



A Timely House Price Index for Belgium: Integrating Listings and Transactions for Improved Forecasting

Peter Reusens (National Bank of Belgium)
Joren Vandenberghe (KU Leuven)

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Disclaimer: The views expressed in this presentation are my own and do not necessarily reflect the views of the NBB



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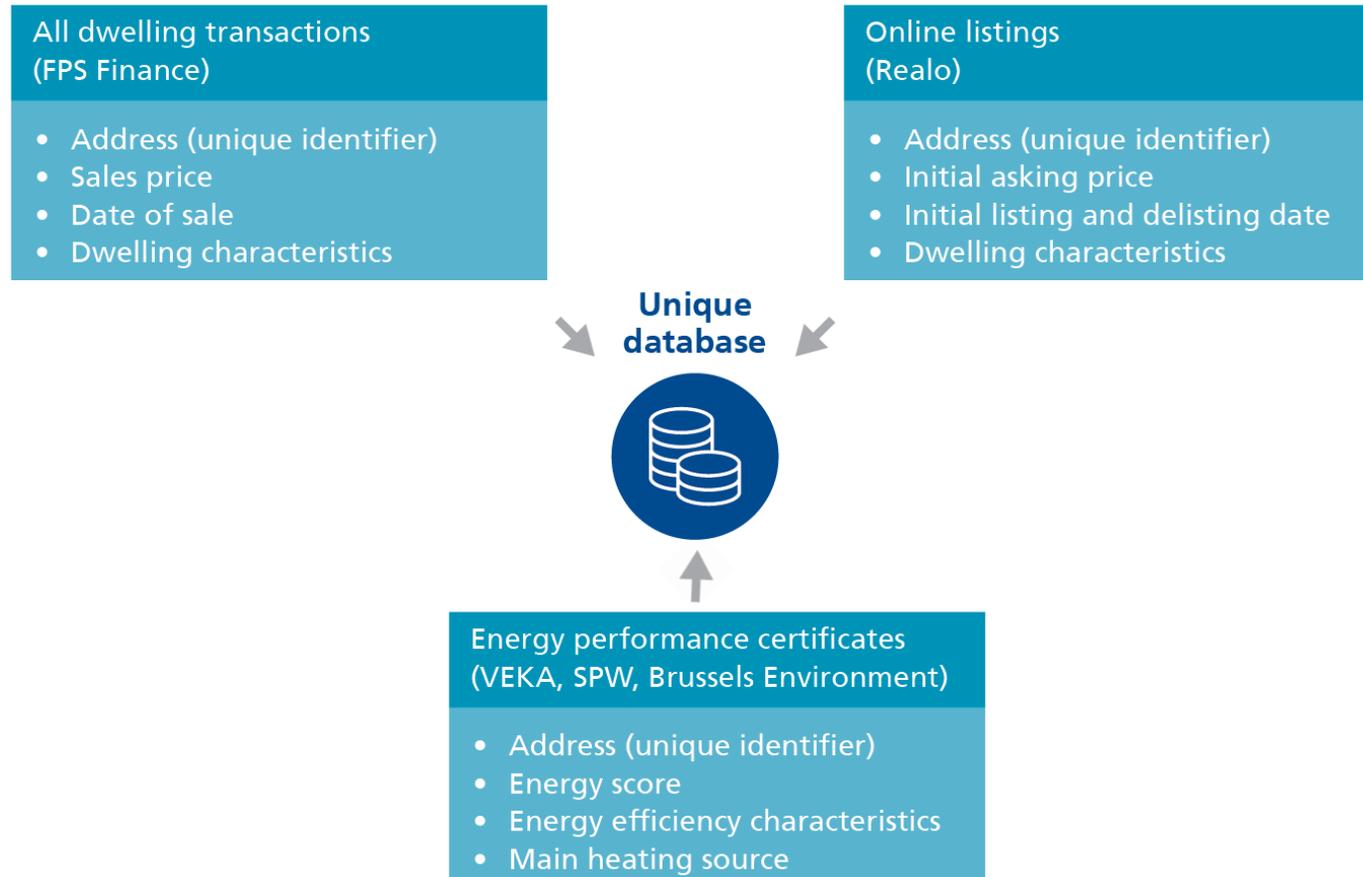
1. Introduction

**FOR
SALE**

Introduction

- Importance of timely house price data for policymakers
- Official indices come with substantial delay
- We use initial asking prices to forecast the sales price index
- Key contribution: we adjust each listing for
 - Expected probability of sale
 - Expected time-until-sale
 - Expected sales-to-listing price ratio

We combine Belgian listings with sales and energy-efficiency data (2016-2025)



Our data lets us determine, for every listing, whether it sold, how long it took to sell, and its sales-to-listing price ratio — but only ex-post

Listing date t^L
(e.g. January 1 2026)

Delisting date
(e.g. March 1 2026)

Selling date (notarial deed) t^S
(e.g. 1 June 2026)



House for sale
€ 300 000

🏠 3 bdrm 🚿 1 bath 📏 167 m²

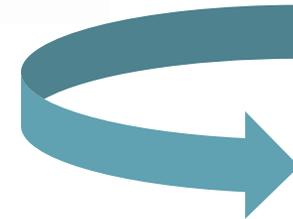


House for sale
€ 300 000

🏠 3 bdrm 🚿 1 bath 📏 167 m²



€ 285 000



Sold:
Time-until-sale: 5 months
Sales-to-listing price ratio: 95%

A hand is shown holding a stylized house icon. A white line graph with three peaks is overlaid on the house, and a large white arrow points upwards from the right side of the graph. The background is a blurred image of a person's arm and hand.

2. Methodology

Methodology

1. Sales price index

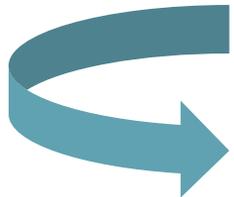
$$\log(p_i^S) = \boxed{\delta_{t^S}} + \beta x_i^S + \epsilon_i \quad \text{for } i = 1, \dots, N^S$$

2. Unadjusted listing price index

$$\log(p_i^L) = \boxed{\delta_{t^L}} + \beta x_i^L + \epsilon_i \quad \text{for } i = 1, \dots, N^L$$

3. Adjusted listing price index (weighted estimation using probability of sale)

$$\log(p_{ir}^L * \widehat{SLPR}_{ir}) = \boxed{\delta_{t_{ir}^S}} + \beta x_i^L + \epsilon_{ir} \quad \text{for } i = 1, \dots, N^L \text{ and } r = 0, \dots, R$$



Estimation of the sales-to-listing price ratio (SLPR), time-until-sale t^S and probability of sale based on a time trend and each listing's characteristics and degree of overpricing

We estimate each listing's sales-to-listing price ratio, time-until-sale and selling probability based on time trend, degree of overpricing and characteristics

1. Time-until-sale

$$\log(TOM_i) = \delta_{iL} + \gamma CLOSING_i + \theta DOP_i + \beta x_i^L + \epsilon_i \quad \text{for } i = 1, \dots, N^M$$

$$\widehat{t}_{ir}^S = t_i^L + \exp(\log(\widehat{TOM}_{ir}) + \widehat{\epsilon}_{ir}) + \widehat{CLOSING}_{ir} \quad \text{for } i = 1, \dots, N^L \text{ and } r = 1, \dots, R$$

2. Probability of sale

$$SOLD_i = \delta_{iL} + \theta DOP_i + \beta x_i^L + \epsilon_i \quad \text{for } i = 1, \dots, N^L$$

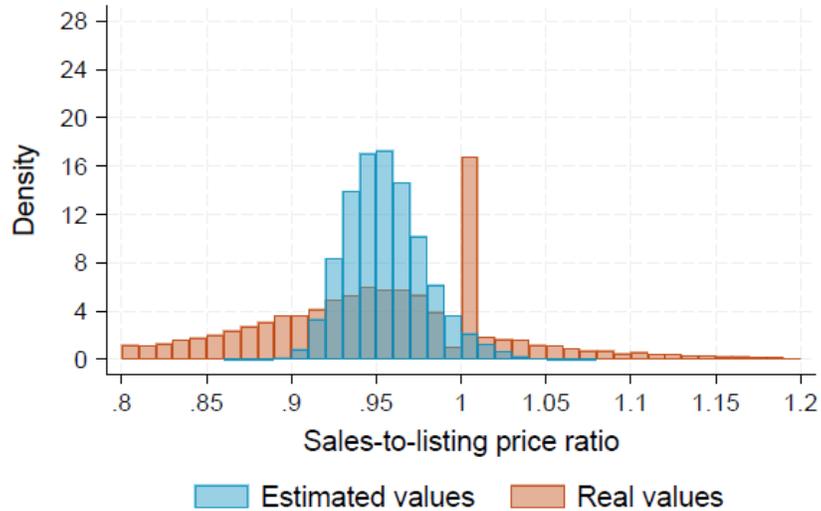
3. Sales-to-listing price ratio

$$\frac{p_i^S}{p_i^L} = \delta_{iS} + \theta DOP_i + \beta x_i^L + \epsilon_i \quad \text{for } i = 1, \dots, N^M$$

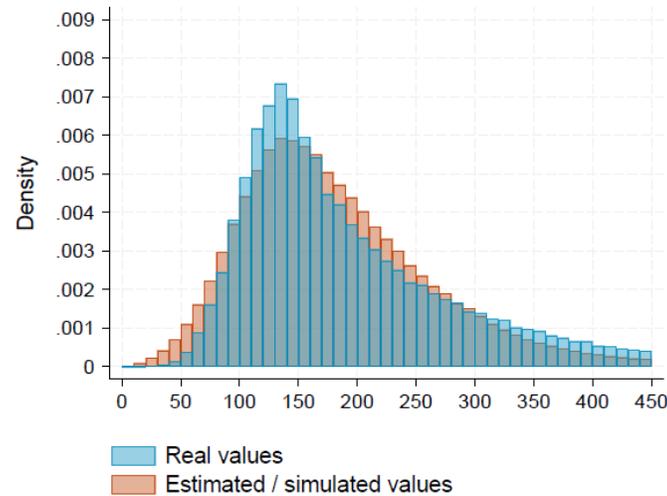
$$\widehat{SLPR}_{ir} = \frac{\widehat{p}_{ir}^S}{p_{ir}^L} = \delta_{\widehat{t}_{ir}^S} + \widehat{\theta} DOP_i + \widehat{\beta} x_i^L \quad \text{for } i = 1, \dots, N^M \text{ and } r = 0, \dots, R$$

Estimated distributions of listing indicators align with actual ones (even though individual-level variation remains largely unexplained)

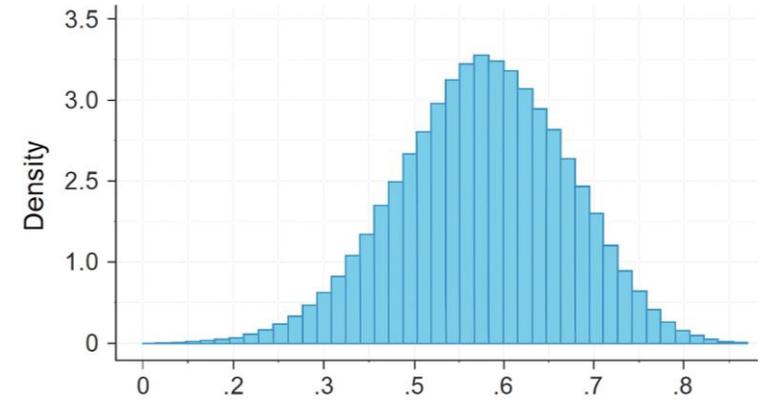
Sales-to-listing price ratio



Time-until-sale



Probability of sale



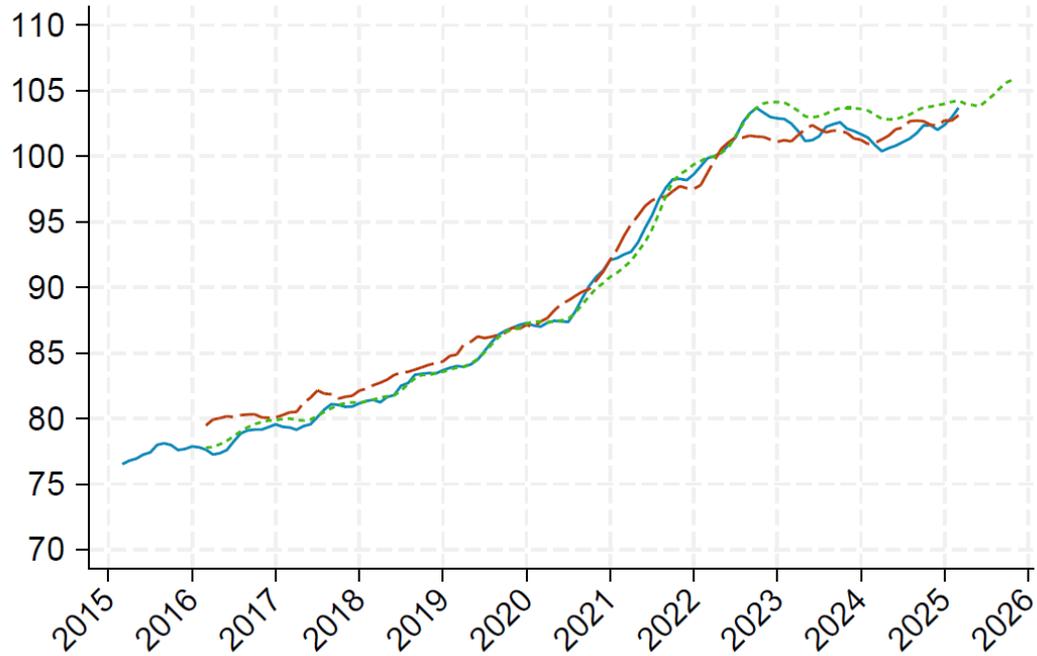


3. Results

The adjusted listing price index estimated on the full sample has almost a perfect correlation with the final sales prices index

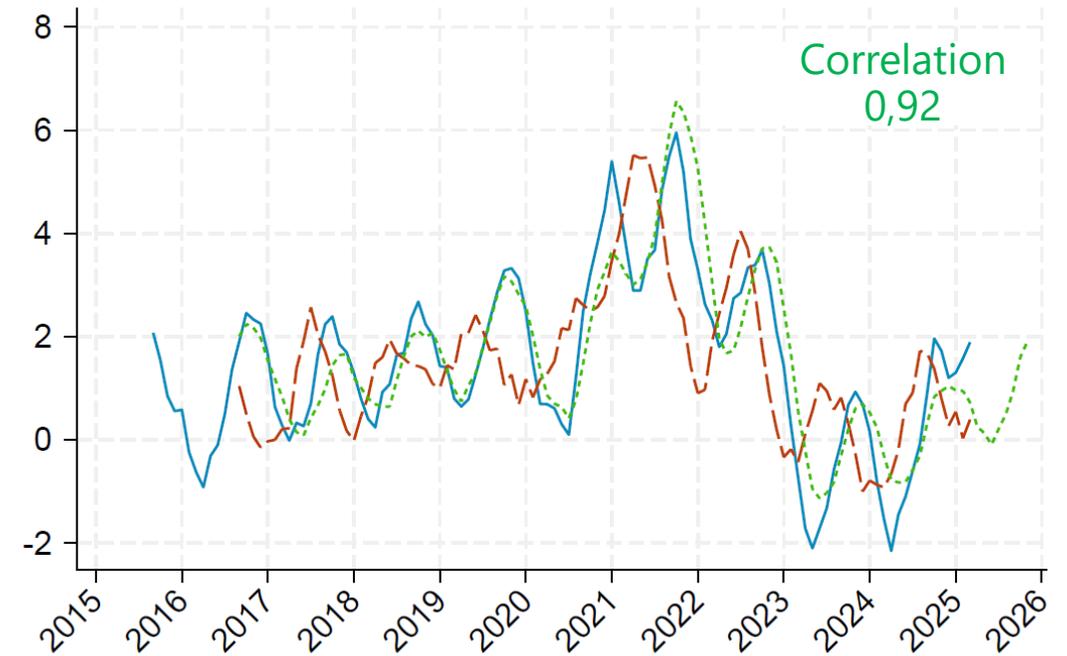
House price index

(index, 2022 March = 100)



Six month growth rate

(in %)



— Sales price index

- - - Unadjusted listing price index

... Adjusted listing price index
(full sample estimate)

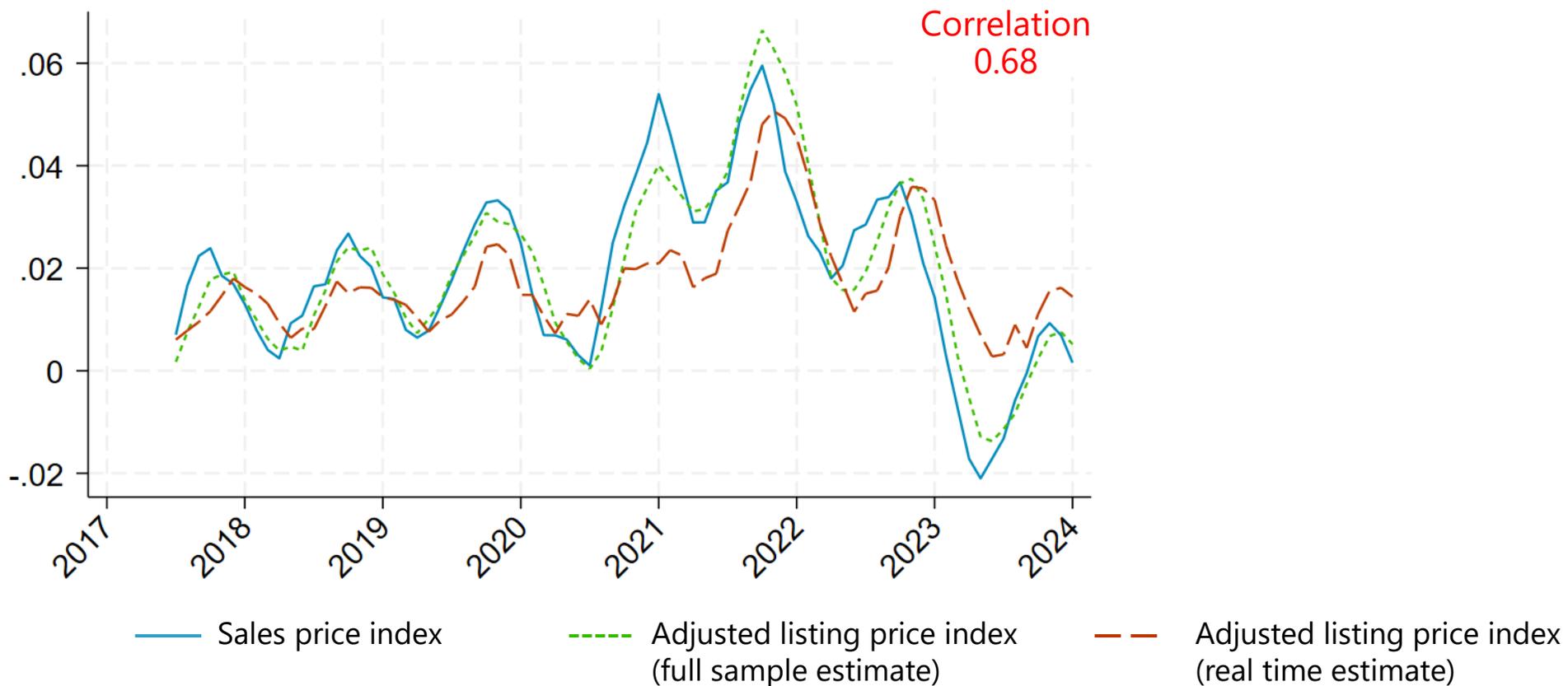
However, the trend sales-to-listing price ratio is not available in real-time and extrapolating it 1 year ahead leads to forecast errors at turning points

Estimated sales-to-listing price ratio for a house with average characteristics¹
(in %)



Therefore, the real-time adjusted listing price index performs worse (especially at turning points), but still yields a solid correlation with the sales price index

Six month growth rate of the house price index
(in %)



Conclusion

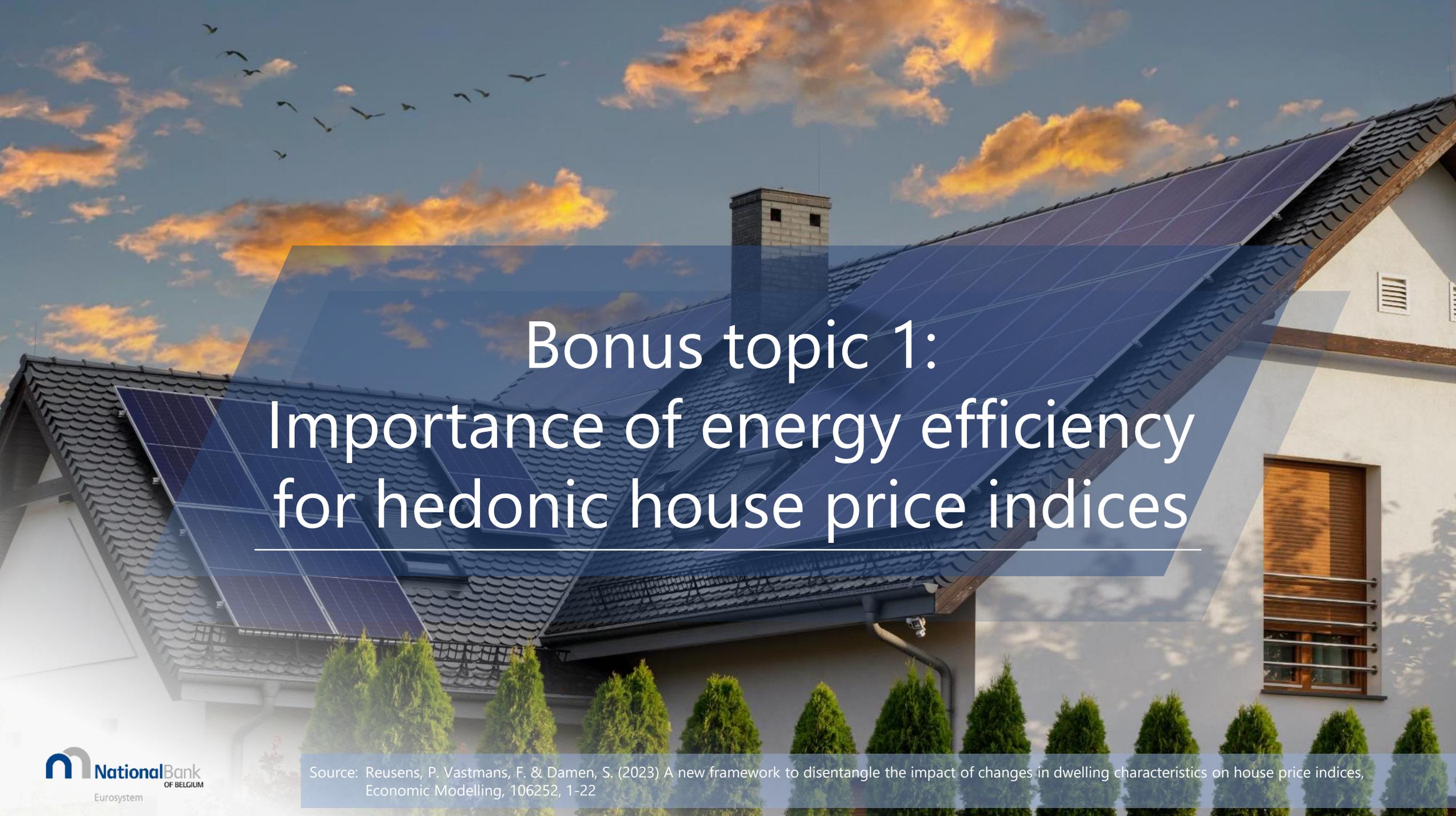
Conclusion

- Belgian listing prices have good real-time forecasting power 6 months ahead for the final sales price index
- Forecasting error mainly arises from difficulty in anticipating changes in the sales-to-listing price ratio
→ Using external timely indicators could improve our current simple “last-observed-value” approach
- More generally, the forecasting power of listing prices is larger for:
 - Markets with more stable sales-price-to-listing ratio (e.g. rental prices)
 - Countries with a longer lag between signing the sales agreement and official registration (≈3 months in BE/FR vs. 6 weeks in the US)

References

- Reusens, Vandenbergh (2026) A Timely House Price Index for Belgium: Integrating Listings and Transactions for Improved Forecasting, Working paper.
- Reusens, Vastmans, Vandenbergh, van Kempen and Damen (2025) Impact of the Flemish energy renovation obligation on house prices [NBB Economic Review 2025 1](#)
- Reusens, P. Vastmans, F. & Damen, S. (2023). [A new framework to disentangle the impact of changes in dwelling characteristics on house price indices](#), *Economic Modelling*, 106252, 1-22

Contact: peter.reusens@nbb.be



Bonus topic 1: Importance of energy efficiency for hedonic house price indices

Unlike average house prices, hedonic house price indices correct for changes over time in the quality of the houses sold

Houses sold in Period 1 (illustrative example)



Houses sold in Period 2



Our paper proposes a new framework to disentangle and quantify the contribution of each individual dwelling characteristic to the quality change

- Standard log-linear hedonic regression model with changing coefficients

$$\log(p_{it}) = \delta_t + \sum_{k=1}^K \beta_t^k x_{it}^k + \varepsilon_{it} \quad \text{for } i = 1, \dots, N_t \text{ and } t = 0, \dots, T.$$

- Decomposition of the average price index as the product of the hedonic price index and the quality change

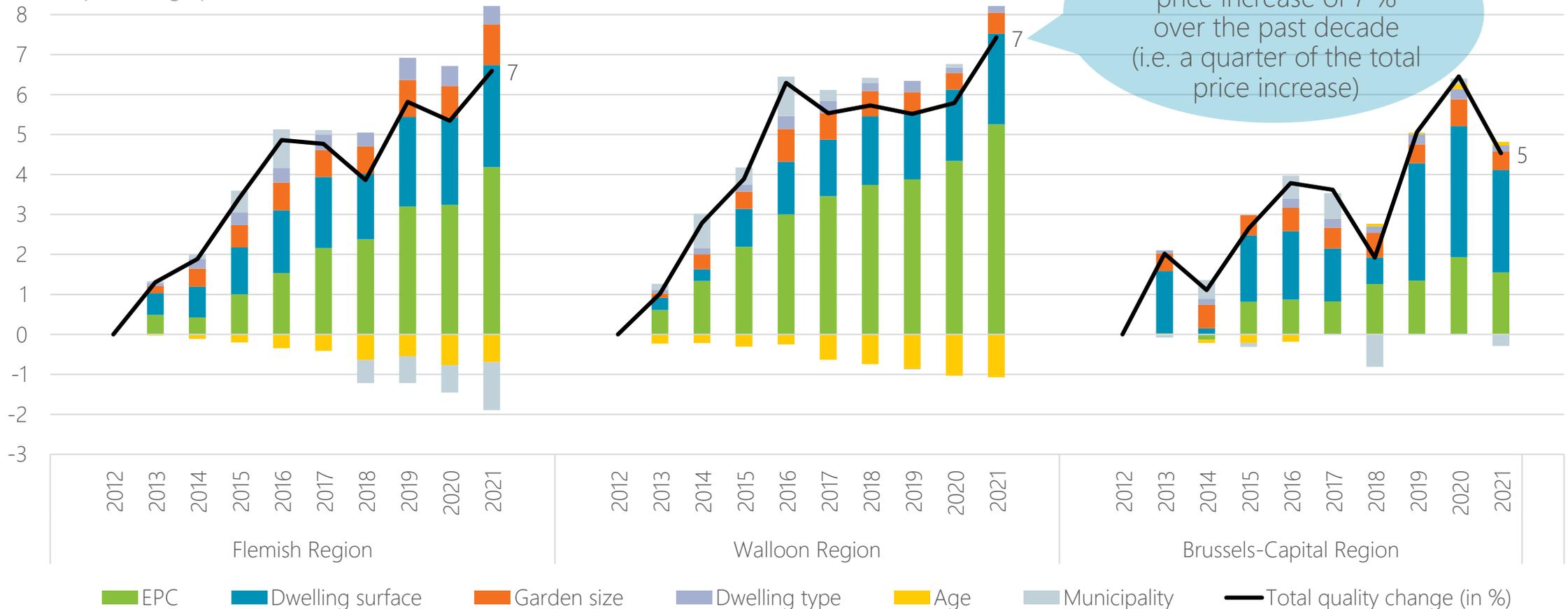
$$\underbrace{\frac{\prod_{i=1}^{N_t} p_{it}^{\frac{1}{N_t}}}{\prod_{i=1}^{N_0} p_{i0}^{\frac{1}{N_0}}}}_{\text{Geometric mean price index}} \approx \underbrace{I_t}_{\text{Hedonic price index}} \underbrace{\prod_{k=1}^K [1 + \hat{\beta}_{0t}^k (\bar{x}_t^k - \bar{x}_0^k)]}_{\text{Hedonic quality change}}$$

Contribution of variable k to the quality change

The quality of the houses sold has improved over the previous decade, mostly driven by improved energy efficiency (as well as larger dwelling sizes)

Contribution to the quality change of the sold houses¹

(in percentage points, 2012=0)



¹ The quality of the houses sold should be broadly interpreted as the value of their dwelling characteristics. Note also that apartments are excluded and that our years are shifted backwards by 2 quarters (e.g. our year "2021" corresponds to the period 2020Q3-2021Q2).

The hedonic house price index has risen 7% less over the past decade compared to average sales prices and it is less subject to (seasonal) fluctuations

Average and hedonic house price indices for the Belgian Regions

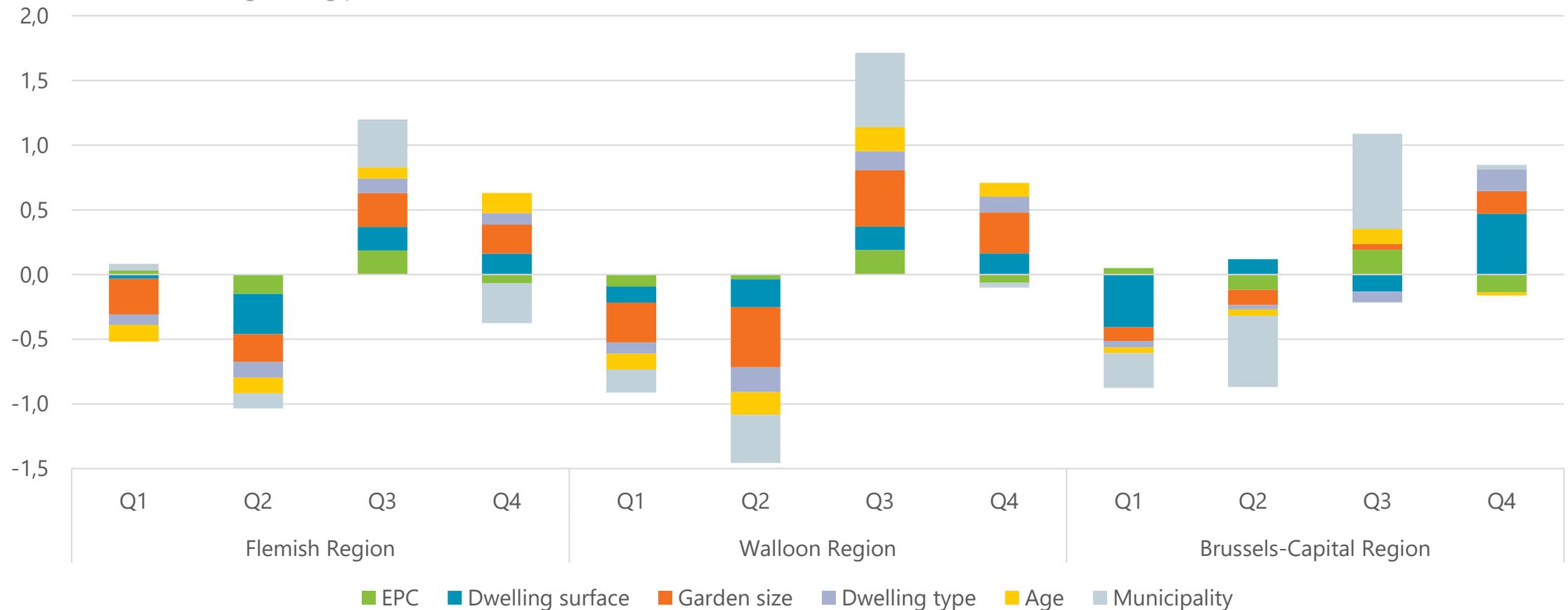
(index 2011Q3-2012Q2=100, nominal prices)



Seasonal pattern in hedonic quality change mainly reflects that dwelling and garden size is on average higher in Q3 and Q4 (sales of the Spring-Summer)¹

Hedonic quality composition effect: average seasonal effect

(in % of the average selling price)

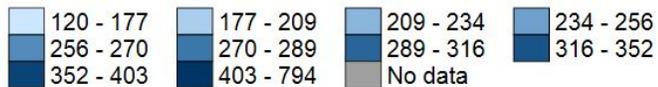
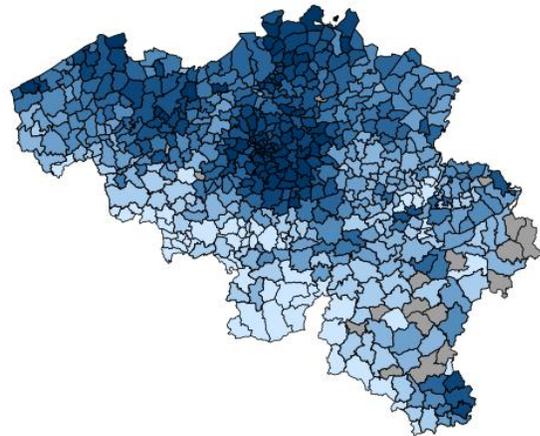


¹ As the notary deed take place about 3 months before the sales agreement, the actual sale of the houses takes place about one quarter earlier.

Average house prices of municipalities differ mainly due to location effect but to a lesser extent also due to quality characteristics (e.g. city houses are smaller)

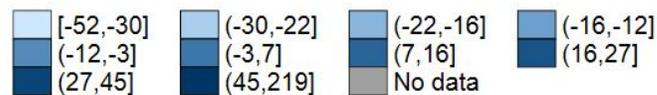
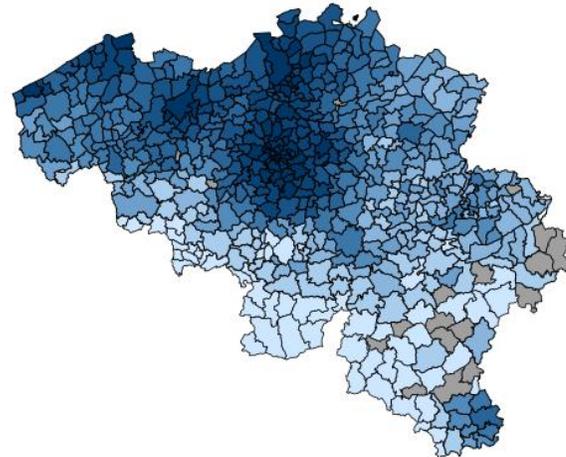
Average house price in 2021¹

(in '000 €)



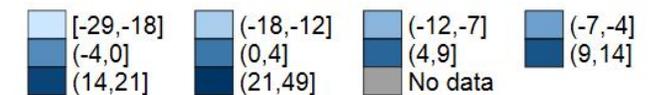
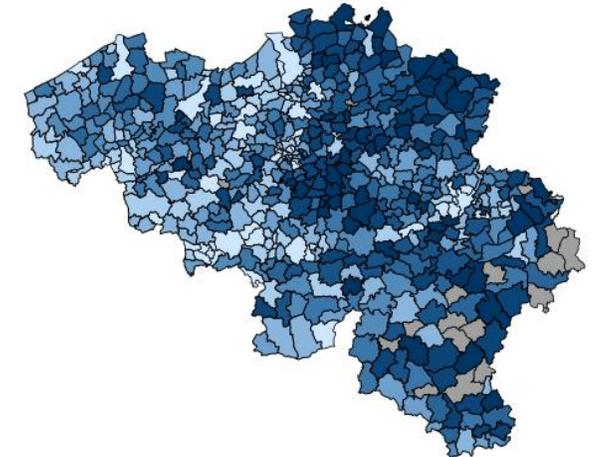
Price difference due to location

(% difference compared to the average municipality)



Price difference due to quality

(% difference compared to the average municipality)



Practical roadmap for the construction and interpretation of hedonic house price indices

