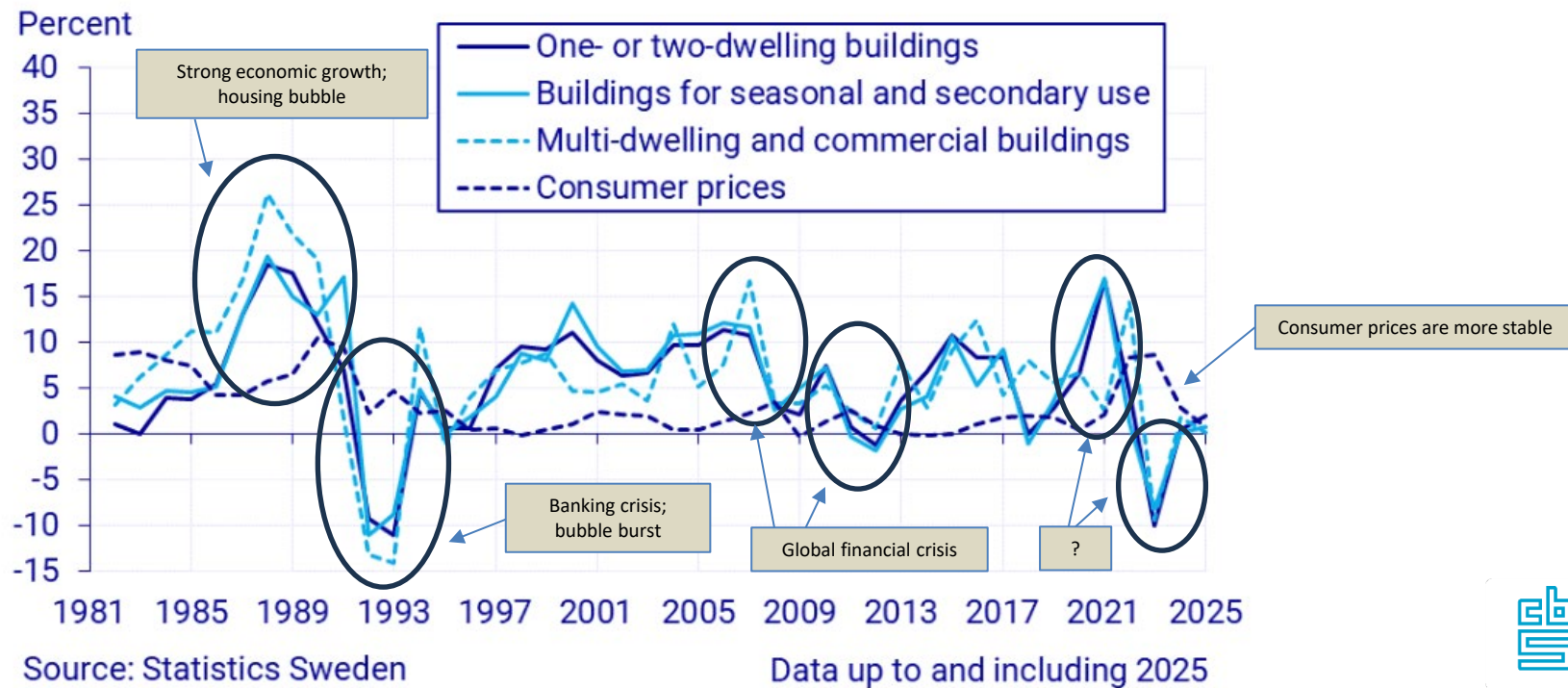


What do we mean by 'real estate price development'?

- Ultimate goal: **constant quality** price developments (inflation/deflation)



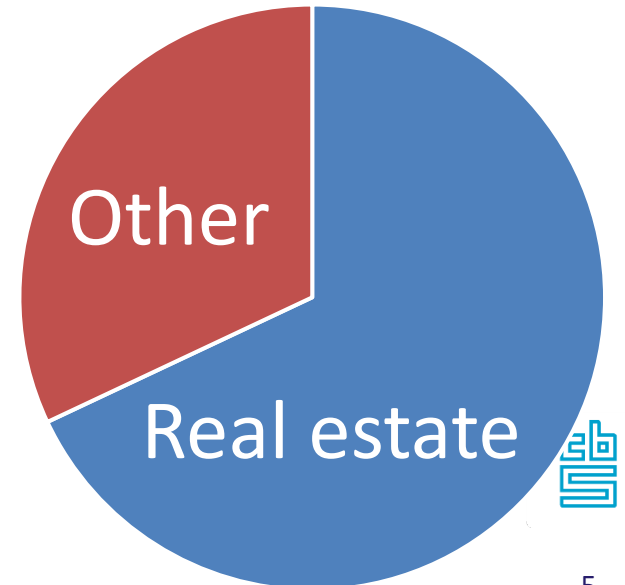
Real estate price developments reflect state of the economy



Importance of property (real estate) prices

- Real estate is one of the cornerstones of the modern economy
- Two-third of all possessions worldwide regards **real estate** ([McKinsey, 2021](#))
- The **real estate** sector plays a crucial role in maintaining economic stability

Global assets €

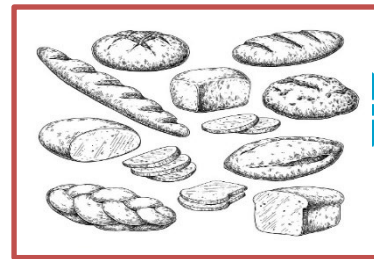
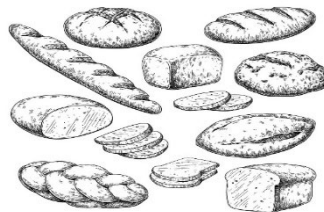
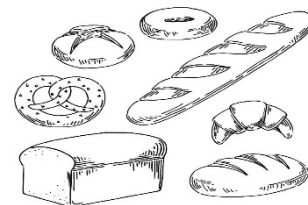
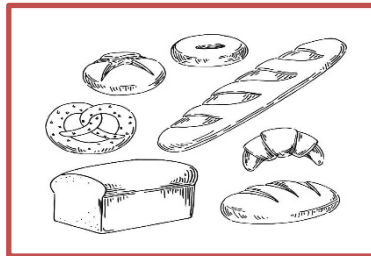
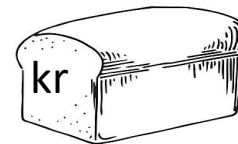
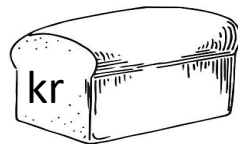


Methodological challenge

- Price indices tend to describe multidimensional phenomena
- In other words: price developments of a **variation of products** are summed in one figure

Base period

Reporting period

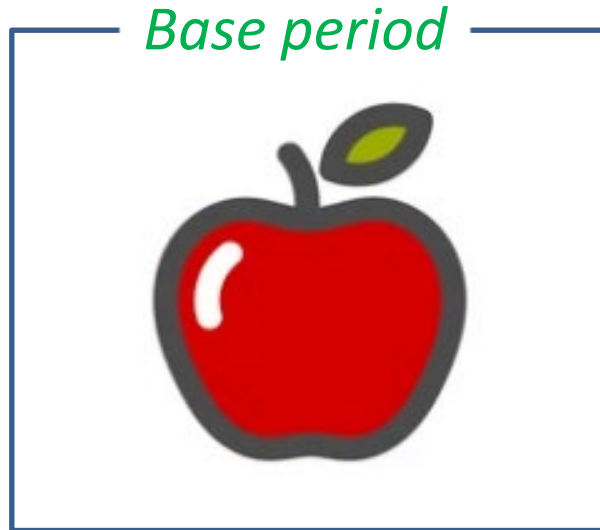


Methodological challenge

Now let's apply this to real estate!

There are no transaction prices for each good every period

Package of sold property is different every period



Price change?



Methodology

- Simple mean/median
- Stratification
- Repeat sales
- Sale Price Appraisal Ratio (SPAR)
- Hedonic regression



Methodology | Simple mean/median

There are several methods for determining a representative value:

- Arithmetic average
- Geometric average
- Median



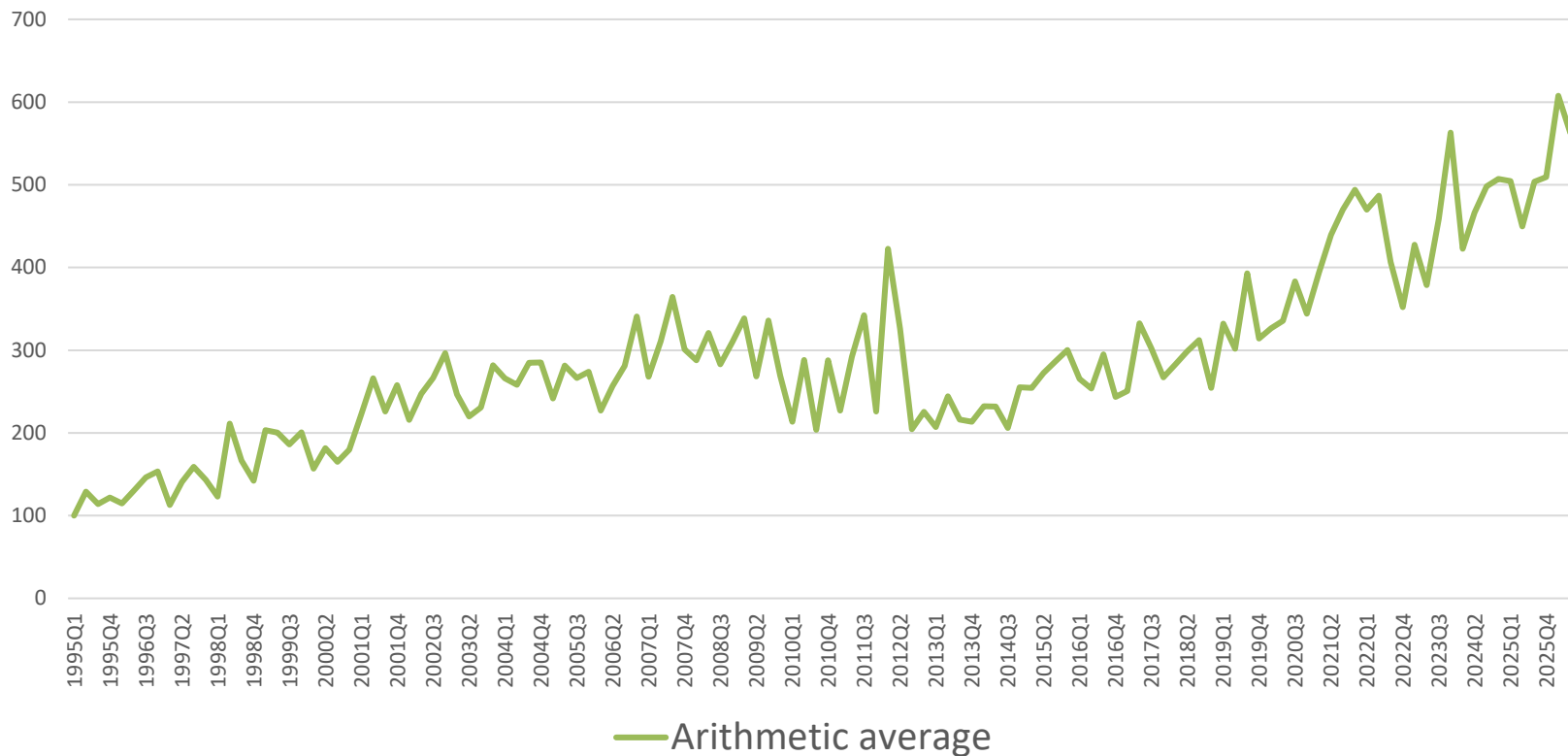
Sensitivity to outliers



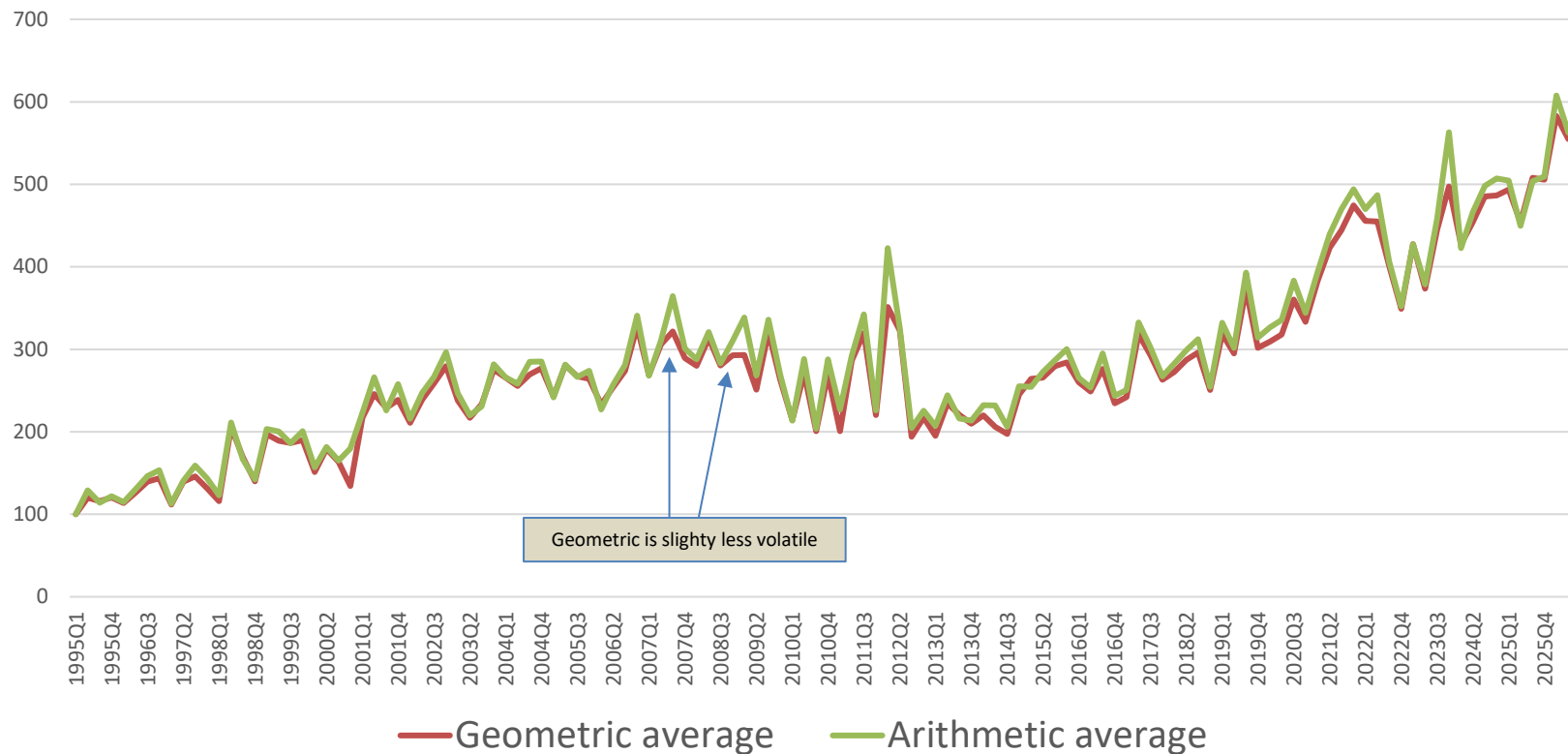
Methodology | Simple mean/median

$$I_{A,B} = \frac{P_B}{P_A} = \frac{\sum p_B/n_B}{\sum p_A/n_A}$$

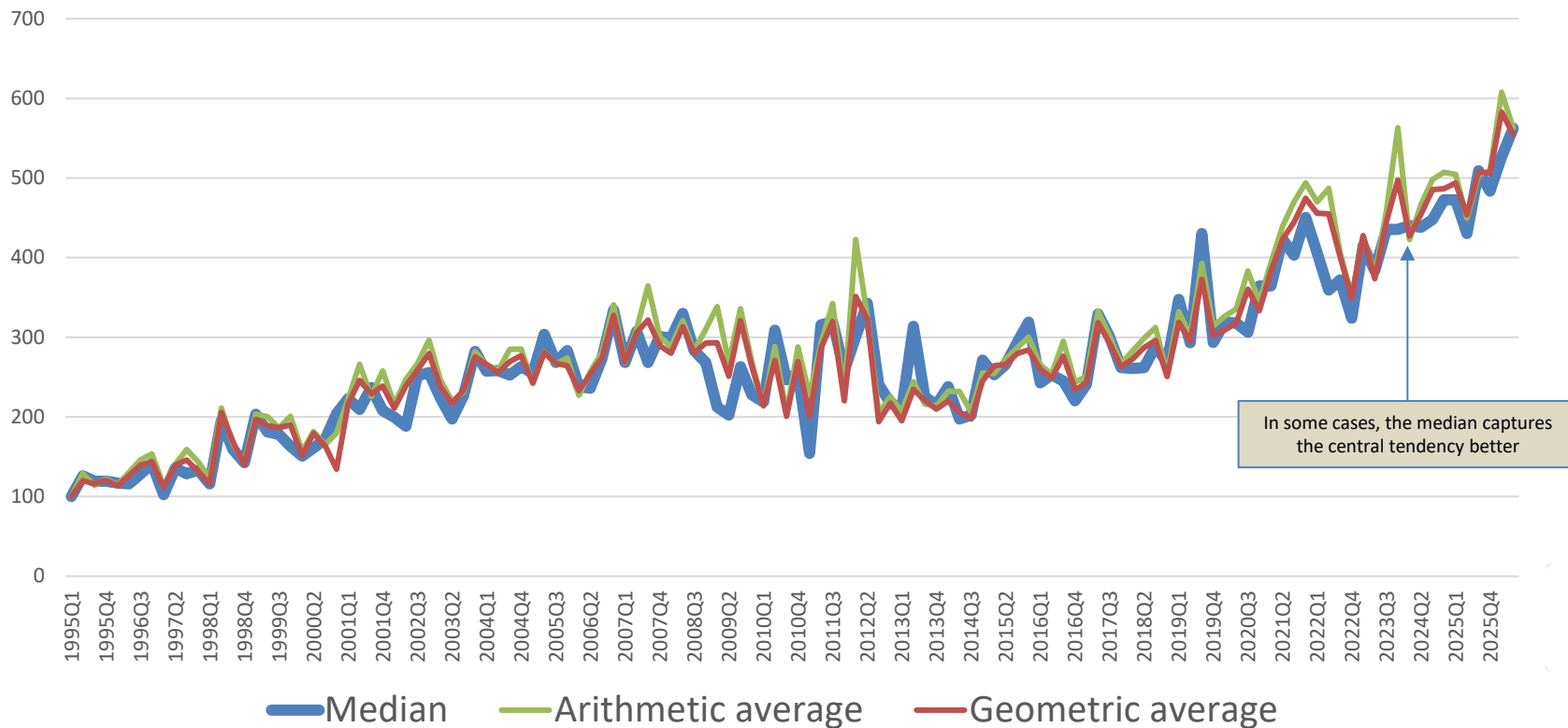
House price developments | small Dutch municipality



House price developments | small Dutch municipality



House price developments | small Dutch municipality



Methodology | Simple mean/median

$$I_{A,B} = \frac{P_B}{P_A} = \frac{\sum p_B/n_B}{\sum p_A/n_A}$$

Advantage

- Only sale prices are required

Disadvantage

- Does not sufficiently consider the mix of property sold



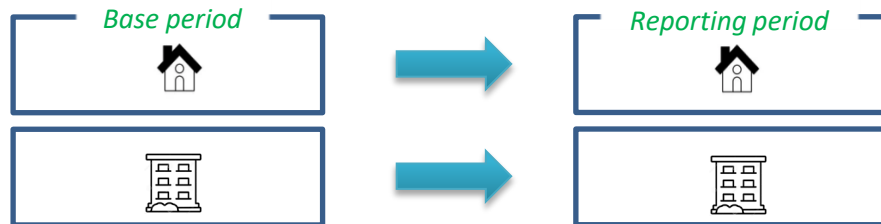
Methodology | Stratification

Make comparable subgroups



Advantages

- Not a lot of variables required (prices, subgroup-variable)
- Price changes at stratum level



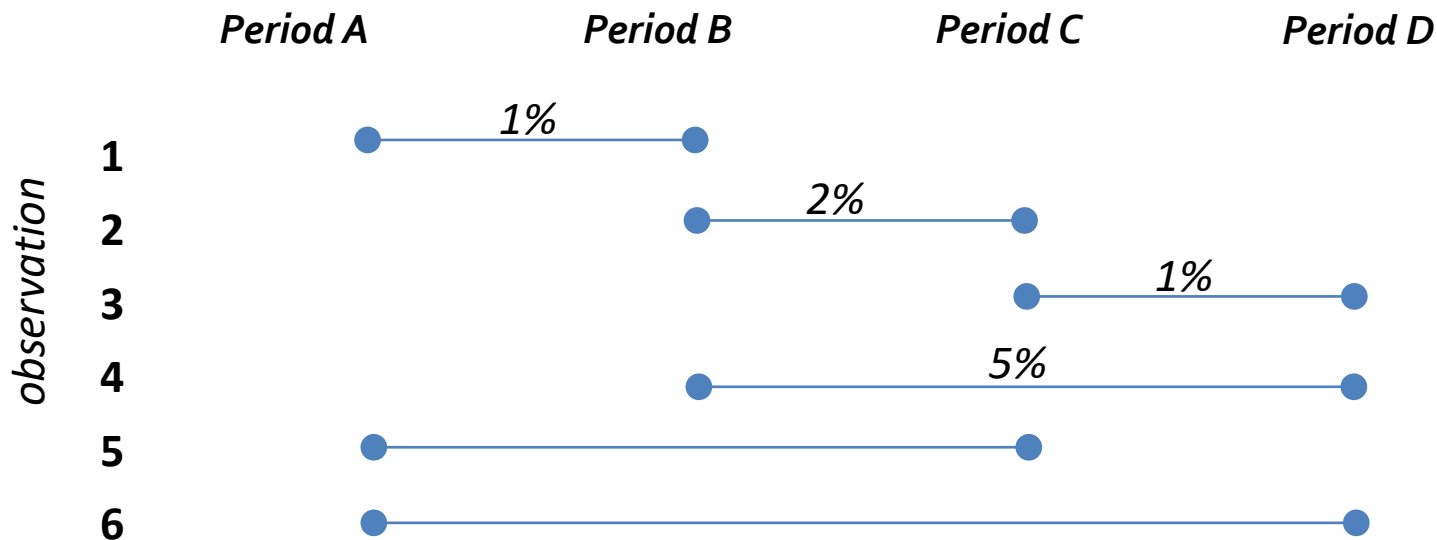
Disadvantages

- Requires sufficient number of observations per stratum
- Does not correct for all heterogeneity



Methodology | Repeat sales

- Make pairs over a longer period of repeatedly sold houses
- Repeat Sales is a multilateral method



Methodology | Repeat sales

- Make pairs over a longer period of repeatedly sold houses
- Repeat Sales is a multilateral method

Advantages

- The exact same houses are compared

Disadvantages

- Does not control for interim adjustments to the house (depreciation/improvement)
- Dependent of pairs → a lot of data is not used
- Price index is subject to revision



Methodology | Sale Price Appraisal Ratio (SPAR)

Compare sales prices (period T) to valuations (period T – 1)

$$I^{A,B} = \frac{\bar{p}^B(S^B)/\bar{a}^A(S^B)}{\bar{p}^A(S^A)/\bar{a}^A(S^A)}$$

$$\text{Index (A} \rightarrow \text{B)} = \frac{\text{sale price B / valuation A}}{\text{sale price A / valuation A}}$$



Methodology | Sale Price Appraisal Ratio (SPAR)

Compare sales prices (period T) to valuations (period T – 1)

Advantages

- Almost all data is used
- If period T and T-1 are close to each other, then interim adjustments to the house are unlikely

Disadvantages

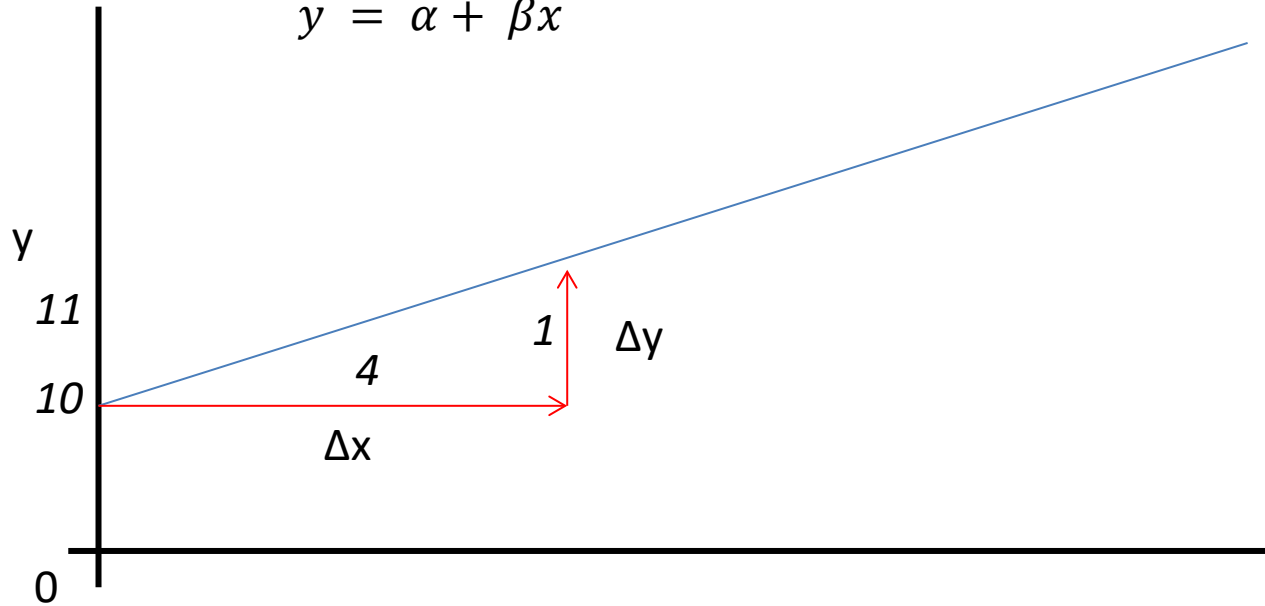
- Dependent on valuations (despite correction factor)
- If period T and T-1 are far from each other, then interim adjustments to the house are more likely



Methodology | Hedonic regression

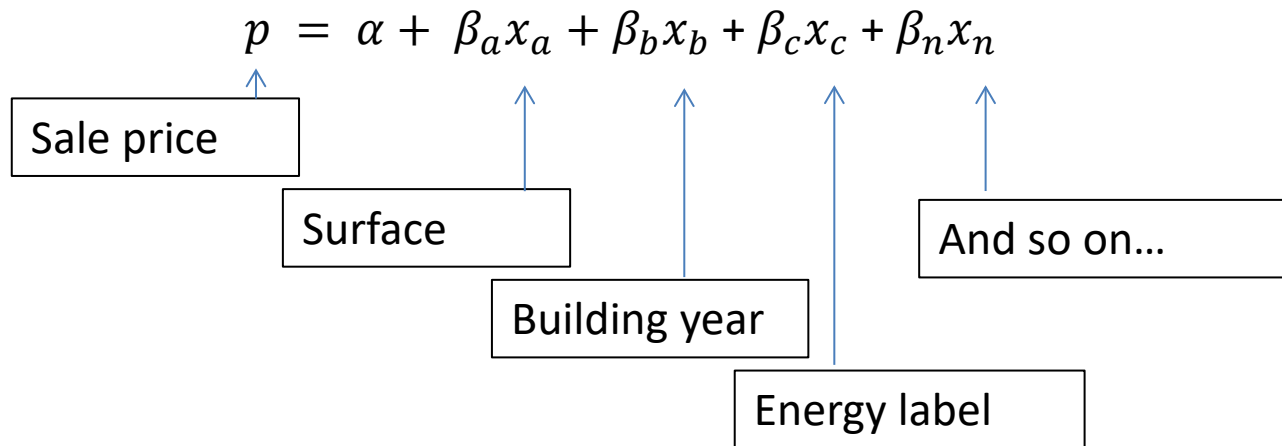
$$11 = 10 + \beta * 4 \quad \Rightarrow \quad \beta = 0,25$$

$\uparrow \quad \uparrow \quad \uparrow$
 $y = \alpha + \beta x$



Methodology | Hedonic regression

- Calculate coherence between sale price and quality characteristics
- Commonly used to determine the effect of something on something else



Methodology | Hedonic regression

- Keep characteristics constant for one period.
- Geometric average of Laspeyres and Paasche → Fisher

$$I_F^{A,B} = \left\{ \begin{array}{l} I_L^{A,B} = \frac{\widehat{p^B}}{p^A} = \frac{\alpha^B + \beta_a^B x_a^A + \beta_b^B x_b^A + \beta_c^B x_c^A + \beta_n^B x_n^A}{\alpha^A + \beta_a^A x_a^A + \beta_b^A x_b^A + \beta_c^A x_c^A + \beta_n^A x_n^A} \\ I_P^{A,B} = \frac{p^B}{\widehat{p^A}} = \frac{\alpha^B + \beta_a^B x_a^B + \beta_b^B x_b^B + \beta_c^B x_c^B + \beta_n^B x_n^B}{\alpha^A + \beta_a^A x_a^B + \beta_b^A x_b^B + \beta_c^A x_c^B + \beta_n^A x_n^B} \end{array} \right.$$

Methodology | Hedonic regression

- Keep characteristics constant for one period
- Geometric average of Laspeyres and Paasche → Fisher

Advantages

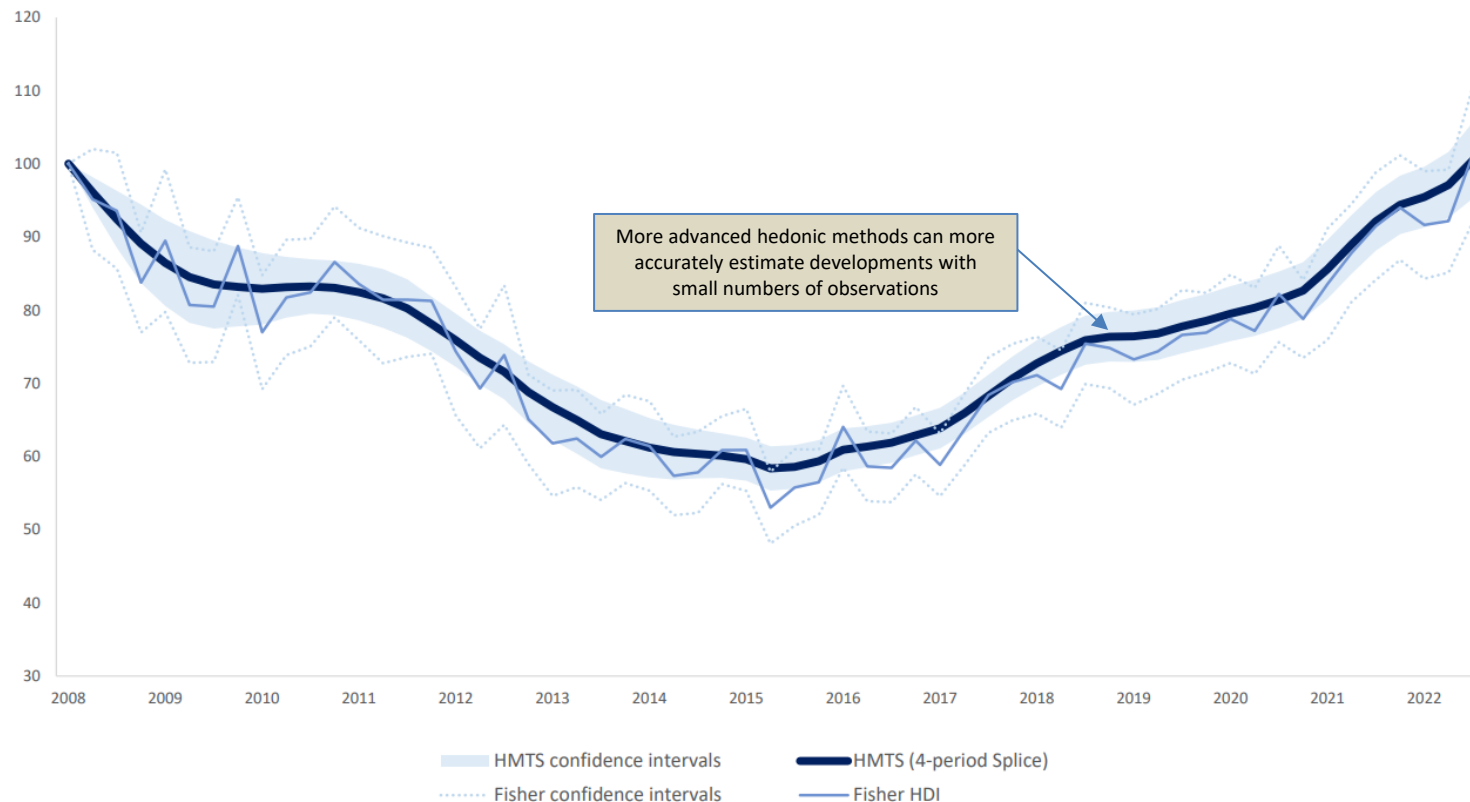
- Almost all data is used
- Corrects for quality and mix of sold objects

Disadvantages

- Requires quality determining elements (which are often not all available)
- Requires a lot of choices → affects the resulting price index

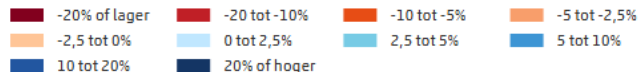


Challenges | small domains

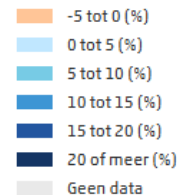
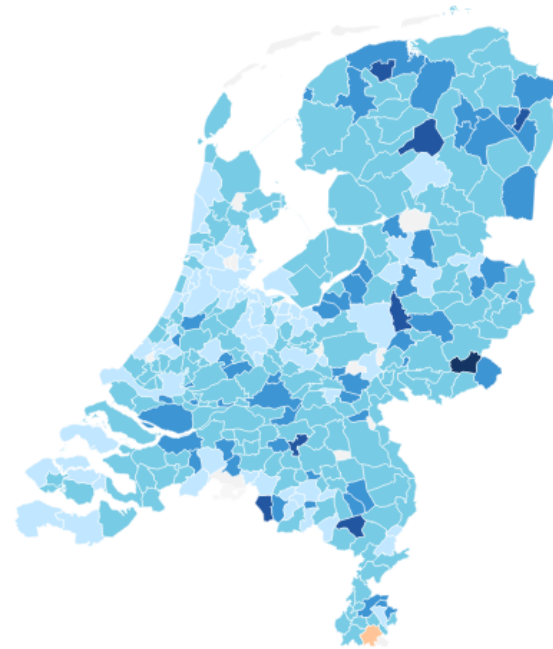


House price developments (%) compared to previous year, 2026 Q1

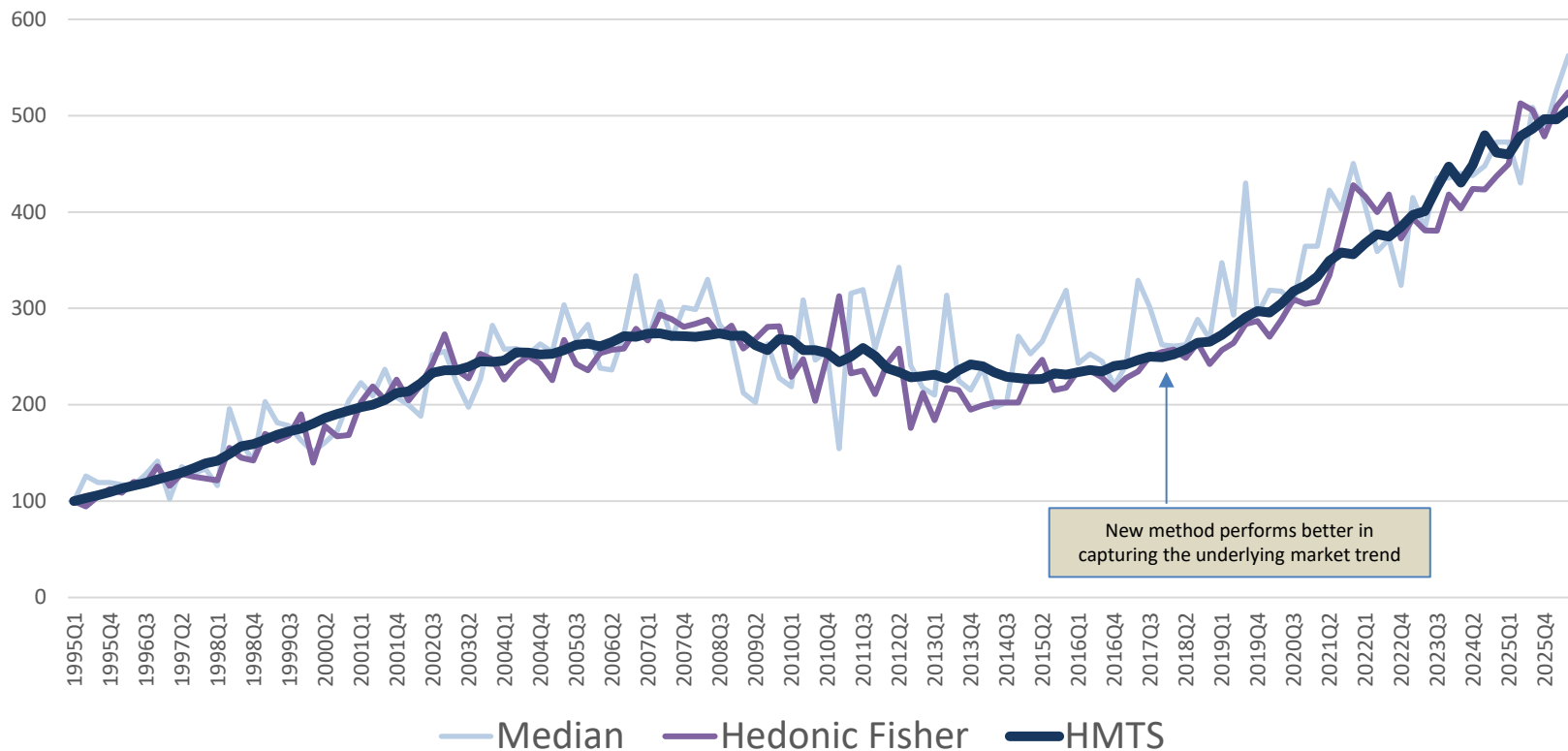
Provinces (standard method)



Municipalities (advanced hedonic method)



House price developments | small Dutch municipality



R-package for using property price index methods

This script demonstrates the possibilities of the package REPS (Real Estate Price Statistics).

Below script uses test data that is included in the package.

To calculate indices, replace test data for real data and run below functions!

Install and load package | Show package information

```
install.packages("REPS")
```

```
library(REPS)
```

```
?REPS
```

Load data

```
Tbl_data = REPS::data_constraxion
```

Calculate price indices

```
Tbl_indices = REPS::calculate_hedonic_index(
```

```
  method = c("fisher", "hmts", "laspeyres", "paasche", "repricing",  
             "timedummy", "rolling_timedummy"),
```

```
  dataset = Tbl_data,
```

```
  period_variable = "period",
```

```
  dependent_variable = "price",
```

```
  numerical_variables = c("floor_area", "dist_trainstation"),
```

```
  categorical_variables = c("neighbourhood_code", "dummy_large_city"),
```

```
  reference_period = "2015",
```

```
  number_of_observations = FALSE,
```

```
  periods_in_year = 4,
```

```
  number_preliminary_periods = 3,
```

```
  window_length = 5)
```

Plot price indices

```
REPS::plot_price_index(Tbl_indices)
```

Calculate regression diagnostics

```
Tbl_diagnostics = REPS::calculate_regression_diagnostics(
```

```
  dataset = Tbl_data,
```

```
  period_variable = "period",
```

```
  dependent_variable = "price",
```

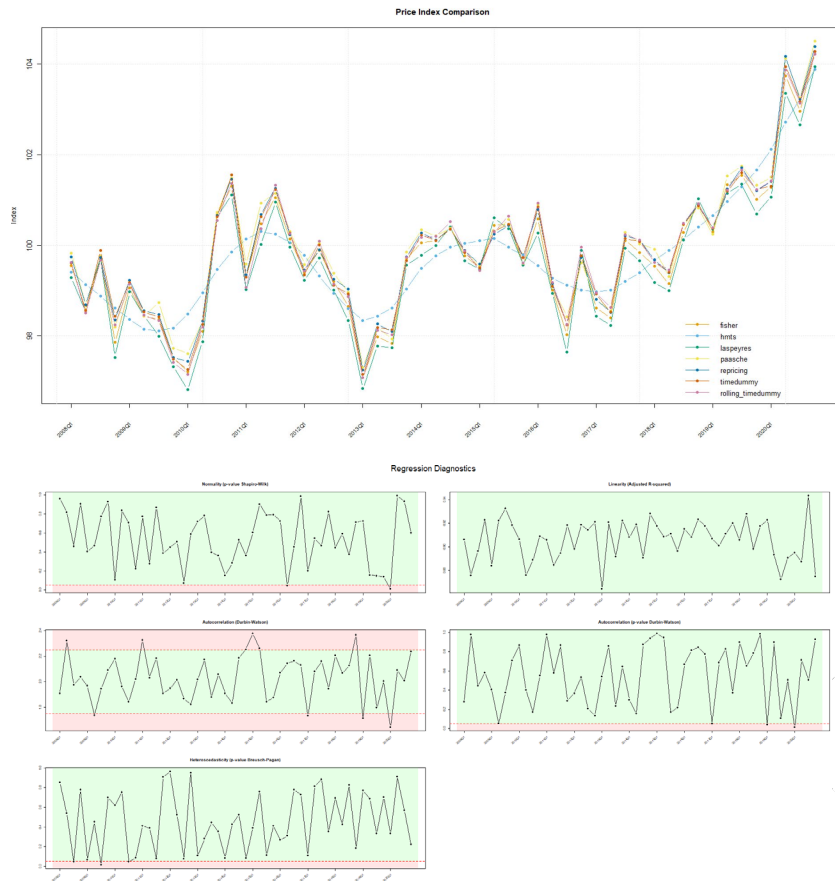
```
  numerical_variables = c("floor_area", "dist_trainstation"),
```

```
  categorical_variables = c("neighbourhood_code", "dummy_large_city"))
```

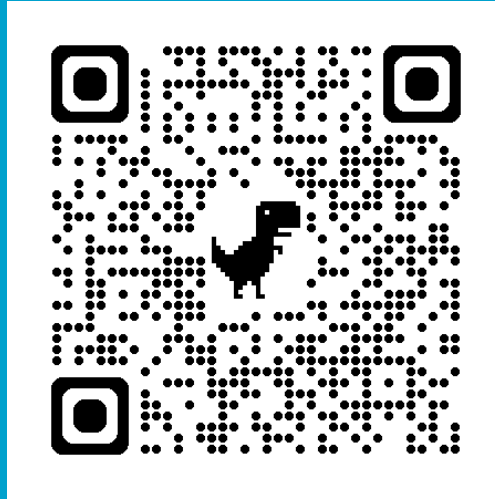
Plot regression diagnostics

```
REPS::plot_regression_diagnostics(Tbl_diagnostics)
```

N.B. in case of an error regarding 'figure margins': increase the size of the plot pane



Questions?



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