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An examination of energy efficiency retrofit depth in Ireland

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ABSTRACT

This study examines energy efficiency retrofit depth in Ireland using data from a national residential grant scheme for energy efficiency upgrades. We specifically examine both the number of retrofit measures adopted per dwelling, and also the comprehensiveness of retrofits upgrades, which are retrofits in excess of the most common and simple retrofit combinations. "Obligated parties", who are required by the State to reduce energy consumption in Ireland, vary in the number of measures undertaken, relative to private retrofits, with some performing better while others perform relatively poorly. All parties are found to perform negatively relative to private applications in engaging homes in 'more comprehensive' retrofits, a term which we define for the purpose of this research. Newer homes, relative to older homes, are more likely to invest in more retrofit measures but less likely to engage in more comprehensive retrofits. Regionally, homes in the Greater Dublin Area are less likely to undertake more retrofit measures but more likely to engage in more comprehensive retrofits, while the opposite is true of rural areas. A seasonal trend also exists, with applications made during autumn and winter much less likely to be made for more comprehensive retrofits. Demand for more measures and more comprehensive retrofits does not appear to be affected by financial incentives as the introduction of a bonus for three- and four-measure retrofits has not coincided with any increases in the demand for such retrofits.

1. Introduction

As part of an ongoing series of energy efficiency directives from the European Union, Ireland is obliged to promote energy efficiency and achieve a targeted reduction in energy consumption of 20% by 2020 [10]. One means of contributing to this reduction is to improve the energy efficiency of the nation's building stock. Nearly 40% of final energy consumption occurs in buildings, with two thirds of the energy consumed in residential buildings used for space heating [9]. Given variations in energy consumption patterns across Europe, this 20% reduction in energy consumption must be implemented at national level, with each state required to develop a National Energy Efficiency Action Plan (NEEAP), to be revised every three years. Ireland's third NEEAP, published in 2014, concluded that by the end of 2012, Ireland had met 39% of its 2020 target [6].

Roughly 50% of residential properties in Ireland are believed to have an energy efficiency status equivalent to a Building Energy Rating (BER) of between D1 and G,[1] which are the lowest six grades on a 15-point scale. This provides an opportunity for policy aimed to improve the energy efficiency of residential buildings and in turn help meet Ireland's obligations under the directive. Ireland's national renovation strategy provides a roadmap of building renovations for residential and other buildings [7]. The Sustainable Energy Authority of Ireland (SEAI) provides grant aid for home owners to improve the energy efficiency in their homes through the Better Energy Homes (BEH) scheme. With greater understanding of the decision to engage in home retrofitting, it may be possible to identify certain characteristics of households that are more or less likely to pursue multiple-measure retrofits. In the context of the BEH scheme, the number of measures that can be undertaken range from one to four. The four types of measure for which grant aid is available are categorised as roof insulation upgrades, wall insulation upgrades, boiler and heating control upgrades and solar collector installation.

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[1] Central Statistics Office (2015) Domestic Building Energy Ratings Release, December 2015, Table 15, available: http://www.cso.ie/en/releasesandpublications/er/dber/domesticbuildingenergyratingsquarter42015/.

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In addition to examining the number of retrofit measures by household characteristics, we also explore the role of obligated parties. Obligated parties are energy distributors and retailers who are obliged under the NEEAP to achieve new energy savings of 1.5% of sales by volume each year to 2020. The role of these parties is described in more detail in Section 2. Generally, more retrofit measures have the potential to provide greater energy efficiency improvements but, given the heterogeneity in household characteristics and behaviours, it is unclear which households are more likely to engage in more comprehensive retrofits beyond the most common and simple retrofit measures. Without such information, it is much more difficult to identify types of residential buildings where energy efficiency savings can be achieved most easily.

There exist many benefits to engaging in retrofit measures in the home, most notably the reduction in energy costs, increased comfort, environmental benefits [5,12], health benefits [17] and in many cases, an increased sale value of the property [18]. Previous literature has explored the drivers of energy efficiency retrofit behaviour. These include socio-economic conditions and specific household characteristics [4], the cost and profitability of the home retrofit investment [1,24] and the availability of financial subsidies [22]. Subsidies encouraging investment in residential energy efficiency retrofits are common across industrialised countries but, while encouraging beneficial activities, a downside to this sort of subsidisation scheme is the issue of free-riders. Free-riders are households who would engage in retrofitting activities regardless of grant aid but who avail of grant aid when it is available. The activity of free-riders is not driven as much by subsidisation but by other factors and research has found that free-rider rates in Germany could be as high of 50% [13]. Specifically in the Irish context, evidence suggests that the decision to invest in Energy Efficiency Measures (EEMs) is determined mainly by the cost of investment and gains in energy savings, followed by comfort gains. Moreover, environmental benefits were found to be of little concern [2].

The literature in this field is dominated by analysis of the propensity of households to engage in energy efficiency retrofitting of the home. These studies generally look at whether a household makes a decision to engage in any retrofit measures, regardless of intensity. This literature exists within a wider literature on technology adoption, which is dominated by duration analysis [14,19,20,23]. Within the more specific field of residential EEM adoption, there exists a greater variety of analyses. Young [28] uses the duration model approach to study the replacement of appliances, such as freezers and washing machines in Canadian homes. Descriptive analysis of the trends in residential energy efficiency schemes have also been used [16,21,22]. Probit models have been used to assess the probability of adoption based on certain determining factors [2,11], while spatial analysis has been used to examine propensities to adopt based on interactions between the proximity to other adopters and other determining factors [26]. Others qualitatively analyse reasons given for participation by households who have used retrofit subsidisation schemes [15].

Across several countries the proportions of residential retrofits that are attributed by the authors as being comprehensive is quite low. Comprehensive retrofits made up only 2% of claims for tax incentives in Italy and 3% in the Netherlands but in Germany rises to rises to 23% of applications for a loan financing intervention and 6% for a grant aid intervention [22]. This study focusses not on the propensity to adopt an energy efficiency measure but rather the retrofit depth among those who have adopted one or more EEMs through the Better Energy Homes (BEH) residential energy retrofit grant scheme in Ireland. This research complements a Canadian study by Gamtessa [11] that considered property and household characteristics that are most closely associated with deeper retrofits.

For the purpose of this research, we analyse two concepts of retrofit depth. The first of these is simply the number of EEMs (e.g. wall insulation, roof insulation, boiler & heating control upgrades, or solar collector installation) and in our dataset can range from one to four measures. The second is referred to as retrofit comprehensiveness. The most common retrofit combinations undertaken by households under the BEH scheme are a one-measure retrofit of boiler with heating controls upgrades and a two-measure retrofit of attic insulation and cavity wall insulation. We view these, alongside all other one-measure retrofits, as simple, or less comprehensive retrofits. We therefore consider retrofit combinations made up of one of these measures, in addition to one or more other measures as a more comprehensive retrofit. The distinction between these two concepts of retrofit depth is that the former is simply a count of EEMs installed, whereas the latter attempts to differentiate by quality of energy efficiency savings potential.

The remainder of the paper is organised as follows: Section 2 provides a description of the BEH data. Section 3 contains a discussion of modelling and estimation issues. This is followed by the presentation and discussion of the estimation results in Section 4, while Section 5 concludes.

2. Descriptive analysis

The Better Energy Homes scheme, originally known as the Home Energy Savings scheme, commenced in 2009 and is administered by the Sustainable Energy Authority of Ireland (SEAI). It is a grant aid scheme for households to engage in energy efficiency improvements, with grants available for various energy efficiency measures (EEMs). Grants are available for roof/attic insulation, one of three types of wall insulation (cavity insulation, external wall insulation or internal dry-lining), three types of boiler upgrade (oil boiler or gas boiler with heating controls upgrade or heating controls upgrade only) and solar collector (panel or tube) installation. This means that a household may adopt up to a maximum of four EEMs as only one type of wall insulation or boiler upgrade may be awarded grant aid. Upgrades must satisfy SEAI standards for grant applications to be successful. The level of grant aid available has changed over time, with information on the dates of these amendments and the changes made detailed in Table 1. It may be noted that bonus payments for more intense retrofits, i.e. three- and four-measure retrofits, were introduced as part of Scheme 5.

The dataset comprises all applications made to the Better Energy Homes scheme from its inception in March 2009 to October 2015, i.e. the population of retrofits made via the BEH scheme. However, it excludes properties where retrofits were undertaken without grant aid or where grant aid was received from another scheme targeted toward homes affected by fuel poverty, the Better Energy Warmer Homes Scheme. The dataset is therefore not fully representative of households undertaking energy efficiency retrofits. However, an overwhelming majority of residential properties that have undertaken energy efficiency retrofits have engaged with the BEH grant scheme. Over 160,000 homes or approximately 12% of qualifying household stock (i.e. built prior to 2006) have made an application for a BEH grant. While there may be potential sample selection biases inherent in the BEH dataset, particularly related to low income households, the data represents the full population of retrofits undertaken under the BEH scheme and the analysis provides practical information on the households that engage with the scheme. Low income households are less likely to engage with a grant scheme such as the BEH because of the co-finance requirement for the EEM investments, which in part reflects why the SEAI administers in parallel the Better Energy Warmer Homes Scheme to target homes subject to fuel poverty.