UNIVERSITY OF CAMBRIDGE
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CEENRG
Cambridge Centre for Environment, Energy and Natural Resource Governance

Assessing the effectiveness of energy efficiency measures in the residential sector through dynamic treatment effects: Evidence for the UK

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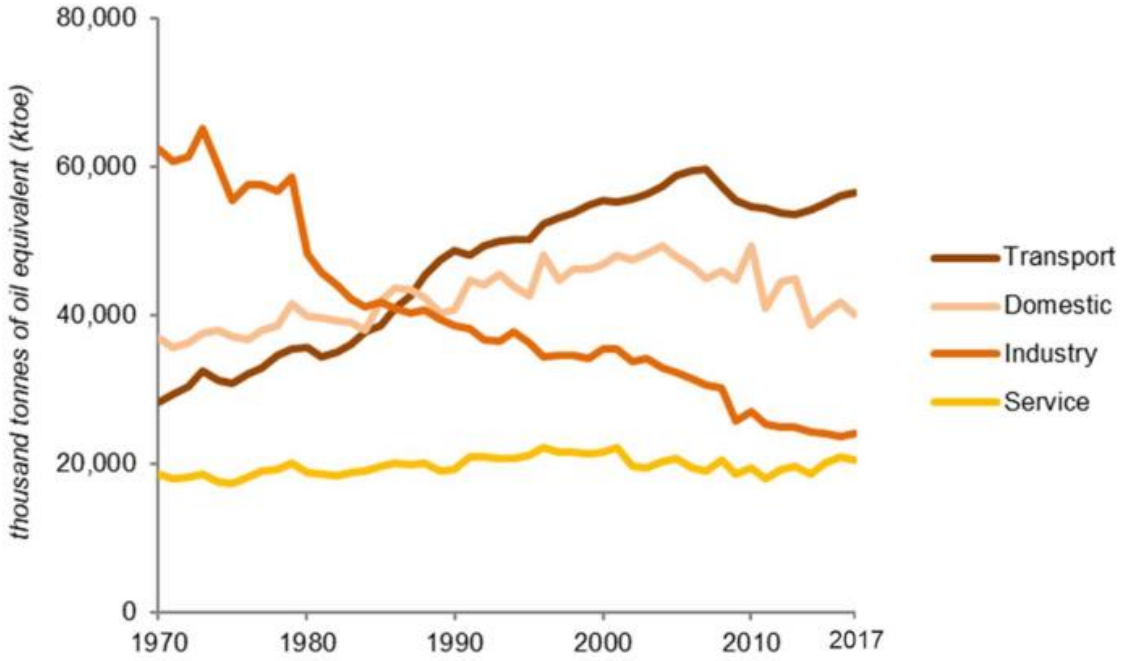
Outline

1. Motivation
2. Goal and Contribution
3. Theoretical background
4. Literature review and research hypotheses
5. Data & Methods
6. Preliminary results
7. Conclusions

Motivation

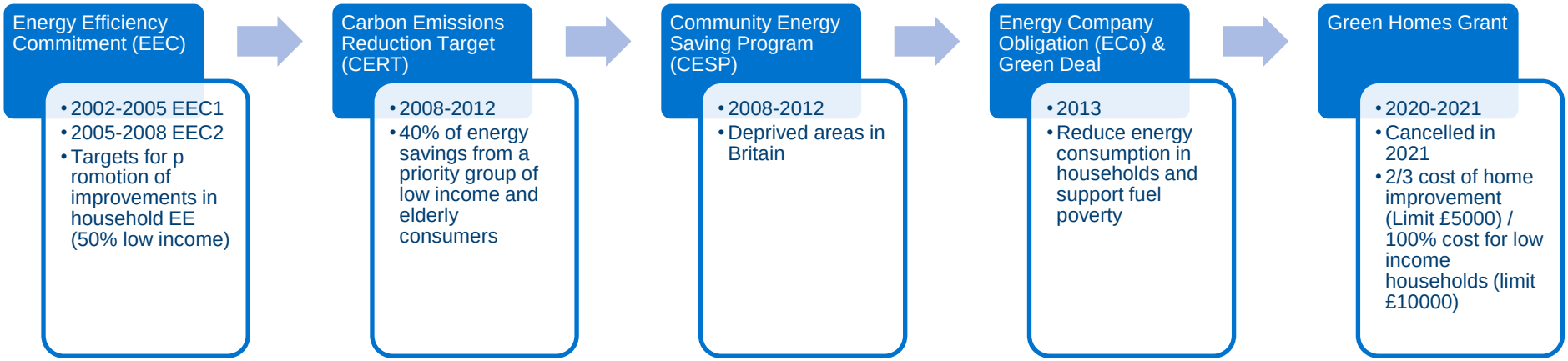
Total final energy consumption in the UK



Source; BEIS ECUK Table 1.01

Motivation

Timeline of EE policies in the UK between 2002-2021



Source: Own elaboration with information from OFGEM

Goal and contribution

- Shed light on the extent to which technical energy efficiency improvements are associated by changes in residential gas consumption

- Analyse the dynamic effects of the installation of such measures and the long lasting effect of the gas consumption reductions

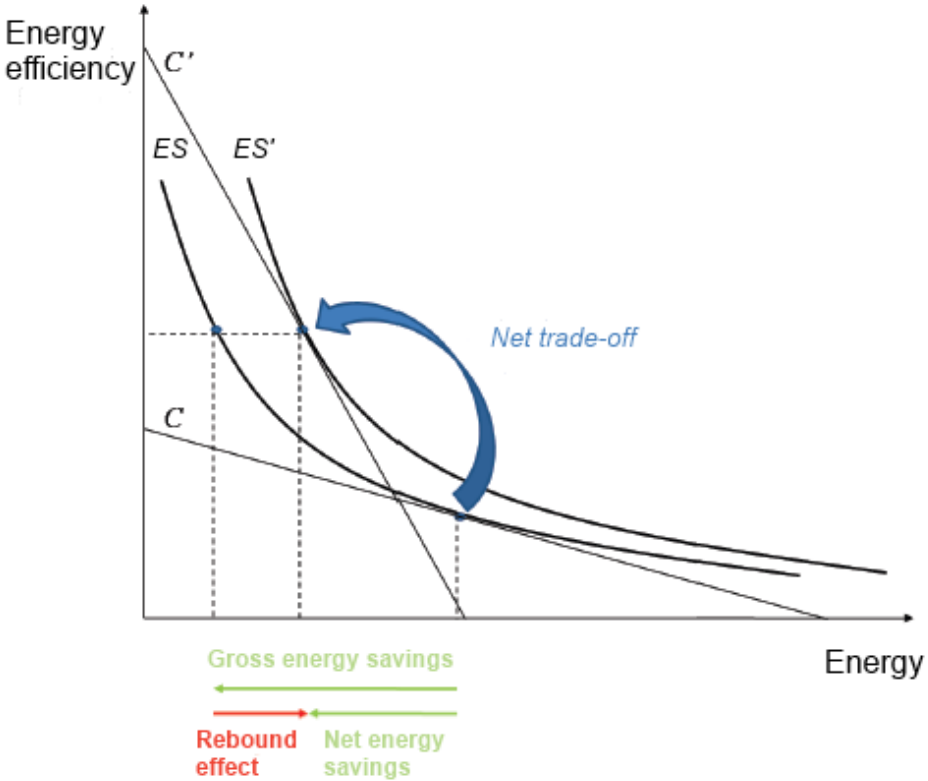
- It also assesses the degree of sensitivity of household gas consumption to changes in energy prices and the groups that benefit from energy efficiency measures

Goal and contribution

- Analysis of gas consumption patterns in the UK at the micro level for a large panel of households of more than 50,000 dwellings.
- Importance of the specific consideration of energy use for heating as there are little evidence on the impact of policies on heating use in buildings (Gillingham et al. 2016; Eyre and Baruah, 2015).
- Disentangle of the long-lasting effects of EE technical improvements in residential buildings with observational and ex post-data through an event study.
- Segmentation of the sample to understand the role of other renovations and the vulnerability of the households.

Theoretical background

Microeconomic representation of the rebound effect



Source: Giraudet (2011)

Literature review and research hypotheses

Impact of household EE technical improvement on energy consumption

- Wide range of ex ante assessments
  - General equilibrium models (Lecca et al., 2014; Bye et al., 2018; Figus et al., 2017; Wei and Liu 2017; Kulmer and Seebauer, 2019),
  - Microeconomic demand systems (Tovar and Wolfing, 2018)
  - Input-output models (Thomas and Azevedo, 2013; Freire-Gonzalez et al., 2017).
  - One of the last contributions regarding the potential of energy savings in the household sector in the UK has been Rosenow et al. (2018) who estimate the lifetime energy savings associated to different levels of deployment of energy efficiency technologies up to 2035.
- With a few notable exceptions (Trotta, 2018; Elsharkawy and Rutherford, 2018; Adan and Fuerst, 2016; Webber et al., 2015)

Expected vs. actual savings

- Social challenges (Sovacool et al., 2017)
- Rebound effects of policy induced improvements (Gillingham et al., 2016; Brockway et al., 2017; Dorner, 2019)
- Other home improvements alongside EE (Judson et al., 2014; Judson & Maller, 2014; Hand et al., 2007; Sandu & Patchey, 2009)
- Sensitivity of rebound effects to income or consumption groups have been something widely studied in literature (Belaid et al. 2020; Gillingham, 2011; Kulmer and Seebauer, 2019; among others). Rebound effects much larger in low-income areas (Webber et al. 2015) and for low income households (Milne and Boardman, 2000)
- Change in occupants' behaviour may risk the energy efficiency potentials of the retrofit (Aydin et al., 2017; Ayding et al., 2018; Psomas et al. 2016; Galassi and Madlener, 2018; Rau et al. 2020)
- Subsidised measures less effective (Chitnis et al., 2014; Webber et al. 2015; Liang et al. 2018)

Literature review and research hypotheses

H1. The installation of EE technical improvements in households is not enough to generate significant reductions in the amount of gas consumed by dwellings vs. those that have not adopted them.

H2. The gas consumption reduction of households in the UK after the installation of an EE technical improvement, if any, does not last in time due to factors unrelated to the effectiveness of technical measures taken.

H3. Households installing EE technical improvements alongside other renovations in dwellings do not experience significant gas consumption reductions

H4. For the two EE measures investigated, vulnerable households installing EE technical measures do not reduce their gas consumption.

Data and methods

Microdata National Energy Efficiency Data-Framework (NEED)

Representative sample of households in England and Wales

Information from 2005 to 2017

Household level data panel about 55,154 households (700,000 obs)

Control group=35,422

Treatment group=18,930

Staggered differences-in-differences approach with dynamic treatment effects

Data and methods

Variable	Definition	Data Source	Expected relation
Total gas consumption by household	Rounded amount of gas used for gas space heating, gas water heating and gas cooking (kWh/yr) provided by energy suppliers through meter readings	NEED	Dependent variable
IMD band	Index of multiple deprivation quintiles, i.e. 1 to 5 (2015 information) 1 = Highest Deprivation To 5= Lowest Deprivation	NEED	(+)
Gas price	Average annual domestic standard gas average unit costs per UK region (cents/KWh)	BEIS	(-)
Household size	Floor area band 1 to 5 1= Under 50 sqm 2= 51 to 100 sqm 3= 101 to 150 sqm 4= 151 to 200 sqm 5= over 200 sqm	NEED	(+)
Property type	Property type 1= Flat 2= Semi detached 3= Detached 4= Mid terrace 5= End terrace 6= Bungalow	NEED	(?)
Age	Dwelling age band 1 to 4 1= Pre 1930 2= 1930-1972 3= 1973-1999 4= 2000 or later	NEED	(-)
Heating degree days[1]	Difference between a reference temperature (T*) (18°C) and the average daily temperatures (Ta) by region $\mathrm{HDD} = \sum_{i=1}^{n} \max(0;\ T^{*} - Ta)$	EUROSTAT	(+)
Conservatory	Dummy variable indicating if the property has a conservatory 1= Yes 0= No	NEED	(+)

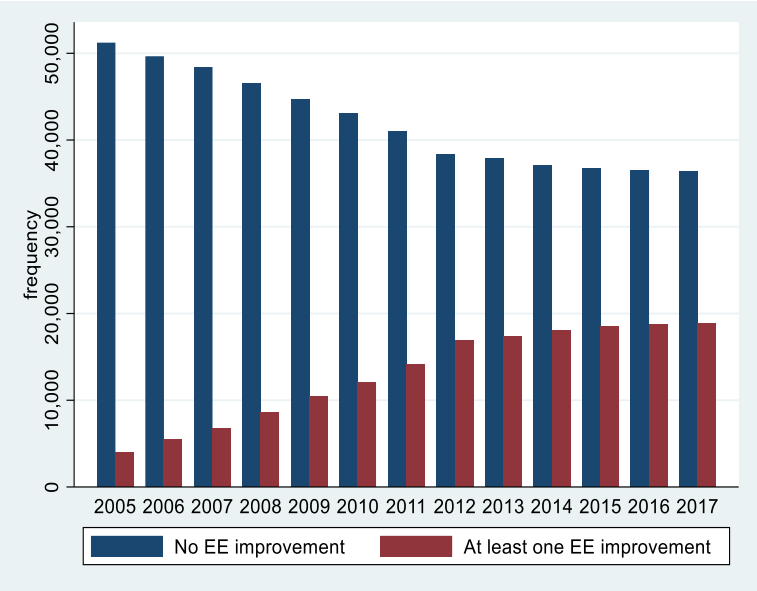
Data and methods

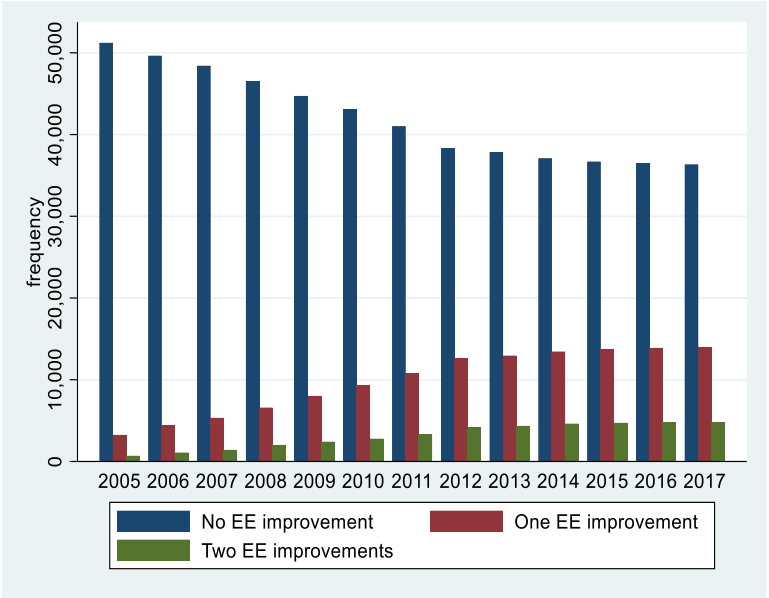
Mean differences for variables in the control and the treatment group

Variable	Control	Treatment	Mean diff
IMD_band	3.011998	2.919651	0.0923468***
Floorsq	2.289425	2.367987	-0.0785627***
Gas price	3.860649	3.848542	0.0121063***
HDD	2683.393	2766.559	-83.16544***
Age dwelling	2.210124	2.07887	0.1312541***
Property type	2.899018	3.31046	-0.411442***
Conservatory	0.039636	0.0472795	-0.0076431***
Number of HH	**35,422**	**18,930**	

Data and methods

Evolution in the number of dwellings with and without an EE improvement





Source: Own elaboration with NEED data 2019.

Data and methods

Binary treatment indicator, i.e. the installation of an EE measure whether loft insulation or cavity wall for household i at time t:

$$EEM_{it} = \begin{cases} 1 \; if \; household \; i \; is \; treated \; at \; time \; t \\ 0 \; otherwise \end{cases}$$

For a regular generalised DiD, we would only allow for treatment effect heterogeneity, in terms of the observed covariates and time, i.e. every household become treated ($EEM_{it} = 1$) at the time when the first EE measure is installed, and that time varies across households. In a traditional application, without dynamic treatment effects we would have some effect before and after the period of intervention (1).

$$\ln(y_{it}) = \alpha + \beta EEM_{it} + \gamma X_{it} + \theta_i + \mu_t + \varepsilon_{it} \qquad (1)$$

Where y_{it} is the annual gas consumption in KWh (outcome variables), i denotes the household and t the year. EEM_{it} represents our variable of interest that identifies the introduction of a specific energy efficiency measure, X_{it} is a vector of household characteristics, θ_i are the households fixed effects while, μ_t is a time fixed effect to control for shocks that are common to all households .

Data and methods

Staggered differences in differences approach (Cerulli and Ventura, 2019)

$$\ln(Y_{it}) = \alpha + \sum_{j=1}^{J} \beta_{pre,j} EEM_{i,t+j} + \sum_{k=0}^{K} \beta_k EEM_{i,t-k} + \gamma X_{it} + \theta_i + \mu_t + \varepsilon_{it}$$

y_{it} = annual gas consumption KWh

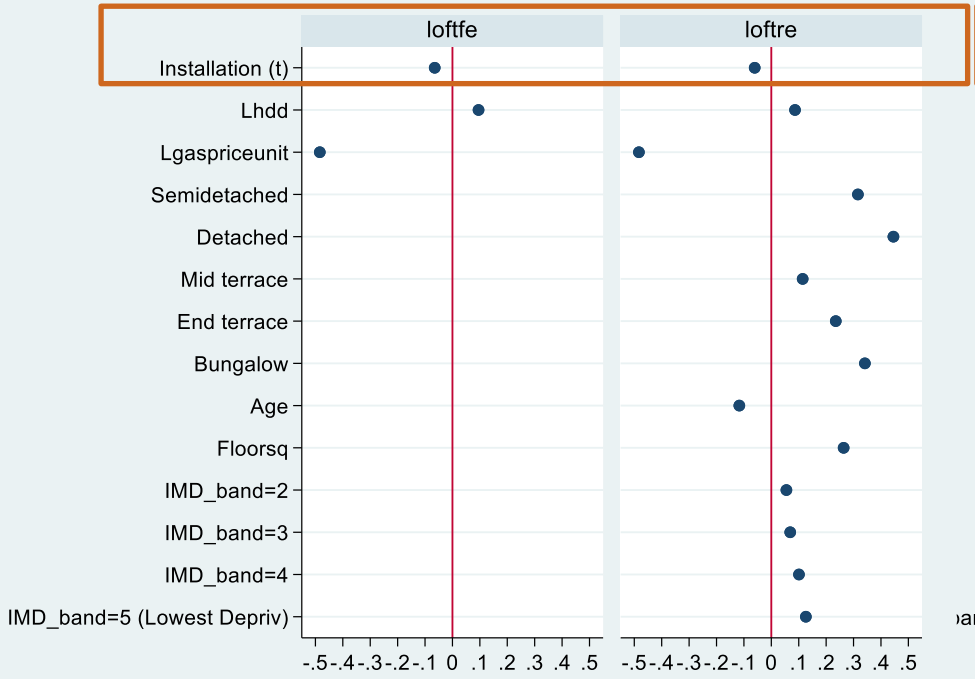
i denotes the household and t the year.

$EEM_{i,t-k}$=year–specific indicators that denote whether a specific household i in year $t-k$ has installed one EE improvement; and $t+j$ will indicate if a household i will have EE improvements implemented in j years in future periods.

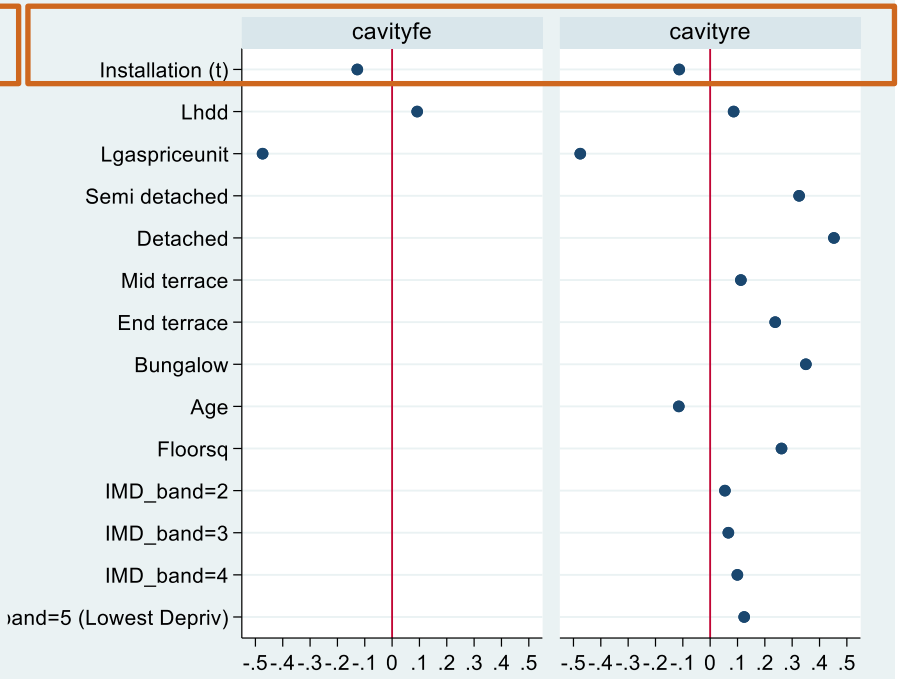
We aim at capturing a pre-installation period and a post-installation period of 5 years.

Preliminary results

Loft insulation installation in t (%)

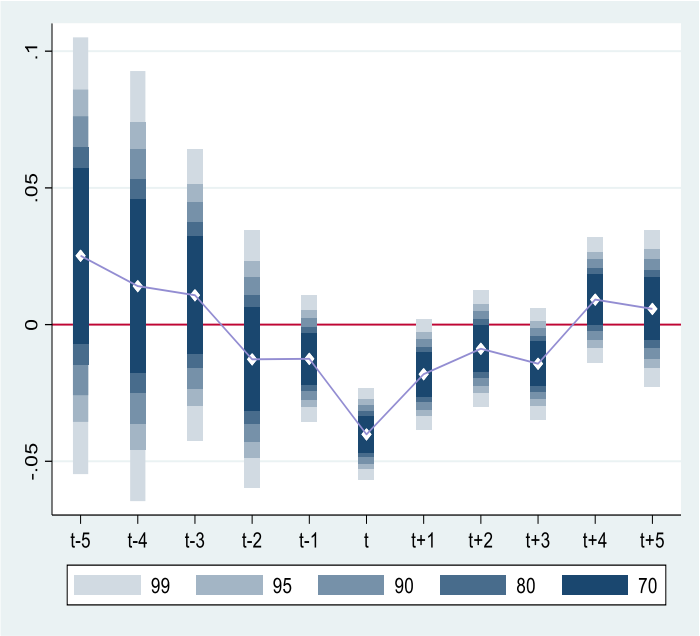


Cavity wall installation in t (%)



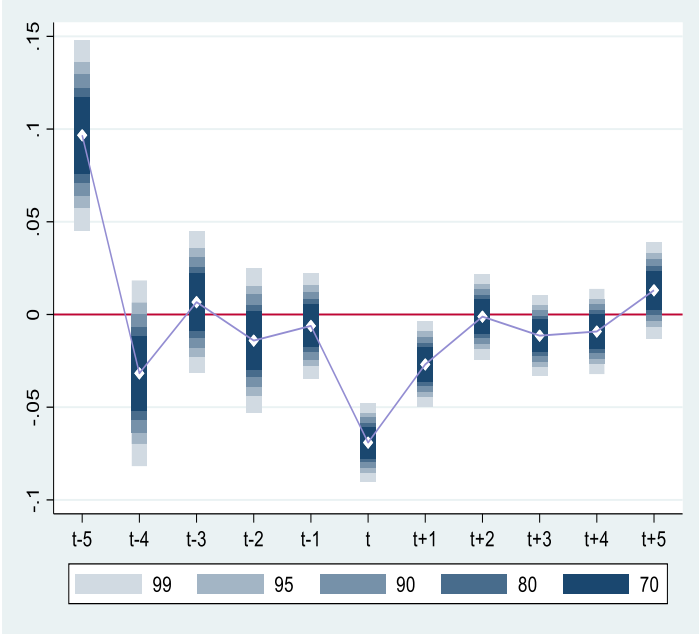
Preliminary results

Loft insulation installation in t (%)



Parallel trend passed
F(1, 46156) = 0.12
Prob > F = 0.7343
R2=0.2800
N observations: 127,384

Cavity wall installation in t (%)



Parallel trend passed
F(1,46145) = 2.93
Prob > F = 0.0870
R2=0.2808
N observations: 127,384

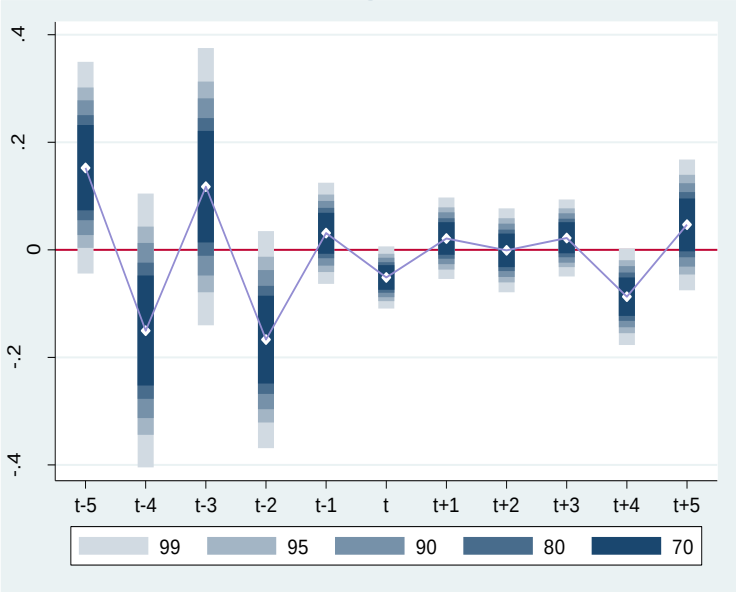
Outcome variable: Ln gas consumption / Treatment variable: Loft insulation or Cavity wall / X variables: property type, age, Lhdd, Lgasprice, floorsq, IMD_band

Preliminary results

	(7)	(8)	(9)	(10)	(11)	(12)
	fe			OLS		
Gas Consumption	Any	loft	cavity	Any	Loft	cavity
EE (t-5)	-0.00152 (0.022133)	0.003428 (0.050578)	0.010499 (0.023925)	0.078901*** (0.019252)	0.025189*** (0.031006)	0.096682*** (0.019965)
EE (t-4)	-0.00357 (0.015068)	-0.00063 (0.02063)	0.002151 (0.016626)	-0.01941 (0.01915)	0.014087 (0.030532)	-0.03172 (0.01944)
EE (t-3)	0.01007 (0.013288)	0.005273 (0.018913)	0.020536 (0.012628)	-0.0006 (0.014527)	0.01075 (0.020697)	0.006685 (0.014861)
EE (t-2)	-0.0136 (0.0118)	-0.01459 (0.014905)	-0.01296 (0.012322)	-0.01552 (0.013981)	-0.0127 (0.018293)	-0.01407 (0.015103)
EE (t-1)	-0.00276 (0.007033)	0.001747 (0.007575)	-0.01377 (0.009066)	-0.01067 (0.008267)	-0.01251 (0.009012)	-0.00614 (0.011053)
EE (t)	-0.04623*** (0.005049)	-0.03479*** (0.005584)	-0.0776*** (0.00636)	-0.04595*** (0.006023)	-0.04015*** (0.006496)	-0.06908*** (0.008199)
EE (t+1)	-0.02394*** (0.005335)	-0.01445** (0.006182)	-0.03708*** (0.0072)	-0.02222*** (0.006664)	-0.01812** (0.007819)	-0.0269*** (0.008974)
EE (t+2)	0.003046 (0.00489)	0.003075 (0.005973)	0.009893 (0.006044)	-0.00451 (0.006762)	-0.00883* (0.008283)	-0.00115 (0.008911)
EE (t+3)	0.004966 (0.004948)	0.0048 (0.006186)	0.011785* (0.006154)	-0.01451** (0.00651)	-0.01431 (0.007891)	-0.01141 (0.008407)
EE (t+4)	0.010703* (0.005547)	0.009929 (0.006777)	0.01198* (0.00664)	0.000956 (0.007279)	0.009148 (0.008924)	-0.00917*** (0.008917)
EE (t+5)	0.009687 (0.006868)	0.01137 (0.008878)	0.021942*** (0.008085)	0.003184 (0.008435)	0.005745 (0.011101)	0.013078 (0.010124)
Property (b. flat)				Yes	Yes	Yes
Age				Yes	Yes	Yes
Floorsq				Yes	Yes	Yes
Lhdd	0.190998*** (0.006115)	0.191403*** (0.006113)	0.190667*** (0.006074)	0.116445*** (0.01225)	0.109273*** (0.012268)	0.113818*** (0.012193)
Lgasprice	-0.27443*** (0.011457)	-0.28672*** (0.010801)	-0.2832*** (0.010696)	-0.21889*** (0.011693)	-0.23488*** (0.011639)	-0.23652*** (0.011383)
IMD_band				Yes	Yes	Yes
Intercept	8.317287*** (0.053533)	8.318963*** (0.054062)	8.324997*** (0.052495)	8.101498*** (0.104573)	8.176551*** (0.104745)	8.176551*** (0.104745)
Test parallel trend 1	Yes	Yes	Yes	No	No	No
Test parallel trend 2	No	Yes	Yes	No	Yes	Yes
Number of observations	127,384	127,384	127,384	127,384	127,384	127,384
F test	F(13,43100) = 186.88 Prob > F = 0.0000	F(13,43100) = 180.78 Prob > F = 0.0000	F(13,43100) = 196.23 Prob > F = 0.0000	F(24, 43100) = 833.93 Prob > F = 0.0000	F(24, 43100) = 827.93 Prob > F = 0.0000	F(24, 43100) = 834.38 Prob > F = 0.0000
R-Squared	0.0019	0.0024	0.0029	0.2809	0.2800	0.2808

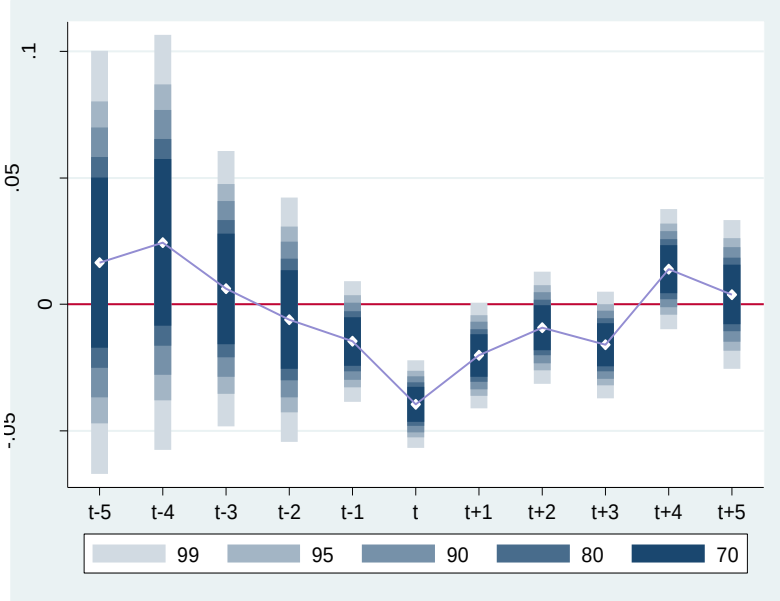
Preliminary results

Loft insulation installation in t - With conservatory



Parallel trend passed
F(5, 1943) = 1.51
Prob > F = 0.1835
R2=0.2628
N observations: 5,766

Loft installation in t - Without conservatory

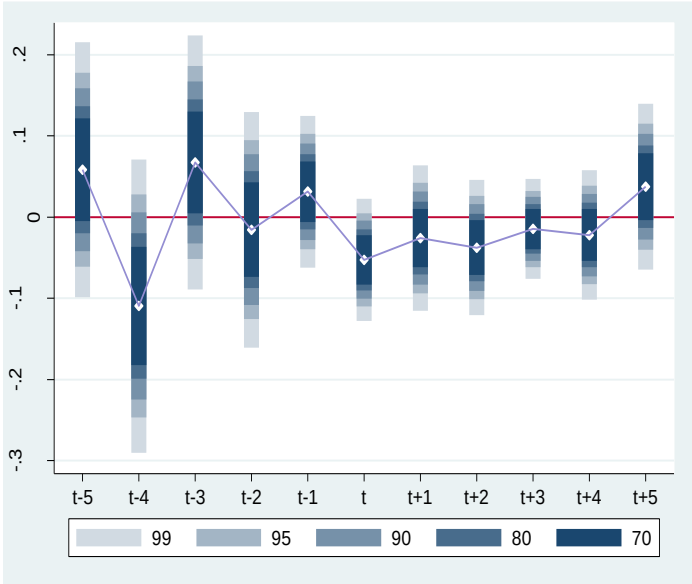


Parallel trend passed
F(1, 44107) = 0.66
Prob > F = 0.4171
R2=0.2775
N observations: 121,618

Outcome variable: Ln gas consumption / Treatment variable: Loft insulation or Cavity wall / X variables: property type, age, Lhdd, Lgasprice, floorsq, IMD_band

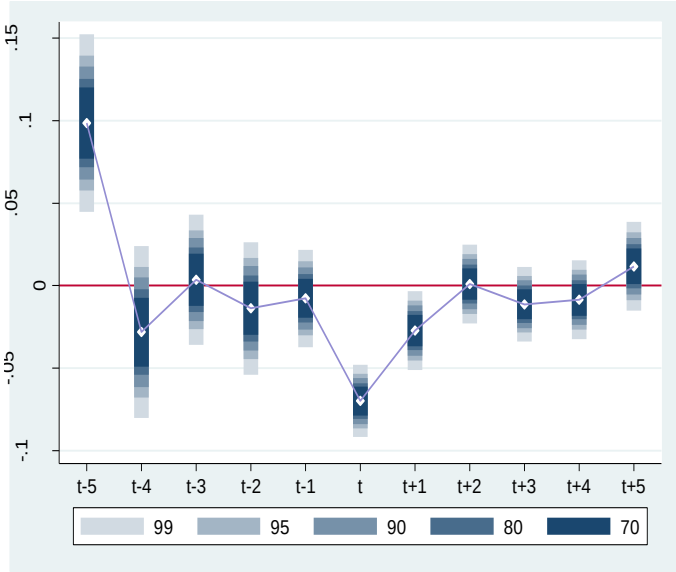
Preliminary results

Cavity wall installation in t - With conservatory



Parallel trend passed
F(1, 2037) = 0.93
Prob > F = 0.3356
R2=0.2640
N observations: 5,766

Cavity wall installation in t Without conservatory



Parallel trend passed
F(1, 44107) = 3.66
Prob > F = 0.0556
R2=0.2784
N observations: 121,618

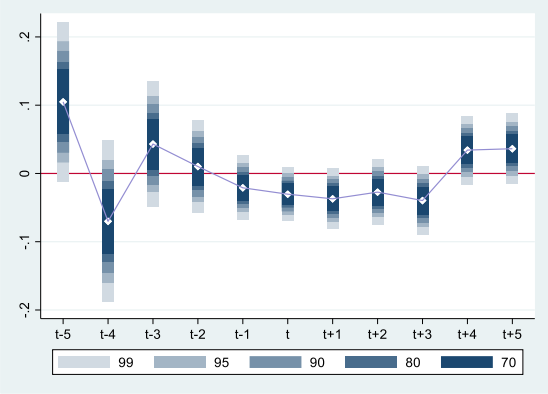
Outcome variable: Ln gas consumption / Treatment variable: Loft insulation or Cavity wall / X variables: property type, age, Lhdd, Lgasprice, floorsq, IMD_band

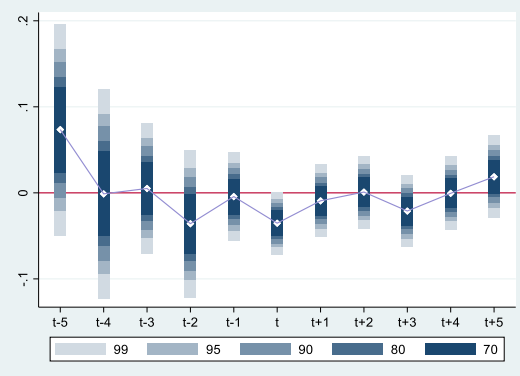
Preliminary results

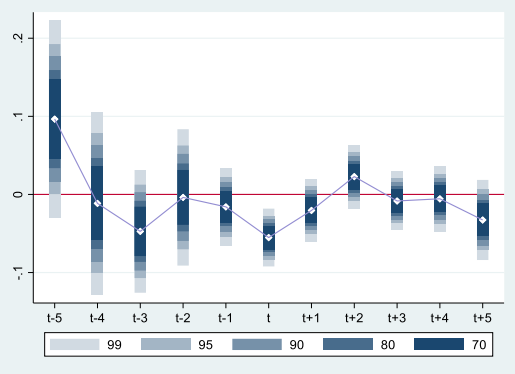
	Any EE improvement		Loft Insulation		Cavity wall	
Gas Consumption	Conservatory	No conservatory	conservatory	Non conservatory	conservatory	No conservatory
EE (t-5)	0.137986*** (0.055225)	0.075204*** (0.02003)	0.152881* (0.076267)	0.016583 (0.032478)	0.058376 (0.060981)	0.098434*** (0.020856)
EE (t-4)	-0.1858*** (0.070231)	-0.01108 (0.019807)	-0.15013 (0.098809)	0.024536 (0.031839)	-0.10947 (0.07004)	-0.02815 (0.020188)
EE (t-3)	0.102252 (0.06895)	-0.0052 (0.014855)	0.117324 (0.099976)	0.006173 (0.021142)	0.067224 (0.060643)	0.003626 (0.015298)
EE (t-2)	-0.08551 (0.052473)	-0.01208 (0.014419)	-0.16701** (0.078427)	-0.00597 (0.018752)	-0.01537 (0.056271)	-0.01376 (0.015591)
EE (t-1)	0.039626 (0.032376)	-0.01301*** (0.008523)	0.03096 (0.036616)	-0.01461 (0.009277)	0.031281 (0.036208)	-0.00768 (0.011443)
EE (t)	-0.04566** (0.020169)	-0.04596*** (0.006248)	-0.05137** (0.022351)	-0.03948*** (0.006734)	-0.05255* (0.029235)	-0.06986*** (0.008488)
EE (t+1)	0.000773 (0.025037)	-0.02353*** (0.006894)	0.021431 (0.0294)	-0.0202** (0.008093)	-0.02582 (0.034833)	-0.02718*** (0.009267)
EE (t+2)	-0.00988 (0.024308)	-0.00414 (0.007013)	-0.00087 (0.03024)	-0.00919 (0.008586)	-0.03747 (0.032315)	0.00098 (0.009238)
EE (t+3)	-0.00501 (0.019953)	-0.01485** (0.006778)	0.022393 (0.027836)	-0.01599* (0.008177)	-0.01457 (0.02388)	-0.01125 (0.008774)
EE (t+4)	-0.04402 (0.026733)	0.003349 (0.007525)	-0.08712** (0.034761)	0.013952 (0.009199)	-0.022 (0.030866)	-0.00855 (0.009241)
EE (t+5)	0.017957 (0.034079)	0.002398 (0.00869)	0.046558 (0.047295)	0.003928 (0.011397)	0.037391 (0.039605)	0.011749 (0.010449)
Property (b. flat)	Yes	Yes	Yes	Yes	Yes	Yest
Age	Yes	Yes	Yes	Yes	Yes	Yes
Floorsq	Yes	Yes	Yes	Yes	Yes	Yes
Lhdd	0.144473*** (0.047271)	0.116611*** (0.012616)	0.137011*** (0.04736)	0.109513*** (0.012634)	0.141742*** (0.046789)	0.113967*** (0.012559)
Lgasprice	-0.14185*** (0.042628)	-0.22245*** (0.012083)	-0.15985*** (0.042855)	-0.2386*** (0.012025)	-0.15112*** (0.041176)	-0.24022*** (0.011767)
IMD_band	Yes	Yes	Yes	Yes	Yes	Yes
Test parallel trend 1	NO	NO	YES	NO	YES	NO
Test parallel trend 2	YES	NO	NO	YES	YES	YES
Number of observations	5,766	121,618	5,766	121,618	5,766	121,618
Treated						
Control						
F test	F(24, 1943) = 33.23 Prob > F = 0.0000	F(24, 41156) = 789.69 Prob > F = 0.0000	F(24, 1943) = 33.35 Prob > F = 0.0000	F(24, 41156) = 784.14 Prob > F = 0.0000	F(24, 1943) = 33.19 Prob > F = 0.0000	F(24, 41156) = 789.83 Prob > F = 0.0000
R-squared	0.2637	0.2785	0.2628	0.2775	0.2640	0.2784

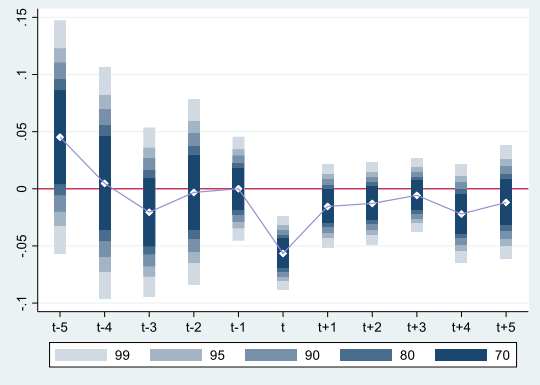
Preliminary results

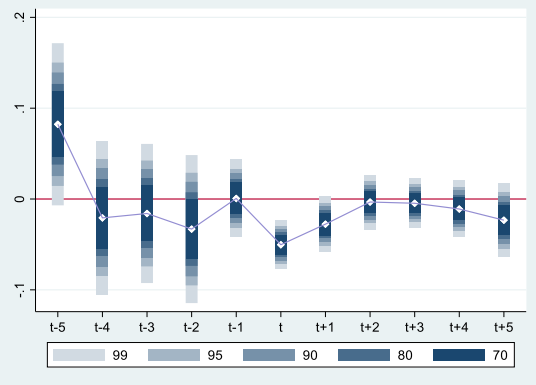
Any type of installation in t - IMD











Preliminary results

Any EE improvement					
Gas Consumption	IMD1	IMD2	IMD3	IMD4	IMD5
	0.104888**	0.073526	0.096476**	0.045173***	0.082285**
EE (t-5)	(0.045317)	(0.047775)	(0.048994)	(0.039691)	(0.034648)
	-0.07011	-0.00117	-0.01143	0.004739	-0.02077
EE (t-4)	(0.045921)	(0.047352)	(0.045415)	(0.039333)	(0.032825)
	0.04311	0.005078	-0.04727	-0.0205	-0.01593
EE (t-3)	(0.035689)	(0.02942)	(0.030493)	(0.02879)	(0.029727)
	0.010178	-0.03584	-0.0038	-0.00319	-0.03311
EE (t-2)	(0.026287)	(0.033175)	(0.033881)	(0.03157)	(0.031623)
	-0.02102***	-0.00432	-0.0159***	5.96E-05	0.000624
EE (t-1)	(0.018212)	(0.019978)	(0.019369)	(0.01766)	(0.016518)
	-0.03037**	-0.03527**	-0.05518***	-0.05659***	-0.05032***
EE (t)	(0.015339)	(0.01417)	(0.014354)	(0.012482)	(0.010402)
	-0.03713**	-0.00925	-0.02045	-0.01543***	-0.02767**
EE (t+1)	(0.017172)	(0.016306)	(0.015488)	(0.014183)	(0.011816)
	-0.02733	0.00093	0.022871	-0.01281	-0.0033
EE (t+2)	(0.018614)	(0.01642)	(0.015848)	(0.014042)	(0.011569)
	-0.03968**	-0.02112	-0.00833	-0.00573	-0.00467
EE (t+3)	(0.019461)	(0.016092)	(0.014626)	(0.01249)	(0.010501)
	0.034252***	-0.00054	-0.00557	-0.02204	-0.01099***
EE (t+4)	(0.019532)	(0.016579)	(0.016196)	(0.01667)	(0.012092)
	0.036228*	0.018728	-0.03269*	-0.0119	-0.02329
EE (t+5)	(0.019973)	(0.018523)	(0.019896)	(0.019354)	(0.015765)
Property (b. flat)	Yes	Yes	Yes	Yes	Yes
Age	Yes	Yes	Yes	Yes	Yes
floorsq	Yes	Yes	Yes	Yes	Yes
	0.006509	0.119589***	0.116824***	0.169945***	0.165989***
Lhdd	(0.031345)	(0.02867)	(0.02791)	(0.025723)	(0.022249)
	-0.39952***	-0.22371***	-0.21644***	-0.15648***	-0.11341***
Lgasprice	(0.030971)	(0.028133)	(0.027026)	(0.023332)	(0.020923)
	9.150103***	8.133561***	8.187405***	7.786324***	7.712297***
Intercept	(0.267518)	(0.244839)	(0.238094)	(0.218678)	(0.189923)
Test parallel trend 1	NO	Yes	YES	YES	YES
Test parallel trend 2	YES	YES	YES	YES	YES
Number of observations	26,187	25,348	24,087	24,620	27,142
F test	F(20, 8950) = 123.18 (0.0000)	F(20, 8570) = 130.22 (0.0000)	F(20, 8139) = 152.97 (0.0000)	F(20,8292) = 185.59 (0.0000)	F(20, 9145) = 259.83 (0.0000)
R-squared	0.1843	0.2118	0.2448	0.2842	0.3336

Preliminary results

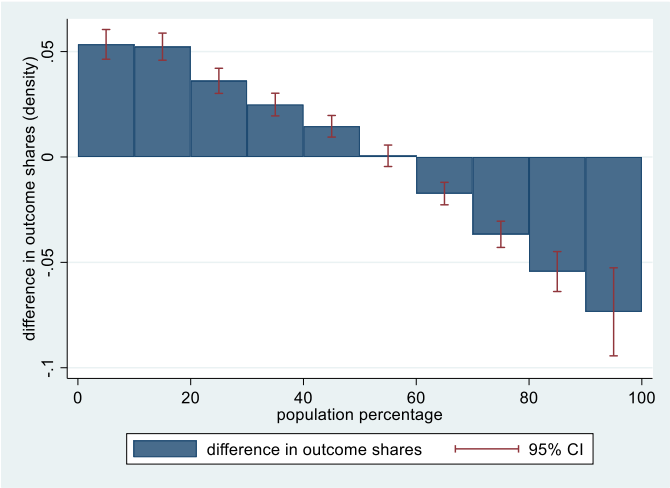
Effect of the installation of EE measure per percentile of gas consumption

	Loft			Cavity			Any		
	Control	Treatment	Diff	Control	Treatment	Diff	Control	Treatment	Diff
0-10th	0.250383 (0.00153)	0.30381 (0.003338)	0.0523428*** (0.0036)	0.249186 (0.001571)	0.309427 (0.003537)	0.06024*** (0.003797)	0.244492 (0.001619)	0.301224 (0.002754)	0.056733*** (0.003099)
10th - 20th	0.472742 (0.001663)	0.525074 (0.002936)	0.052332*** (0.0033)	0.470186 (0.0016)	0.538631 (0.003205)	0.068446*** (0.00352)	0.465186 (0.001745)	0.527234 (0.002489)	0.062048*** (0.002937)
20th - 30th	0.616914 (0.001451)	0.653033 (0.002778)	0.036120*** (0.0030)	0.613257 (0.001452)	0.672627 (0.002674)	0.05937*** (0.002983)	0.610357 (0.001518)	0.659729 (0.002101)	0.049373*** (0.00249)
30th - 40th	0.739424 (0.001298)	0.764296 (0.002531)	0.024872*** (0.0027)	0.736377 (0.001306)	0.783928 (0.00252)	0.047551*** (0.002781)	0.735015 (0.001435)	0.771679 (0.002002)	0.036665*** (0.002355)
40th - 50th	0.85653 (0.001216)	0.871088 (0.002428)	0.014558*** (0.0026)	0.854889 (0.001288)	0.887616 (0.00225)	0.032727*** (0.002533)	0.854795 (0.00134)	0.877383 (0.001906)	0.022588*** (0.002222)
50th - 60th	0.979391 (0.001226)	0.979957 (0.002397)	0.00057 (0.0026)	0.97908 (0.001233)	0.992134 (0.00224)	0.013055*** (0.002501)	0.980919 (0.001342)	0.984952 (0.001877)	0.004034* (0.002203)
60th - 70th	1.119174 (0.001256)	1.101816 (0.002516)	-0.01736*** (0.0027)	1.120016 (0.001306)	1.109288 (0.002346)	-0.01073*** (0.002631)	1.123249 (0.00136)	1.105068 (0.001926)	-0.01818*** (0.002259)
70th - 80th	1.288549 (0.001519)	1.25186 (0.002908)	-0.03669*** (0.0032)	1.290253 (0.001451)	1.251691 (0.002792)	-0.03856*** (0.003081)	1.293727 (0.001642)	1.253548 (0.002335)	-0.04018*** (0.002733)
80th - 90th	1.532052 (0.002217)	1.477692 (0.004503)	-0.05436*** (0.0048)	1.53699 (0.002236)	1.4604 (0.00381)	-0.07659*** (0.004297)	1.540409 (0.002337)	1.473335 (0.003292)	-0.06707*** (0.003831)
90th - 100th	2.144842 (0.004728)	2.071373 (0.010108)	-0.07347*** (0.0107)	2.149767 (0.004826)	1.994257 (0.009857)	-0.15551*** (0.010634)	2.151853 (0.004975)	2.045848 (0.007985)	-0.106*** (0.008841)

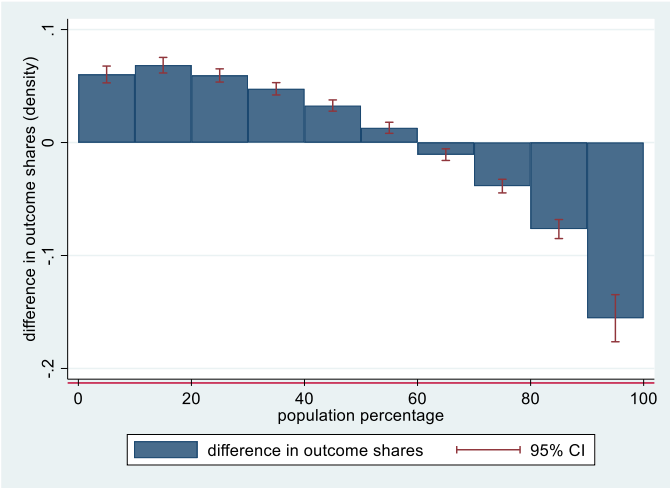
Preliminary results

Effect of the installation of EE measure per percentile of gas consumption (relative differences)

Loft insulation

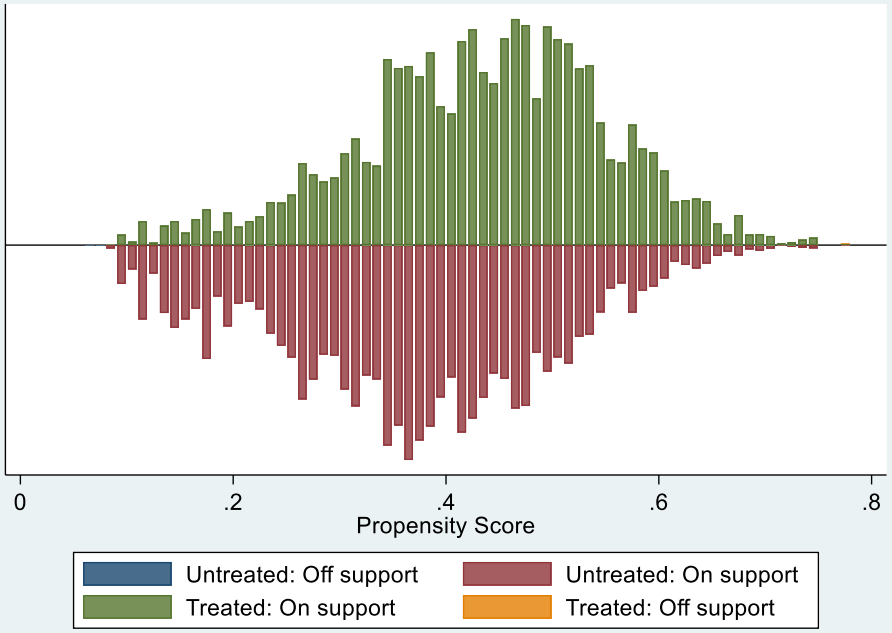


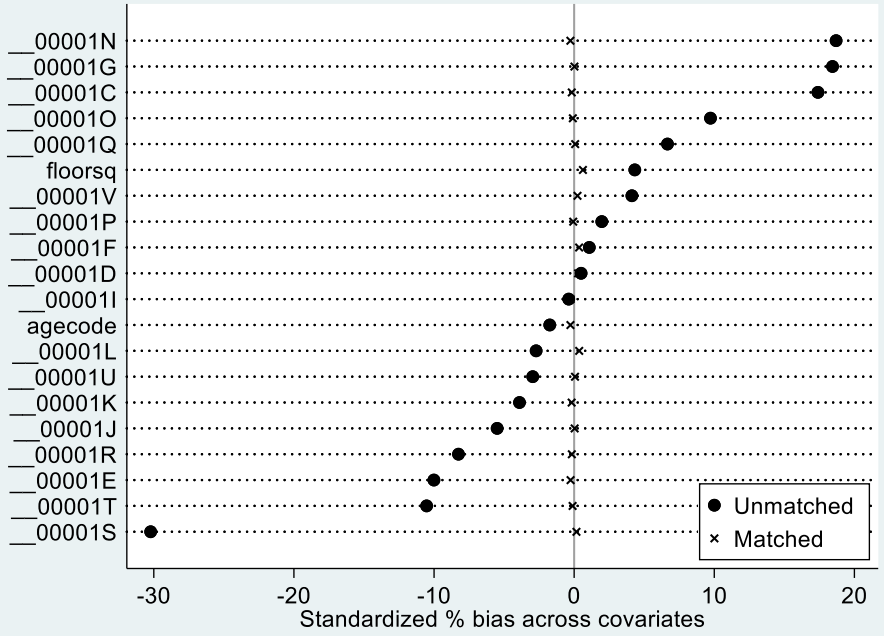
Cavity wall



Preliminary results

Robustness check: Propensity score matching

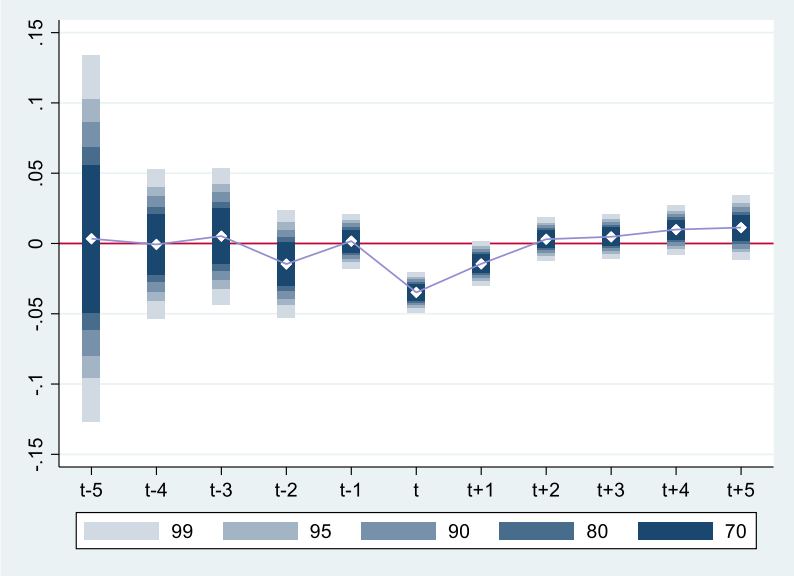




Preliminary results

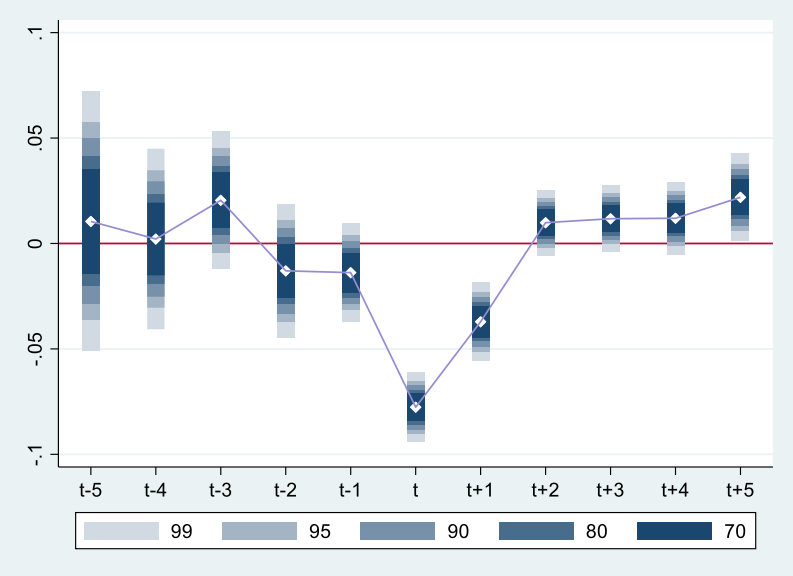
Robustness check: Propensity score matching

Loft insulation installation in t (%)



Parallel trend passed
F(1, 45502) = 0.16
Prob > F = 0.6932
N observations: 125,698

Cavity wall installation in t (%)



Parallel trend passed
F(1, 45502) = 3.22
Prob > F = 0.0728
N observations: 125,698

FE model. Outcome variable: Ln gas consumption / Treatment variable: Loft insulation or Cavity wall / X variables: Lhdd and Lgasprice

Conclusions

- H1. The installation of EE technical improvements in households is not enough to generate significant reductions in the amount gas consumed by dwellings vs. those that have not adopted them – Rejected→ Reductions happens during the first and second year after the installation

- H2. The gas consumption reduction of households in the UK after the installation of an EE technical improvement, if any, does not last in time due to factors unrelated to the effectiveness of the technical measured taken – Confirmed → The impact of the EE measure fades away after two to four years after the installation

- H3. Households installing EE technical improvements alongside other renovations in dwellings do not experience significant energy consumption reductions – Partially confirmed → Reductions only happen the first year but the pattern improve the randomness in consumption in those households with conservatories

- H4. For all the EE measures investigated, vulnerable households installing EE technical measures do not reduce their energy consumption – Confirmed → Those households in vulnerable areas experience much less reductions on average. In addition to that, those ones already in the lower percentiles of the distribution of gas consumption increases their consumption after the adoption of EE measures

Conclusions – Policy implications

1. The impact of the adoption of these measures varies considerably depending on the level of deprivation of the areas in which households are located.

2. Energy efficiency policies may be having a positive impact on reducing fuel poverty, but the energy efficiency schemes are not effective in this segment of the population and they do not get the expected energy savings.

3. Need to establish more tailored energy policies adapted to the individual characteristics of the households. Technical measures are effective in the short-term, it seems that in order to get long-term effects additional policy support would be needed.

4. We hypothesize that the implementation of energy efficiency schemes consisting of a mix of regulatory, instruments, i.e. tighter standards for newly constructed dwellings and for renovations, financial incentives and soft instruments is needed

Further explorations

Quantitatively: Multiple treatments

Qualitatively: Survey with UK household to explore behaviours

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Thank you very much – Questions/Comments?

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