A Comparative Analysis of Dutch House Price Indices

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Motivation

- Analyze impact of **specification level** of house price index on **risk-return** profile of housing corporations
  - local indices
  - house type specific

- Four different suppliers of house price indices in the Netherlands
  - Dutch Brokerage Organization NVM
  - Statistics Netherlands (CBS) / Land Registry (Kadaster)
  - ABF
  - OrtaX

- Focus on comparison of returns:
  - averages
  - volatilities (standard deviations)
  - autocorrelations
## Motivation

### Price changes in percentages for the Netherlands

<table>
<thead>
<tr>
<th>Period</th>
<th>NVM</th>
<th>CBS</th>
<th>ABF</th>
<th>OrtaX</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008Q1</td>
<td>0.0</td>
<td>1.0</td>
<td>1.1</td>
<td>0.6</td>
</tr>
<tr>
<td>2008Q2</td>
<td>1.9</td>
<td>0.2</td>
<td>0.0</td>
<td>1.0</td>
</tr>
<tr>
<td>2008Q3</td>
<td>-0.7</td>
<td>1.2</td>
<td>1.1</td>
<td>0.8</td>
</tr>
<tr>
<td>2008Q4</td>
<td>-2.5</td>
<td>-0.7</td>
<td>-1.0</td>
<td>-0.2</td>
</tr>
<tr>
<td>2009Q1</td>
<td>-3.1</td>
<td>-1.0</td>
<td>-0.8</td>
<td>-1.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>-4.4</strong></td>
<td><strong>0.7</strong></td>
<td><strong>0.4</strong></td>
<td><strong>1.1</strong></td>
</tr>
</tbody>
</table>

![Graph showing price changes over time for various entities: ABF, CBS, OrtaX, and NVM. The graph spans from 1995 to 2010 with price levels ranging from 125 to 275.](image)
Outline

1. Motivation
2. Data
3. Price Index Construction Methods
   - Simple Statistics
   - SPAR
   - Hedonic
   - Repeat Sales
   - Comparison of methods
4. Comparison of Price Indices
   - Yearly
   - Quarterly
   - Monthly
5. Conclusions
House price index data

Two main data providers for selling prices in the Netherlands:

1. **NVM**: Dutch Brokerage Organization; from 1985 current market share: 70%
   - date of preliminary sale contract
   - asking price history, time on the market, transaction price
   - including all housing characteristics

2. **Kadaster**: (Kadaster/CBS, OrtaX, and ABF indices)
   - Availability of all prices in the Netherlands from 1993 (3.5 mln)
   - The only characteristics are
     - address details
     - house type
     - lot size
     - transaction date, price and circumstances (transaction between relatives, house is rented out, buyer is a legal entity, etc.)
   - Transaction date: date of legal transfer of property
   \[
   \text{Date}_{\text{Transfer property}} \approx \text{Date}_{\text{Preliminary sale contract}} + 2 - 6 \text{ Months}
   \]
**Price Index Construction Methods**

*Table:* Index methodologies.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>NVM</td>
<td>Median</td>
</tr>
<tr>
<td>CBS</td>
<td>SPAR (Sales Price Appraisal Ratio)</td>
</tr>
<tr>
<td>ABF</td>
<td>“Hedonic Price Model”</td>
</tr>
<tr>
<td>OrtaX*</td>
<td>Repeat sales</td>
</tr>
</tbody>
</table>

* OrtaX also provides hedonic price indices, however in this research only the repeat sales index is considered.
Simple Statistics: NVM

- Median selling price is calculated in period $t$ and $t + 1$ for each market segment
- A weighted average of the segment medians is calculated
  - weights: the relative number of sales

The relative price change equals

$$\left(\frac{M_{t+1}}{M_t} - 1\right) \times 100\%,$$

where

$$M_t = \frac{n_{1,t} \times M_{1,t} + \cdots + n_{B,t} \times M_{B,t}}{n_{1,t} + \cdots + n_{B,t}}.$$
Sale Price Appraisal Ratio (SPAR): CBS / Kadaster

SPAR is given by

\[
\text{Index}_{\text{SPAR},t} = \frac{\sum_{j=1}^{n_t} T_{jt} / \sum_{j=1}^{n_t} A_{j0}}{\sum_{j=1}^{n_0} T_{j0} / \sum_{j=1}^{n_0} A_{j0}}
\]

- \( T \) is the transaction price (not in logs)
- \( A \) is the appraised value (WOZ-value); to correct for the differences between properties
- for each property an appraised value must be available
- (almost) all transaction prices are used
- WOZ-value is not always market value because of fictions
- Easy to construct
- Constant quality index
Hybrid method: ABF (WOX index model)

Four steps

1. *Hedonic* price model per COROP region
2. *Comparability* model per COROP region: comparability coefficient between 0 and 1
3. A typical house is selected per zipcode: the value is determined by a weighted average of corrected sales prices
   - corrected sales price: from step (1)
   - weights: from step (2)
4. Price index for a segment is calculated by aggregating the monthly values
Hybrid method: ABF (WOX index model)

WOX index model
- a constant quality index
- a total housing stock index
  - not only transacted houses, or owner-occupied houses
- vulnerable to specification errors
  - functional form
  - omitted variables
- ad hoc method:
  - combining hedonics and comparables
  - how to compute confidence bounds for price changes?
  - re-estimating the model every month can result in unexpectedly varying coefficients/indices over time
Local linear Trend Repeat Sales Model (OrtaX)

Case and Shiller (1987, 1989) repeat sales model

\[ y_{it} - y_{is} = \beta_t - \beta_s + \varepsilon_{it} - \varepsilon_{is} + \omega_{i,s+1} + \cdots + \omega_{i,t}, \]

- \( y_{it} - y_{is} \): difference in log transaction price
- \( \beta_t \) is price level at time \( t \)
- Assumptions:
  - characteristics do not change over time
  - Influence of characteristics is constant over time
- Smoothing:
  - Goetzmann (1992): periodic return is normally distributed:
    \( \Delta \beta_t \sim N(\kappa, \sigma^2) \)
  - Local linear trend repeat sales (Francke, 2009): varying slope:
    \( \Delta \beta_t \sim N(\kappa_t, \sigma^2) \), and \( \kappa_t \) follows a random walk, \( \kappa_{t+1} = \kappa_t + \eta_t \).
Local linear Trend Repeat sales model

- It is a constant quality index
- **All single transactions are omitted** (approx. 40% remains).
- **Sample selection bias** Properties with high number of transactions may not be representative.
  - Solution: Heckman’s (1979) procedure, Gatzlaff and Haurin (1997)
- **Revision** Due to the repeat sales structure updating of index produces “backward adjustments” in the historical return series as new “second sales” link back to earlier “first sales”.
  - Local linear trend model reduces considerably revision effect.
- **Flips** Properties sold within short time periods (say 6 months) can have extreme price increases.
  - Flips can either be removed from sample or explicitly modeled.
- **Volatile** In small samples the estimated price trend can be very volatile, due to noise in the transaction prices.
  - Local linear trend model reduces effect of transaction noise.
## Comparison of transaction based index methods

<table>
<thead>
<tr>
<th></th>
<th>NVM</th>
<th>CBS</th>
<th>ABF</th>
<th>OrtaX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transaction date</strong></td>
<td>Sales contract</td>
<td>Legal transfer</td>
<td>Legal transfer</td>
<td>Legal transfer</td>
</tr>
<tr>
<td><strong>Data</strong></td>
<td>Subsample</td>
<td>All</td>
<td>All</td>
<td>Subsample</td>
</tr>
<tr>
<td><strong>Sample selection bias</strong></td>
<td>Less</td>
<td>Less</td>
<td>Less</td>
<td>More</td>
</tr>
<tr>
<td><strong>Constant quality</strong></td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Appraised values required</strong></td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Detailed property information required</strong></td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Vulnerable to specification error</strong></td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Ass. of no change in characteristics</strong></td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Ass. of no change in impact of char.</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Revisions</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
Comparison of Price Indices

Table: Details on start, frequency, region and house type classification of different indices.

<table>
<thead>
<tr>
<th></th>
<th>Start</th>
<th>Frequency</th>
<th>Region</th>
<th>House Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>NVM</td>
<td>1985Q1*</td>
<td>Q/Y</td>
<td>NVM/NL</td>
<td>T, R, C, S, D, A</td>
</tr>
<tr>
<td>CBS</td>
<td>1995M1</td>
<td>M/Q/Y</td>
<td>PROV/NL</td>
<td>T, SF, R, C, S, D, A</td>
</tr>
<tr>
<td>ABF**</td>
<td>1995Q1</td>
<td>Q/Y</td>
<td>COROP/PROV/NL</td>
<td>T, SF, A</td>
</tr>
<tr>
<td>OrtaX</td>
<td>1993M1</td>
<td>M/Q/Y</td>
<td>NVM/COROP/PROV/NL</td>
<td>T, R+C, S, D, A</td>
</tr>
</tbody>
</table>

* Also available from 1972 on a yearly basis.
** Publicly available.

Effect of Transaction Noise

- Expectation: No effect
- Standard deviation: Increase
- Autocorrelation: Decrease
Comparison of Price Indices

COROP Regions and Provinces

Francke, Kuijl, and Kramer (Ortec Finance)
Yearly price changes


<table>
<thead>
<tr>
<th></th>
<th>All houses</th>
<th>NVM 72-08</th>
<th>NVM</th>
<th>CBS</th>
<th>ABF</th>
<th>OrtaX</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\mu$</td>
<td>6.5%</td>
<td>7.0%</td>
<td>8.4%</td>
<td>7.9%</td>
<td>8.2%</td>
<td></td>
</tr>
<tr>
<td>$\sigma$</td>
<td>9.7%</td>
<td>5.2%</td>
<td>5.1%</td>
<td>4.7%</td>
<td>4.4%</td>
<td></td>
</tr>
<tr>
<td>ACF(-1)</td>
<td>0.617</td>
<td>0.592</td>
<td>0.758</td>
<td>0.754</td>
<td>0.799</td>
<td></td>
</tr>
<tr>
<td>ACF(-2)</td>
<td>0.221</td>
<td>0.232</td>
<td>0.421</td>
<td>0.418</td>
<td>0.516</td>
<td></td>
</tr>
</tbody>
</table>

- The NVM has a lower average rate of return
- The volatility almost doubles when the sample period is extended to 1972–2008.
- Variation over house types
  - Average: from 7.7% (row houses) to 9.8% (detached houses)
  - Volatility: from 4.4% (row houses) to 6.6% (detached houses)
- No large differences between different methods, except for detached houses
  - CBS: average and volatility: 9.8% and 6.6%
  - OrtaX: average and volatility: 8.9% and 5.2%
Quarterly price changes

Comparison ABF and OrtaX price changes over COROP regions (40)

- Large variation between COROP regions:
  - Average return varies from 1.54% (1.45%) to 2.25% (2.20%)
  - Volatility varies from 1.12% (1.35%) to 1.51% (2.79%)

- There is some spatial clustering in the average return rate.
  - High average returns can be found in the Amsterdam region (21–24), Friesland (4–6) and Brabant (35–36), all > 2.0%.
  - On the lower end the regions Limburg (37–39) and Flevoland (40) can be found.

- On average the volatility of the ABF series is much higher than the OrtaX series, 1.96% versus 1.12%.
  - The ABF series show some negative autocorrelation for the first time-lag. A possible explanation is the impact of transaction noise in the index: negative autocorrelations tend to coincide with large volatilities. A large price increase (decrease) in one period is compensated for in the next period, resulting in negative autocorrelations.
Monthly price changes

Comparison CBS and OrtaX price changes over provinces (12)

- Differences in average return rates between CBS and OrtaX are small
- Differences in average return rates over provinces are substantial
  - From 136% (Limburg) to 222% (Noord-Holland) price increase in the period 1995–2008
- Differences in volatilities between CBS and OrtaX are large
  - Average volatility CBS: 1.23%
  - Average volatility OrtaX: 0.36%
  - Volatility CBS series ranging from 0.77% to 1.79% over provinces (average rate of return is 0.63%)
  - Volatility OrtaX series ranging from 0.28% to 0.44% over provinces
Monthly price changes

Comparison CBS and OrtaX price changes over provinces (12)

- The CBS series can be characterized by having large standard deviations and negative first time-lag autocorrelation;
  - for row houses between 0.88% and 2.35%,
  - for semi-detached houses between 1.46% and 4.13%,
  - for detached houses between 2.18% and 5.41%, and
  - for apartments between 0.97% and 6.93%.
- The impact of transaction and appraisal noise is apparently higher, as the number of observations can be quite small (24 a month)

- The OrtaX series can be characterized by having relatively small standard deviations and relatively large autocorrelations.
  - The standard errors are ranging between 0.31% and 0.43% for row houses,
  - for semi-detached houses between 0.24% and 0.45%,
  - for detached houses between 0.28% and 0.54% and
  - for apartments between 0.29% and 1.28%.
  - The autocorrelations are approximately 0.95 for time-lag 1, 0.90 for time-lag 2 and 0.65 for time-lag 12.
Price Index for thin market

CBS/Kadaster Monthly Price Index for Apartments in Friesland

Monthly Price change in %

Francke, Kuijl, and Kramer (Ortec Finance)
Conclusions

- NVM index
  - leading the other indices
  - no constant quality index: unreliable in thin markets

- Other index series
  - Differences in averages and volatilities over regions/house types
  - Differences between methods
    - OrtaX series is the only series where monthly/quarterly/yearly volatilities are consistent

<table>
<thead>
<tr>
<th>Volatilities (all houses)</th>
<th>CBS</th>
<th>ABF</th>
<th>OrtaX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yearly</td>
<td>5.10%</td>
<td>4.70%</td>
<td>4.40%</td>
</tr>
<tr>
<td>Quarterly (annualized)</td>
<td>8.07%</td>
<td></td>
<td>4.56%</td>
</tr>
<tr>
<td>Monthly (annualized)</td>
<td>15.80%</td>
<td></td>
<td>4.41%</td>
</tr>
</tbody>
</table>

- Companion paper: “The impact of house price index specification levels on the risk profile of housing corporations” (Session 6E - Housing)