How does an increase in energy efficiency affect housing prices?

A case study of a renovation

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Energy efficiency and housing prices: some context

- **Energy efficiency is a key topic**
  - An EU-Directive states a goal of increasing the energy efficiency of the economy by 20% until 2020
  - The largest potential for increasing energy efficiency lies in buildings – among them, residential housing properties

- **Energy efficiency has several positive effects:**
  - A greener economy
  - Smaller energy costs – possible questions:
    - Can residential properties be renovated in a cost-effective way?
    - **How does greater energy efficiency influence housing prices?**
Related literature: a very brief overview

- Most economics papers on the subject measure energy efficiency through "energy labels" or similar, official designations.

- There are at least two current research papers focusing on European countries:
  - Brounen et al (2011): Holland

- Both find significant positive effects: greater energy efficiency entails a higher price.
Our case study: Faluház

- „Faluház“ (meaning „house for a whole village“) is the largest residential building in Hungary
  - It has 10 floors, 15 staircases, 884 flats and over 3000 inhabitants
  - It is located in the third district of the capital city Budapest (despite its name, not in a village!)
  - It is a so-called „block house“, built of ready-made concrete blocks, and is surrounded by similar buildings
  - In the past decade, it has undergone major energy-efficiency related renovation
  - No such renovation has taken place in the surrounding blocks

=> A natural experiment!
Faluház and its surroundings
Faluház and its surroundings

controls

Faluház
Renovations in Faluház

- 2004/05: It became possible for inhabitants to regulate the level of heating in their own flats (however, energy usage was still not measured individually)
  - Cost: 62 000 HUF/flat – about 210 EUR
  - Source: inhabitants’ contributions and government funds

- 2009: Major renovation: insulation, windows replaced, energy usage (heating and hot water) became measureable and billable to each flat separately, solar panels installed
  - Cost: 1 330 000 HUF/flat – about 4500 EUR
  - Source: inhabitants’ contributions (27%), government and EU funds
Data

- **Transaction data from 2003 onwards**
  - Price, size, address, year, whether the property is a block flat, ...
  - „Faluház“ transactions can be identified by their address
  - The surrounding block flats are the control group
    - We conducted field studies to pinpoint the exact addresses in the control group

- **Data on energy costs for Faluház flats (at 2011 prices)**
  - 2004: 220,000 HUF/flat (net) – about 745 EUR
  - 2008: 197,000 HUF/flat (net) – about 670 EUR
  - 2011: 150,000 HUF/flat (net) – about 510 EUR
Number of observations by year

2003: Faluház, Control group
2004: Faluház, Control group
2005: Faluház, Control group
2006: Faluház, Control group
2007: Faluház, Control group
2008: Faluház, Control group
2009: Faluház, Control group
2010: Faluház, Control group
2011: Faluház, Control group
2012: Faluház, Control group
Number of observations by year

Median price


Faluház  Kontroll
Median price per square metre

Median price

Faluház  Kontroll
Median price per square metre, for 49sqm flats

Median price
Methodology

- A difference-in-differences estimation:

\[ y = \beta_0 + \beta_1 \text{after} + \beta_2 \text{faluhaz} + \]
\[ + \beta_3 \text{after} \times \text{faluhaz} + \text{controls} \]

- Now, \( \hat{\beta}_3 \) is the DID-estimator that we seek:

\[ \hat{\beta}_3 = (\bar{y}_{\text{faluhaz,after}} - \bar{y}_{\text{faluhaz,before}}) - \]
\[ (\bar{y}_{\text{control,after}} - \bar{y}_{\text{faluhaz,before}}) \]
Methodology

- The dependent variable:
  - Log of the price per square metre, deflated by a local housing price index
  - The price per square metre, deflated by a local housing price index
  - The price, deflated by a local housing price index

- Controls:
  - Year dummies, to pick up any residual trends
  - Size of the flats (and the square of the size)
The timeline

Relevant time periods:
- Before the first renovation: 2003
- The first renovation: 2004-05
- Between the two renovations: 2006-08
- The second renovation: 2009
- After the second renovation: 2010-12
The first renovation (2004-05): no significant effect

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<tbody>
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<td></td>
<td>(0.0556***)</td>
<td>(10 538***</td>
<td>(456 795**)</td>
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<td>(0.0198)</td>
<td>(3 930)</td>
<td>(207 806)</td>
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<td>Faluház</td>
<td>(-0.0968**)</td>
<td>(-18 565***</td>
<td>(-802 899***</td>
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<td>317 928</td>
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<td>(0.0428)</td>
<td>(6 607)</td>
<td>(330 651)</td>
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<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Year dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Observations</td>
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<tr>
<td>R-squared</td>
<td>0.133</td>
<td>0.160</td>
<td>0.281</td>
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The second renovation (2009): a strong, significant effect

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<td><strong>After</strong></td>
<td>-0.0586*** (0.0246)</td>
<td>-13 099*** (5 187)</td>
<td>-817 882*** (282 344)</td>
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<td>Faluház</td>
<td>-0.0475** (0.0197)</td>
<td>-12 556*** (3 597)</td>
<td>-548 305*** (181 817)</td>
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<td><strong>Faluház·After</strong></td>
<td>0.0981*** (0.0289)</td>
<td>19 921*** (5 576)</td>
<td>1 091 940*** (290 877)</td>
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<td>R-squared</td>
<td>0.147</td>
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Discussion

There are several aspects of placing these price difference results in context:

1. Comparing the price difference (stock) with the savings in energy costs (flow)
   - Answers questions such as: “Do buyers gauge correctly the savings that greater energy efficiency entails?”

2. Comparing the price difference with the cost (borne by the owners, or by outside sources)
   - Answers questions such as: “Are outside sources needed in order to make energy efficiency investments worthwhile for owners?”
Discussion, ctd.

A few back-of-the-envelope calculations:

1. The relationship between the savings and the price difference is plausible:
   - The present value of about 50 000 HUF (about 170 EUR) savings per year, at a 4% interest rate, and a 10% price increase, over 15 years is 1 million HUF (about 3380 EUR) – the price increase we found

2. The relationship between the costs and the price difference implies that outside funding is necessary:
   - Costs of around 1.3 million HUF (about 4500 EUR) as opposed to a price increase of around 1 million HUF (about 3380 EUR)
Conclusions and further work

- The major, energy-efficiency related renovation of 2009 significantly affected housing prices.

- Further work:
  - We are striving to obtain more data on the exact cash flows connected to the renovation
  - Energy labels introduced in Hungary in 2012: if data can be obtained, it would be interesting to see their effect
  - This is a case-study, however, several similar renovations have taken place in Hungary: a more general approach?
Thank you for your attention!
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