Split incentives, asymmetric information and energy efficiency subsidies

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Introduction

- **Split incentives**: one agent decides how much to invest in energy efficiency, while another agent uses capital and pays operating costs, e.g. landlord-tenant
- In a perfect market, differences in energy efficiency will capitalize in prices thereby creating the necessary incentives to invest optimally
- If information is asymmetric, end users might not be willing to pay for full savings mitigating the incentive for producers to invest → **agency issues**
- Previous papers: energy efficiency gap when incentives are split.
- Agency issues might not only contribute to the energy efficiency gap, but also lower **cost-effectiveness** of **subsidy programs** aiming to close this gap

This paper

Research design: compare cost-effectiveness and response to a subsidy program between a regime in which incentives are split (developer-buyer) to a regime in which they are not

Results:

- Cost per kWh saved is two to seven times higher in case incentives are split.
- Lower cost-effectiveness is the result of a smaller response:
  - Response at extensive margin is ten times lower
  - Response at intensive margin is about half
- Additional evidence suggests information w.r.t. energy efficiency is asymmetric
- Cost-effectiveness of program would improve 33% if information is perfect

Literature

This paper bridges an important gap between two literatures:

1. Agency issues in energy efficiency investment
   (e.g. Davis, 2012; Gillingham et al., 2012; Myers, 2020)
   - Contribution: first evidence on agency issues between developers and buyers in market for new residential development → argument for building energy code

2. Effectiveness of subsidy programs for energy efficiency investments
   (e.g. Davis et al., 2014; Alberini et al., 2016; Houde and Aldy, 2017)
   - Contribution: identify agency issues as an important determinant of the cost-effectiveness of subsidy programs

Policy

- Property tax reduction for energy efficient housing units in Flanders in 2009
  - Based on E-level: measure of energy efficiency similar to EPC
- Newly developed or thoroughly renovated units
- Energy efficiency level of housing unit below or equal to threshold level
- Tax reduction of 20% (E60) to 40% (E40) for ten years
- Statutory incidence of property tax falls on owner of housing unit
  1. Build your own house → incentives not split (owner-built units)
  2. Buy a house built by a developer → incentives are split (developer-built units)

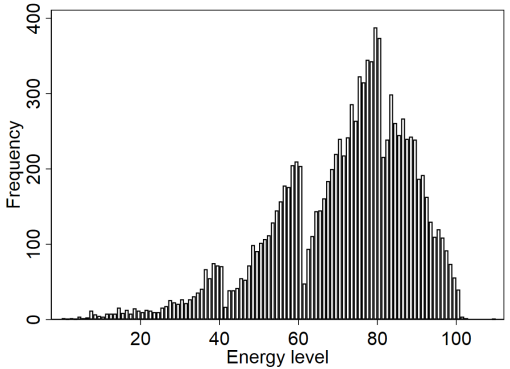
Data and empirical methodology

- Energy performance and indoor climate declarations (EPB)
  - 87,108 housing units in the EPB data
  - 54,684 housing units (63%) developer-built
  - 32.382 housing units (37%) owner-built
- Follow bunching approach developed by Kleven and Waseem (2013): estimate counterfactual E-level distribution around thresholds

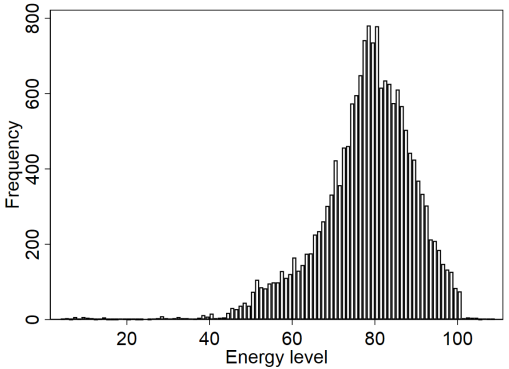
$$n_j = \sum_{i=0}^{p} \beta_i (E_j)^i + \sum_{k=L}^{U} \gamma_k \mathbb{1}(E_k = E_j) + \epsilon_j \tag{1}$$

Preliminary evidence

Figure 1. The distribution of E-levels of housing units with an application from 2009



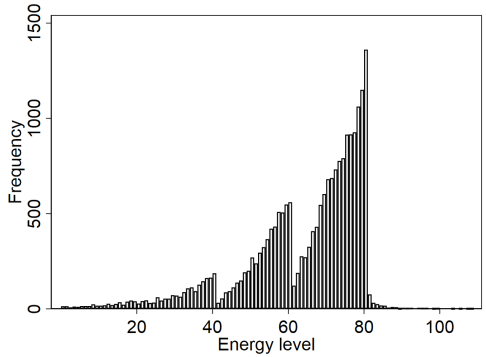
(a) Owner-built units



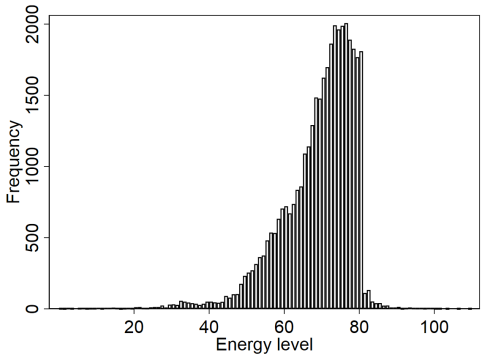
(b) Developer-built units

Preliminary evidence

Figure 3. The distribution of E-levels of housing units with an application 2010-2011

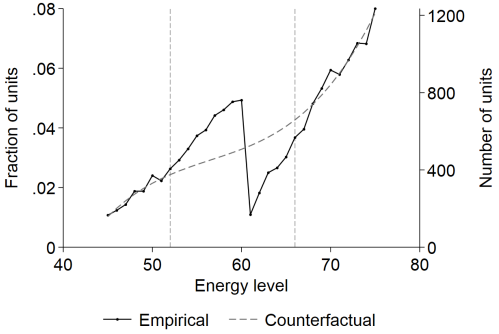


(a) Owner-built units

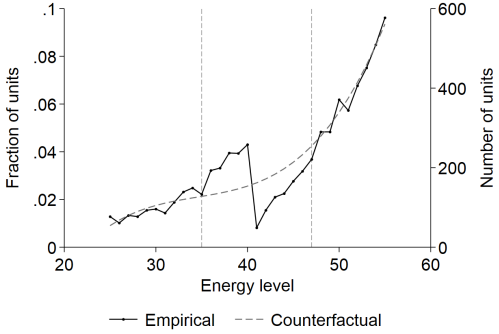


(b) Developer-built units

Empirical and counterfactual distributions: owner-built units

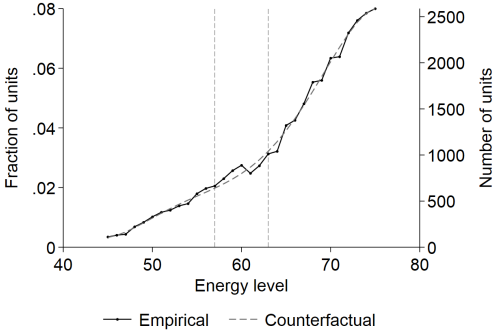


(a) Threshold E60

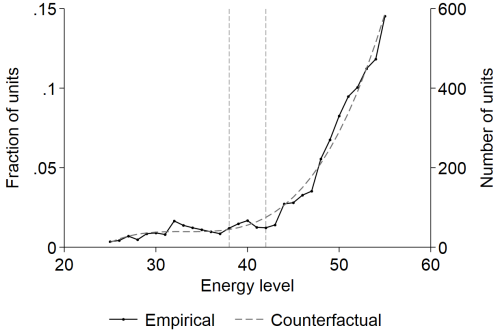


(b) Threshold E40

Empirical and counterfactual distributions: developer-built units



(a) Threshold E60



(b) Threshold E40

Program cost, energy savings and cost-effectiveness

- Total savings in E-points more than 10 times larger in owner-built sample
  - Owner-built: 9,705 vs. developer-built: 640
  - Corresponds to annual savings in kWh equal to 4,486,816 and 295,924
- Total program cost only roughly twice as large in owner-built sample
  - Corresponds to a cost per saved kWh equal to 0.37 euro and 2.71 euro
- Difference in cost per saved kWh smaller when we only consider houses
  - Cost per saved kWh equal to 0.37 euro and 0.68 euro

Inframarginal units and average reduction at E60

- Inframarginal use = inframarginal units/eligible units
  - Owner-built: 86% vs. developer-built: 97%
  - Only houses: Owner-built: 86% vs. developer-built: 94%
- Conditional average reduction in E-points
  - Owner-built: 5.12 vs. developer-built: 2.12
  - Only houses: Owner-built: 5.12 vs. developer-built: 5.43
- Average yearly tax reduction actually higher in owner-built sample (199.60 vs. 153.95 euro)

Asymmetric information

- Developers are not obligated to communicate conditional E-level during sale
- Housing units are sold before E-level officially certified
- Final E-level differs from listed E-level in data from largest Belgian real estate agency:
  - Listed E-level: 65.13 (19.25)
  - Final E-level: 63.43 (20.60)

  } Difference: 1.70 (7.96)
- Builders might be better aware of subsidy programs than buyers
  - Builders hire an EPB certifier
  - Search for information regarding energy efficiency investments

Asymmetric information

Did the tax reduction capitalize into sales prices?

$$ln(P)_{it} = \beta_1 \times E_i + \beta_2[\gamma_{E_T} T_i \times D(r, H_t)] + \delta' X_i + \tau_t + \mu_m + \varepsilon_{it} \quad (2)$$

	Constructed in 2009-2011			Full sample		
	(1)	(2)	(3)	(4)	(5)	(6)
E-level (β_1)	-0.0020***	-0.0006	-0.0010	-0.0020***	-0.0009***	-0.0012***
	(0.0004)	(0.0004)	(0.0009)	(0.0002)	(0.0002)	(0.0003)
Reduction (β_2)			-0.0195			-0.0112
			(0.0366)			(0.0097)
Characteristics	No	Yes	Yes	No	Yes	Yes
Observations	3,142	3,128	3,083	9,245	9,144	8,980
R^2	0.33	0.61	0.61	0.25	0.56	0.56

Counterfactual analysis

	All	Owner	Developer		
			All	Houses	Apartments
	(1)	(2)	(3)	(4)	(5)
Baseline	0,46	0,37	2,71	0,68	7,03
Energy efficiency	0,44	0,37	1,18	0,63	1,64
Bunching rate	0,36	0,37	0,35	0,17	0,64
Inframarginal use	0,43	0,37	0,62	0,28	1,21
Full information	0,31	0,37	0,24	0,24	0,25

Conclusion

- We compare the cost-effectiveness of a subsidy program between a group in which agency issues are present to a group in which they are not
- Cost per kilowatt-hour saved is seven times larger in the sample of developer-built housing units
- Cost-effectiveness of the subsidy program would improve 33% if response in both samples was similar
- Additional evidence points to asymmetric information w.r.t. energy efficiency level of housing units
- Agency issues due to asymmetric information significantly lower cost-effectiveness of subsidy programs
  - Policy recommendation: change statutory incidence