A National Grant Aid Scheme for Residential Energy Efficiency Retrofits: Application Abandonment, Retrofit Depth and Free-Riding

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- Ireland's main residential energy efficiency grant scheme
- Application Abandonment
- Retrofit Depth
- Free-riding

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"Better Energy Homes" (BEH) Scheme

Measure	Category Sub-Category	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Scheme 5
		Mar-09	Jun-10	May-11	Dec-11	Mar-15
		€	€	€	€	€
Roof	Roof/Attic Insulation	250	250	200	200	300
Wall	Cavity Wall Insulation	400	400	320	250	300
	Internal Dry-Lining	2500	2500	2000		
	Apartment or Mid-terrace House				900	1200
	Semi-detached or End of Terrace				1350	1800
	Detached House				1800	2400
	External Wall Insulation	4000	4000	4000		
	Apartment or Mid-terrace House				1800	2250
	Semi-detached or End of Terrace				2700	3400
	Detached House				3600	4500
Boiler	High efficiency boiler (oil or gas) upgrade with heating controls	700	700	560	560	700
	Heating Controls upgrade only	500	500	400	400	600
Solar	Solar Heating			800	800	1200
BER	Before & After Building Energy Rating	100				
	Mandatory Before & After Building Energy Rating		100	80	50	50
Bonus	Bonus for 3rd measure					300
	Bonus for 4th measure					100

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Application Process

- Private applications
- Large energy companies required achieve savings of 1.5% sales p.a.



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Application Abandonment

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Background: First-time applications



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- Which households are most likely to abandon an application?
- O application-specific predictors of abandonment exist?
- Has the role of Obligated Parties affected application abandonment?

Rate of Abandonment over time



• A Logistic Regression model analyses the probability that a first-time application will be fully abandoned

$$Y_{ijm} = rac{e^{\Sigmaeta_{ijm}X_{ijm}}}{1+e^{\Sigmaeta_{ijm}X_{ijm}}}$$

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Results: Obligated Parties



• Obligated parties: 6-month learning phase

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Results: Property Age



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Results: Retrofit Combinations



• Winter applications are 20% more likely to be abandoned than Spring applications

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- BMW house, built 1981-2000, attic + cavity, obligated party application during spring
 - Risk score = 7.24% (low risk)
- Urban house, built 1961-1980, attic + cavity + boiler, private application during summer
 - Risk score = 41.23% (high risk)

- Identifies attributes of properties more likely to abandon
 - Older dwellings, Apartments (some regional variations)
- Application-specific predictors of high abandonment rates:
 - 3- and 4-Measure applications
 - Winter applications
- Applications made via OPs are less likely to be abandoned
 Role for independent 3rd party advisor / project manager?

Retrofit Depth

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- Which households are most likely to engage in deeper retrofits?
- Impact of bonus payments?
- Obligated Parties affecting retrofit depth?

Considered two measures of retrofit depth:

- Number of retrofit measures undertaken (grant maximum = 4)
- More Comprehensive Retrofits: The propensity of a household to undertake a 'more comprehensive' retrofit
 - 88% of successful applications are made for 'less comprehensive' retrofits

Number of Measures over Time



1-EEM 2-EEM 3-EEM 4-EEM

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Average BER improvements across retrofit combinations



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'Comprehensive' retrofits over time



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Number of Measures by Obligated Party



Methodology

Used three estimation methods:

Number of measures

- Ordered Logistic Regression
 - P(Intensity = n) = f(grant aid, household characteristics, contracting type) + ε
 - ▶ 1 ≤ n ≤ 4
- Count Data Model: Double-Truncated Poisson Regression
 - Number of measures = f(grant aid, household characteristics, contracting type) + ε

More Comprehensive Retrofits

Logistic Regression

 P(More Comprehensive) = f(grant aid, household characteristics, contracting type) + ε

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Results: Obligated Parties



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Results: Location and Property Type



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Results: Scheme Rule Changes and Early Adopter Effects

- Bonus payments for 3- and 4-measure retrofits had no measurable impact
- 'Early adopter' effect deeper retrofits in first 12 months of the scheme

- Identifies some features of households engaging in deeper retrofits?
 - Nothing on household occupants/decision makers
- Ø Bonus payments have no measurable impact
- Mixed news on Obligated Parties re retrofit depth

Free riding

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- O To what extent would households have paid 100% for retrofits?
 - Nauleau (2014) Free-riders 40%-85% of retrofits
 - Alberini (2014) Italian tax credit free-riding 'rampant'
 - Grösche and Vance (2009) German households: 96.5% classed free-riders

• Compare Total WTP for retrofit with Gross cost of retrofit

- 'Free-rider': Gross Cost of Retrofit \leq WTP
- 'Partial Free-rider': Net Cost < WTP < Gross Cost</p>
- 'Dependent': WTP \leq Net Cost
- We observe/calculate EE Improvement
- Estimate WTP per unit EE improvement
- Total WTP = WTP * EE Improvement

$$U = \alpha + \beta \mathit{Cost} + \gamma \mathit{Improvement} + error$$

$$MRS_{IC} = -\frac{\gamma}{\beta} \tag{2}$$

• Random utility framework & Multinominal logit estimator

- Grant scheme participants face multiple options
- Insulation retrofits excluded, only considering Boiler w/HC,HC,Solar

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Participant who engaged in a Boiler with Heating Controls retrofit:

Application ID	Retrofit Choice	Pre-Works BER	Floor Area	Type	Previous?	Exp. Improvement	Exp. Cost	Choice
		$(kWh/m^2/yr)$	(m ²)			(kWh/yr)	(€)	
XXXX10	No Retrofit	293	132	House	No	0	0	0
XXXX10	Boiler w/ Heat. Cons.	293	132	House	No	12,545	1,066	1
XXXX10	Heating Cons. only	293	132	House	No	8,566	276	0
XXXX10	Solar	293	132	House	No	5,590	2,071	0
XXXX10	Boiler w/ HC, Solar	293	132	House	No	19,048	1,553	0
XXXX10	Heating Cons., Solar	293	132	House	No	10,536	1,815	0

Pr(Choice) = f(Expected Cost, Expected Improvement, Household Characteristics, Choice-specific Characteristics)

Results: Willingness-to-Pay



Avg. marginal willingness-to-pay

- 1st-time v previous retrofits
 - Information gap
- "Pre-works BER"
 - Income effect
 - Contamination by previous retrofits
- Floor Area/ Dwelling Type
 - Income effect?

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Results: Free-Riding



- Overall relatively low level of free-riding
- Reconsider Heating Controls grant aid level?
- Greater WTP by those with prior retrofit: significant information gap?

Thank You

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