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Bunching of residential building energy performance certificates at threshold values

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HIGHLIGHTS

- Examines energy performance certificate (EPC) pre and post energy efficiency retrofit.
- Bunching in distribution of post-works EPCs but not in the equivalent pre-works EPCs.
- Use a regression discontinuity design and estimate counter-factual distribution of EPCs.
- Find no evidence of illicit behaviour by EPC assessors.
- High rates of low energy lights prevalent among EPC in bunching areas of distribution.

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ABSTRACT

Energy performance certificates (EPC) provide a measure of and raise awareness of the energy efficiency of homes. The Irish system of energy performance certificates comprises fifteen alpha-numeric grades, which imposes fourteen discrete notches in an otherwise continuous scale. Visual evidence of bunching occurs in the distribution of EPC certificates on the favourable side of EPC grades among homes that have completed energy efficiency retrofits but not in the equivalent distribution of EPC certificates prior to completion of retrofits. Using a regression discontinuity design and estimation of a counter-factual distribution, evidence is found of bunching in the post-works distribution but not the pre-works distribution. We analyse whether statistical evidence exists of drivers of this bunching and whether sources of bunching can be identified. We find that bunching is widespread but not systemic and find discontinuities in the distribution of certain parameters of assessment (i.e. low energy lighting) which suggests their contribution toward bunching. With comparable EPC schemes across Europe the results have policy implications for other countries. Where continuous EPC scales are used, additional energy efficiency improvements may be achieved if a multi-point scale is considered. In countries where multi-point EPC scales are used, bunching of assessments is also likely to occur and quality control measures may be necessary to ensure that the bunching is due to genuine energy efficiency improvements and not a reflection of illicit activity.

1. Introduction

The Energy Performance of Buildings Directive [1], transposed into Irish law in 2006 [2], established a methodological framework for calculating energy performance and required the development of Energy Performance Certificates (EPC) to communicate the energy performance of homes using a standardised ranking. Ireland's EPC, Building Energy Rating (BER), uses a 15-point scale ranging from A1 to G, with A1 as the most energy efficient grade. The assignment of alpha-numeric grade follows an on-site assessment of more than 130 property characteristics, yielding a building energy performance measurement in units kWh/m^2/yr, which is transposed into the 15-point alpha-numeric scale. EPCs provide various market benefits, particularly the reduction of information asymmetry. With an energy efficiency rating system, agents seeking to buy or rent are aware of the energy performance of buildings which would otherwise be unknown. Provided consumers value energy efficiency, for comfort gains, for monetary savings through reduced energy usage, for environmental concerns or otherwise, this will be reflected in property prices. A body of research exists to show that properties with higher energy efficiency secure higher

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prices, for example in Ireland [3,4], England [5], Wales [6], Germany [7], and the Netherlands [8]. EPCs also provide knowledge of the energy efficiency status of the building stock, which allows policy makers to identify where policy implementation may need adjustment. For example, certain categories of the building stock might require greater investment than others. For these benefits to be most effectively translated to the market, performance ratings must be accurate and dwellings appropriately labelled.

This paper provides evidence of bunching of BER assessments on the favourable side of the thresholds on the 15-point BER scale in Ireland. Bunching in this instance is not inherently a bad outcome, as it indicates home-owners are striving to improve their properties' energy efficiency. But there is a financial incentive from having an assessment on the favourable side of the thresholds within the 15-point scale. Each 1-point improvement along the scale, on average, is associated with a 1% increase in the property's price [4]. Understanding whether the bunching is real and reflects accurate assessments of properties' energy performance or the result of illicit activity is important. If the bunching reflects reality then dividing the continuous BER scale, denoted in units $kWh/m^2/yr$, into a 15-point scale has achieved a beneficial outcome of encouraging home-owners to upgrade their homes beyond the next attainable threshold. This has policy implications for other EU countries that use continuous rather than multi-point EPC scales, e.g. Germany and Belgium. If the bunching represents illicit activity the associated price premiums constitute a fraud on buyers or renters and has relevance for the integrity of the BER scheme. While the analysis in this paper is specific to the Irish EPC scheme it has much wider policy implications. EPC schemes across Europe have their origins in the Energy Performance of Buildings Directive introduced in 2002 and revised in 2010 [1,9]. Any successes or challenges in implementing the Directive in one country are useful lessons for authorities in other European countries implementing the same legislation. Understanding the drivers of bunching in the Irish BER scale, including what retrofit measures are most closely associated with the bunching, has relevance for policy-makers and those involved in improving the energy efficiency of the residential building stock across Europe. Furthermore, the level of accessibility to EPC databases for research purposes varies widely across Europe and Ireland stands out as having one of the most well-established databases and provides opportunities for research not feasible elsewhere [10]. Access to property level statistical data from the BER scheme is freely available for "personal, research or education purposes".[1]

An energy labelling system with discrete performance thresholds may give rise to perverse incentive, i.e. a policy incentive may also lead to unintended and undesirable outcomes. Bunching may be a symptom of this perverse incentive, as the introduction of an incentive to improve a building's energy efficiency may have also enticed misrepresentation of energy efficiency ratings. Bevan and Hood [11] define three types of perverse incentive, one of which is potentially relevant in this instance. Threshold effects refer to the use of minimum performance standards which incentivise improved performance for those below the threshold but lead to stagnation of those above the threshold. The outcome of a BER assessment is visible to an assessor throughout the assessment procedure and parameters can be adjusted during the assessment process. Combined with how the property market values energy efficiency, there is an incentive to marginally falsify BER assessments, i.e. to manipulate the assessment in such a manner to move a rating from the less desirable side of a BER threshold to the more desirable side. On the other hand, an ongoing awareness by assessors of the assessment score during the assessment procedure also allows assessors to advise home-owners of measures that could be easily undertaken to improve their BER, which would have a positive impact on the energy efficiency of the building stock. Understanding which is the source of the bunching is important both for the integrity of the scheme but also from a policy perspective to learn which retrofit measures are being used to nudge BER assessments to the favourable side of the threshold.

Bunching analysis was initially developed to estimate behavioural responses in the public finance literature [12–14], though there are now applications in many settings [15]. It investigates whether discontinuities in incentives elicit behavioural responses. For example, Saez [12], Chetty et al. [13], Kleven and Waseem [14] find that discontinuities, i.e. thresholds, in the application of income taxes lead people to organise their individual affairs in a such a way that collectively there is bunching on one side of the threshold. It is the threshold, or the discontinuity in the incentive, that is driving the bunching behaviour. Whether in taxation or elsewhere incentive discontinuities have existed in perpetuity but bunching analysis is a relatively recent approach, closely linked to the upsurge in research using administrative data. As bunching usually occurs in close proximity to specific points, large datasets are required to observe the phenomenon. Bunching is rarely observed in survey data due to small sample sizes and measurement error [15]. In large administrative datasets simply plotting the raw data can often reveal evidence of bunching, as is evident for the BER data in Fig. 3. In addition to public finance, applications of bunching analysis cover pensions [16], health insurance [17], labour market [18] and electricity prices [19], amongst others. There are also a number of applications related to EPCs. There is evidence of bunching in EPC assessments in residential properties in the United Kingdom [20] and in commercial properties both in the United States and United Kingdom [21]. Within the energy efficiency literature Pierce and Snyder [22] argue that bunching is a sign that cheating is taking place. They investigate vehicle emissions testing in New York, finding evidence of bunching in the distribution of test scores at the passing thresholds for five out of six emissions tests. Sallee and Slemrod [23] argue that bunching reduces welfare because it provides discontinuous incentives and induces actions that have negative net social benefits related to air emissions and health impacts. Similarly, Alberini et al. [24] show that in the presence of bunching at arbitrary thresholds, that consumers are willing to pay more for otherwise identical goods. Within specific buildings any welfare impact associated with bunching is likely to be confined to private benefits, specifically to participants in property transactions, i.e. affecting the sale or rental price. Both Matisoff et al. [25] and Shewmake and Viscusi [26] argue that the motivation for bunching in EPCs relates to the price premium associated with EPC labels and that builders or owners strategically incorporate energy efficient features to achieve higher ratings rather than attempt to cheat.

Hyland et al. [27] already show evidence of bunching in Irish BERs, finding that the bunching is particularly strong at the lower end of the BER scale. They suggest that property vendors, for which a BER is mandatory to complete the sale, have a strong preference for receiving a high BER rating, motivated by a strong 'asking' or 'offer' price premium [3,27,4]. However, they suggest that there is no incentive for BER assessors to cheat, as their services are remunerated by fixed fee and not directly linked to the sale price of a property. The research by Hyland et al. [27] is consistent with the arguments of Matisoff et al. [25] and Shewmake and Viscusi [26] suggesting that a price premium is motivating owners to achieve higher BER grades, which are achieved by genuine means rather through cheating on the BER assessment. The existence or perception of a price premium is central to this thesis on the bunching of BER grades. While BERs are mandatory to conclude a property transaction in Ireland, not all BER assessments are undertaken in anticipation of a property transaction. Many BER assessments are undertaken as part of a grant application for a residential energy efficiency retrofit without any intention to subsequently sell or rent the property. Bunching of BER grades also occurs for such properties, which makes the price premium motivation less credible, or at least not the only motivation for bunching. There are a number of alternative

[1] The National BER Research Tool is available at https://ndber.seai.ie/BERResearchTool/Register/Register.aspx