Assessing house prices in Germany: evidence from an estimated stock-flow model using regional data

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The presentation is based on a revised version of our Bundesbank Discussion Paper No 46/2013. The views expressed represent the authors' personal opinions and not necessarily those of the Deutsche Bundesbank or its staff.
Motivation

- Since 2010 relatively strong house price increases in Germany
- Regional heterogeneity
- Which macroeconomic factors help to explain house prices?
- How large is the deviation of house prices from their fundamental value?
- Differentiate between subsets of regions
Benefits of regional data

- Standard valuation indicators based on short sample or limited regional/sectoral coverage

- Signs of coefficients in house price equation based on time-series approaches sometimes hard to interpret

- House prices in €/sqm and several standard macroeconomic variables for 402 districts 2004-2013

- Cross-section variation provides more information than time-series dimension for German data

- Evaluate house price developments in different subsets of regions
Panel model specification

- Estimation equation

\[ p_{it} = \beta' x_{it} + \delta' w_{t} + c_{i} + \epsilon_{it} \]

- \( p_{it} \): real house price in district \( i=1,2,\ldots,I \) and period \( t=1,2,\ldots,T \)
- \( x_{it} \): housing stock \( (s_{it}) \), income \( (y_{it}) \), population aged between 30 and 55 \( (a_{it}) \), population density \( (d_{it}) \), unemployment rate \( (u_{it}) \)
- \( w_{t} \): interest rate \( (r_{t}) \), growth expectations \( (g_{t}^{e}) \)
- Unobserved district-specific effects \( c_{i} \)

- Logarithmic specification
- Explanatory variables measured in volumes expressed in per-capita terms
Hausman-Taylor estimator

- Instrumental variables random-effects estimator which can account for endogenous regressors

- Use IVs on individual endogenous regressors

- Hausman-Taylor (1981): district-specific means of exogenous regressors as instruments; time-demeaned regressors for endogenous variables

  \[ \bar{y}_i, \ldots, s_{it} - \bar{s}_i, \ldots \]

- Hausman-Wu test to determine exogenous regressors
Baseline estimation results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Apartments</th>
<th>Single-family houses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hausman-Wu test statistic</td>
<td>HT</td>
</tr>
<tr>
<td>$a_{it}$</td>
<td>11.6</td>
<td>$-1.31^{***}$</td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
<td></td>
</tr>
<tr>
<td>$y_{it}$</td>
<td>$-0.6$</td>
<td>$-1.4$</td>
</tr>
<tr>
<td>$a_{it}$</td>
<td>2.5</td>
<td>$2.45^{***}$</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(0.09)</td>
</tr>
<tr>
<td>$d_{it}$</td>
<td>4.1</td>
<td>$0.43^{***}$</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td></td>
</tr>
<tr>
<td>$u_{it}$</td>
<td>$-19.0$</td>
<td>$-23.6$</td>
</tr>
<tr>
<td>$r_t$</td>
<td>$-2.96^{***}$</td>
<td>$-0.65^{***}$</td>
</tr>
<tr>
<td></td>
<td>(0.19)</td>
<td>(0.17)</td>
</tr>
<tr>
<td>$g_t^C$</td>
<td>$10.48^{***}$</td>
<td>$4.42^{***}$</td>
</tr>
<tr>
<td></td>
<td>(0.97)</td>
<td>(0.86)</td>
</tr>
<tr>
<td>constant</td>
<td>5.43***</td>
<td>6.44***</td>
</tr>
<tr>
<td></td>
<td>(0.19)</td>
<td>(0.15)</td>
</tr>
</tbody>
</table>

$R^2$
- within: 0.50
- between: 0.15
- overall: 0.16
- Obs: 4020

Robust standard errors in parentheses. *, **, *** denotes significance on the 10%, 5%, 1%-level. Instruments: District means of exogenous regressors and demeaned endogenous regressors, except those whose within-correlation with prices differs in sign from their between-correlation.
Aggregate house price misalignment

- Fundamental house price = fitted house price from panel estimation $\hat{p}_{it}$

- Measure for aggregate house price misalignment

\[
\hat{e}_t = \ln p_t - \ln \hat{p}_t = \sum_{i=1}^{I} \frac{n_{it}}{n_t} \hat{e}_{it} = \sum_{i=1}^{I} \frac{n_{it}}{n_t} (\ln p_{it} - \ln \hat{p}_{it})
\]

- With variance

\[
\text{Var} \{ \hat{e}_t \} = \sum_{i=1}^{I} \left( \frac{n_{it}}{n_t} \right)^2 \text{Var} \{ \hat{e}_{it} \} + 2 \sum_{i=1}^{I} \left( \frac{n_{it}}{n_t} \right)^2 \text{Cov} \{ \hat{e}_{it}, W \hat{e}_{it} \}
\]

- Moran’s I:

\[
\rho_{\hat{e}_t,W\hat{e}_t} = \frac{\text{Cov} \{ \hat{e}_{it}, W \hat{e}_{it} \}}{\text{Var} \{ \hat{e}_{it} \}}
\]
Results: Deviations from fundamental price

Whole country

Baseline estimate
95% confidence band

93 cities

Baseline estimate
95% confidence band

7 big cities

Baseline estimate
95% confidence band
Extended sample period for a subset of cities

- Sample period 2004 – 2013: Residential property broadly undervalued?

- Growth expectations and interest rates without cross-section

- Caveat: Correlations along time dimension get more important
Estimation sample 1996-2013

- **Single-family houses**
  - 93 cities
  - Baseline estimate and 95% confidence band

- **Apartments**
  - 7 big cities
  - Baseline estimate and 95% confidence band

Estimation sample 1996-2013
The role of interest rates

- Quantify the effect of the exceptionally low interest rates (and mortgage rates) on house prices

- Scenario A: Constant interest rates since 2009
Conclusions

- Cross-section variation helps to pin down important drivers of house prices
- Signs of coefficients in line with economic intuition
- For Germany as a whole virtually no overvaluation of residential property
- In the cities sizeable overvaluations of apartments, for single-family house prices modest deviations from fundamentals
- Downward trend in real house prices since the mid-1990s associated with declining long-term growth expectations
- Apartments prices around 4 percentage points higher due to currently exceptionally low level of interest rates.
Thank you for your attention!