Evidence, drivers and sources of distortions in the distribution of building energy ratings prior to and after energy efficient retrofitting

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- EU Energy Performance of Buildings Directive (2002) imposed framework to calculate energy efficiency

- Are there any unintended consequences?
  - Incentive to manipulate assessments: more efficient homes could attract a price premium or seem more attractive to renters
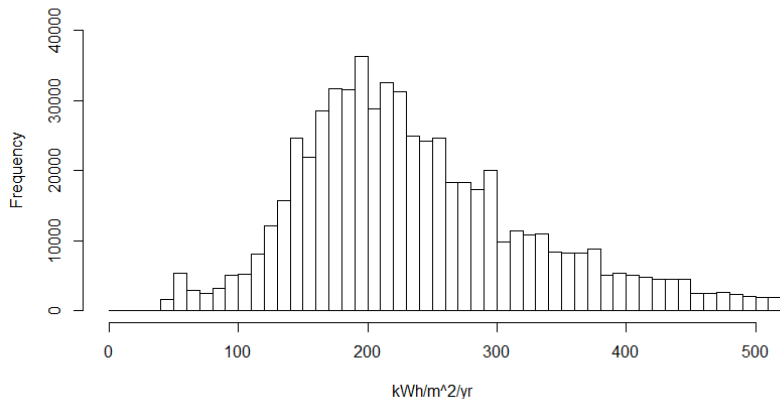
Building Energy Rating

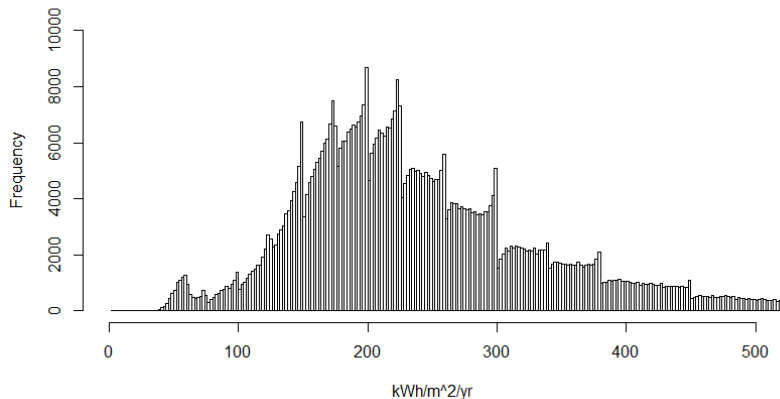Irish Residential Energy Performance Certificate:
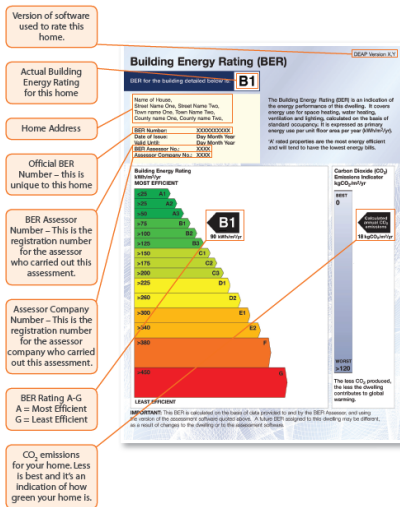
Motivation I

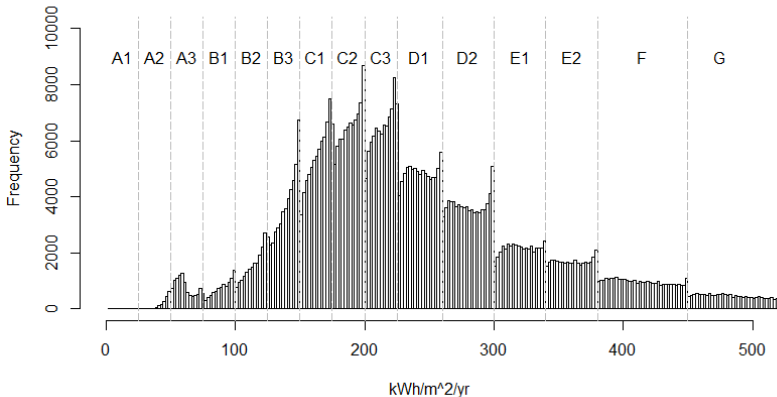Distribution of Building Energy Ratings among retrofit grant scheme participants:

Motivation II

Same distribution of Building Energy Ratings among retrofit grant scheme participants:

Same distribution of Building Energy Ratings among retrofit grant scheme participants:

Research Questions

1. Is there statistically significant evidence of bunching in the distribution of pre-works and post-works Building Energy Ratings?

2. Are there identifiable drivers of bunching?

3. What are the sources of adjustment of BERs?

Literature - Bunching in Energy Labelling

- Sallee and Slemrod (2012) - Found bunching in fuel economy ratings for energy efficient cars in Canada

- Alberini et al. (2014) - Evidence of bunching in energy efficiency labels of Swiss cars, with A-grade cars extracting a price premium

- Hyland at al. (2016) - Evidenced bunching in Irish BERs and found that a change in letter grade led to a price premium

Data

- Better Energy Homes Data:
  - Administrative data for all applications
  - Pre-works BER estimate
  - Post-works BER assessment

- BER Data:
  - All registered BER assessments
  - Anonymous ID for assessors
  - Values of all calculation parameters

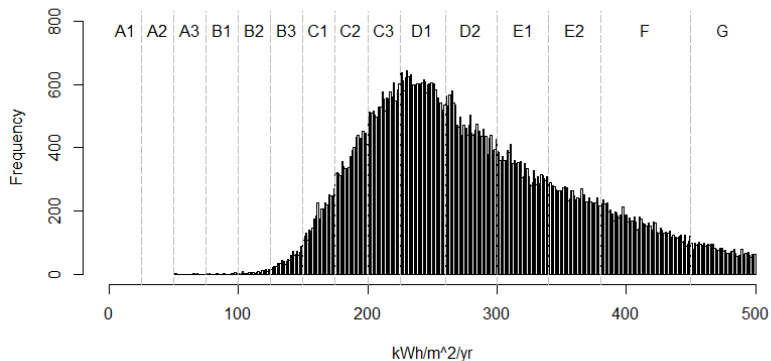- Regression Discontinuity Design: Pooled polynomial

$$y_j = \alpha + \tau.T + \Sigma_{i=3}^{p}[\beta_{i1}(X_j - c)^i + \beta_{i2}.T.(X_j - c)^i] + \epsilon \quad (1)$$

- X_j: bin number
- c: bin number at threshold
- T=1 if bin is on more efficient size
- τ provides significance of discontinuity
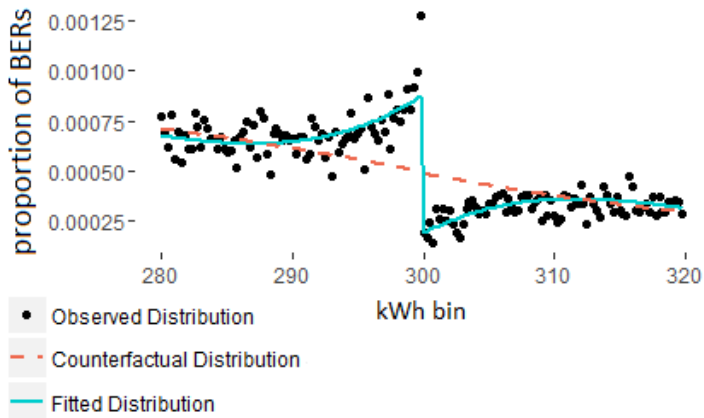
Evidence: Results I

- Pre-works distribution of BERs

- No statistical evidence at any grade threshold

- Post-works example: D2/E1 threshold

- • Observed Distribution
- - - Counterfactual Distribution
- — Fitted Distribution

Evidence: Results III

Grade Threshold	Total "Manipulated" Assessments	Proportion of All Assessments	Proportion Surrounding Threshold (%)
A1/A2	(not statistically significant)		
A2/A3	(not statistically significant)		
A3/B1	(not statistically significant)		
B1/B2	(not statistically significant)		
B2/B3	(not statistically significant)		
B3/C1	774	0.687	5.95
C1/C2	838	0.744	4.26
C2/C3	985	0.874	4.61
C3/D1	1,418	1.259	8.09
D1/D2	414	0.367	3.91
D2/E1	592	0.525	10.36
E1/E2	59	0.052	2.35
E2/F	(not statistically significant)		
F/G	35	0.031	8.62

Drivers: Method

- Gini coefficient created to measure polarisation of assessors in each county

- Less polarised counties should possess more competitive markets for assessors

- Measured correlations in extent of bunching in each county:
  - between competition gini and grade thresholds
 - between grade thresholds

Drivers: Results

- No correlations exist between grades

- No consistent pattern of correlation between assessor competition and grades

	B3	C1	C2	C3	D1	D2	E1	F
Gini Coefficient	0.090	0.031	-0.362	0.017	-0.075	0.095	0.534	0.332
Potential adjustment:								
All Grades	0.603	0.334	0.587	0.850	0.549	0.384	0.430	0.126
B3	.	0.178	0.085	0.484	0.341	0.080	0.094	0.147
C1	.	.	0.039	0.176	-0.263	0.116	0.021	-0.349
C2	.	.	.	0.526	0.173	0.093	0.244	0.148
C3	.	.	.	.	0.456	0.118	0.270	0.095
D1	.	.	.	.	.	0.074	0.297	0.199
D2	.	.	.	.	.	.	0.118	-0.080
E1	.	.	.	.	.	.	.	0.115

Sources: Method

- Distribution of all BERs divided into 5 kWh bins

- Plotted proportional distribution of parameters that may be susceptible to manipulation

- Only one parameter found to possess noticeable discontinues: "Low-energy Lighting"

Sources: Results

- Proportional distribution of low-energy lighting parameter

Conclusions I
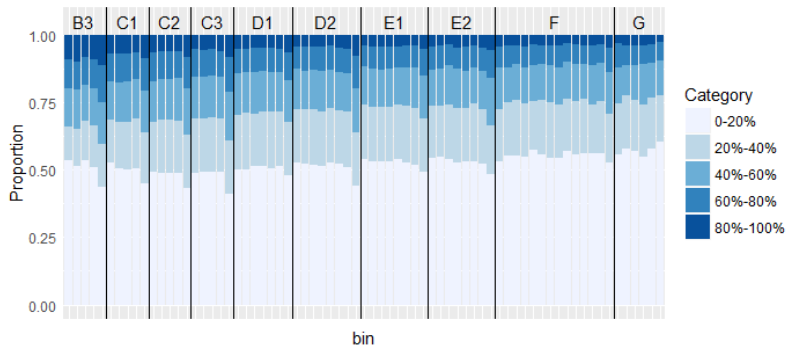
Is there statistically significant evidence of distortions in the distribution of pre-works and post-works Building Energy Ratings?

- No evidence of distortions in the distribution of pre-works BERs

- Distortions are found at most grades in post-works distributions of BERs, strongest at letter grades

Are there identifiable drivers of these distortions?

- Distortion is not found to possess a systemic cause

What are the sources of distortions?

- Low-energy lighting is manipulated and is difficult to audit

Policy Implications

- Introduction of Energy Performance Certificates has resulted in bunching of energy ratings in Ireland

- Difficult to identify whether this is caused by positive or negative intent

- More auditing should help to identify cause

Thank You

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