Limited attention in the housing market: Threshold effects of energy-performance certificates on property prices and energy-efficiency investments

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Abstract

We study limited attention and heuristic decision-making in the housing market. We analyse the effect that energy efficiency (EE) information has on the final sale price of a property and we show that the provision of simplified information in the form of EE rating bands leads to price discontinuities at the rating band thresholds. Using a novel dataset, we analyse over 5 million residential property sale transactions in England and Wales, each containing sale price, property characteristics, location and the energy performance certificate (EPC) at the date of sale. The EPC includes an energy cost rating (SAP rating) as a measure of energy cost requirements (ranging from 1 to 100) which is assigned to a predefined fixed colour-coded rating band from green A to red G. Applying a Regression Discontinuity Design (RDD) we identify and estimate statistically significant price discontinuities at the rating band thresholds. We estimate that, all else equal, having a higher rating band increases the final sale price of a property between 2.5% and 0.8% (£6,625 and £2,000 based on average sale prices) depending on the threshold crossed. The presence of price discontinuities suggests that individuals are more attentive to the less precise, more salient and simpler colour-coded rating band and partially inattentive to the more precise SAP rating. We also find evidence that the probability of sellers making EE investments before a sale is between 11% and 0.4% higher before crossing a rating band threshold, suggesting that the price discontinuities generate incentives that influence market behaviour. We discuss policy considerations that can be extended to other settings where the provision of aggregate information creates reference thresholds.

Keywords: Limited attention, inattention, heuristic decision-making, price discontinuities, housing market, behavioural industrial organization, anchoring and adjustment, coarse thinking, energy efficiency, energy performance certificates, EPC

JEL Classification: D12, D83, L15, R21, R31, Q48

1 Introduction

The role of information processing by agents in market interactions is central to modern economic theory. Neo-classical economic models normally assume that agents, in order to make optimal decisions, process all of the information available to them within a utility maximising function. Yet, even when presented with all the relevant information, agents may not have the necessary skills, the cognitive ability (Simon 1955), the incentives (Stigler 1961) or the time to process or evaluate it as part of a complex utility maximisation calculation. A growing body of literature proposes models in which agents simplify decisions by processing only a subset of the available information, a heuristic referred to as inattention or limited attention (DellaVigna 2009, Gabaix 2019). In certain markets, policy makers may attempt to help inattentive agents make better decisions by requiring the provision of additional simplified information and thus reduce the complexity of processing information or acquiring the skills to do so.

In this paper, we present evidence that requiring the provision of simplified information in certain markets can create threshold effects and we discuss how these can be leveraged to improve policy design. We study inattention and heuristic decision-making in the housing market by analysing the effect that *energy efficiency* (EE) information has on the final sale price of a property. We show that the provision of simplified information in the form of arbitrary EE rating bands, on top of a more comprehensive *energy cost rating* (referred to as SAP rating and provided on a scale from 1 to 100), leads to price discontinuities at the rating band thresholds. Specifically, the SAP rating scale (raging from 1 to 100) is split into 6 rating bands, labelled with different letters and colours from A (green) to G (red). Under the assumption of full attention, since the rating band classification does not provide additional information over the SAP rating, there should be no systematic price discontinuities at the thresholds.

Using a novel dataset, we analyse over 5 million geocoded residential property sale transactions completed after the introduction of legislation that made it mandatory for sellers to provide an energy performance certificate (EPC) to potential buyers. For each transaction, we observe sale date, price, property characteristics, location information and the EPC at the date of sale. The EPC contains energy performance indicators including the SAP rating and the associated rating band. We implement a regression discontinuity design (RDD) with local linear estimators and find statistically significant discontinuities at the rating band thresholds. We estimate that, all else equal, the sale price of a property increases between 2.5% and 0.8% on average when the SAP rating crosses a rating band threshold (compared to counterfactual predicted prices for the SAP rating without the higher rating band assigned). These results are robust to different modelling strategies, the inclusion of a wide range of baseline covariates (property

characteristics, geographic area fixed effects and date fixed effects) and a set of comprehensive placebo tests. The sizes of these estimates are economically significant, as a back of the envelope calculation they range from £6,625 (2.5% at the G-F threshold with a mean sale price of £265,000 around the threshold) to £2,000 (0.8% at the D-C threshold with a mean sale price of £250,000 around the threshold).

We also find evidence that some sellers make EE investments that improve the rating band of a property, for example from D to C, before marketing it for sale. We document that the probability of sellers making EE investments prior to a sale is considerably higher before crossing a rating band threshold of between 11% and 0.4% (depending on the rating band threshold) relative to the total number of properties that made EE investments. Our findings suggest that some sellers are aware of the price discontinuities, and are willing to invest in EE before a sale under the expectation of obtaining a higher selling price that covers the EE investments plus the additional price premium. These results suggest that policies can leverage threshold effects to improve overall welfare, for instance the investment incentives we identify can lead to a more energy efficient housing stock and thus help reduce CO_2 emissions from energy generation.

Irrespective of whether inattention is driven by behavioural biases (e.g. salience – Finkelstein 2009, Chetty et al. 2009) or deliberate attentional choice (i.e. agents minimising information acquisition costs – Stigler 1961, Caplin 2016), our results suggest that agents follow an anchoring and adjustment decision process (as proposed by Gabaix 2019 incorporating concepts from Tversky & Kahneman 1974). We argue that agents anchor at the simplified colour coded rating band and adjust with the more detailed SAP rating, adjustment is insufficient and thus may lead to imperfect optimisation. We also anticipate that limited attention in the housing market is linked to limited attention in other markets through the model of coarse thinking by transference and framing proposed by Mullainathan et al. (2008). Agents may transfer informational content from other situations into the housing market (for example appliance energy efficiency ratings as they use a similar rating graphic) and regulators may attempt to frame the provision of simplified information to maximise overall welfare, for example by using green A as the most energy efficient property rating.

Our paper is related to the existing literature on limited attention in functioning markets. Lacetera et al. (2012) and Englmaier et al. (2018)[1] find evidence of limited attention in car markets, which suggests individuals can be inattentive in durable product markets. Gilbert et al. (2012) and DellaVigna & Pollet (2009)[2]

[1]Other authors also expanded on the topic, including Busse et al. (2013) who extend the analysis of Lacetera et al. (2012).

[2]Similarly, other authors also provide further evidence of inattention in financial markets,

document inattention in financial investment markets (e.g. the stock market). Our paper provides evidence that limited attention also plays a role in high-value asset markets, such as the housing market, where consumers spend considerable more time and effort making purchasing decisions, but invest less frequently. Our paper also contributes to current research on limited attention as the result of the provision of summary information. Pope (2009) studies the effect that simplified aggregate information, in the form of rankings, have on hospital non-emergency admissions and finds an effect even after accounting for the underlining objective information on which the rankings are based. Gilbert et al. (2012) find that stock market and government futures prices react sharply to a monthly summary statistic constructed from previously released detailed information. Although our research focuses on the provision of simplified aggregate information and the resulting threshold effects, it is also more broadly related to studies that find imperfect optimisation as the result of shrouded information (Chetty et al. 2009, Gabaix et al. 2006) or information that is visible but not considered when making decisions (Englmaier et al. 2018 and Lacetera et al. 2012). We argue that providing aggregate EE information in the housing market may lead to imperfect optimisation by agents. Nonetheless, it is important to note that other market inefficiencies may arise if aggregate information (in the form of rating bands) is not provided, for instance some agents may not know how to accurately interpret detailed information or they may look for other anchoring reference points (e.g. the left-most digit of the SAP score, a heuristic referred to as left-digit bias). Our paper further contributes to the literature on limited attention by discussing policy implications when leveraging the threshold effects generated by aggregate information.

This paper is also closely related to the literature on housing energy efficiency, particularly the work by Comerford et al. (2018) who provide evidence of bunching at the EPC rating band thresholds after the introduction of the EPC legislation in the UK. In our study we find evidence that some sellers actively invest to get their property to the next rating band, supporting the mechanism proposed by Comerford et al. (2018), and thus suggesting that they are aware of rating band price premiums. Although indirectly, we also confirm the positive relationship between price and energy performance in the UK reported by Fuerst et al. (2015).

The subsequent sections are organised as follows. Section 2 explains EPCs in the context of the UK housing market, Section 3 describes our data. Sections 4, 5 and 7 present our empirical strategy, the results of our analysis and the wide range of robustness checks we performed. Section 6 discusses the implications of our results for market behaviour and Section 8 concludes.

including Hirshleifer et al. (2009).

2 Energy Performance Certificates in the UK Housing Market

Before entering the market, residential and commercial properties in the UK are required to undergo an energy performance audit and the resulting Energy Performance Certificate (EPC) must be provided to potential buyers or tenants at the earliest point of contact (e.g. as part of marketing materials or during an arranged viewing). The audit and EPC requirements were introduced in the *Energy Performance of Buildings (Certificates and Inspections) (England and Wales) 2007* which came into force in 2007 as part of the UK government's strategy to reduce greenhouse gas emissions and following the European Union (EU) directive on the energy performance of buildings - EU 2002/91/EC (Housing Act 2004). The *Energy Performance of Buildings (Certificates and Inspections) (England and Wales) (Amendment) Regulations 2011* came into force in April 2012 making it mandatory to include the energy performance rating in all marketing publications, including printed material and online listings (in line with the recast of the EU directive - HMG 2016)[3]. An EPC contains detailed information about the energy performance of the property including expected running energy costs, the energy efficiency rating, recommendations for improving energy performance and the overall impact of the energy consumption of the property on the environment. Importantly for our study, the EPC displays the energy efficiency rating of the property in a graph with a predefined format (an example is shown in Figure 1). An accredited assessor must perform the audit and issue the corresponding EPC. All EPCs must be lodged by the assessor in a centralised public access register managed by the government agency responsible for housing[4]. EPCs are valid for 10 years from the date they were issued, after this time the property must undergo a new audit and a new EPC must be lodged, however a new audit and EPC can be requested at any time, for example after efficiency improvements such as roof insulation have been installed in a property.

The energy performance audit for residential properties (i.e. dwellings) is performed following the UK Government's Standard Assessment Procedure (SAP) methodology. The SAP was developed in 1993 by the Building Research Estab-

[3]The *Energy Performance of Buildings (England and Wales) Regulations 2012* came into force in January 2013 with the requirement to provide a valid EPC to potential buyers at the first point of contact unchanged and the requirement to include the energy efficiency rating in marketing materials made more explicit.

[4]As of 2019, the register is managed by the Ministry of Housing, Communities and Local Government. Although owners can request their properties to be removed from the register it rarely happens as they can only request the whole property to be removed from the register i.e. they cannot request a specific certificate (e.g. a less favourable recent certificate) to be removed (DCLG 2019*a*).

lishment (BRE), then a UK government-funded research laboratory, and is revised and updated regularly by the now independent BRE[5], the present edition is SAP 2012 with the latest revision from 2014 (BRE 2014). The aim of the SAP is to provide uniform energy consumption estimates for dwellings as to the energy consumption required to deliver a defined level of comfort and service provision based on standard occupancy and behaviour patterns (DCLG 2014).

The SAP audit generates a set of energy performance indicators that are presented in the EPC, including the total expected energy cost and the energy cost rating (SAP rating). These indicators are calculated using a range of property factors that affect energy efficiency (e.g. property type, build materials, efficiency of heating systems, etc.), regional environmental information (e.g. climatic data) and predefined fuel prices which are calculated as averages of the previous three years across all regions (BRE 2014). This means that, for the purposes of the SAP calculations, energy prices are uniform across the UK and across months, although fuel prices are updated regularly. The energy cost of various energy requirement categories (e.g. space heating, electricity for lighting, etc.) is calculated by multiplying its energy demand in kWh/year by the standardised fuel cost, and the total energy cost for a property is simply the total sum of all category costs.

The SAP rating is calculated based on the total energy cost using a formula that accounts for the total floor area of the property (to make it comparable across different property sizes) and using a cost deflator parameter to provide comparability across years and SAP revisions. The SAP rating is presented on a scale from 1 to 100 where higher values represent lower running energy costs and thus higher energy efficiency. While the formula is not linear and slightly penalises high-energy cost properties (BRE 2014), the non-linearity kink occurs at SAP rating 51, which does not coincide with a band threshold and therefore does not represent a concern for our analysis[6].

Importantly for our study, starting in 2005 and in preparation for the introduction of the EPC legislation, the SAP audit additionally produces colour coded rating bands from green A to red G (BRE 2005). Each rating band represents a predefined range of SAP rating scores (of between 20 and 9 units), with the least efficient scores (1 to 20) assigned to rating band red G and the most efficient scores (92 and above) to rating band green A. That is, the rating band for a property is assigned exclusively based on the calculated SAP rating and where it falls

[5]The BRE was privatised in 1997 and is now owned by the registered charity BRE Trust.

[6]The formula for calculating the SAP rating (BRE 2014) involves the calculation of an energy cost factor (ECF):

$ECF = deflator \times totalcost/(totalfloorarea + 45)$

$if ECF >= 3.5, SAP = 117–121 \times log(ECF)$

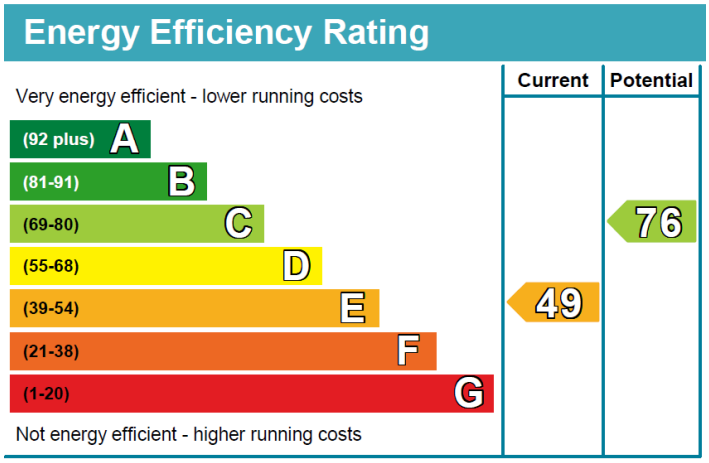
$if ECF < 3.5, SAP = 100–13.95 \times ECF$

When the ECF is around the kink (3.5) both formulas will result in an SAP rating of 51.

within the rating band ranges. For instance, a property with SAP rating 15 will be assigned the rating band G as it falls within the range of 1 to 20.

The total energy cost, the SAP rating and the rating band are included in the first page of the EPC[7]. In the present format of the EPC[8], the total energy cost is shown first (below general property information) as the estimated costs for three years (i.e. multiplied by three). The SAP rating and the rating band are shown in a graph following the visual format specified in the EU Energy Labelling Framework Directive (EU 92/75/EEC) where energy efficiency is presented as a discrete colour-coded grade from green A to red G overlapped over the continuous SAP rating. The energy efficiency rating graph also shows the rating band ranges as part of the colour coded row (e.g. 1-20 for G, 21-38 for F, etc.). An example EPC energy efficiency rating graph is shown in Figure 1.

Figure 1: Example Energy Efficiency Rating Graph



The first legislation referencing EE rating bands is the *The Energy Efficiency (Private Rented Property) (England and Wales) Regulations 2015*. This legislation requires any property offered for rent on or after April 2018 (and tenancy renewals after the 1st of April 2020) to have a rating band E or better. Buyers of properties with rating bands G and F will have to make EE investments if they want to offer them for rent after this date. Our formal analysis shows that while these changes generate fewer sales of properties with rating bands G and F after April 2018 they do not drive, or have a substantial effect, on our identified price discontinuities.

[7]The first page of an example EPC is shown in Appendix E.

[8]The format of the EPC changed slightly as part of the regulation amendments of 2012, but the unchanged rating graph was maintained as the main source of information.

3 Data

In order to identify sale price discontinuities at the rating band thresholds we use a novel dataset constructed by merging three data sources: a) Her Majesty's Land Registry (HMLR) *Price Paid Data* (PP); b) The Department for Communities and Local Government (DCLG) *Energy Performance of Buildings Data: England and Wales* (EPB); and c) Rural Urban Classification official statistics. The PP dataset contains transaction information for residential properties sold in England and Wales at full market value after 1995 and submitted to HMLR for registration (HMLR 2019). The EPB dataset contains property level data from the Energy Performance Certificate register for England and Wales covering the period from October 2008 to September 2019 (DCLG 2019*b*). The datasets were matched by property addresses using the official address data lookup dataset, maintained by Ordnance Survey (the national mapping agency of Great Britain). Urban area classification information (based on population density) was then added to the dataset from the Rural Urban Classification official statistics (Bibby 2013). The address matching process followed a deterministic multi-stage approach. Each address in the PP and EPB datasets was matched applying different address equality criteria at each stage. The first stage attempted an exact match on house name, house number, street name and postcode, the second stage attempted an exact match on house number, street name and postcode, and so forth. The matching was successful on 94% of the sale transactions. There were no systematic differences between the type of properties, location or prices between the matched and unmatched transactions (detailed information about the address matching process and the balance tests is included in Appendix D).

As explained in Section 2, legislation amendments requiring sellers to provide energy rating information during marketing activities became effective on April 2012 with the purpose of ensuring an EPC was available to buyers before they make an offer for a property (HMG 2016). Prior to this date, legislation could be interpreted as only requiring an EPC before the sale was completed, or when requested by a buyer, potentially allowing some sellers to commission the EPC after a price was agreed and other sellers to actively promote the EPC as a desirable feature. In order to ensure our results are not biased, our main analysis is performed over residential property sales completed on or after July 2012 (3 months after the amended legislation became effective).

We exclude new buildings from our analysis as due to construction regulations (HMG 2016) most of them (70%) fall within rating band B[9]. Moreover, an EPC is not always available during the selling process as new buildings can be sold

[9]Construction requirements are not specified in SAP rating units but rather in building material qualities, for example heat transfer (HMG 2016).

by developers as off-plan (i.e. where the sale happens before the construction is complete) and thus a sale price can be agreed before the *SPA rating* or the rating band are known. The results of our analysis for new buildings are included in Appendix A and as anticipated show no systematic discontinuities at the rating band thresholds.

The frequency distribution of sales across the SAP rating scale is presented in Panel A of Figure 2, the vertical lines show the rating band thresholds with the rating band names (G, F, E, etc.) included at the top. The distributions of existing and new properties are presented separately to highlight that they represent two distinct populations. Both are approximately normally distributed. The distribution of sales for existing properties peaks at SAP rating 67 and for new properties at SAP rating 84. An aspect worth mentioning is the potential clustering of transactions just above the rating band thresholds, which may indicate the presence of sellers who are aware of threshold effects. Minor, but noticeable, frequency increases are visible at the rating band thresholds in Panel A of Figure 2. It is worth noting that these frequency increases are unlikely due to misreporting or gaming of the EE auditing process, which is rule based and does not leave room for much distortion on the auditors part. Rather, we are able to precisely identify the sale transactions where more than one EPC was commissioned before a sale and which resulted in a rating band increase. The latest EPC for each of these transactions is produced after a new audit took place and where EE improvements were reported, providing evidence that the rating band increases are the results of actual investment in EE. It is important for our study to identify these transactions as they could represent sellers aiming for a specific rating band before advertising a property for sale. Panel B of Figure 2 shows the frequency distribution excluding transactions with a rating band increase as previously described. The slightly higher frequencies at rating band thresholds decrease considerably especially at SAP rating 69. These density increases are accounted for in our formal analysis and we show in Section 7 that they do not drive the price discontinuities. Finally, we re-address this issue in Section 6.1 which presents a more detailed discussion of seller behaviour.

The final dataset contains over 5 million transactions from July 2012 to September 2019 where a valid EPC was available at the date of sale (81% of the total sale transactions during that period)[10]. Each transaction contains the sale date and price, property characteristics, location information and the valid EPC at the date of sale. Summary statistics for key variables are provided in Tables 1 and 2. Property characteristics and location are fixed before the EPC audit (i.e. they are

[10]Sales of properties with total floor area of less than $30m^2$ and sale prices of less than £1,000 were excluded from the analysis to avoid registration errors and extreme outliers (e.g. living spaces of less than $30m^2$ are not realistic).

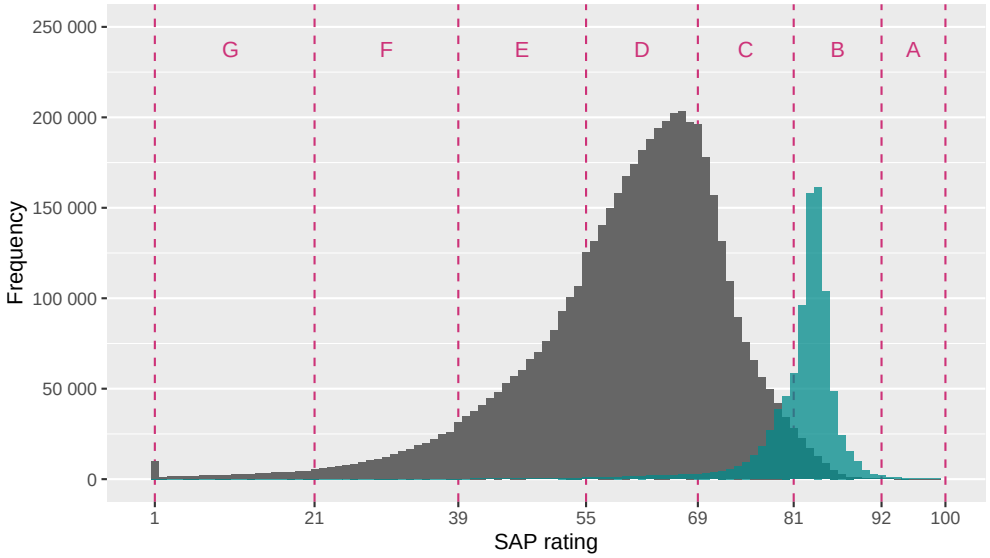
pre-assignment variables), the sale price and date can be influenced by the energy efficiency rating reported in the EPC[11] (i.e. they are post-assignment variables).

Detached houses account for 23.5% of the transactions we study, flats for 15.2%, semi-detached houses for 29.5% and terraced properties for 31.8%. The tenure of a property indicates the ownership of the building and the land it stands on, with freehold representing perpetual ownership and leasehold a lease from the freeholder, usually long term (90+ years), agreed at the beginning and decreasing by year. Typically freehold properties will sell for a higher price. The majority of sales in our data are freehold (79.8%), with leasehold transactions mostly for Flats/Maisonettes (74.2% of leasehold transactions). Almost 40% of the transactions are from the south of England (South East, South West and London), suggesting a more active housing market in the region, also the majority of transactions are for properties in urban areas (81.4%). There is an upward trend in the number of properties sold by year, though in our data set 2012 only covers 6 months and 2019 covers 9 months. The average house price in our data is £263,677 and the average size is 94 m^2. Finally, most of the properties have a rating band D (almost 48.3%), with the average SAP rating at 60.

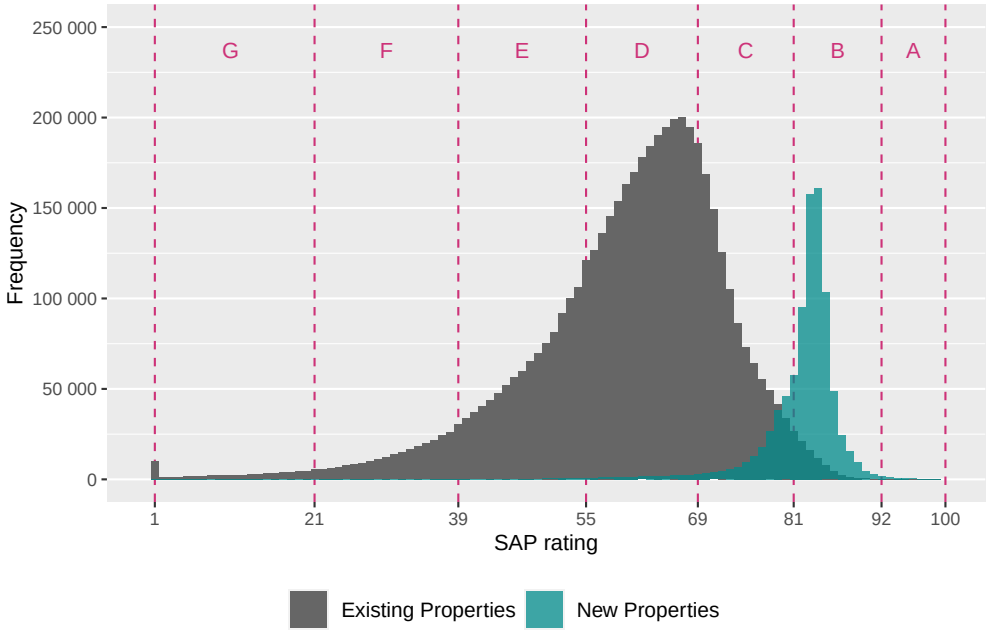
[11]The energy rating can affect the time a property stays in the market, and thus the final sale date.

Figure 2: Sale Frequency Distribution by SAP Rating

Panel A. All sales



Panel B. Excluding sales with Rating Band increases



Notes: Panel A plots the frequency distribution of all sales for each SAP rating. Panel B plots the frequency distribution excluding sales where the rating band increased before the sale. The distributions of existing and new properties are shown separately.

Table 1: Summary Statistics for Continuous Variables

	Mean	*Median*	*SD*	*Min*	*Max*
Price Paid (£)	263,677	200,000	290,167	1,000	46,013,365
Total Floor Area (m^2)	94	84	47	30	8,824
Price per Square Meter (£/m^2)	2,807	2,361	1,958	4	266,340
SAP Rating	60	62	13	1	100
Observations	5,000,363				

Notes: This table presents summary statistics for key continuous variables. SD stands for Standard Deviation.

Table 2: Summary Statistics for Categorical Variables

Variable	*Freq.*	%	Variable	*Freq.*	%
Property Type			Sale Date		
Detached	1,175,542	23.5	2012	281,456	5.6
Flat	761,388	15.2	2013	623,752	12.5
Semi-detached	1,472,852	29.5	2014	745,699	14.9
Terraced	1,590,581	31.8	2015	742,152	14.8
Tenure			2016	733,036	14.7
Freehold	3,991,578	79.8	2017	720,415	14.4
Leasehold	1,008,785	20.2	2018	702,791	14.1
Location			2019	451,062	9.0
East	578,688	11.6	Energy rating band		
East Midlands	439,281	8.8	A	967	0.0
London	554,630	11.1	B	98,920	2.0
North East	210,194	4.2	C	1,185,556	23.7
North West	625,745	12.5	D	2,411,210	48.2
South East	858,930	17.2	E	1,002,156	20.0
South West	544,138	10.9	F	240,746	4.8
Wales	249,443	5.0	G	60,808	1.2
West Midlands	469,721	9.4	Rating band increase before sale		
Yorkshire and			No	4,881,291	97.6
The Humber	469,593	9.4	Yes	119,072	2.4
Area Density					
Urban	4,068,522	81.4			
Rural	931,841	18.6			
Observations	5,000,363				

Notes: This table presents the frequencies and proportions (%) for key categorical variables.

4 Empirical Strategy

Our strategy for inference and estimation of the price discontinuities at rating band thresholds follows a regression discontinuity (RD) design (for an overview of the applicability and methodological implications of RD designs see Lee & Lemieux 2010). The discontinuous changes in sale prices that occur as the SAP rating crosses a rating band threshold are interpreted as the causal effect of a property having a higher rating band during a sale transaction beyond the underlying rating that it is based on. The treatment variable is the rating band, which is deterministically assigned from the SAP rating (the running variable), a design normally referred to as sharp RD in the literature.

We model property price as a function of the SAP rating. As sellers cannot precisely predict the SAP rating before an EPC is commissioned (they will at most have imprecise control) the distribution of properties with different characteristics across each SAP rating unit can be assumed to be as-good-as random and the relationship between price and SAP rating will be continuous. As the rating bands are assigned based solely on the SAP rating, price discontinuities at the thresholds strongly suggest that the rating band has an effect on price beyond that attributable to the increased SAP rating score. We run models at each threshold using a local-linear regression approach as described in Imbens & Lemieux (2008) and Gelman & Imbens (2019)[12] with the following specification:

$$P_i = \alpha + \tau T_i + \beta_{-} SAP_i + \beta_{+} T_i SAP_i + \epsilon_i \ , \tag{1}$$

where the dependent variable P_i represents the price per square meter[13] of property i, T_i represents the treatment variable (i.e. whether the SAP rating has crossed the rating band threshold), SAP_i represents the SAP rating of property i (normalised at the rating band threshold), and e_i the random error term. The coefficient of interest is τ which represents the difference between the price of a property at a rating band threshold and a counterfactual predicted price per square meter of the property without the higher rating band assigned (for a more detailed explanation of RD design estimation models see Lee & Lemieux 2010). τ can then be interpreted as the discontinuous increase in price as the SAP rating of a property crosses a rating band threshold. The interaction between T_i and SAP_i, and the

[12]Our results also hold under parametric estimation specifications similar to Lacetera et al. (2012) as discussed in Section 7.

[13]We use price per square meter as our dependent variable to increase the comparability of properties of different sizes, as discussed in Section 7 the results are similar when using total sale price as the dependent variable.

corresponding coefficients β_- and β_+, allow for different slopes at each side of the threshold, which is important in our study as the slopes across rating bands are in fact different.

While some property characteristics are correlated with the SAP rating, this does not represent a threat to our identification strategy because of the inability of sellers to precisely predict the SAP rating before the EPC audit. For example, the property type is correlated with energy performance, and flats may have another flat above and/or below them, which reduces heat loss even without insulation. Thus, in order to show that the discontinuities are not driven by differences in covariates (or, put differently, that covariates are balanced around the thresholds), we present our results both without and with the baseline covariates described in Tables 1 and 2. The model specification when including covariates is:

$$P_i = \alpha + \tau T_i + \beta_- SAP_i + \beta_+ T_i SAP_i + \boldsymbol{Z_i}\gamma + \epsilon_i \ , \tag{2}$$

where Z_i represents the vector of baseline covariates for property i.

Note that, our running variable (the SAP rating) is a rounded, and therefore clustered, measure of the energy costs of a property (as explained above, when calculating the SAP rating clustering aims at providing comparability across different types, sizes and locations of properties), thus although it runs from 1 to 100, it is discrete at each unit point. Although rounding takes place during the SAP rating calculations (as explained in Section 2), since the formula and rounding criteria (to the closest integer) are the same at both sides of each cut-off any potential rounding errors are unlikely to systematically affect our results. The assignment of the rating band is determined exclusively using the final SAP rating, and because our design is aimed at estimating the effect that information provided as rating bands has on sale prices, there is no need to account for rounding errors in our study[14]. Having a clustered running variable with a large number of observations in each cluster does not present a limitation for inference (Kolesár & Rothe 2018) or estimation (Bartalotti & Brummet 2017).

To reduce estimation bias and coverage errors we run the regressions independently for each threshold (which implies multiple cut-offs) as the functional form is not uniform across the SAP rating range. As will become clear from the graphical analysis presented in the next section, a pooled estimation would not be suitable due to different sizes of the discontinuities and the different functional forms

[14]SAP ratings are rounded to the closest integer, there is no rounding-down or truncation, and thus methods similar to the one proposed by Dong 2015 are not applicable to our analysis.

around each threshold. When running the analysis at each threshold we include the transactions from the current rating band and the previous rating band. For example to run the analysis for the threshold at SAP rating 55 (rating band D), we include the transactions from rating bands E (left of the threshold - SAP ratings 39 to 54) and D (right of the threshold - SAP ratings 55 to 68). As explained with the frequency distributions in Figure 2, we find evidence of sorting around the thresholds, specifically that some sellers increase the rating band of a property before a sale. To be on the safe side with respect to identification, we exclude these transactions from our main analysis (they only amount to 2.4% of our data - 119,072 out of 5,000,363 transactions) and we show in Section 7 that they do not in fact increase the price discontinuities but rather that these properties sell for lower prices on average, thus reducing the size of the discontinuities when included. We present a detailed analysis of the sorting behaviour induced by the thresholds in Section 6.

We implement local-linear regressions with data-driven optimal bandwidths for estimation and inference at each rating band threshold (as described in Imbens & Kalyanaraman 2012, Calonico et al. 2014 and Calonico et al. 2018). We use data-driven mean square error (MSE) optimal bandwidths to minimize the asymptotic MSE of the τ estimator, and robust bias-corrected (RBC) inference methods to calculate confidence intervals as proposed by Calonico et al. (2018). To validate the local regression fit near the threshold (see Calonico et al. 2018 for an in depth explanation) we run local-linear regressions using both uniform kernel functions (where all observations are weighted equally) and triangular kernel functions (where observations are linear down-weighted away from the threshold), and likewise, using a single MSE-optimal bandwidth per threshold and two MSE-optimal bandwidths per threshold (i.e. one before and one after the threshold). Our formal analysis clusters standard errors at the SAP rating to guard against model misspecification due to the discrete nature of the running variable as proposed by Lee & Card (2008).

5 Analysis

We first present graphical analysis to provide an intuitive description of the relationship between property prices and SAP ratings and the occurrence of price discontinuities at the rating band thresholds. We then present and discuss the estimation and inference results of the parametric local-linear regression analysis.

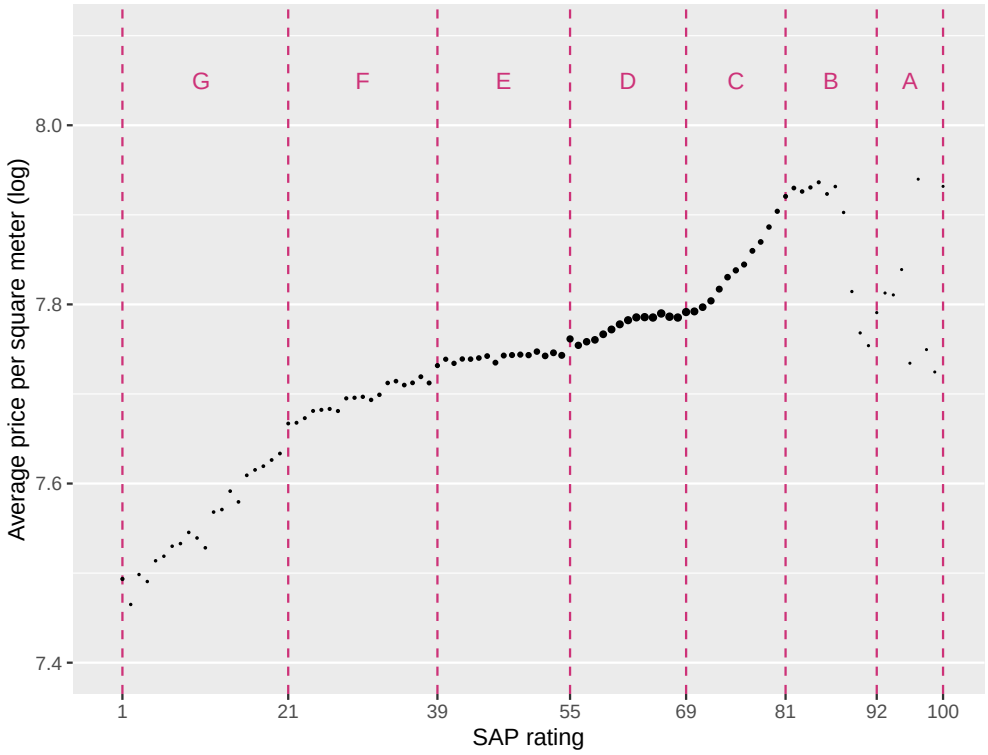
5.1 Graphical Analysis

We begin with the graphical analysis of property price as a function of the energy efficiency SAP rating score. Figure 3 shows average price per square meter (log) bins for each SAP rating unit, with the size of the symbol proportional to the frequency of sale transactions in the bin[15]. The vertical lines show the rating band thresholds, the arbitrary change from one rating band to the next one, with the rating band names (G, F, E, D, C, B and A) shown at the top. Price discontinuities are clearly visible around the thresholds between bands G, F, E, D and C and between B and A. Different slopes for each rating band are also visible. Although the functional form is not linear, it is continuous, reinforcing our claim that sellers do not have perfect control over the SAP rating or the rating band. The differences in slopes and sizes of discontinuities suggest that the most appropriate empirical strategy is one that focuses on estimating price discontinuities separately (as mentioned in the previous section). The relationship between price per meter and energy efficiency is naturally positive: properties with higher energy efficiency will command higher sale prices (e.g. triple window glazing compared to single window glazing or a modern combi-boiler compared to an older electric boiler). The number of observations for SAP ratings 88 and above drops considerably as shown in the histogram in Figure 3 (with only roughly 3,000 observations for the range 88 to 100), and thus the functional form is much less clear and the discontinuity between rating bands B and A, although visible, needs to be interpreted with caution.

In order to verify graphically that the discontinuities are not driven by differences in covariates, Figure 4 shows the price per square meter residuals after controlling for property characteristics (property type and tenure), location (geographic area and urban classification) and the sale date (year and quarter). The identified price discontinuities are still pronounced and the different slopes around each rating band also remain. Further evidence that the baseline covariates are in fact balanced around the rating band thresholds for existing properties is presented in Section 7 as a robustness check.

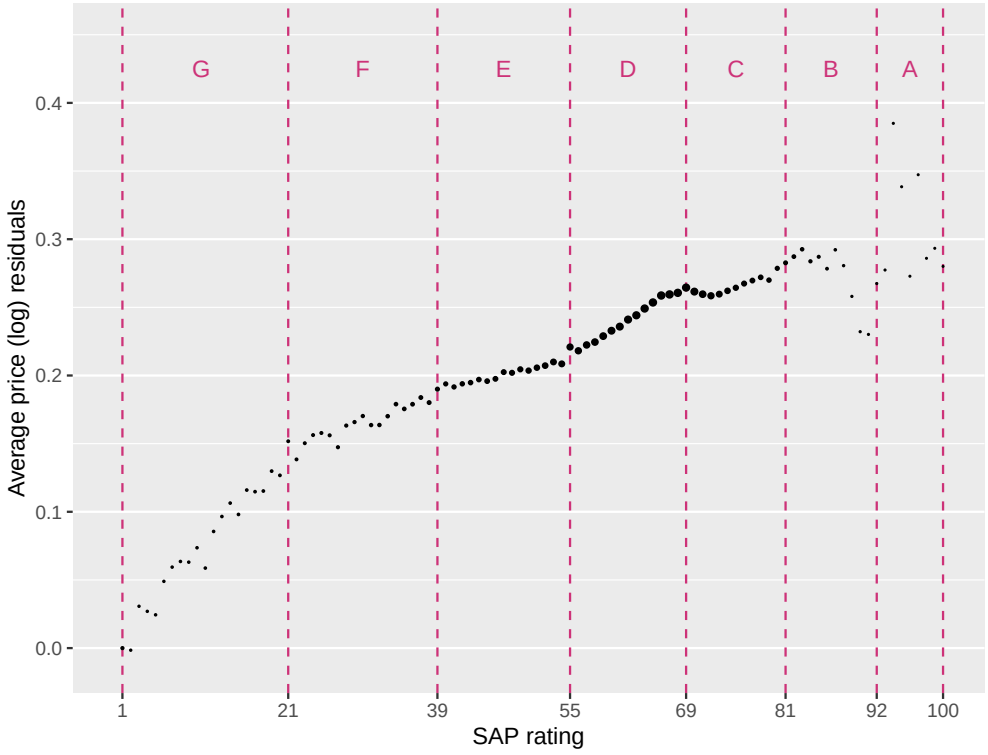
[15]We apply the log transformation because the distribution of price per square meter is right-skewed but normally log distributed. The non-log transformed analysis produces similar results although noisier and is discussed in Section 7.

Figure 3: Price Per Square Meter (Log) – SAP Rating



Notes: This figure plots average price per meter (log) bins for each *SAP rating unit.* N=4,881,291.

Figure 4: Price Per Square Meter (Log) Residuals – SAP Rating



Notes: This figure plots average residual price per square meter (log) bins for each SAP rating after controlling for property characteristics, location and sale date.
N= 4,881,291.

5.2 Regression Results

We now present the results of the regression analysis using Specifications (1) and (2) with price per square meter (log) as the dependent variable [16]. Table 3 presents the estimated price discontinuities from local-linear regressions at each rating band threshold in panel rows from F [SAP 21] to B [SAP 81] (the SAP rating of the threshold is included in square brackets). For example, the first panel row reports the results for threshold G-F at SAP rating 21. Each column represents a separate model. The parameter τ is our discontinuity estimate and can be interpreted as the percentage increase[17] in price of having the higher rating band. The standard errors of the estimate are shown in parenthesis. We also include the robust bias-corrected (RBC) confidence interval and p-value (RBC reduces coverage error for inference – Calonico et al. 2019) obtained using the methods presented by Calonico et al. (2019) and Calonico et al. (2018) . The data-driven MSE-optimal bandwidths (as explained in Section 4) for the estimate and the RBC correction are shown as BW estimate (h) and BW bias (b) respectively. Each panel row also shows the total number of observations for the threshold and the effective number of observations (i.e. the observations within the optimal bandwidth) used in the local linear regression. The stars next to the estimators represent the significance level of their corresponding RBC p-value.

Column (1) shows the estimated price discontinuities under Specification (1) (without baseline covariates), using a triangular kernel (i.e. observations linear down-weighted away from the threshold), with a data driven MSE-optimal bandwidth and standard errors clustered at the SAP rating. Column (2) shows the results using a uniform kernel (i.e. all observations equally weighted) and Column (3) using two MSE-Optimal bandwidths (one for each side of the threshold). Columns (4) through (7) show the estimations under Specification (2) while controlling for covariate fixed effects (FE). Column (4) controls for property characteristics (property type and tenure), Column (5) for geographic area FE (region and urban classification), Column (6) for date FE (sale year and sale quarter) and Column (7) is the most restrictive controlling for all of the previously mentioned FE.

The price discontinuities for thresholds G-F, F-E, E-D and D-C are positive and statistically significant and vary between 2.5% (at threshold G-F) and 0.8% (at threshold D-C) of the property sale price under Specification (1) (Column 1) and 1.9% (at threshold G-F) and 0.2% (at threshold D-C) of the property sale

[16] As explained above we apply log transform because the distribution of price per square meter is right-skewed but normally log distributed. Non-log transformed analysis produces qualitatively similar results that are discussed in more detail in Section 7.

[17] We interpret the coefficient τ as a percentage increase since our dependent variable is the log transformation of price per square meter.

price under Specification (2) (Column 7). The results for these thresholds are robust to the kernel specification and to using different bandwidths at each side of the threshold as there is little variation in the estimations shown in Columns (2) and (3). The results do not change significantly when controlling for property characteristics (Column 4) or date FE (Column 6). The estimated discontinuities when controlling for geographic area FE are smaller, especially for threshold D-C, suggesting that the location of a property will play a part in the size of the rating band price premium. The results when controlling for all FE (Column 7) are statistically significant although the size of the estimate is smaller due to the geographic area effects. We present robustness checks in Section 7 to further confirm that the heterogeneity of property characteristics, geographic area and date are not driving the discontinuities. The price discontinuities for thresholds B-C and B-A are positive but the RBC confidence intervals include 0 and vary considerably across specifications and the inclusion of covariate controls. The number of observations for rating band A is too low for the estimation of threshold B-A to be reliable.

In summary, the results of the regression analysis mirror those of the graphical analysis and provide strong evidence of price discontinuities when crossing rating band thresholds G-F, F-E, E-D and D-C. These results are economically significant, on average the price discontinuities range from £6,625 (2.5% at the G-F threshold with a mean sale price of £265,000 around the threshold) to £2,000 (0.8% at the D-C threshold with a mean sale price of £250,000 around the threshold) under Specification (1). Furthermore, although the results are smaller for rating band C, this threshold contains the largest number of transactions (Figure 3 shows the frequency distribution) and thus the overall effect on the market of these transactions is bigger.

Table 3: Local Linear RD Estimates for Price Discontinuities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
F [SAP 21] τ	0.025***	0.026***	0.025***	0.020***	0.021**	0.025***	0.019**
	(0.001)	(0.002)	(0.001)	(0.002)	(0.009)	(0.001)	(0.008)
Bias-corrected 95% CI	0.020|0.035	0.021|0.035	0.021|0.033	0.016|0.025	0.006|0.044	0.020|0.035	0.006|0.039
Bias-corrected p-value	0.000	0.000	0.000	0.000	0.010	0.000	0.008
BW estimate (h)	3.697|3.697	4.443|4.443	3.769|4.472	5.335|5.335	5.731|5.731	3.689|3.689	5.496|5.496
BW bias (b)	6.924|6.924	7.077|7.077	7.403|7.728	8.608|8.608	7.608|7.608	6.797|6.797	7.927|7.927
Observations	60,808|239,167	60,808|239,167	60,808|23,9167	60,808|239,167	60,808|239,167	60,808|239,167	60,808|239,167
Effective observations	12,824|24,642	16,634|32,253	12,824|32,253	20,202|40,545	20,202|40,545	12,824|24,642	20,202|40,545
E [SAP 39] τ	0.020***	0.019***	0.020***	0.017***	0.016***	0.017***	0.010***
	(0.004)	(0.005)	(0.004)	(0.004)	(0.002)	(0.004)	(0.001)
Bias-corrected 95% CI	0.013|0.030	0.009|0.030	0.013|0.029	0.010|0.029	0.015|0.024	0.010|0.027	0.009|0.017
Bias-corrected p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	4.391|4.391	3.417|3.417	4.448|4.439	3.791|3.791	3.843|3.843	4.529|4.529	3.467|3.467
BW bias (b)	6.263|6.263	5.660|5.660	6.510|5.765	6.001|6.001	6.115|6.115	6.364|6.364	5.650|5.650
Observations	239,167|990,784	239,167|990,784	239,167|990,784	239,167|990,784	239,167|990,784	239,167|990,784	239,167|990,784
Effective observations	92,187|185,700	72,323|141,765	92,187|185,700	72,323|141,765	72,323|141,765	92,187|185,700	72,323|141,765
D [SAP 55] τ	0.016***	0.019***	0.016***	0.015***	0.014***	0.016***	0.012***
	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)
Bias-corrected 95% CI	0.012|0.024	0.015|0.026	0.014|0.023	0.013|0.023	0.013|0.019	0.012|0.024	0.012|0.016
Bias-corrected p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	3.936|3.936	2.954|2.954	4.256|4.311	3.669|3.669	3.910|3.910	3.915|3.915	3.569|3.569
BW bias (b)	5.743|5.743	5.197|5.197	7.434|5.307	5.406|5.406	6.022|6.022	5.725|5.725	5.562|5.562
Observations	990,784|235,7103	990,784|235,7103	990,784|235,7103	990,784|2,357,103	990,784|2,357,103	990,784|2,357,103	990,784|2,357,103
Effective observations	297,781|529,425	205,917|384,020	379,385|683,250	297,781|529,425	29,7781|52,9425	297,781|529,425	297,781|529,425
C [SAP 69] τ	0.008***	0.007***	0.006***	0.008***	0.003***	0.007***	0.002***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.000)	(0.001)	(0.000)
Bias-corrected 95% CI	0.007|0.015	0.006|0.016	0.006|0.014	0.006|0.014	0.004|0.009	0.006|0.014	0.002|0.007
Bias-corrected p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	3.866|3.866	3.452|3.452	3.576|5.067	3.611|3.611	3.685|3.685	3.906|3.906	3.567|3.567
BW bias (b)	5.548|5.548	5.755|5.755	5.784|5.054	5.999|5.999	5.308|5.308	5.561|5.561	5.243|5.243
Observations	2,357,103|1,139,132	2,357,103|1,139,132	2,357,103|1,139,132	2,357,103|1,139,132	2,357,103|1,139,132	2,357,103|1,139,132	2,357,103|1,139,132
Effective observations	593,851|629,750	593,851|629,750	593,851|821,323	593,851|629,750	593,851|629,750	593,851|629,750	593,851|629,750
B [SAP 81] τ	0.002	0.002	0.002*	0.005	0.001	0.002	0.001
	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
Bias-corrected 95% CI	-0.006|0.001	-0.007|0.001	-0.007|0.000	-0.001|0.009	-0.006|0.006	-0.006|0.001	-0.005|0.005
Bias-corrected p-value	0.214	0.180	0.050	0.085	0.987	0.099	0.972
BW estimate (h)	4.177|4.177	3.971|3.971	3.494|7.352	4.038|4.038	3.776|3.776	4.226|4.226	4.298|4.298
BW bias (b)	6.942|6.942	6.107|6.107	5.183|6.283	6.255|6.255	6.360|6.360	6.946|6.946	6.543|6.543
Observations	1,139,132|93,583	1,139,132|93,583	1,139,132|93,583	1,139,132|93,583	1,139,132|93,583	1,139,132|93,583	1,139,132|93,583
Effective observations	180,116|84,097	124,580|76,039	124,580|92,258	180,116|84,097	124,580|76,039	180,116|84,097	180,116|84,097
A [SAP 92] τ	0.071*	0.054	0.073*	0.013*	0.056***	0.071*	0.017
	(0.009)	(0.003)	(0.010)	(0.004)	(0.008)	(0.010)	(0.007)
Bias-corrected 95% CI	0.007|0.103	-0.112|0.253	0.008|0.092	0.002|0.065	0.027|0.074	0.008|0.111	-0.015|0.033
Bias-corrected p-value	0.025	0.451	0.018	0.037	0.000	0.023	0.440
BW estimate (h)	3.769|3.769	2.529|2.529	3.630|4.511	3.105|3.105	4.111|4.111	3.760|3.760	3.301|3.301
BW bias (b)	5.706|5.706	6.188|6.188	5.321|5.471	6.251|6.251	5.693|5.693	5.953|5.953	5.751|5.751
Observations	93,583|714	93,583|714	93,583|714	93,583|714	93,583|714	93,583|714	93,583|714
Effective observations	1,325|571	740|488	1,325|631	1,325|571	2,431|631	1,325|571	1,325|571
BW selection	MSE-Optimal	MSE-Optimal	Two MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Uniform	Triangular	Triangular	Triangular	Triangular	Triangular
Property Characteristics				Yes			Yes
Area FE					Yes		Yes
Date FE						Yes	Yes

Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: This table presents the results from the local linear RD analysis for price discontinuities at each rating band threshold. Each panel row contains the estimate for the coefficient τ which represents the estimated price discontinuity of having the higher rating band (Section 4 explains our empirical strategy in detail). Each column contains the results from a different model, Columns (1) to (3) present the results from Specification (1) with different bandwidth selection procedures and kernels. Columns (4) to (7) present the results from Specification (2) including different sets of covariate controls. Property characteristics include property type and tenure, area fixed effects (FE) include region and urban classification and date FE adds sale year and sale quarter.

6 Discussion: Market Behaviour

Having identified price discontinuities at the rating band thresholds, we now discuss the effect that these have on market behaviour and policy considerations.

6.1 Seller Behaviour

Price discontinuities at rating band thresholds can generate incentives for sellers to extract additional profit. These incentives will exist if: *a*) buyers fall for this behavioural effect and; *b*) sellers are aware of the price discontinuities. The housing market for existing properties in England and Wales follows a double auction structure. Sellers set an initial asking price and potential buyers make offers over, or under, this reference price. A seller then decides which offer to accept, if any (offers are not legally binding - HM Government 2020), buyers can make offers for multiple properties simultaneously. With respect to *a*), in Section 5 we analyse final sale transactions (i.e. buyer offers that were accepted by sellers), thus the price discontinuities we identify at rating band thresholds suggest that some buyers exhibit limited attention and end up paying a rating band price premium. Regarding *b*), in this section we show evidence that rating band thresholds influence the decision of some sellers to make EE investments before offering a property for sale, suggesting that they are aware of rating band price premiums.

The clearest incentive is for sellers who have a property with an SAP rating just below a rating band threshold, and who can make small investments to get the property to the next rating band (as described in Comerford, Moro and Lange 2017 – for example by investing in LED light bulbs). Naturally, only a limited number of properties will have these low cost EE improvement opportunities. Nonetheless, since rational sellers will only invest in a pre-sale EE improvement if they believe they are able to, at the very least, recoup the full investment cost, investments that get over a rating band threshold will have a better chance of achieving this because of the additional profits from the discontinuity. Then, the incentive for sellers who anticipate price discontinuities is to make EE investments that will take the property to a higher rating band. If a property has an SAP rating just above the threshold the incentive will be lower as it will be more expensive and difficult to make EE improvements to take the property to the next rating band, for instance by having to make a big investment to replace all windows with triple glazing and further delay the sale of the property. Rational sellers who want to exploit buyers naivety and bet on the price premium of a higher rating band will use the pre-defined thresholds (at SAP ratings 21, 39, 55, 69, 81 and 92) as reference points for investment. Sellers are provided with the necessary information in the EPC to evaluate the required investment to take the property to the next rating band. As explained in Section 2, the recommendation section of the EPC

contains information about the expected cost of EE improvements (e.g. increased loft insulation at a cost of £100-£350) and, importantly, the resulting colour coded rating band and SAP rating in case the improvements are implemented.

In order to study seller behaviour around the thresholds, we re-analyse our sample of properties that made EE improvements before a sale. Specifically, we look at properties that requested more than one EPC before a sale and where the latest SAP rating is higher than the previous one. As the property characteristics (e.g. property type, location, etc.) remain fixed, and as energy prices have been increasing, a higher SAP rating is evidence that EE improvements were made on the property. For many sellers, a new EPC (with a new SAP rating) will be a belief update and they can react by either continuing with the selling process or making additional investments and requesting a new EPC audit.

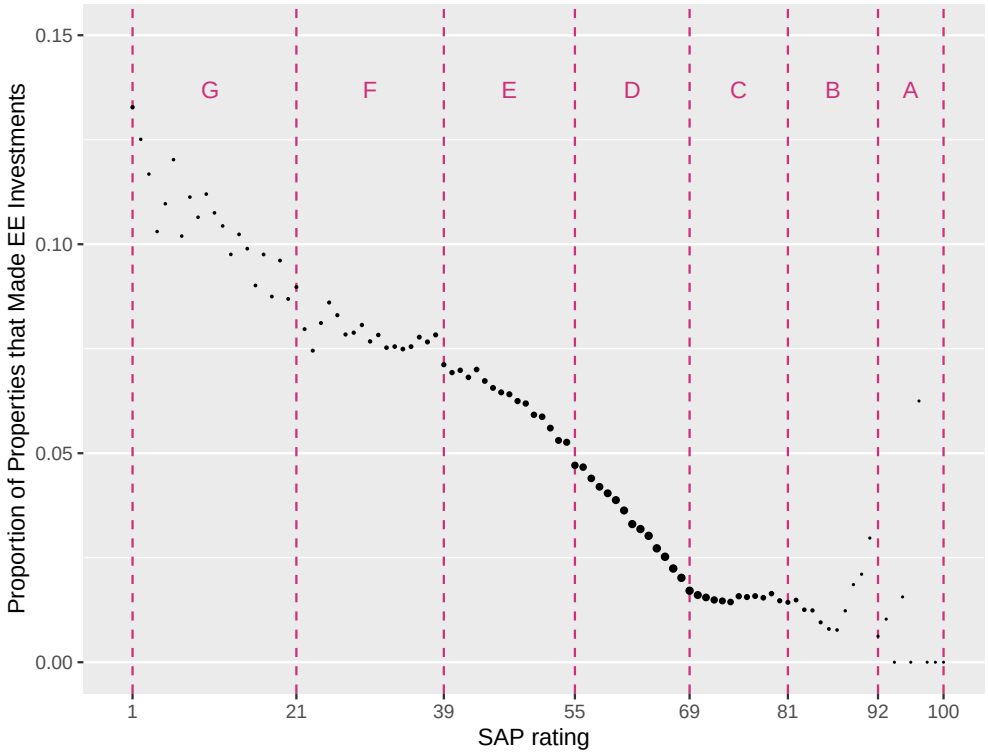
We analyse whether rating band thresholds have an effect on the probability of pre-sale investing, as this would be an indication that the arbitrary thresholds are having an effect on seller behaviour in the market. To avoid confounding our results with buy-to-rent transactions we exclude properties sold on or after April 2018 since, as explained in Section 2, regulations require properties offered for rent after that date to have a minimum rating band E.

Figure 5 shows the proportion of properties that made pre-sale EE investments before a sale for each SAP rating (based on the initial SAP rating before the investment for properties that increased their EE). The proportion of properties that make EE investments decreases as the SAP rating increases since, as explained above, it becomes more expensive and difficult to improve the EE of properties with an already high rating. Importantly, the proportion of properties that made EE investment before a sale drops considerably after crossing the rating band thresholds at F-E, E-D, D-C and B-A.

To obtain an estimate of the effect that rating band thresholds have on the decision to invest in EE, we perform a regression discontinuity analysis similar to our price discontinuity analysis. The same assumptions stated in Section 4 apply as the initial SAP rating (our running variable for this analysis) cannot be precisely controlled by sellers when requesting the initial EPC. We measure the probability to invest in EE as the proportion of properties that made EE investments at each SAP rating score and the treatment (if a threshold was crossed) is the higher rating band assigned. We use the following specifications for a linear probability model to estimate the difference in the probability to invest as a result of rating band thresholds.[18]

[18]We use a linear probability model to simplify the interpretation of results from a regression discontinuity analysis.

Figure 5: Proportion of Properties that Made EE Investments – Initial SAP Rating



Notes: This figure plots the proportion of properties that made EE investments before a sale for each SAP rating. The SAP rating is the initial rating for properties that made EE investments (i.e. the rating before making an investment).
N=3,999,153.

$$I_i = \alpha + \tau T_i + \beta_- SAP_i^s + \beta_+ T_i SAP_i^s + \epsilon_i \tag{3}$$

$$I_i = \alpha + \tau T_i + \beta_- SAP_i^s + \beta_+ T_i SAP_i^s + \boldsymbol{Z_i}\gamma + \epsilon_i \tag{4}$$

The dependent variable I_i takes the value of 1 if property i had EE investments before the sale[19], and 0 otherwise. T_i represents the rating band treatment (i.e. if a threshold was crossed), SAP_i^s represents the initial SAP rating of property i

[19]If the EPC at the date of sale has a higher SAP rating than the previously registered EPC.

(normalised at the rating band threshold), and ϵ_i the error term. The coefficient of interest is τ which represents the difference in the proportion of properties that invested in EE at a rating band threshold and a counterfactual predicted probability at the same SAP score without a higher rating band being assigned. Similar to our main analysis, the interaction between T_i and SAP_i^s, and the corresponding coefficients β_- and β_+, allow for different slopes at each side of the threshold. Z_i in Specification 4 represents the vector of baseline covariates for property i, which are the same as those of our price discontinuity analysis (property characteristics, geographic area FE and date FE).

Table 4 presents the estimated discontinuities using local linear regressions of the same form as our main analysis, we run the models separately for each threshold. The results confirm the graphical analysis of Figure 5, with statistically significant estimates for rating band thresholds F-E, E-D, D-C and B-A[20]. The estimates do not change much across all of our specifications. In our dataset the proportion of properties that invested in EE before a sale is 4.06% (203,081 of 5,000,363), so as a back of the envelope calculation our estimate for threshold F-E (-0.008) represents a considerable 3.25% higher probability of investing in EE for properties with an SAP rating just below the threshold. Similarly, the estimates for E-D (-0.003) would represent 1.22%, D-C (-0.001) 0.4% and B-A (-0.027) 11% higher probabilities before crossing the corresponding thresholds (under Specification 3).

[20]As with our main analysis, the estimates for threshold B-A need to be interpreted with caution as there are only 714 observations with a rating band A.

Table 4: Local Linear RD Estimates for EE Investment Probability

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
F [SAP 21] τ	0.000	0.011	-0.002	0.000	0.000	0.000	0.000
	(0.005)	(0.001)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Bias-corrected 95% CI	-0.010|0.012	0.000|0.028	-0.010|0.009	-0.010|0.013	-0.010|0.013	-0.010|0.013	-0.010|0.013
Bias-corrected p-value	0.854	0.053	0.877	0.854	0.791	0.849	0.827
BW estimate (h)	4.524|4.524	2.533|2.533	6.855|4.401	4.636|4.636	4.482|4.482	4.548|4.548	4.624|4.624
BW bias (b)	7.274|7.274	5.452|5.452	11.015|6.614	7.396|7.396	7.259|7.259	7.316|7.316	7.432|7.432
Observations	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881
Effective observations	14,758|28,710	7,779|15,863	20,863|28,710	14,758|28,710	14,758|28,710	14,758|28,710	14,758|28,710
E [SAP 39] τ	-0.008***	-0.007***	-0.008***	-0.008***	-0.007***	-0.008***	-0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Bias-corrected 95% CI	-0.010|-0.006	-0.010|-0.004	-0.011|-0.006	-0.010|-0.005	-0.010|-0.005	-0.011|-0.006	-0.010|-0.005
Bias-corrected p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	4.085|4.085	3.613|3.613	3.686|4.985	4.004|4.004	3.844|3.844	4.117|4.117	3.861|3.861
BW bias (b)	6.376|6.376	5.404|5.404	6.122|8.189	6.302|6.302	6.210|6.210	6.424|6.424	6.219|6.219
Observations	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082
Effective observations	82,257|162,878	64,682|124,591	64,682|162,878	82,257|162,878	64,682|124,591	82,257|162,878	64,682|124,591
D [SAP 55] τ	-0.003**	-0.002*	-0.003***	-0.003*	-0.003*	-0.003**	-0.003*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Bias-corrected 95% CI	-0.005|-0.001	-0.005|0.000	-0.006|-0.002	-0.004|-0.001	-0.004|-0.001	-0.005|-0.001	-0.004|-0.001
Bias-corrected p-value	0.006	0.038	0.000	0.011	0.011	0.004	0.012
BW estimate (h)	6.182|6.182	4.022|4.022	3.922|4.916	6.557|6.557	6.395|6.395	6.074|6.074	6.570|6.570
BW bias (b)	9.124|9.124	6.385|6.385	6.612|5.771	9.587|9.587	9.570|9.570	9.037|9.037	9.844|9.844
Observations	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099
Effective observations	441,896|841,490	318,459|569,763	249,402|569,763	441,896|841,490	441,896|841,490	441,896|841,490	441,896|841,490
C [SAP 69] τ	-0.001**	-0.001**	-0.001	-0.001**	-0.001***	-0.001***	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Bias-corrected 95% CI	-0.001|0.000	-0.002|0.000	-0.001|0.000	-0.001|0.000	-0.001|0.000	-0.001|0.000	-0.001|0.000
Bias-corrected p-value	0.002	0.004	0.097	0.004	0.001	0.001	0.003
BW estimate (h)	4.935|4.935	4.551|4.551	3.801|6.524	4.350|4.350	4.855|4.855	5.004|5.004	4.379|4.379
BW bias (b)	5.377|5.377	5.134|5.134	8.280|5.849	5.454|5.454	5.401|5.401	5.355|5.355	5.437|5.437
Observations	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395
Effective observations	617,403|585,021	617,403|585,021	463,988|712,117	617,403|585,021	617,403|585,021	768,864|653,892	617,403|585,021
B [SAP 81] τ	0.000	0.000	0.002	0.000	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Bias-corrected 95% CI	-0.001|0.002	-0.002|0.002	0.000|0.004	-0.001|0.002	-0.001|0.002	-0.001|0.002	-0.001|0.002
Bias-corrected p-value	0.751	0.924	0.098	0.698	0.776	0.746	0.724
BW estimate (h)	4.508|4.508	4.379|4.379	2.948|6.038	4.622|4.622	4.532|4.532	4.504|4.504	4.643|4.643
BW bias (b)	6.509|6.509	6.353|6.353	5.365|5.877	6.537|6.537	6.519|6.519	6.507|6.507	6.568|6.568
Observations	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629
Effective observations	143,176|68,490	143,176|68,490	59,917|73,952	143,176|68,490	143,176|68,490	143,176|68,490	143,176|68,490
A [SAP 92] τ	-0.027***	-0.027***	-0.028***	-0.024***	-0.025***	-0.028***	-0.021***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Bias-corrected 95% CI	-0.033|-0.024	-0.033|-0.017	-0.034|-0.025	-0.031|-0.021	-0.029|-0.022	-0.033|-0.022	-0.027|-0.015
Bias-corrected p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	4.806|4.806	4.157|4.157	4.234|4.375	3.739|3.739	4.919|4.919	4.768|4.768	3.837|3.837
BW bias (b)	5.532|5.532	5.234|5.234	5.122|5.086	5.525|5.525	5.568|5.568	5.487|5.487	5.498|5.498
Observations	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515
Effective observations	1,677|452	1,677|452	1,677|452	864|413	1,677|452	1,677|452	864|413
BW selection	MSE-Optimal	MSE-Optimal	Two MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Uniform	Triangular	Triangular	Triangular	Triangular	Triangular
Property Characteristics				Yes			Yes
Area FE					Yes		Yes
Date FE						Yes	Yes

Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: This table presents the results from the local linear RD analysis for EE investment probability discontinuities at each rating band threshold. Each panel row contains the estimate for coefficient τ which represents the estimated EE investment discontinuity of being above the rating band threshold. Columns (1) to (3) present the results from Specification (3) with different bandwidth selection procedures and kernels. Columns (4) to (7) present the results from Specification (4) including different sets of covariate controls. Property Characteristics include property type and tenure, Area FE include region and urban classification and Date FE adds sale year and sale quarter.

6.2 Policy Considerations

Our results suggest that the EE investment incentives generated for sellers, by price discontinuities at the rating band thresholds are aligned with the main objective of the policy, which, as explained in Section 2, is to reduce greenhouse gas emissions by making the UK housing stock more energy efficient. Nonetheless, our findings also provide evidence that the design of the rating bands can be improved to further incentivise EE investments. Although our recommendations are focused on EE in the housing market, we believe them to also be relevant for other settings where labelling is implemented aggregating detailed information into broader categories and thereby creating arbitrary thresholds.

We find that effect sizes of rating band thresholds on price and seller investment behaviour decrease as EE increases. For instance, we estimate a price premium of 2.5% for rating band F, 0.8% for rating band C, and find no statistically significant discontinuity for rating band B. Similarly, our estimated probability of investment in EE before a sale is 3.5% higher before crossing the threshold for rating band E, 0.4% higher before crossing the threshold for rating band C and there is no effect for rating band B[21]. The lower investment probabilities can be explained by a lower expected price premium and the increasing cost and effort of making EE improvements[22] when the SAP rating is high. Thus, it is unclear if moving the thresholds towards the higher end of the SAP rating scale (for example by increasing the threshold for rating band D from 55 to 65) would maintain the size of the effects[23]. rating band thresholds are currently designed so that the lower bands are wider, for instance rating band G comprises 20 SAP rating units while rating band A only 9. Thus, an alternative design to further incentivise EE investments, given the results of our analysis and the distribution of properties across the SAP rating scale, is to make the lower rating bands narrower and the higher rating bands wider as this would increase the number thresholds where we find stronger effects.

We find no price or incentive discontinuities at the threshold between rating bands C and B, and although we observe an investment incentive discontinuity between rating bands B and A those results need to be interpreted with caution as there are very few observations with an A rating. A possible explanation for the absence of consistent discontinuities in this range is that rating bands A, B and C are all coloured green and thus not strikingly visually different. Previous

[21]While we find price and EE investment incentive effects for rating band A, our average estimates are very noisy and need to be interpreted with caution due to the limited number of properties within this rating band (0.01% of all transactions).

[22]For example by having to replace all wall insulation or install solar panels.

[23]It should be noted though that almost half of the properties in our sample (48%) have a rating band of either D or C.

research (e.g. Waechter et al. 2016) propose that the salience of the colour traffic-light system (Green-Yellow-Red) is stronger than the letter scale in the EU energy efficiency label, and thus it is possible that once a property has reached the green rating C the marginal benefit of increasing it to a *greener* B or A is seen as lower than increasing from red to yellow, or yellow to green. A more salient colour variation for these bands, for example moving C and B towards the yellow scale, could help trigger the price and EE investment threshold effects we identified in Section 6.1. A possible explanation for the EE investment incentive discontinuity for reaching rating band A (11%) is that some sellers are targeting a very specific group of buyers (e.g. individuals who have a high valuation for the environment or who are very cost sensitive with regards to energy consumption), and because other sellers are reaching that A rating for different reasons (e.g. the quality of the materials) the heterogeneity around this threshold is large and therefore the price premium discontinuities are not statistically significant. As mentioned before, we refrain from drawing conclusions from evidence around this threshold due to the limited amount of transactions with rating band A.

We also show that rating band price premiums are present in sales of existing properties but not of newly built properties. While having the same EE rating scale for existing and new buildings[24] can help individuals compare EE across properties, the potential different sale process and geographic distribution of existing and new buildings make the comparison less relevant, as mentioned above, new buildings are sometimes sold off-plan before an EPC is available and normally as part of a new area development. Our results suggest that individuals are more attentive to the rating bands which by themselves do not provide precise information that buyers can use to compare the estimated running energy costs between existing and new properties. Furthermore, as there is legislation in place requiring strict minimum levels of EE for new and repurposed buildings (HMG 2016[25] most of the new properties in our dataset (70%) have SAP ratings between 81 and 86 that fall within rating band B. The distribution of new buildings across the SAP range is too compressed and discrimination at the top is not currently possible. Also, some existing properties (due to their built type or their listed building status[26]) cannot reach the higher ends of the current SAP rating scale and thus achieve higher rating bands. We propose that having a different EE efficiency scale for new buildings, either at the SAP ratings or the rating bands, can distribute them across a broader

[24]As mentioned in Section 2, the procedure for calculating the SAP rating is different for existing properties and new properties, but the final results are based on the same energy costs methodology.

[25]This requirements are not specified in SAP rating units but rather in building material qualities (e.g. heat transfer - HMG 2016)

[26]Listed buildings are of historic or architectural interest and thus structural changes are normally not permitted, for instance replacing the window structure.

range of SAP ratings and across rating bands to trigger the threshold effects we identified. For instance, new properties that are at the lower end of the new scale can be assigned an orange or yellow rating band leveraging the salience of the colour traffic-light system discussed above. This change would also give room for adjusting the EE scale of existing buildings to provide a wider distribution across the higher rating bands and further incentivise investment. With the current scale some old buildings have a *potential* rating band of E or F, which means that even by making all of the EE improvements listed in the EPC it is not possible to reach a higher rating band. An adjusted scale could allow these properties to reach the higher yellow or green rating bands and trigger the threshold effects we identify.

Finally, the literature on behavioural organisational economics studies how rational firms, or sophisticated sellers in the case of the housing market, profit from limited attention and how policies can be promoted to protect inattentive buyers. The argument is subtly different in high value asset markets, such as the housing market, where purchasing transactions amount to wealth acquisition at the same time: While the rating bands are static and the validity of the EPCs is long term (currently 10 years), although buyers may pay a price premium for an EE rating band they will expect to get that price premium back if they decide to sell. However, the welfare effects will be different if rating bands are dynamic (i.e. the thresholds change at different times) or if the base measurement has depreciation implications (e.g. SAP ratings are based on energy costs which are sensitive to large increases across time, higher energy costs translate to lower SAP ratings), then the surplus that buyers get will diminish over time. For instance, a buyer might purchase a property with rating band C that drops to D after requesting a new EPC, and they will be forced to make increasingly more expensive EE investments to take it back to rating C. This may create an unstable equilibrium where sellers benefit the most. The impact would be stronger for individuals entering the market (e.g. first time home buyers) as homeowners moving up the housing market (e.g. buying bigger houses) would be able to extract the price premium before they sale. As former buyers can become future sellers, the general problem is that of heterogeneity in agent sophistication (i.e. the savviness of market participants). Nonetheless, dynamic rating bands where the thresholds regularly shift upwards, towards the more efficient end of the SAP scale, have the potential to continuously incentivise EE investments during the sale process and help make the housing stock more energy efficient. Therefore, we put forward for consideration that while the benefits of promoting EE investments in the overall housing stock using labels can be attractive, the welfare effects are not immediately clear.

As mentioned earlier, our findings and recommendations are relevant to settings other than EE in the housing market. Labelling policies that require aggregating

detailed information into broad categories will create thresholds that may trigger the effects that we document in this paper. For instance, our recommendations apply closely to the UK market of household appliances (e.g. refrigerators or washing machines). The appliances EE labels, using a similar visual format to the EPC, group kilowatt hours (kWh) ranges into colour coded rating bands[27], these groupings will create thresholds that can be leveraged, for example by moving them to ranges that are more cost effective for manufacturers and thus increase their incentives to produce more EE lines. Similarly, the food labelling legislation in the UK require a traffic light system to convey the "healthiness" of consumables purchased in retailers (e.g. supermarkets). The information on the contents of sugar, salt, fat and saturated fat in a product must be displayed as a percentage of the recommended daily allowance and within a colour coded box (red, amber or green). The specific colour for each component is assigned using rules that takes into account the total contents (in grams) compared to the total recommended daily allowance. These rules create thresholds that, as before, can be leveraged to further incentivise the production and consumption of healthy alternatives.

7 Robustness Analysis

To show the validity of our findings, we perform a wide range of robustness checks, which we summarise here. The comprehensive results of the tests described in this section are included in Appendices B and C.

7.1 Price Discontinuities

7.1.1 Empirical Specification

Our main analysis for price discontinuities (Section 5) already documents that results are robust to different bandwidth selection procedures and kernels for local linear regressions. We also perform the bandwidth selection procedure using the full range of SAP ratings for each threshold, instead of only the previous and current rating bands, and obtain results that are essentially the same. We also run the analysis using wider ad-hoc bandwidths and find no substantial differences. The results obtained with different bandwidths are shown in Table B1.

We repeat our analysis using price per square meter as the dependent variable (instead of its log-transformed version) and find the same qualitative results. The discontinuities are present and statistically significant for rating band thresholds

[27]The current appliances EE labels include the A+, A++ and A+++ rating bands for the most efficient products.

G-F, F-E, E-D and D-C and vary from £53.10 per square-meter at threshold G-F to £19.79 per square-meter at threshold D-C under Specification (1). Similar to our main results, there are no statistically significant price increases for rating band thresholds B and A. The results of this analysis are included in Table B2. We perform our analysis using total sale price (log) as the dependent variable (instead of price per square meter (log)). As with our main analysis, the results (Table B3) show statistically significant price discontinuities at the thresholds G-F, E-F, E-D and D-C with similar effect sizes to our main results when the controls include total floor area.[28]

To further rule out specification issues we perform various falsification and placebo tests. We test for discontinuities for three SAP rating units before and after the thresholds and find no consistent or statistically significant discontinuities (results are presented in Table B4). Similarly, to rule out the presence of left digit bias, we perform tests at 10 SAP rating intervals (10, 20, 30, etc.) and find no systematic discontinuities as shown in Table B5. These results provide further evidence that market participants pay less attention to the more precise SAP rating, as at least some left-digit bias would be expected[29] if the underlying SAP rating was an important metric for market participants.

Finally, we replicated our analysis using a high-order polynomial function model, similar to Englmaier et al. (2018) and Lacetera et al. (2012) and find largely similar results. The main difference is that under this method the discontinuity at D-C (69) is now consistently estimated at 1%.

7.1.2 Baseline Covariates

Our main analysis already includes baseline covariate controls throughout to document that the discontinuities are not the result of differences in the distribution of property characteristics, sale dates or geographic areas around the thresholds. We additionally check for discontinuities at the rating band thresholds for each of the covariates by performing separate discontinuity analyses with local linear regressions. Figures B1, B2, B3 and B4 present the proportions per SAP rating for geographic region, sale year, sale quarter and property type respectively. The results of the regression analysis for area covariates (Table B6) show no systematic discontinuities. The results for date covariates (Table B7) show a discontinuity for

[28]The analysis using total sale price (log) as the dependent variable also finds a statistically significant discontinuity for threshold B-A. However, the effect size varies considerably with the inclusion of covariates and as explained above must be interpreted with caution due to the limited number of properties with rating band A.

[29]Left-digit bias is a heuristic where individuals focus on the left-most digit of a number and are inattentive to the other digits, evidence of this bias in the car market is provided by Englmaier et al. (2018) and Lacetera et al. (2012).

year 2019 at the F-E threshold. As explained in Section 2, regulations came into force in 2018 requiring properties that are offered for rent to have rating band E or higher, which makes this discontinuity likely the result of buy-to-rent transactions. We show that our estimated price discontinuities are not driven by these transactions by running the price discontinuity analysis excluding sales registered on or after April 2018. The results of this (Table B8) vary little from our main estimates and are even bigger for threshold G-F, providing further evidence that these transactions are not responsible for the price discontinuities. The results for property covariates show small but statistically significant discontinuities only in the proportion of detached properties (Table B9). While these results could potentially be indicative of sorting for detached houses, we again show that the price discontinuities are not driven by the differences in proportions by running the price discontinuity analysis excluding detached properties. Again the estimated price discontinuities vary very little as shown in Table B10.

Since the dependent variable in our main analysis is price per square meter, we also perform the discontinuity analysis for total floor area (Figure B5 and Table B11). Although we find discontinuities at the E-D and D-C thresholds, the estimates are small (0.428 and 0.856 square meters after controlling for covariates) and, importantly, positive[30]. The higher total floor area averages at these thresholds are unlikely to drive the size of our estimated price discontinuities as the relationship between price per square meter and total floor area is negative[31]. If anything, the total floor area discontinuities will understate the higher prices above the threshold and make our estimates slightly smaller. Nonetheless, total floor area discontinuities provide further evidence of sorting (similar to the density increases mentioned in Section 3), which we discuss in more detail in Section 6. The sorting in this case would be of large properties. A potential explanation is that people with larger houses may react stronger to the price and EE investment threshold effects we identify (discussed in Sections 5 and 6.1) due to the expectation of higher energy cost savings.

7.1.3 Rating Band Increases

Our main analysis excludes properties that we have identified as having increased their rating band before a sale as they could represent self-selection into treatment. On average, the price per square meter for these properties is lower than that of

[30]We also find a statistically significant discontinuity at the B-A threshold of $21.22m^2$ without there being a statistically significant *price* discontinuity, which is most likely due to the limited amount of properties and the resulting erratic density around that threshold, as discussed in Section 5.2.

[31]A regression with price per meter (log) as the dependent variable yields a coefficient of -0.02% per additional square meter at a significance level of 0.1%.

other properties, for instance the average square meter price for properties with SAP rating 69 that have not increased their rating band is £2,781 compared to £2,640 for properties that increased their rating band before a sale[32]. Table B12 presents the results of our analysis when we include properties that increased their rating band, the estimated discontinuities do not vary considerably but, as expected, are smaller. These results provide evidence that the price discontinuities estimated in our main analysis are not the result of self-selected properties that we could not identify. We discuss the behaviour of sellers who invest in EE before a sale in Section 6.1.

7.1.4 Counterfactual Scenario

While our analysis only uses sales between July 2012 and September 2019, recall that our full dataset contains sale transactions from October 2008 to September 2019. As explained in Section 2, from October 2008 to March 2012 the legislation in place could be interpreted as requiring sellers to provide the EPC to buyers before the sale was completed but not necessarily before a price was agreed (i.e. not necessarily as part of marketing materials). While self-section may be present in these transactions in a small scale, where some sellers could advertise the EE rating of a property as a desirable feature, it also brings us close to a counterfactual scenario where the EE ratings would not play a significant role when negotiating the sale price.

We find that the relationship between sale price and SAP rating during this period is continuous across the range. We find no consistent or statistically significant discontinuities at rating band thresholds. Figure B6 shows the average price per square meter (log) for each SAP rating and Table B13 shows the results of the formal analysis.

Importantly, these results confirm our main assumption for the use a regression discontinuity design as our identification strategy (stated in Section 4), the distribution of properties with different characteristics across each SAP rating unit is as-good-as random, and in the absence of EE rating band information during the sale process there are no price discontinuities at the thresholds.

[32]The averages of the log transformation of price per square meter and total sale price at SAP rating 69 are also lower for properties that have increased their rating band, 7.71 compared to 7.79 and 12.16 compared to 12.22 respectively.

7.2 Seller Investment Behaviour

7.2.1 Empirical Specification

Our analysis of threshold effects on seller EE investment probability (Section 6.1) documents that results are robust to different bandwidth selection procedures and kernels for local linear regressions. We also perform the analysis using different ad-hoc bandwidths (Table C1) and show that the results do not change substantially, the size of the estimates is slightly larger when using smaller bandwidths. We run falsification and placebo tests (for up to three SAP rating units before and after the threshold and at 10 SAP rating unit intervals) and find no systematic discontinuities (Tables C2 and C3).

7.2.2 Baseline Covariates

Our analysis in Section 6.1 also includes various sets of baseline covariate controls as evidence that results are not driven by differences in the distribution of property characteristics, sale dates or geographic areas around the thresholds. Moreover, we check for discontinuities at the thresholds for each of the covariates by performing separate local linear regression discontinuity tests. Note that the running variable, initial SAP rating before EE improvements, is not the same as the one used in the price discontinuity analysis, which is the final SAP rating after EE improvements. The results for geographic area (Figure C1 and Table C4) and sale date (Figures C2 and C3 and Table C5) show no systematic discontinuities at the thresholds. The results for property type show small but statistically significant discontinuities in the proportion of detached houses (Figure C4 and Table C6). Nonetheless, as our running variable is the *initial* SAP rating and our dependent variable is the proportion of properties that *will* make EE investments, a higher proportion of detached houses (to start with) does not represent a problem for our empirical strategy. If anything, it would be an indication that detached properties are more likely to have already made some EE investments (for example to reduce energy costs or improve comfort) during the time the previous owner was living in the property.

7.2.3 Counterfactual Scenario

Finally, we repeat our analysis using transactions between October 2008 and March 2012 as our close counter factual scenario (discussed in more detail in Section 7.1). While the graphical analysis does not show clear discontinuities at the thresholds (Figure C5), the results from local linear regressions show discontinuities at thresholds E-D, D-C and C-B (Table C7). These discontinuities do not suggest a consistent rating band threshold effect, for instance the sign for the discontinuities

at E-D and C-B is negative (similar to the results from our main analysis) but positive for D-C. As mentioned above, during these period sellers could selectively advertise the rating band of a property as a desirable feature, so these noisy discontinuities may be the result of a small number of sellers who are making EE investments in an attempt to promote the property better.

8 Conclusion

We find strong evidence of limited attention in the housing market. Individuals seem to be more attentive to the colour coded letter rating band and less attentive to the more informative SAP rating (energy cost rating). The rating band is provided to help understand the information presented in the EPC, and there are no economic benefits for the classification, the presence of discontinuities at the rating band thresholds and the different slopes for each rating band suggest a role of inattention in the market. We estimate the price discontinuities for crossing the rating band thresholds to be between 2.5% at the G-F threshold (the most energy inefficient bands) and 0.8% at the D-C threshold (where most sales are recorded). Provided the average sale prices around these thresholds, a back-of-the-envelope calculation would yield a price difference of £6,625 and £2,000 for crossing a rating band threshold, which in many cases (especially at the lower end of the scale) can be achieved by inexpensive EE improvements.

We also present evidence that the probability of sellers making EE investments is considerably higher before crossing a rating band threshold. We estimate that the probability of investing in EE is between 11% and 0.4% higher before crossing a rating band threshold (depending on the specific threshold) relative to the total number of properties that made EE investments in our dataset. These results suggest that some sellers may be aware of the price discontinuities and willing to bet on extracting the price premium by making EE investments to take the property to a higher rating band.

Irrespective of whether inattention is driven by behavioural biases (e.g. salience – as in Finkelstein 2009 and Chetty et al. 2009) or deliberate attentional choice (i.e. agents minimising information acquisition costs – Stigler 1961, Caplin 2016), we propose that providing aggregate energy efficiency information may create threshold effects that need to be considered during policy design. Gabaix (2019) provides a framework for analysis (incorporating psychology concepts proposed by Tversky & Kahneman 1974) where agents follow an anchoring and adjustment decision process, with adjustment typically insufficient provided the limited information obtained as a result of inattention. Our results, the price discontinuities and the different slopes and functional forms at each rating band, fit well within this framework, with agents anchoring on the colour coded letter (e.g. green C) and adjusting

with the SAP rating, however the adjustments are not perfect leading to price and EE investment discontinuities at the thresholds. We also anticipate that inattention in the housing market may be related to inattention in other markets where labels are designed by aggregating detailed information into more salient but less precise categories. In order to assess the relationship between the housing market and other markets, comparisons of a structurally estimated inattention parameter can be performed, for example against EE ratings for appliances in the UK where the rating graphic follows the same colour-letter design.

As the EPC requirement is relatively new, investigating if the price discontinuities are increasing or decreasing over time would provide an insight into the mechanisms of market learning under inattention. List (2003, 2011) provides evidence that market learning reduces behavioural biases, although in low-value markets, where market participants seem to be less prone to different biases as they gain experience. The next step in this line of research is to investigate how the supply and demand of properties in the market is reacting, signalled by changing magnitudes of the price discontinuities at different locations, property prices and across time. These estimations could also provide some insight into whether inattention in the market is behavioural or deliberate ("rational"), by estimating the opportunity costs of acquiring the knowledge and skills to understand the SAP rating and comparing it to the property price and location as a proxy for wealth and education.

We also provide considerations for policy that can be extended to other settings where the provision of aggregate information creates reference thresholds. We find that threshold effects are stronger towards the lower end of the EE scale and put forward the notion that having more thresholds around this area can further incentivise EE investment as improvement costs are lower. Our results do not find consistent discontinuities between rating bands A, B and C, and we propose that this may be due to them being all shown as green in the EE graph, as previous research suggest (e.g. Waechter et al. 2016), increasing the salience of green (e.g. by showing rating bands C and B more towards a yellow hue) may trigger threshold effects around this range. We find discontinuities in the sales of existing properties but not on sales of newly built properties since both groups have very different distributions[33] and their EE rating band comparability is limited (as it does not by itself provide information about energy costs), we propose that having different scales either at the SAP rating or the rating bands can increase the effects of thresholds. Finally, we discuss the welfare implications of having dynamic or short term rating bands in investment and asset markets (as the housing market), where ratings are based on a measure that depreciates over time (e.g. increasing energy costs), as these may reduce buyer surplus and where sellers benefit the most.

[33]Due to building legislation most of the new buildings have rating band B.

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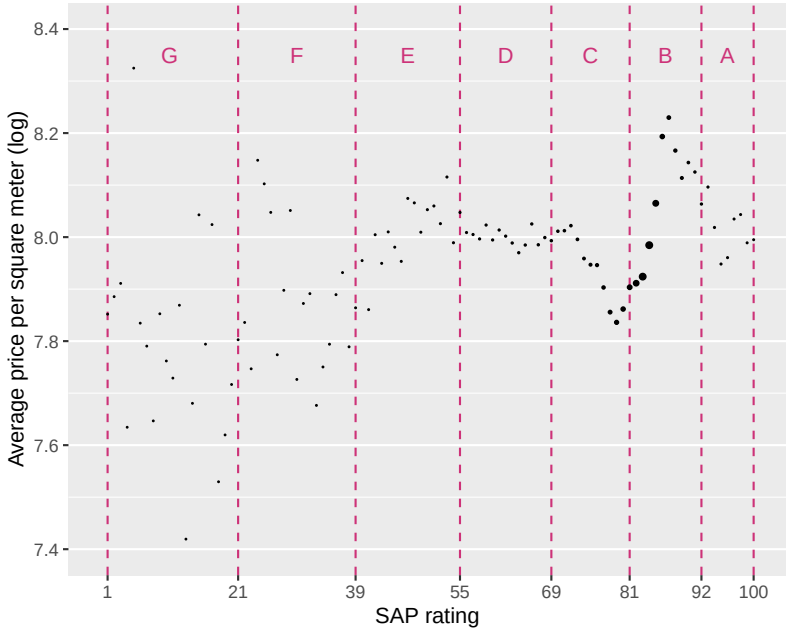
Appendix A New Buildings

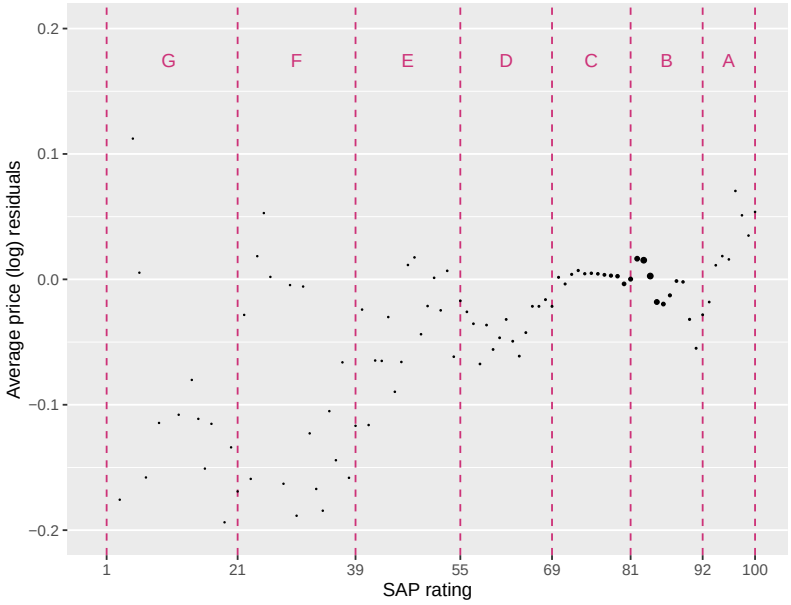
The average price per meter (log) bins for SAP rating units for new properties are shown in Panel A of Figure A1. The price residuals after controlling for property characteristics (property type, tenure and new building), location (postcode area and urban classification) and the sale year quarter are shown in Panel B of Figure A1. The discontinuities between rating bands G, F, E, D and C are not as clear because the low frequencies of new properties with these bands. The discontinuity between rating bands C and B also disappears after controlling for covariates. New properties have to comply with minimum energy efficiency regulations and in the UK housing market the final sale price can be agreed before construction is finished, thus it is expected that energy efficiency rating bands will have a much lower effect in the final sale price.

Figure A1: Price – SAP Rating for New Properties

Panel A. Price Per Square Meter (Log) – SAP Rating for Existing Properties



Panel B. Price Per Square Meter (Log) Residuals – SAP Rating for Existing Properties



Notes: N=893,534

Table A1: Local Linear RD Estimates for New Properties

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
F [SAP 21] τ	0.215	0.001	0.185	0.164	0.049	0.140	-0.051*
	(0.100)	(0.031)	(0.097)	(0.101)	(0.038)	(0.113)	(0.038)
Robust 95% CI	-0.019|0.520	-0.381|0.279	-0.030|0.443	-0.137|0.502	-0.053|0.112	-0.162|0.439	-0.176|-0.013
Robust p-value	0.068	0.762	0.088	0.263	0.481	0.365	0.024
BW estimate (h)	6.898|6.898	2.975|2.975	6.861|5.536	5.564|5.564	4.706|4.706	6.757|6.757	4.425|4.425
BW bias (b)	11.772|11.772	6.378|6.378	13.380|8.829	9.830|9.830	6.619|6.619	10.705|10.705	6.726|6.726
Observations	299|1,061	299|1,061	299|1,061	299|1,061	299|1,061	299|1,061	299|1,061
Effective observations	112|244	39|88	112|202	83|202	72|152	112|244	72|152
E [SAP 39] τ	0.108***	0.201**	0.136***	0.125***	0.092*	0.091**	0.069
	(0.045)	(0.048)	(0.049)	(0.053)	(0.067)	(0.048)	(0.070)
Robust 95% CI	0.096|0.284	0.104|0.417	0.113|0.326	0.114|0.344	0.020|0.278	0.067|0.264	-0.031|0.248
Robust p-value	0.000	0.001	0.000	0.000	0.024	0.001	0.129
BW estimate (h)	3.757|3.757	2.937|2.937	3.392|7.646	3.389|3.389	4.455|4.455	3.889|3.889	5.203|5.203
BW bias (b)	6.291|6.291	5.559|5.559	6.163|9.947	5.927|5.927	6.642|6.642	6.444|6.444	7.405|7.405
Observations	1,061|5,340	1,061|5,340	1,061|5,340	1,061|5,340	1,061|5,340	1,061|5,340	1,061|5,340
Effective observations	320|664	218|471	320|1,638	320|664	419|896	320|664	485|1,119
D [SAP 55] τ	0.017	0.037	0.075	0.030	0.062	0.030	0.069*
	(0.052)	(0.062)	(0.048)	(0.053)	(0.036)	(0.049)	(0.030)
Robust 95% CI	-0.061|0.148	-0.051|0.198	0.000|0.239	-0.053|0.167	-0.009|0.179	-0.045|0.160	0.020|0.170
Robust p-value	0.419	0.248	0.050	0.307	0.077	0.269	0.013
BW estimate (h)	6.322|6.322	3.533|3.533	4.014|3.706	6.100|6.100	3.783|3.783	5.777|5.777	3.877|3.877
BW bias (b)	9.461|9.461	6.507|6.507	6.650|5.372	9.214|9.214	6.436|6.436	9.012|9.012	6.534|6.534
Observations	5,340|22,248	5,340|22,248	5,340|22,248	5,340|22,248	5,340|22,247	5,340|22,248	5,340|22,247
Effective observations	3,092|7,784	1,762|3,732	2,281|3,732	3,092|7,784	1,762|3,732	2,713|6,332	1,762|3,732
C [SAP 69] τ	0.009	0.019	-0.010	0.005	-0.011	0.011	-0.011
	(0.012)	(0.015)	(0.006)	(0.008)	(0.009)	(0.013)	(0.005)
Robust 95% CI	-0.033|0.068	-0.026|0.083	-0.061|0.046	-0.021|0.054	-0.027|0.004	-0.037|0.079	-0.029|0.005
Robust p-value	0.506	0.299	0.784	0.386	0.147	0.474	0.173
BW estimate (h)	3.860|3.860	3.489|3.489	2.599|4.506	3.525|3.525	4.695|4.695	3.705|3.705	4.216|4.216
BW bias (b)	5.618|5.618	5.373|5.373	5.723|4.976	5.556|5.556	5.915|5.915	5.666|5.666	6.263|6.263
Observations	22,248|177,930	22,248|177,930	22,248|177,930	22,248|177,930	22,247|177,924	22,248|177,930	22,247|177,924
Effective observations	7,058|14,347	7,058|14,347	4,962|19,943	7,058|14,347	9,080|19,943	7,058|14,347	9,080|19,943
B [SAP 81] τ	0.031	0.023	0.009	0.029***	0.029***	0.011	0.022***
	(0.031)	(0.042)	(0.018)	(0.005)	(0.004)	(0.034)	(0.007)
Robust 95% CI	-0.015|0.046	-0.017|0.075	-0.028|0.001	0.011|0.034	0.009|0.017	-0.015|0.036	0.012|0.020
Robust p-value	0.323	0.220	0.071	0.000	0.000	0.434	0.000
BW estimate (h)	6.183|6.183	5.127|5.127	3.291|4.686	4.681|4.681	3.844|3.844	6.830|6.830	5.448|5.448
BW bias (b)	6.834|6.834	6.294|6.294	5.091|5.589	7.460|7.460	5.059|5.059	6.735|6.735	5.690|5.690
Observations	177,930|680,640	177,930|680,640	177,930|680,640	177,930|680,640	177,924|680,629	177,930|680,640	177,924|680,629
Effective observations	151,062|647,921	141,651|623,553	111,081|575,031	128,873|575,031	111,077|471,801	151,062|647,921	141,645|623,542
A [SAP 92] τ	-0.065**	-0.032	-0.064***	-0.079***	0.047***	-0.066**	0.026***
	(0.021)	(0.014)	(0.022)	(0.004)	(0.010)	(0.021)	(0.006)
Robust 95% CI	-0.179|-0.045	-0.174|0.048	-0.179|-0.051	-0.152|-0.067	0.027|0.065	-0.172|-0.048	0.020|0.044
Robust p-value	0.001	0.264	0.000	0.000	0.000	0.001	0.000
BW estimate (h)	3.850|3.850	2.831|2.831	3.864|4.014	2.738|2.738	4.590|4.590	3.890|3.890	3.692|3.692
BW bias (b)	5.756|5.756	4.966|4.966	5.653|4.862	5.642|5.642	5.584|5.584	5.794|5.794	6.092|6.092
Observations	680,640|6,016	680,640|6,016	680,640|6,016	680,640|6,016	680,629|6,016	680,640|6,016	680,629|6,016
Effective observations	17,222|4,361	7,465|3,722	17,222|4,826	7,465|3,722	32,719|4,826	17,222|4,361	17,222|4,361
BW selection	MSE-Optimal	MSE-Optimal	Two MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Uniform	Triangular	Triangular	Triangular	Triangular	Triangular
Property Characteristics				Yes			Yes
Area FE					Yes		Yes
Date FE						Yes	Yes

Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: N=893,534.

Appendix B Price Discontinuities Robustness Analysis Results

B.1 Empirical Specification

Table B1: Local Linear RD Estimates with Different Bandwidths

	BW = 2		BW = 3		BW = 4		BW = 5	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
F [SAP 21] τ	0.026***	0.035***	0.026***	0.031***	0.025***	0.021***	0.026***	0.019***
	(0.000)	(0.000)	(0.001)	(0.005)	(0.001)	(0.009)	(0.002)	(0.009)
Robust 95% CI	0.031|0.031	0.032|0.032	0.026|0.026	0.051|0.051	0.026|0.026	0.047|0.054	0.022|0.026	0.016|0.048
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
BW bias (b)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
Observations	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167
Effective observations	8800|17837	8800|17837	12824|24642	12824|24642	16634|32253	16634|32253	20202|40545	20202|40545
E [SAP 39] τ	0.026***	0.012***	0.028***	0.012***	0.021***	0.010***	0.019***	0.007***
	(0.000)	(0.000)	(0.002)	(0.000)	(0.004)	(0.001)	(0.004)	(0.002)
Robust 95% CI	0.022|0.022	0.011|0.011	0.040|0.040	0.017|0.017	0.039|0.043	0.017|0.018	0.022|0.039	0.015|0.017
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
BW bias (b)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
Observations	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784
Effective observations	50486|101503	50486|101503	72323|141765	72323|141765	92187|185700	92187|185700	110618|233133	110618|233133
D [SAP 55] τ	0.021***	0.014***	0.020***	0.013***	0.016***	0.012***	0.015***	0.010***
	(0.000)	(0.000)	(0.002)	(0.001)	(0.003)	(0.002)	(0.003)	(0.002)
Robust 95% CI	0.019|0.019	0.013|0.013	0.028|0.028	0.017|0.017	0.026|0.028	0.015|0.017	0.012|0.025	0.013|0.017
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
BW bias (b)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
Observations	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103
Effective observations	205917|384020	205917|384020	297781|529425	297781|529425	379385|683250	379385|683250	454663|846571	454663|846571
C [SAP 69] τ	0.007***	0.002***	0.007***	0.002***	0.008***	0.002***	0.005***	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.002)	(0.001)
Robust 95% CI	0.006|0.006	0.003|0.003	0.004|0.004	0.001|0.001	0.004|0.004	0.001|0.001	0.006|0.016	0.002|0.008
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002
BW estimate (h)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
BW bias (b)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
Observations	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132
Effective observations	394801|504167	394801|504167	593851|629750	593851|629750	788324|734771	788324|734771	978811|821323	978811|821323
B [SAP 81] τ	-0.001***	-0.005***	0.000***	-0.005***	0.001**	0.000***	0.004**	0.001
	(0.000)	(0.000)	(0.001)	(0.000)	(0.002)	(0.002)	(0.003)	(0.003)
Robust 95% CI	0.011|0.011	-0.001|-0.001	-0.002|-0.002	-0.014|-0.014	-0.003|-0.001	-0.014|-0.014	-0.008|-0.001	-0.012|0.001
Robust p-value	0.000	0.000	0.000	0.000	0.003	0.000	0.006	0.124
BW estimate (h)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
BW bias (b)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
Observations	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583
Effective observations	75416|64188	75416|64188	124580|76039	124580|76039	180116|84097	180116|84097	244541|88765	244541|88765
A [SAP 92] τ	0.051***	0.003***	0.053***	0.002***	0.072***	0.025***	0.109**	0.048
	(0.000)	(0.000)	(0.002)	(0.004)	(0.010)	(0.007)	(0.026)	(0.014)
Robust 95% CI	0.042|0.042	0.015|0.015	0.019|0.019	-0.020|-0.020	0.018|0.022	-0.019|-0.006	0.005|0.017	-0.015|0.012
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.789
BW estimate (h)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
BW bias (b)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
Observations	93583|714	93583|714	93583|714	93583|714	93583|714	93583|714	93583|714	93583|714
Effective observations	740|488	740|488	1325|571	1325|571	2431|631	2431|631	4818|654	4818|654
BW selection	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular
Property Characteristics		Yes		Yes		Yes		Yes
Area FE		Yes		Yes		Yes		Yes
Date FE		Yes		Yes		Yes		Yes

Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: N=4,881,291.

Table B2: Local Linear RD Estimates for Existing Properties using Price per Meter

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
F [SAP 21] τ	53.099***	56.081***	52.357***	40.977***	44.819*	51.868***	38.616*
	(5.076)	(6.383)	(5.174)	(6.916)	(21.016)	(5.371)	(20.238)
Robust 95% CI	38.808|74.855	41.117|93.928	38.831|73.787	21.103|57.297	8.906|94.187	37.188|76.087	7.576|85.121
Robust p-value	0.000	0.000	0.000	0.000	0.018	0.000	0.019
BW estimate (h)	3.933|3.933	3.634|3.634	3.857|4.744	4.542|4.542	6.253|6.253	3.847|3.847	5.826|5.826
BW bias (b)	6.403|6.403	6.767|6.767	6.318|8.682	7.542|7.542	7.482|7.482	6.362|6.362	7.460|7.460
Observations	60752|238895	60752|238895	60752|238895	60752|238895	60752|238895	60752|238895	60752|238895
Effective observations	12815|24620	12815|24620	12815|32218	16622|32218	23479|49668	12815|24620	20188|40503
E [SAP 39] τ	48.412***	48.334***	47.526***	42.173***	38.308***	41.343***	22.869***
	(7.748)	(10.187)	(7.934)	(7.702)	(3.965)	(7.796)	(3.508)
Robust 95% CI	34.070|68.340	22.803|73.216	32.652|67.174	23.673|64.876	38.286|53.098	26.772|61.324	21.703|36.986
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	5.041|5.041	3.349|3.349	4.971|6.548	4.418|4.418	4.549|4.549	5.059|5.059	4.340|4.340
BW bias (b)	7.454|7.454	5.998|5.998	7.711|9.160	6.626|6.626	9.031|9.031	7.535|7.535	8.268|8.268
Observations	238895|989680	238895|989680	238895|989680	238895|989680	238895|989680	238895|989680	238895|989680
Effective observations	110488|232839	72234|141584	92082|284845	92082|185455	92082|185455	110488|232839	92082|185455
D [SAP 55] τ	40.624***	33.674**	39.239***	41.965***	33.958***	39.738***	31.245***
	(9.183)	(11.690)	(10.072)	(7.695)	(6.782)	(9.188)	(5.584)
Robust 95% CI	24.664|66.514	13.292|68.099	28.801|65.220	32.953|65.135	29.593|52.659	24.713|65.425	29.215|48.458
Robust p-value	0.000	0.004	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	3.894|3.894	3.019|3.019	3.810|4.244	3.688|3.688	4.268|4.268	3.881|3.881	3.835|3.835
BW bias (b)	5.559|5.559	5.065|5.065	6.384|5.302	5.293|5.293	6.868|6.868	5.539|5.539	6.203|6.203
Observations	989680|2355356	989680|2355356	989680|2355356	989680|2355356	989680|2355356	989680|2355356	989680|2355356
Effective observations	297480|528971	297480|528971	297480|682660	297480|528971	378985|682660	297480|528971	297480|528971
C [SAP 69] τ	19.792**	8.426*	13.705**	21.337**	2.644	18.645**	0.471
	(3.589)	(6.536)	(4.693)	(3.871)	(2.383)	(3.682)	(2.802)
Robust 95% CI	10.112|41.468	2.848|28.554	7.435|35.621	9.354|41.682	-2.970|21.385	8.668|40.329	-7.735|15.305
Robust p-value	0.001	0.017	0.003	0.002	0.138	0.002	0.520
BW estimate (h)	3.831|3.831	4.202|4.202	3.144|5.073	3.976|3.976	3.532|3.532	3.876|3.876	3.212|3.212
BW bias (b)	5.933|5.933	6.047|6.047	5.598|5.207	5.830|5.830	5.847|5.847	5.932|5.932	5.807|5.807
Observations	2355356|1138060	2355356|1138060	2355356|1138060	2355356|1138060	2355356|1138060	2355356|1138060	2355356|1138060
Effective observations	593465|629272	787800|734182	593465|820645	593465|629272	593465|629272	593465|629272	593465|629272
B [SAP 81] τ	-1.339*	1.601	-0.876***	8.806	-26.328*	-1.994*	-17.236*
	(8.268)	(10.938)	(11.100)	(5.165)	(1.893)	(8.393)	(8.543)
Robust 95% CI	-35.485|-2.995	-42.852|10.192	-40.352|-13.841	-20.208|18.171	-62.324|-5.397	-35.630|-4.632	-48.249|-6.192
Robust p-value	0.020	0.228	0.000	0.917	0.020	0.011	0.011
BW estimate (h)	4.019|4.019	3.681|3.681	3.136|7.147	3.368|3.368	3.010|3.010	4.045|4.045	3.285|3.285
BW bias (b)	6.843|6.843	5.905|5.905	5.108|6.224	5.917|5.917	5.843|5.843	6.881|6.881	5.987|5.987
Observations	1138060|93486	1138060|93486	1138060|93486	1138060|93486	1138060|93486	1138060|93486	1138060|93486
Effective observations	179861|84013	124394|75959	124394|92161	124394|75959	124394|75959	179861|84013	124394|75959
A [SAP 92] τ	190.351	182.129	177.154	66.138*	127.046***	190.692	65.004*
	(8.412)	(8.397)	(6.221)	(9.635)	(5.777)	(9.899)	(10.870)
Robust 95% CI	-52.401|358.102	-113.261|483.025	-11.957|160.879	28.388|238.629	71.448|169.673	-39.073|365.069	11.631|131.134
Robust p-value	0.144	0.224	0.091	0.013	0.000	0.114	0.019
BW estimate (h)	3.500|3.500	2.349|2.349	2.719|4.340	2.877|2.877	3.999|3.999	3.493|3.493	3.678|3.678
BW bias (b)	5.974|5.974	5.842|5.842	5.025|5.876	5.930|5.930	5.124|5.124	5.974|5.974	5.799|5.799
Observations	93486|714	93486|714	93486|714	93486|714	93486|714	93486|714	93486|714
Effective observations	1325|571	740|488	740|631	740|488	1325|571	1325|571	1325|571
BW selection	MSE-Optimal	MSE-Optimal	Two MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Uniform	Triangular	Triangular	Triangular	Triangular	Triangular
Property Characteristics				Yes			Yes
Area FE					Yes		Yes
Date FE						Yes	Yes

Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: The distribution of price per meter is heavily right skewed, to avoid outliers from affecting the results we exclude properties with price per meter over £20,000 (4,348 properties). N=4,876,943.

Table B3: Local Linear RD Estimates for Existing Properties using Total Sale Price (Log)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
F [SAP 21] τ	0.037***	0.036***	0.036***	0.023***	0.030***	0.037***	0.023***
	(0.006)	(0.007)	(0.007)	(0.003)	(0.005)	(0.006)	(0.006)
Robust 95% CI	0.022|0.058	0.022|0.051	0.018|0.056	0.015|0.031	0.020|0.047	0.022|0.059	0.015|0.037
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	4.131|4.131	5.585|5.585	3.369|4.741	4.696|4.696	4.179|4.179	4.226|4.226	4.897|4.897
BW bias (b)	6.067|6.067	8.310|8.310	6.100|6.211	7.377|7.377	5.815|5.815	6.131|6.131	6.555|6.555
Observations	60,808|239,167	60,808|239,167	60,808|239,167	60,808|239,167	60,808|239,167	60,808|239,167	60,808|239,167
Effective observations	16,634|32,253	20,202|40,545	12,824|32,253	16,634|32,253	16,634|32,253	16,634|32,253	16,634|32,253
E [SAP 39] τ	0.022***	0.019*	0.024***	0.018***	0.016***	0.019***	0.011***
	(0.006)	(0.008)	(0.005)	(0.004)	(0.004)	(0.006)	(0.001)
Robust 95% CI	0.019|0.038	0.004|0.038	0.020|0.038	0.014|0.031	0.015|0.031	0.015|0.036	0.012|0.019
Robust p-value	0.000	0.016	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	4.797|4.797	4.668|4.668	4.201|4.418	3.908|3.908	4.489|4.489	4.904|4.904	3.651|3.651
BW bias (b)	6.171|6.171	6.059|6.059	6.224|5.644	5.656|5.656	6.482|6.482	6.259|6.259	5.540|5.540
Observations	239,167|990,784	239,167|990,784	239,167|990,784	239,167|990,784	239,167|990,784	239,167|990,784	239,167|990,784
Effective observations	92,187|185,700	92,187|185,700	92,187|185,700	72,323|141,765	92,187|185,700	92,187|185,700	72,323|141,765
D [SAP 55] τ	0.024***	0.027***	0.023***	0.017***	0.020***	0.023***	0.013***
	(0.004)	(0.003)	(0.004)	(0.002)	(0.003)	(0.004)	(0.002)
Robust 95% CI	0.021|0.034	0.023|0.036	0.021|0.034	0.014|0.025	0.019|0.028	0.021|0.033	0.014|0.019
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	3.706|3.706	2.882|2.882	3.716|4.314	3.665|3.665	4.271|4.271	3.694|3.694	3.527|3.527
BW bias (b)	5.239|5.239	5.006|5.006	5.460|5.315	5.381|5.381	7.099|7.099	5.234|5.234	5.419|5.419
Observations	990,784|2,357,103	990,784|2,357,103	990,784|2,357,103	990,784|2,357,103	990,784|2,357,103	990,784|2,357,103	990,784|2,357,103
Effective observations	297,781|529,425	205,917|384,020	297,781|683,250	297,781|529,425	379,385|683,250	297,781|529,425	297,781|529,425
C [SAP 69] τ	0.013***	0.013***	0.012***	0.008***	0.009***	0.012***	0.003**
	(0.001)	(0.002)	(0.002)	(0.001)	(0.000)	(0.001)	(0.001)
Robust 95% CI	0.013|0.022	0.010|0.024	0.011|0.021	0.005|0.014	0.011|0.018	0.012|0.021	0.002|0.009
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.001
BW estimate (h)	3.432|3.432	3.059|3.059	4.071|4.518	3.353|3.353	3.148|3.148	3.459|3.459	3.557|3.557
BW bias (b)	5.474|5.474	5.312|5.312	6.624|5.241	5.983|5.983	5.026|5.026	5.486|5.486	5.154|5.154
Observations	2,357,103|1,139,132	2,357,103|1,139,132	2,357,103|1,139,132	2,357,103|1,139,132	2,357,103|1,139,132	2,357,103|1,139,132	2,357,103|1,139,132
Effective observations	593,851|629,750	593,851|629,750	788,324|734,771	593,851|629,750	593,851|629,750	593,851|629,750	593,851|629,750
B [SAP 81] τ	-0.003***	-0.012	-0.007***	0.003**	-0.004***	-0.004**	-0.002
	(0.005)	(0.009)	(0.009)	(0.002)	(0.005)	(0.005)	(0.001)
Robust 95% CI	0.006|0.019	-0.002|0.025	0.007|0.019	0.003|0.011	0.010|0.016	0.005|0.018	-0.002|0.005
Robust p-value	0.000	0.082	0.000	0.001	0.000	0.001	0.467
BW estimate (h)	4.342|4.342	4.148|4.148	3.568|7.298	3.805|3.805	4.356|4.356	4.330|4.330	3.724|3.724
BW bias (b)	6.732|6.732	6.038|6.038	5.783|5.669	6.657|6.657	6.837|6.837	6.774|6.774	7.074|7.074
Observations	1,139,132|93,583	1,139,132|93,583	1,139,132|93,583	1,139,132|93,583	1,139,132|93,583	1,139,132|93,583	1,139,132|93,583
Effective observations	180,116|84,097	180,116|84,097	124,580|92,258	124,580|76,039	180,116|84,097	180,116|84,097	124,580|76,039
A [SAP 92] τ	0.210***	0.223***	0.198***	0.045***	0.187***	0.206***	0.055***
	(0.015)	(0.030)	(0.013)	(0.007)	(0.011)	(0.014)	(0.001)
Robust 95% CI	0.167|0.365	0.177|0.384	0.158|0.372	0.051|0.083	0.144|0.357	0.162|0.357	0.049|0.079
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	2.648|2.648	2.436|2.436	2.479|4.926	2.854|2.854	2.747|2.747	2.648|2.648	2.954|2.954
BW bias (b)	5.869|5.869	5.784|5.784	5.136|5.733	6.426|6.426	5.661|5.661	5.930|5.930	6.040|6.040
Observations	93,583|714	93,583|714	93,583|714	93,583|714	93,583|714	93,583|714	93,583|714
Effective observations	740|488	740|488	740|631	740|488	740|488	740|488	740|488
BW selection	MSE-Optimal	MSE-Optimal	Two MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Uniform	Triangular	Triangular	Triangular	Triangular	Triangular
Property FE				Yes			Yes
Area FE					Yes		Yes
Date FE						Yes	Yes

Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: N=4,881,291.

Table B4: Local Linear RD Estimates for Falsification Tests

	TH -3		TH -2		TH -1		TH +1		TH +2		TH +3	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
F [SAP 21] τ	-0.016	-0.009	-0.004	0.009**	0.011*	0.001	-0.003	-0.012	-0.011	0.004	-0.001	0.007
	(0.006)	(0.003)	(0.006)	(0.004)	(0.009)	(0.010)	(0.010)	(0.011)	(0.006)	(0.010)	(0.005)	(0.008)
Robust 95% CI	-0.042|0.002	-0.020|0.002	-0.021|0.014	0.006|0.025	0.001|0.030	-0.019|0.017	-0.028|0.012	-0.041|0.005	-0.029|0.002	-0.016|0.028	-0.018|0.016	-0.014|0.033
Robust p-value	0.079	0.120	0.691	0.001	0.036	0.924	0.435	0.125	0.078	0.585	0.912	0.448
BW estimate (h)	3.895|3.895	3.934|3.934	5.051|5.051	4.160|4.160	4.769|4.769	5.461|5.461	6.903|6.903	6.923|6.923	5.096|5.096	8.326|8.326	4.546|4.546	4.076|4.076
BW bias (b)	6.412|6.412	6.017|6.017	6.751|6.751	6.122|6.122	5.873|5.873	7.284|7.284	11.165|11.165	10.898|10.898	8.799|8.799	11.370|11.370	8.985|8.985	7.538|7.538
Observations	47847|251457	47847|251457	51855|247449	51855|247449	56118|243186	56118|243186	66093|233211	66093|233211	71968|227336	71968|227336	78422|220882	78422|220882
Effective observations	10647|18246	10647|18246	17763|33356	14655|26567	15626|29093	18918|36680	25601|54325	25601|54325	24121|48450	34768|85326	22304|41996	22304|41996
E [SAP 39] τ	0.009***	0.000	0.003	-0.001	-0.008**	-0.003	-0.001	0.001	-0.015***	-0.005*	0.001	0.000
	(0.002)	(0.002)	(0.005)	(0.002)	(0.005)	(0.003)	(0.006)	(0.003)	(0.003)	(0.001)	(0.004)	(0.001)
Robust 95% CI	0.011|0.019	-0.007|0.005	-0.006|0.019	-0.008|0.003	-0.020|-0.003	-0.008|0.002	-0.021|0.007	-0.006|0.006	-0.029|-0.010	-0.010|-0.001	-0.010|0.015	-0.004|0.005
Robust p-value	0.000	0.722	0.316	0.374	0.007	0.253	0.352	0.986	0.000	0.014	0.700	0.713
BW estimate (h)	2.984|2.984	4.961|4.961	3.899|3.899	4.998|4.998	3.943|3.943	5.029|5.029	4.083|4.083	6.339|6.339	4.198|4.198	4.228|4.228	4.219|4.219	4.226|4.226
BW bias (b)	5.534|5.534	8.894|8.894	5.663|5.663	8.499|8.499	6.276|6.276	7.008|7.008	6.900|6.900	9.205|9.205	8.303|8.303	8.550|8.550	7.664|7.664	7.505|7.505
Observations	166482|1061756	166482|1061756	188285|1039953	188285|1039953	212690|1015548	212690|1015548	269408|958830	269408|958830	303143|925095	303143|925095	340033|888205	340033|888205
Effective observations	38230|72194	69816|136661	60033|114858	76516|151748	66035|127343	100921|211409	102926|202055	141156|310357	114858|220320	114858|220320	127343|239732	127343|239732
D [SAP 55] τ	-0.006	-0.001	0.003	-0.001	0.003	0.000	-0.017***	-0.011***	0.011	-0.000	0.002	-0.004
	(0.002)	(0.001)	(0.003)	(0.002)	(0.006)	(0.003)	(0.005)	(0.003)	(0.001)	(0.004)	(0.003)	(0.000)
Robust 95% CI	-0.011|-0.003	-0.003|0.002	-0.003|0.013	-0.006|0.002	-0.008|0.013	-0.005|0.005	-0.039|-0.016	-0.026|-0.009	-0.009|0.036	-0.011|0.010	-0.006|0.015	-0.011|0.005
Robust p-value	0.000	0.685	0.213	0.255	0.658	0.972	0.000	0.000	0.234	0.909	0.424	0.480
BW estimate (h)	5.140|5.140	6.427|6.427	3.725|3.725	5.075|5.075	4.907|4.907	4.424|4.424	3.433|3.433	3.364|3.364	2.880|2.880	4.041|4.041	3.326|3.326	2.780|2.780
BW bias (b)	8.243|8.243	9.499|9.499	5.319|5.319	7.219|7.219	6.551|6.551	5.814|5.814	5.357|5.357	5.511|5.511	5.401|5.401	7.073|7.073	6.264|6.264	5.962|5.962
Observations	692113|2651343	692113|2651343	783875|2559581	783875|2559581	883680|2459776	883680|2459776	1110366|2233090	1110366|2233090	1237156|2106300	1237156|2106300	1373124|1970332	1373124|1970332
Effective observations	351024|681011	407326|826250	248450|453281	383131|734488	348255|634683	348255|634683	326491|561661	326491|561661	247594|434871	453281|767634	383562|631666	262758|462030
C [SAP 69] τ	0.002***	0.001	-0.005***	-0.004***	-0.002	-0.001	-0.001	-0.005**	0.001	-0.002	0.004	-0.001
	(0.002)	(0.000)	(0.002)	(0.001)	(0.002)	(0.002)	(0.003)	(0.001)	(0.002)	(0.002)	(0.001)	(0.000)
Robust 95% CI	0.005|0.008	-0.001|0.003	-0.011|-0.003	-0.007|-0.004	-0.004|0.005	-0.002|0.004	-0.008|0.004	-0.007|-0.002	-0.007|0.006	-0.004|0.005	-0.000|0.007	-0.001|0.005
Robust p-value	0.000	0.213	0.000	0.000	0.811	0.698	0.442	0.001	0.838	0.774	0.084	0.162
BW estimate (h)	4.323|4.323	4.812|4.812	4.779|4.779	3.602|3.602	4.495|4.495	4.479|4.479	4.919|4.919	4.448|4.448	3.291|3.291	3.521|3.521	3.643|3.643	3.663|3.663
BW bias (b)	5.755|5.755	7.180|7.180	5.533|5.533	5.191|5.191	6.468|6.468	6.065|6.065	6.365|6.365	6.064|6.064	5.534|5.534	5.222|5.222	5.314|5.314	5.589|5.589
Observations	1761060|1714432	1761060|1714432	1959785|1515707	1959785|1515707	2159599|1315893	2159599|1315893	2539603|935889	2539603|935889	2708162|767330	2708162|767330	2856824|618668	2856824|618668
Effective observations	745832|947102	745832|947102	766920|897039	583148|748377	782962|822256	782962|822256	778543|632190	778543|632190	548563|463631	548563|463631	502930|386870	502930|386870
B [SAP 81] τ	-0.005***	-0.001	0.003	-0.003***	0.003	0.006***	-0.007**	0.003	-0.017***	0.000	0.004***	-0.005***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.004)	(0.001)
Robust 95% CI	-0.015|-0.005	-0.005|-0.000	-0.007|0.005	-0.006|-0.002	-0.006|0.003	0.004|0.010	-0.010|-0.002	-0.004|0.009	-0.013|-0.012	-0.003|0.005	0.007|0.020	-0.006|-0.002
Robust p-value	0.000	0.041	0.713	0.000	0.590	0.000	0.004	0.394	0.000	0.679	0.000	0.000
BW estimate (h)	2.843|2.843	5.306|5.306	3.646|3.646	5.930|5.930	4.003|4.003	3.932|3.932	4.622|4.622	3.022|3.022	4.801|4.801	3.325|3.325	3.801|3.801	3.557|3.557
BW bias (b)	4.947|4.947	6.421|6.421	5.771|5.771	6.675|6.675	6.446|6.446	7.060|7.060	5.847|5.847	6.028|6.028	5.282|5.282	5.995|5.995	5.901|5.901	6.282|6.282
Observations	1005291|202641	1005291|202641	1051438|156494	1051438|156494	1090055|117877	1090055|117877	1146356|61576	1146356|61576	1166031|41901	1166031|41901	1181014|26918	1181014|26918
Effective observations	115491|116307	377330|175723	161638|114593	319162|140464	200255|101847	137775|90959	141065|57253	94918|52967	114593|39692	75976|37578	59416|24709	59416|24709
A [SAP 92] τ	-0.073*	-0.030***	0.024***	-0.000	0.056*	0.038**	-0.012***	0.030***	0.000	-0.017*	-0.011	-0.068***
	(0.020)	(0.007)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.004)	(0.009)	(0.004)	(0.018)	(0.011)
Robust 95% CI	-0.099|-0.012	-0.056|-0.020	0.055|0.087	-0.038|0.043	0.013|0.152	0.015|0.073	-0.059|-0.046	0.014|0.043	-0.078|0.020	-0.050|-0.005	-0.083|0.015	-0.109|-0.062
Robust p-value	0.013	0.000	0.000	0.910	0.020	0.003	0.000	0.000	0.242	0.018	0.175	0.000
BW estimate (h)	3.250|3.250	3.794|3.794	2.075|2.075	2.849|2.849	3.007|3.007	2.896|2.896	2.516|2.516	2.645|2.645	3.026|3.026	2.891|2.891	4.508|4.508	3.667|3.667
BW bias (b)	5.422|5.422	5.379|5.379	4.775|4.775	5.695|5.695	5.662|5.662	6.185|6.185	5.679|5.679	5.959|5.959	5.801|5.801	6.623|6.623	6.304|6.304	6.770|6.770
Observations	85123|1853	85123|1853	85655|1321	85655|1321	86045|931	86045|931	86542|434	86542|434	86671|305	86671|305	86775|201	86775|201
Effective observations	7398|1419	7398|1419	1530|887	1530|887	1920|730	922|626	497|309	497|309	626|253	337|232	730|187	441|172
BW selection	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular
Property Characteristics		Yes		Yes		Yes		Yes		Yes		Yes
Area FE		Yes		Yes		Yes		Yes		Yes		Yes
Date FE		Yes		Yes		Yes		Yes		Yes		Yes

Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: N=4,881,291.

Table B5: Local Linear RD Estimates for Placebo Tests

	(1)	(2)
SAP 10 τ	-0.021**	-0.001
	(0.009)	(0.007)
Robust 95% CI	-0.041|-0.006	-0.009|0.026
Robust p-value	0.010	0.349
BW estimate (h)	4.028|4.028	3.790|3.790
BW bias (b)	5.553|5.553	6.545|6.545
Observations	23805|4857486	23805|4857486
Effective observations	7996|13505	6333|10388
SAP 20 τ	0.011	0.001
	(0.009)	(0.009)
Robust 95% CI	-0.003|0.027	-0.019|0.017
Robust p-value	0.125	0.922
BW estimate (h)	5.129|5.129	6.018|6.018
BW bias (b)	6.769|6.769	8.189|8.189
Observations	56285|4825006	56285|4825006
Effective observations	18975|36776	22092|45068
SAP 30 τ	-0.007	-0.003
	(0.003)	(0.004)
Robust 95% CI	-0.012|0.001	-0.011|0.006
Robust p-value	0.126	0.577
BW estimate (h)	6.079|6.079	7.162|7.162
BW bias (b)	11.768|11.768	12.262|12.262
Observations	131776|4749515	131776|4749515
Effective observations	53131|117713	59602|142152
SAP 40 τ	0.007	0.001
	(0.007)	(0.003)
Robust 95% CI	-0.010|0.019	-0.005|0.007
Robust p-value	0.563	0.747
BW estimate (h)	7.280|7.280	7.482|7.482
BW bias (b)	10.258|10.258	10.676|10.676
Observations	330756|4550535	330756|4550535
Effective observations	157933|370511	157933|370511
SAP 50 τ	-0.003	-0.002
	(0.002)	(0.001)
Robust 95% CI	-0.009|0.003	-0.004|0.001
Robust p-value	0.330	0.242
BW estimate (h)	5.974|5.974	5.541|5.541
BW bias (b)	10.481|10.481	11.079|11.079
Observations	836096|4045195	836096|4045195
Effective observations	302988|575610	302988|575610
SAP 60 τ	0.004	0.001
	(0.002)	(0.002)
Robust 95% CI	-0.002|0.008	-0.003|0.005
Robust p-value	0.204	0.667
BW estimate (h)	5.295|5.295	5.467|5.467
BW bias (b)	8.126|8.126	11.021|11.021
Observations	1974009|2907282	1974009|2907282
Effective observations	683250|1080002	683250|1080002
SAP 70 τ	0.000	-0.005*
	(0.003)	(0.001)
Robust 95% CI	-0.007|0.006	-0.006|-0.001
Robust p-value	0.942	0.018
BW estimate (h)	6.384|6.384	4.729|4.729
BW bias (b)	8.908|8.908	6.749|6.749
Observations	3833966|1047325	3833966|1047325
Effective observations	1164915|772912	779955|635219
SAP 80 τ	0.008	0.004**
	(0.003)	(0.002)
Robust 95% CI	-0.002|0.008	0.001|0.010
Robust p-value	0.256	0.010
BW estimate (h)	4.873|4.873	4.693|4.693
BW bias (b)	7.336|7.336	7.569|7.569
Observations	4753109|128182	4753109|128182
Effective observations	210656|109924	210656|109924
SAP 90 τ	0.040	0.017
	(0.003)	(0.001)
Robust 95% CI	-0.007|0.136	-0.020|0.064
Robust p-value	0.075	0.309
BW estimate (h)	2.307|2.307	2.575|2.575
BW bias (b)	5.527|5.527	6.018|6.018
Observations	4879837|1454	4879837|1454
Effective observations	1691|971	1691|971
BW selection	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Triangular
Property Characteristics		Yes
Area FE		Yes
Date FE		Yes

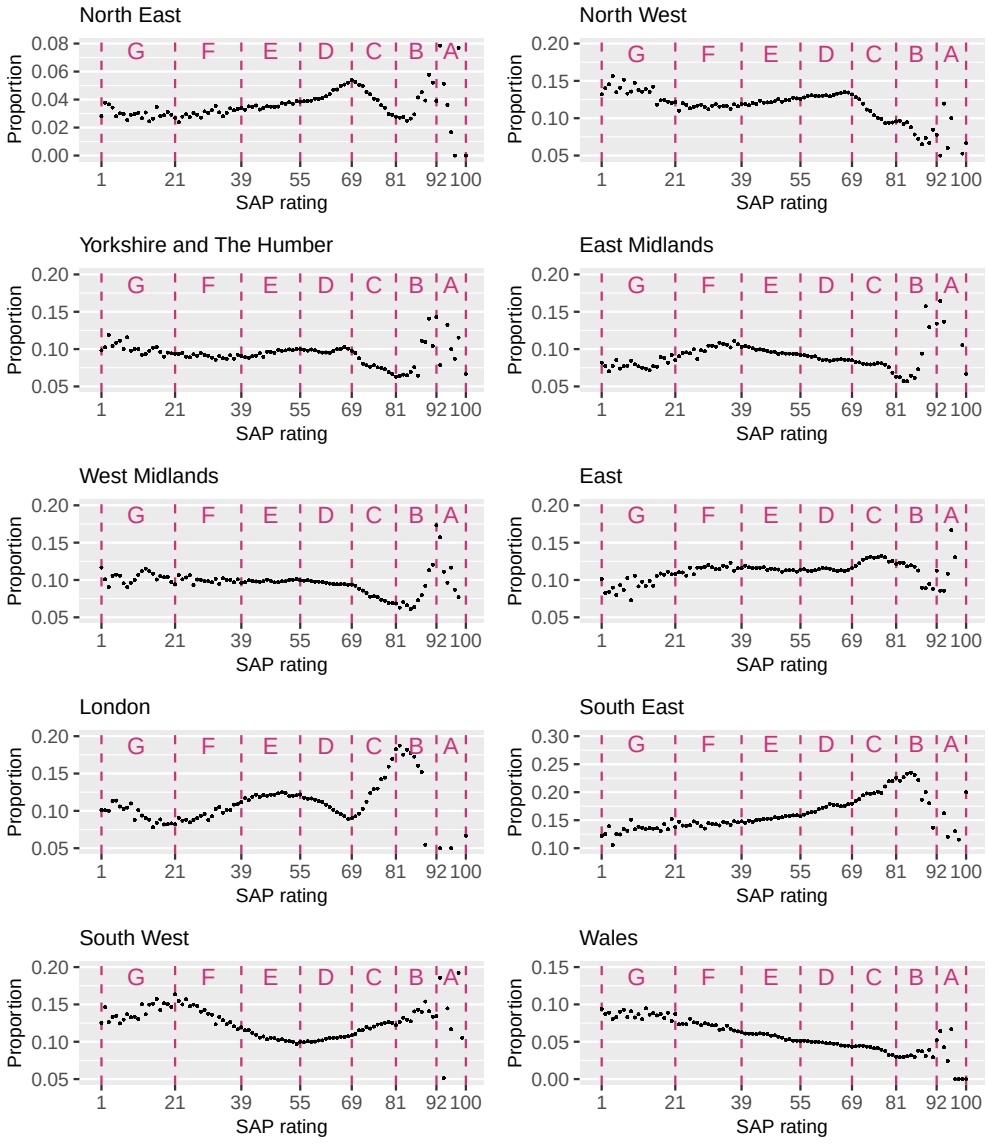
Standard errors in parentheses

Notes: N=4,881,291.

B.2 Baseline Covariates

B.2.1 Location

Figure B1: Region Proportion – SAP Rating



Notes: This figure plots average price per meter (log) bins for each *SAP rating unit.* N=4,881,291.

Table B6: Local Linear RD Estimates for Area Covariate Proportions

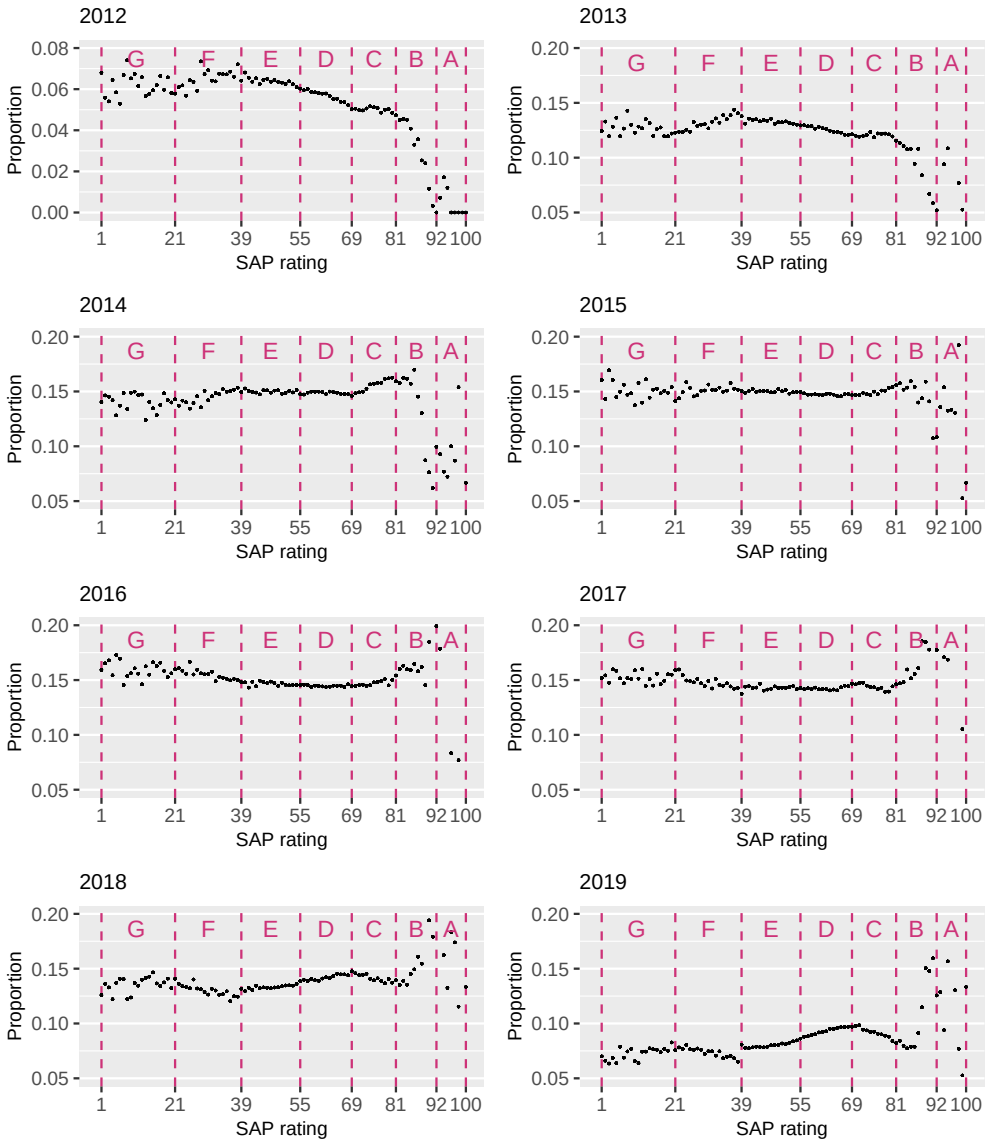
	North East	North West	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East	South West	Wales	Urban
F [SAP 21] τ	-0.004	-0.000	0.001	-0.008	0.002	0.002	0.003	-0.014**	0.013**	0.005	-0.010*
	(0.002)	(0.004)	(0.001)	(0.004)	(0.005)	(0.002)	(0.003)	(0.006)	(0.004)	(0.006)	(0.007)
Robust 95% CI	-0.008|0.001	-0.011|0.006	-0.003|0.006	-0.019|0.001	-0.007|0.011	-0.000|0.009	-0.004|0.011	-0.033|-0.006	0.004|0.023	-0.003|0.019	-0.026|-0.001
Robust p-value	0.109	0.569	0.418	0.092	0.646	0.055	0.392	0.004	0.004	0.166	0.039
BW estimate (h)	5.480|5.480	4.961|4.961	5.561|5.561	4.084|4.084	6.015|6.015	3.908|3.908	4.618|4.618	4.701|4.701	4.759|4.759	4.927|4.927	6.978|6.978
BW bias (b)	10.017|10.017	7.867|7.867	11.297|11.297	6.968|6.968	7.922|7.922	7.519|7.519	7.350|7.350	7.392|7.392	8.000|8.000	7.749|7.749	9.515|9.515
Observations	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167
Effective observations	20202|40545	16634|32253	20202|40545	16634|32253	23498|49718	12824|24642	16634|32253	16634|32253	16634|32253	16634|32253	23498|49718
E [SAP 39] τ	-0.000	0.002	-0.003	-0.005	-0.003	0.004	0.001	-0.000	0.007***	0.001	-0.010**
	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.001)	(0.001)	(0.003)
Robust 95% CI	-0.003|0.001	-0.003|0.006	-0.009|0.001	-0.014|0.002	-0.007|0.002	-0.001|0.012	-0.004|0.004	-0.004|0.004	0.005|0.013	-0.001|0.004	-0.018|-0.002
Robust p-value	0.489	0.588	0.113	0.174	0.229	0.088	0.950	0.908	0.000	0.336	0.011
BW estimate (h)	4.936|4.936	4.363|4.363	4.963|4.963	3.998|3.998	6.281|6.281	4.941|4.941	6.219|6.219	5.268|5.268	3.687|3.687	4.489|4.489	3.827|3.827
BW bias (b)	10.619|10.619	7.731|7.731	7.842|7.842	7.187|7.187	9.234|9.234	8.978|8.978	11.338|11.338	9.004|9.004	5.848|5.848	10.055|10.055	6.555|6.555
Observations	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784
Effective observations	92187|185700	92187|185700	92187|185700	72323|141765	127152|285192	92187|185700	127152|285192	110618|233133	72323|141765	92187|185700	72323|141765
D [SAP 55] τ	-0.001	-0.001	-0.001	-0.001***	-0.003***	0.005***	-0.000	-0.002***	0.005***	0.001	-0.002*
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
Robust 95% CI	-0.004|0.000	-0.004|0.002	-0.003|0.000	-0.001|-0.001	-0.004|-0.002	0.005|0.007	-0.004|0.001	-0.003|-0.001	0.005|0.007	-0.001|0.002	-0.003|-0.000
Robust p-value	0.117	0.669	0.056	0.000	0.000	0.000	0.364	0.000	0.000	0.737	0.040
BW estimate (h)	3.382|3.382	3.825|3.825	3.722|3.722	3.973|3.973	4.938|4.938	3.051|3.051	3.797|3.797	4.065|4.065	3.555|3.555	3.762|3.762	4.927|4.927
BW bias (b)	5.988|5.988	5.598|5.598	6.898|6.898	5.740|5.740	7.078|7.078	5.377|5.377	6.374|6.374	6.277|6.277	5.376|5.376	7.027|7.027	6.127|6.127
Observations	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103
Effective observations	297781|529425	297781|529425	297781|529425	297781|529425	379385|683250	297781|529425	297781|529425	379385|683250	297781|529425	297781|529425	379385|683250
C [SAP 69] τ	0.001	-0.003***	-0.002	-0.001	0.001**	0.002	0.004***	-0.001***	0.001	-0.001**	0.001
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
Robust 95% CI	-0.000|0.002	-0.003|-0.001	-0.004|0.003	-0.001|0.001	0.000|0.002	-0.001|0.003	0.004|0.006	-0.004|-0.002	-0.001|0.002	-0.003|-0.001	-0.001|0.004
Robust p-value	0.139	0.000	0.684	0.931	0.001	0.447	0.000	0.000	0.465	0.005	0.286
BW estimate (h)	4.653|4.653	4.456|4.456	3.632|3.632	3.981|3.981	4.617|4.617	4.075|4.075	4.162|4.162	3.155|3.155	3.877|3.877	3.774|3.774	3.992|3.992
BW bias (b)	6.904|6.904	6.683|6.683	5.576|5.576	5.150|5.150	5.686|5.686	6.071|6.071	5.490|5.490	5.270|5.270	5.428|5.428	6.563|6.563	6.341|6.341
Observations	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132
Effective observations	788324|734771	788324|734771	593851|629750	593851|629750	788324|734771	788324|734771	788324|734771	593851|629750	593851|629750	593851|629750	593851|629750
B [SAP 81] τ	0.001	0.001	0.000	0.000***	0.000	0.000	0.002	-0.000	-0.003**	0.000	-0.001***
	(0.001)	(0.000)	(0.000)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)
Robust 95% CI	-0.001|0.004	-0.004|0.002	-0.000|0.003	0.002|0.006	-0.004|0.002	-0.003|0.007	-0.008|0.005	-0.008|0.010	-0.004|-0.001	-0.003|0.005	-0.010|-0.005
Robust p-value	0.395	0.508	0.075	0.000	0.572	0.467	0.634	0.795	0.004	0.783	0.000
BW estimate (h)	4.056|4.056	3.825|3.825	4.216|4.216	3.823|3.823	4.795|4.795	4.293|4.293	3.902|3.902	3.526|3.526	4.483|4.483	4.067|4.067	4.170|4.170
BW bias (b)	6.495|6.495	6.197|6.197	7.296|7.296	6.864|6.864	6.301|6.301	6.548|6.548	6.860|6.860	5.816|5.816	6.341|6.341	6.837|6.837	6.840|6.840
Observations	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583
Effective observations	180116|84097	124580|76039	180116|84097	124580|76039	180116|84097	180116|84097	124580|76039	124580|76039	180116|84097	180116|84097	180116|84097
A [SAP 92] τ	-0.015	-0.019*	0.029	-0.094**	0.038***	0.018	0.010	-0.013	0.022	0.026***	0.047
	(0.011)	(0.010)	(0.024)	(0.031)	(0.004)	(0.007)	(0.006)	(0.009)	(0.015)	(0.006)	(0.014)
Robust 95% CI	-0.040|0.003	-0.047|-0.006	-0.016|0.100	-0.169|-0.033	0.022|0.047	-0.004|0.027	-0.081|0.103	-0.046|0.035	-0.003|0.065	0.012|0.041	-0.005|0.051
Robust p-value	0.087	0.012	0.158	0.004	0.000	0.150	0.812	0.779	0.073	0.000	0.112
BW estimate (h)	3.778|3.778	3.337|3.337	3.428|3.428	3.884|3.884	5.680|5.680	4.132|4.132	3.502|3.502	3.230|3.230	3.679|3.679	3.482|3.482	3.524|3.524
BW bias (b)	5.785|5.785	5.890|5.890	6.170|6.170	6.328|6.328	6.474|6.474	6.122|6.122	6.403|6.403	5.704|5.704	5.830|5.830	5.629|5.629	5.957|5.957
Observations	93583|714	93583|714	93583|714	93583|714	93583|714	93583|714	93583|714	93583|714	93583|714	93583|714	93583|714
Effective observations	1325|571	1325|571	1325|571	1325|571	4818|654	2431|631	1325|571	1325|571	1325|571	1325|571	1325|571
BW selection	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular

Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: N=4,881,291.

B.2.2 Sale Date

Figure B2: Sale Year Proportion – SAP Rating



Notes: This figure plots average price per meter (log) bins for each SAP rating unit. N=4,881,291.

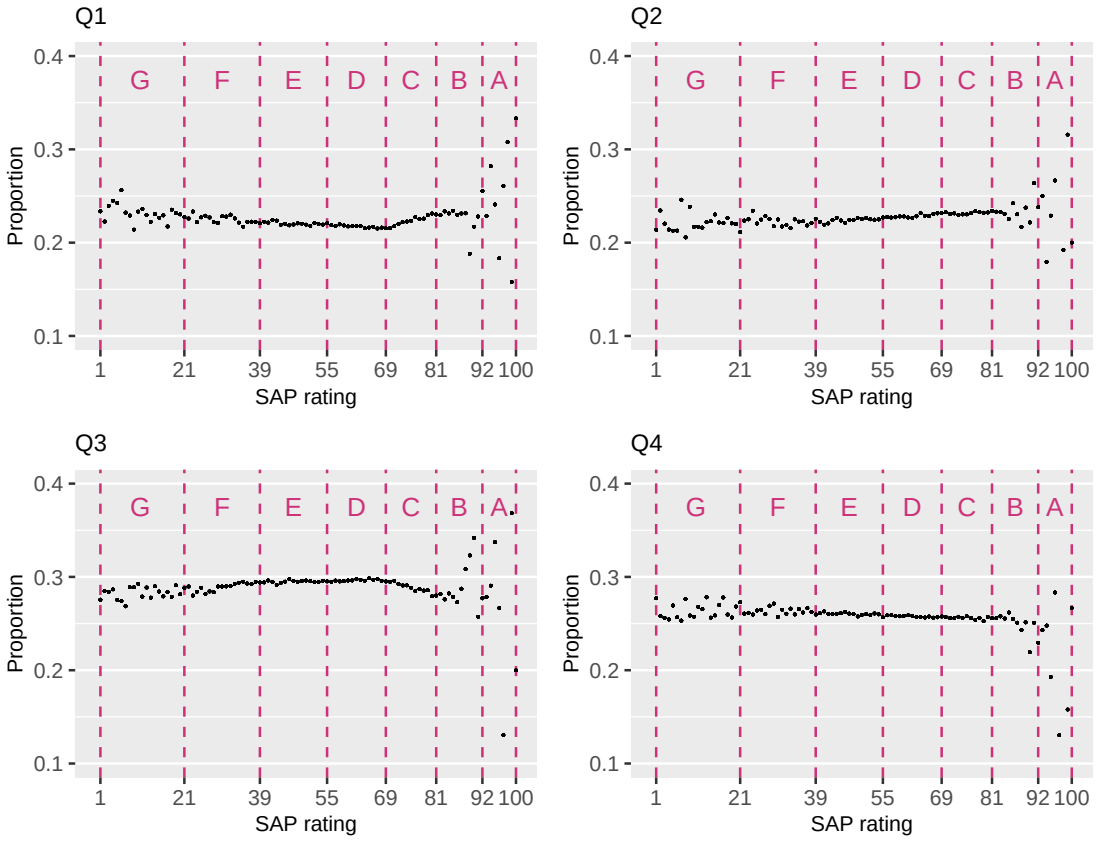


Figure B3: Sale Quarter Proportion – SAP Rating

Notes: This figure plots average price per meter (log) bins for each SAP rating unit. N=4,881,291.

Table B7: Local Linear RD Estimates for Date Covariate Proportions

	2012	2013	2014	2015	2016	2017	2018	2019	Q1	Q2	Q3	Q4
F [SAP 21] τ	0.002	0.001	0.001	-0.012***	0.008	0.003	0.005	-0.004	-0.003	-0.004	0.003	0.003
	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.004)	(0.003)	(0.003)	(0.004)	(0.005)	(0.007)
Robust 95% CI	-0.003|0.012	-0.005|0.007	-0.008|0.012	-0.019|-0.007	0.000|0.018	-0.004|0.008	-0.004|0.014	-0.013|0.002	-0.014|0.007	-0.010|0.003	-0.007|0.014	-0.016|0.024
Robust p-value	0.249	0.817	0.681	0.000	0.050	0.463	0.287	0.176	0.491	0.266	0.554	0.688
BW estimate (h)	4.242|4.242	4.331|4.331	5.105|5.105	5.505|5.505	4.991|4.991	5.540|5.540	5.801|5.801	7.333|7.333	4.279|4.279	4.721|4.721	6.062|6.062	4.582|4.582
BW bias (b)	7.167|7.167	7.526|7.526	9.990|9.990	9.876|9.876	8.837|8.837	8.945|8.945	8.714|8.714	11.988|11.988	8.711|8.711	6.121|6.121	9.052|9.052	7.469|7.469
Observations	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167
Effective observations	16634|32253	16634|32253	20202|40545	20202|40545	16634|32253	20202|40545	20202|40545	26615|59926	16634|32253	16634|32253	23498|49718	16634|32253
E [SAP 39] τ	-0.006*	-0.008*	-0.004**	0.001	-0.002*	-0.002	0.005	0.015***	-0.001	0.005*	-0.001	-0.002
	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.000)	(0.002)	(0.001)	(0.002)
Robust 95% CI	-0.012|-0.001	-0.014|-0.001	-0.007|-0.001	-0.003|0.008	-0.004|-0.000	-0.006|0.001	-0.002|0.010	0.013|0.019	-0.004|0.002	0.001|0.011	-0.003|0.002	-0.006|0.004
Robust p-value	0.015	0.017	0.006	0.414	0.042	0.205	0.192	0.000	0.378	0.017	0.658	0.631
BW estimate (h)	6.053|6.053	7.322|7.322	5.070|5.070	3.784|3.784	4.293|4.293	4.734|4.734	3.959|3.959	5.831|5.831	3.969|3.969	4.718|4.718	4.389|4.389	4.720|4.720
BW bias (b)	8.617|8.617	10.671|10.671	7.584|7.584	7.466|7.466	6.214|6.214	6.396|6.396	8.066|8.066	10.589|10.589	6.151|6.151	8.353|8.353	7.591|7.591	7.549|7.549
Observations	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784
Effective observations	127152|285192	142289|341561	110618|233133	72323|141765	92187|185700	92187|185700	72323|141765	110618|233133	72323|141765	92187|185700	92187|185700	92187|185700
D [SAP 55] τ	0.000	0.000	-0.005**	-0.001	0.000	0.001	0.001	0.001	0.002	0.002***	-0.002***	-0.003*
	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Robust 95% CI	-0.001|0.002	-0.000|0.001	-0.008|-0.002	-0.004|0.000	-0.001|0.001	-0.001|0.004	-0.001|0.002	-0.000|0.001	-0.000|0.004	0.001|0.002	-0.003|-0.002	-0.005|-0.000
Robust p-value	0.528	0.098	0.001	0.058	0.879	0.251	0.269	0.098	0.065	0.000	0.000	0.019
BW estimate (h)	4.860|4.860	4.541|4.541	3.587|3.587	3.572|3.572	3.581|3.581	5.219|5.219	3.083|3.083	4.071|4.071	3.906|3.906	3.308|3.308	3.308|3.308	3.869|3.869
BW bias (b)	8.834|8.834	6.154|6.154	5.569|5.569	5.788|5.788	6.946|6.946	8.137|8.137	5.554|5.554	6.866|6.866	7.094|7.094	5.234|5.234	5.651|5.651	5.622|5.622
Observations	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103
Effective observations	379385|683250	379385|683250	297781|529425	297781|529425	297781|529425	454663|846571	297781|529425	379385|683250	297781|529425	297781|529425	297781|529425	297781|529425
C [SAP 69] τ	-0.001	0.001	-0.001***	-0.001*	-0.004***	0.001	0.004***	0.000	-0.001	-0.000	0.000	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)
Robust 95% CI	-0.001|0.000	-0.001|0.002	-0.002|-0.001	-0.004|-0.000	-0.008|-0.002	-0.001|0.003	0.004|0.005	-0.000|0.001	-0.003|0.002	-0.004|0.002	-0.001|0.003	-0.000|0.003
Robust p-value	0.387	0.339	0.000	0.043	0.000	0.356	0.000	0.400	0.571	0.492	0.242	0.104
BW estimate (h)	3.067|3.067	3.675|3.675	3.699|3.699	3.265|3.265	2.811|2.811	4.366|4.366	3.669|3.669	5.792|5.792	3.255|3.255	2.641|2.641	4.201|4.201	3.328|3.328
BW bias (b)	5.821|5.821	5.073|5.073	5.712|5.712	5.378|5.378	5.131|5.131	6.681|6.681	5.456|5.456	5.998|5.998	5.808|5.808	5.567|5.567	6.555|6.555	5.621|5.621
Observations	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132
Effective observations	593851|629750	593851|629750	593851|629750	593851|629750	394801|504167	788324|734771	593851|629750	978811|821323	593851|629750	394801|504167	788324|734771	593851|629750
B [SAP 81] τ	-0.001	-0.002***	-0.005***	0.001	0.004	-0.001	0.000	0.002**	-0.004***	0.002**	0.004**	-0.003
	(0.001)	(0.000)	(0.001)	(0.001)	(0.003)	(0.001)	(0.002)	(0.001)	(0.001)	(0.000)	(0.002)	(0.002)
Robust 95% CI	-0.003|0.001	-0.002|-0.001	-0.007|-0.002	-0.002|0.002	-0.005|0.011	-0.007|0.001	-0.003|0.005	0.001|0.005	-0.007|-0.003	0.001|0.003	0.002|0.010	-0.009|0.001
Robust p-value	0.406	0.000	0.000	0.785	0.484	0.181	0.530	0.006	0.000	0.007	0.008	0.117
BW estimate (h)	4.020|4.020	3.684|3.684	4.430|4.430	4.558|4.558	3.312|3.312	3.765|3.765	5.301|5.301	3.648|3.648	3.258|3.258	3.592|3.592	3.514|3.514	3.277|3.277
BW bias (b)	6.366|6.366	6.181|6.181	6.131|6.131	7.158|7.158	5.880|5.880	6.619|6.619	7.047|7.047	5.937|5.937	6.614|6.614	5.885|5.885	6.528|6.528	6.139|6.139
Observations	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583
Effective observations	180116|84097	124580|76039	180116|84097	180116|84097	124580|76039	124580|76039	244541|88765	124580|76039	124580|76039	124580|76039	124580|76039	124580|76039
A [SAP 92] τ	0.008*	-0.001	0.063***	0.029	-0.024*	-0.066**	0.074***	-0.044**	0.013	-0.063**	0.087	-0.017
	(0.001)	(0.003)	(0.008)	(0.005)	(0.005)	(0.016)	(0.001)	(0.003)	(0.004)	(0.006)	(0.017)	(0.017)
Robust 95% CI	0.001|0.016	-0.057|0.027	0.039|0.083	-0.007|0.078	-0.065|-0.006	-0.117|-0.022	0.062|0.112	-0.053|-0.015	-0.022|0.023	-0.119|-0.025	-0.013|0.219	-0.062|0.020
Robust p-value	0.034	0.481	0.000	0.106	0.017	0.004	0.000	0.001	0.945	0.002	0.081	0.323
BW estimate (h)	3.811|3.811	2.418|2.418	4.875|4.875	3.411|3.411	2.573|2.573	3.494|3.494	2.439|2.439	2.945|2.945	2.348|2.348	2.913|2.913	3.045|3.045	3.493|3.493
BW bias (b)	5.857|5.857	5.686|5.686	6.531|6.531	6.528|6.528	5.634|5.634	6.176|6.176	5.516|5.516	5.674|5.674	5.988|5.988	5.767|5.767	6.886|6.886	6.463|6.463
Observations	93583|714	93583|714	93583|714	93583|714	93583|714	93583|714	93583|714	93583|714	93583|714	93583|714	93583|714	93583|714
Effective observations	1325|571	740|488	2431|631	1325|571	740|488	1325|571	740|488	740|488	740|488	740|488	1325|571	1325|571
BW selection	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular

Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: N=4,881,291.

Table B8: Local Linear RD Estimates Excluding Sales On or After April 2018

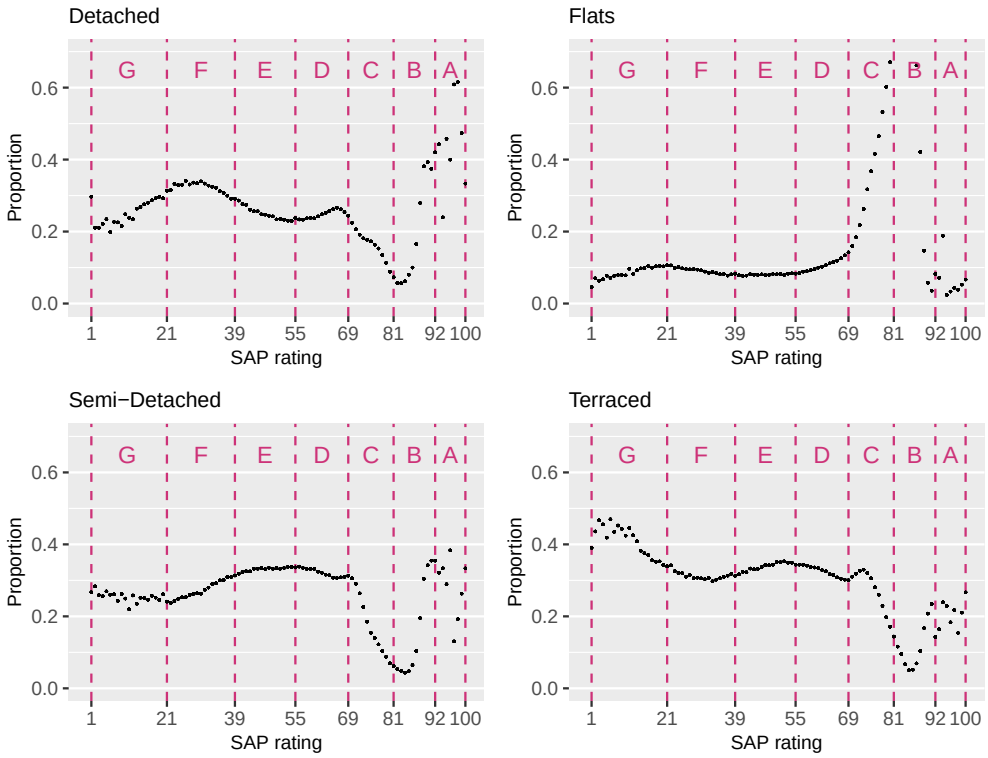
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
F [SAP 21] τ	0.037***	0.034***	0.037***	0.030***	0.031***	0.036***	0.025**
	(0.002)	(0.003)	(0.002)	(0.002)	(0.010)	(0.002)	(0.009)
Robust 95% CI	0.032|0.050	0.026|0.052	0.031|0.051	0.024|0.038	0.016|0.056	0.031|0.048	0.010|0.047
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.002
BW estimate (h)	3.499|3.499	3.063|3.063	3.531|4.396	6.129|6.129	5.753|5.753	3.444|3.444	5.682|5.682
BW bias (b)	8.008|8.008	7.483|7.483	7.553|8.639	12.722|12.722	9.051|9.051	8.005|8.005	8.810|8.810
Observations	50,165|198,495	50,165|198,495	50,165|198,495	50,165|198,495	50,165|198,495	50,165|198,495	50,165|198,495
Effective observations	10,469|20,150	10,469|20,150	10,469|26,401	19,210|40,731	16,546|33,176	10,469|20,150	16,546|33,176
E [SAP 39] τ	0.019***	0.020***	0.020***	0.018***	0.013***	0.019***	0.010***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.001)	(0.003)	(0.001)
Robust 95% CI	0.015|0.027	0.013|0.028	0.015|0.027	0.013|0.028	0.013|0.020	0.014|0.026	0.009|0.017
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	4.921|4.921	3.748|3.748	4.670|4.189	3.970|3.970	3.632|3.632	4.922|4.922	3.329|3.329
BW bias (b)	6.273|6.273	5.342|5.342	6.286|5.353	5.914|5.914	5.876|5.876	6.358|6.358	5.351|5.351
Observations	198,495|807,968	198,495|807,968	198,495|807,968	198,495|807,968	198,495|807,968	198,495|807,968	198,495|807,968
Effective observations	77,126|152,149	60,623|116,291	77,126|152,149	60,623|116,291	60,623|116,291	77,126|152,149	60,623|116,291
D [SAP 55] τ	0.016***	0.014***	0.015***	0.015***	0.014***	0.015***	0.012***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)
Robust 95% CI	0.013|0.022	0.010|0.023	0.014|0.022	0.014|0.021	0.014|0.018	0.013|0.022	0.012|0.017
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	4.303|4.303	3.033|3.033	4.085|4.371	3.995|3.995	3.925|3.925	4.215|4.215	3.725|3.725
BW bias (b)	6.054|6.054	5.131|5.131	7.240|5.310	5.533|5.533	5.574|5.574	6.014|6.014	5.475|5.475
Observations	807,968|1,874,238	807,968|1,874,238	807,968|1,874,238	807,968|1,874,238	807,968|1,874,238	807,968|1,874,238	807,968|1,874,238
Effective observations	308,082|548,194	241,655|425,139	308,082|548,194	241,655|425,139	241,655|425,139	308,082|548,194	241,655|425,139
C [SAP 69] τ	0.007***	0.007***	0.005***	0.008***	0.001**	0.007***	0.002**
	(0.001)	(0.002)	(0.002)	(0.000)	(0.000)	(0.001)	(0.000)
Robust 95% CI	0.008|0.016	0.007|0.017	0.006|0.014	0.007|0.014	0.002|0.008	0.008|0.016	0.001|0.007
Robust p-value	0.000	0.000	0.000	0.000	0.002	0.000	0.008
BW estimate (h)	3.715|3.715	3.376|3.376	4.181|5.142	3.380|3.380	3.710|3.710	3.748|3.748	3.646|3.646
BW bias (b)	5.274|5.274	5.452|5.452	7.072|5.142	5.784|5.784	5.181|5.181	5.282|5.282	5.232|5.232
Observations	1,874,238|903,600	1,874,238|903,600	1,874,238|903,600	1,874,238|903,600	1,874,238|903,600	1,874,238|903,600	1,874,238|903,600
Effective observations	468,540|496,590	468,540|496,590	622,001|648,866	468,540|496,590	468,540|496,590	468,540|496,590	468,540|496,590
B [SAP 81] τ	0.004	0.004	0.004	0.008***	-0.000	0.003	-0.000
	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)	(0.003)
Robust 95% CI	-0.002|0.002	-0.003|0.001	-0.002|0.002	0.004|0.013	-0.008|0.004	-0.002|0.001	-0.007|0.004
Robust p-value	0.831	0.561	0.978	0.000	0.559	0.712	0.570
BW estimate (h)	4.053|4.053	3.897|3.897	3.742|6.972	4.768|4.768	3.676|3.676	4.113|4.113	4.303|4.303
BW bias (b)	6.654|6.654	6.048|6.048	5.301|6.159	6.687|6.687	6.277|6.277	6.608|6.608	6.525|6.525
Observations	903,600|75,592	903,600|75,592	903,600|75,592	903,600|75,592	903,600|75,592	903,600|75,592	903,600|75,592
Effective observations	144,734|68,219	100,269|61,728	100,269|73,839	144,734|68,219	100,269|61,728	144,734|68,219	144,734|68,219
A [SAP 92] τ	0.068	0.052	0.053	0.010	0.066**	0.067	0.026
	(0.010)	(0.005)	(0.005)	(0.002)	(0.007)	(0.011)	(0.007)
Robust 95% CI	-0.029|0.138	-0.151|0.286	-0.031|0.084	-0.020|0.067	0.025|0.096	-0.027|0.139	-0.009|0.049
Robust p-value	0.202	0.543	0.369	0.295	0.001	0.186	0.184
BW estimate (h)	3.283|3.283	2.567|2.567	2.828|4.341	2.946|2.946	3.169|3.169	3.268|3.268	3.012|3.012
BW bias (b)	6.001|6.001	6.481|6.481	5.120|6.010	6.218|6.218	5.950|5.950	5.956|5.956	5.856|5.856
Observations	75,592|515	75,592|515	75,592|515	75,592|515	75,592|515	75,592|515	75,592|515
Effective observations	905|412	511|349	511|451	511|349	905|412	905|412	905|412
BW selection	MSE-Optimal	MSE-Optimal	Two MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Uniform	Triangular	Triangular	Triangular	Triangular	Triangular
Property Characteristics				Yes			Yes
Area FE					Yes		Yes
Date FE						Yes	Yes

Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: N= 3,910,573.

B.2.3 Property Type

Figure B4: Property Type Proportion – SAP Rating



Notes: This figure plots average price per meter (log) bins for each SAP rating unit. N=4,881,291.

Table B9: Local Linear RD Estimates for Property Covariate Proportions

	Detached	Flat	Semi-Detached	Terraced	Leasehold
F [SAP 21] τ	0.017***	0.002*	-0.021**	0.003	-0.005***
	(0.004)	(0.002)	(0.007)	(0.004)	(0.001)
Robust 95% CI	0.016|0.028	0.000|0.007	-0.039|-0.008	-0.008|0.012	-0.011|-0.003
Robust p-value	0.000	0.025	0.003	0.692	0.000
BW estimate (h)	5.714|5.714	4.993|4.993	5.725|5.725	4.257|4.257	4.123|4.123
BW bias (b)	6.937|6.937	10.116|10.116	8.514|8.514	5.894|5.894	7.550|7.550
Observations	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167
Effective observations	20202|40545	16634|32253	20202|40545	16634|32253	16634|32253
E [SAP 39] τ	0.008***	0.001	0.001	-0.009***	0.000
	(0.001)	(0.002)	(0.002)	(0.001)	(0.003)
Robust 95% CI	0.007|0.013	-0.005|0.004	-0.003|0.007	-0.012|-0.009	-0.010|0.005
Robust p-value	0.000	0.791	0.482	0.000	0.473
BW estimate (h)	4.359|4.359	4.281|4.281	4.624|4.624	5.068|5.068	4.274|4.274
BW bias (b)	8.614|8.614	5.994|5.994	6.765|6.765	6.393|6.393	6.101|6.101
Observations	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784
Effective observations	92187|185700	92187|185700	92187|185700	110618|233133	92187|185700
D [SAP 55] τ	0.007***	-0.002	-0.002	-0.004	-0.000
	(0.002)	(0.001)	(0.002)	(0.001)	(0.000)
Robust 95% CI	0.004|0.010	-0.005|0.000	-0.006|0.001	-0.005|0.001	-0.005|0.005
Robust p-value	0.000	0.051	0.210	0.269	0.974
BW estimate (h)	5.776|5.776	4.953|4.953	4.381|4.381	4.707|4.707	3.012|3.012
BW bias (b)	7.008|7.008	8.720|8.720	6.006|6.006	6.482|6.482	5.340|5.340
Observations	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103
Effective observations	454663|846571	379385|683250	379385|683250	379385|683250	297781|529425
C [SAP 69] τ	-0.004***	-0.006	0.005	0.004	-0.008***
	(0.001)	(0.008)	(0.003)	(0.002)	(0.008)
Robust 95% CI	0.002|0.007	-0.004|0.001	-0.004|0.000	-0.004|0.002	-0.005|-0.002
Robust p-value	0.000	0.254	0.067	0.575	0.000
BW estimate (h)	3.655|3.655	7.460|7.460	4.210|4.210	5.518|5.518	7.184|7.184
BW bias (b)	4.876|4.876	5.853|5.853	5.231|5.231	6.677|6.677	5.828|5.828
Observations	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132
Effective observations	593851|629750	1340670|959016	788324|734771	978811|821323	1340670|959016
B [SAP 81] τ	0.001***	-0.012***	0.006***	0.001	-0.006***
	(0.005)	(0.007)	(0.003)	(0.002)	(0.009)
Robust 95% CI	0.012|0.017	-0.040|-0.023	0.005|0.014	-0.003|0.009	-0.032|-0.018
Robust p-value	0.000	0.000	0.000	0.291	0.000
BW estimate (h)	4.591|4.591	4.980|4.980	7.352|7.352	5.630|5.630	5.362|5.362
BW bias (b)	6.784|6.784	6.133|6.133	7.269|7.269	5.392|5.392	6.073|6.073
Observations	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583
Effective observations	180116|84097	180116|84097	404361|92258	244541|88765	244541|88765
A [SAP 92] τ	0.075***	0.061	-0.016**	-0.142***	0.071
	(0.015)	(0.010)	(0.003)	(0.011)	(0.010)
Robust 95% CI	0.092|0.162	-0.072|0.006	0.005|0.033	-0.198|-0.117	-0.056|0.022
Robust p-value	0.000	0.093	0.009	0.000	0.389
BW estimate (h)	2.624|2.624	2.990|2.990	2.991|2.991	5.199|5.199	2.994|2.994
BW bias (b)	5.703|5.703	5.289|5.289	5.244|5.244	6.324|6.324	5.316|5.316
Observations	93583|714	93583|714	93583|714	93583|714	93583|714
Effective observations	740|488	740|488	740|488	4818|654	740|488

Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: N=4,881,291.

Table B10: Local Linear RD Estimates Excluding Detached Properties

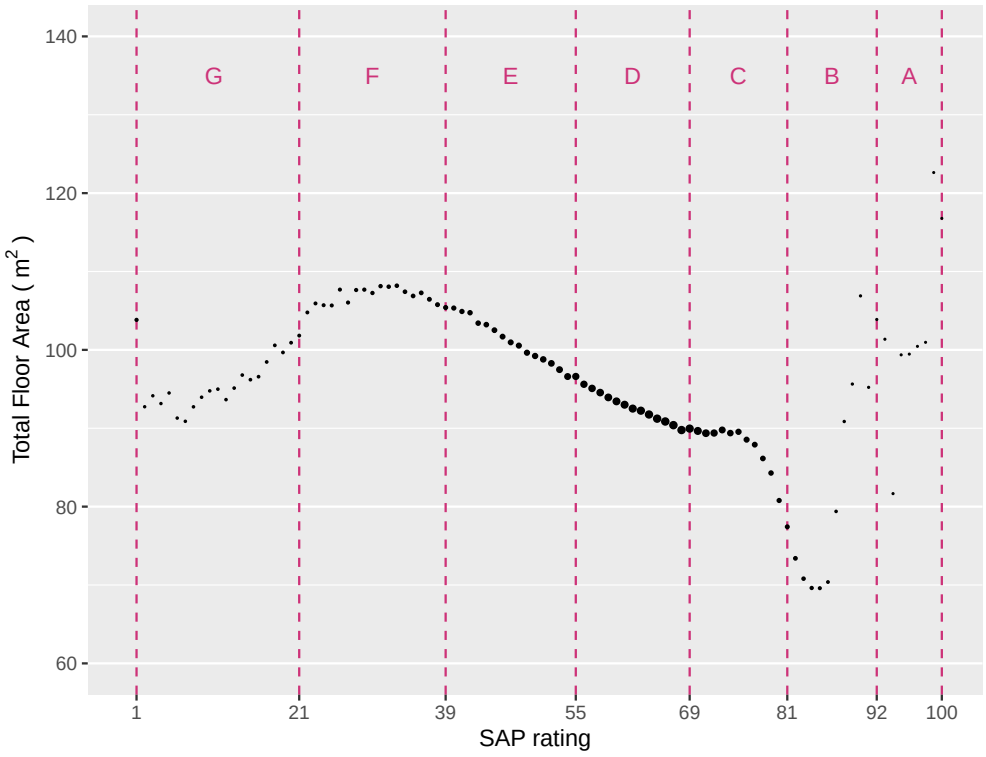
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
F [SAP 21] τ	0.022***	0.024***	0.025***	0.023**	0.014**	0.021***	0.016**
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.005)
Robust 95% CI	0.013|0.034	0.019|0.039	0.017|0.037	0.008|0.037	0.005|0.026	0.014|0.032	0.007|0.027
Robust p-value	0.000	0.000	0.000	0.002	0.003	0.000	0.001
BW estimate (h)	4.688|4.688	3.486|3.486	4.190|6.722	5.533|5.533	6.333|6.333	4.606|4.606	6.294|6.294
BW bias (b)	7.755|7.755	6.254|6.254	7.596|9.429	9.577|9.577	8.826|8.826	7.795|7.795	8.717|8.717
Observations	44655|162919	44655|162919	44655|162919	44655|162919	44655|162919	44655|162919	44655|162919
Effective observations	11772|21779	9055|16677	11772|33384	14342|27245	16730|33384	11772|21779	16730|33384
E [SAP 39] τ	0.019***	0.019**	0.019***	0.018**	0.017***	0.018**	0.013***
	(0.005)	(0.006)	(0.005)	(0.005)	(0.002)	(0.005)	(0.002)
Robust 95% CI	0.009|0.031	0.006|0.032	0.009|0.030	0.009|0.031	0.016|0.028	0.007|0.030	0.013|0.024
Robust p-value	0.000	0.005	0.000	0.001	0.000	0.001	0.000
BW estimate (h)	4.472|4.472	3.129|3.129	4.716|4.438	4.357|4.357	3.386|3.386	4.489|4.489	3.173|3.173
BW bias (b)	6.436|6.436	5.738|5.738	7.676|5.551	6.193|6.193	5.859|5.859	6.424|6.424	5.457|5.457
Observations	162919|746919	162919|746919	162919|746919	162919|746919	162919|746919	162919|746919	162919|746919
Effective observations	64358|134353	50693|101880	64358|134353	64358|134353	50693|101880	64358|134353	50693|101880
D [SAP 55] τ	0.019***	0.023***	0.018***	0.020***	0.015***	0.019***	0.015***
	(0.003)	(0.002)	(0.004)	(0.003)	(0.002)	(0.003)	(0.002)
Robust 95% CI	0.013|0.030	0.017|0.032	0.014|0.028	0.018|0.030	0.012|0.021	0.013|0.029	0.014|0.021
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	3.797|3.797	2.913|2.913	3.754|4.295	3.599|3.599	4.008|4.008	3.799|3.799	3.864|3.864
BW bias (b)	5.514|5.514	5.024|5.024	6.414|5.249	5.216|5.216	6.290|6.290	5.500|5.500	6.150|6.150
Observations	746919|1770856	746919|1770856	746919|1770856	746919|1770856	746919|1770856	746919|1770856	746919|1770856
Effective observations	229006|404895	158561|293918	229006|522065	229006|404895	291440|522065	229006|404895	229006|404895
C [SAP 69] τ	0.010***	0.010***	0.009***	0.010***	0.004**	0.010***	0.003**
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.000)
Robust 95% CI	0.008|0.018	0.007|0.020	0.008|0.018	0.008|0.018	0.002|0.008	0.008|0.018	0.002|0.008
Robust p-value	0.000	0.000	0.000	0.000	0.001	0.000	0.002
BW estimate (h)	3.851|3.851	3.185|3.185	3.512|4.638	3.579|3.579	3.862|3.862	3.862|3.862	3.373|3.373
BW bias (b)	5.509|5.509	5.585|5.585	5.671|5.069	5.596|5.596	5.552|5.552	5.516|5.516	5.129|5.129
Observations	1770856|920637	1770856|920637	1770856|920637	1770856|920637	1770856|920637	1770856|920637	1770856|920637
Effective observations	439041|491591	439041|491591	439041|577589	439041|491591	439041|491591	439041|491591	439041|491591
B [SAP 81] τ	0.004	0.005	0.003	0.008***	0.001	0.003	0.000
	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
Robust 95% CI	-0.002|0.006	-0.002|0.013	-0.002|0.004	0.004|0.014	-0.004|0.006	-0.002|0.005	-0.003|0.006
Robust p-value	0.267	0.170	0.592	0.000	0.780	0.454	0.584
BW estimate (h)	5.123|5.123	4.828|4.828	3.376|7.502	4.214|4.214	4.611|4.611	5.469|5.469	4.732|4.732
BW bias (b)	6.639|6.639	5.613|5.613	5.220|6.445	6.144|6.144	6.660|6.660	6.626|6.626	6.813|6.813
Observations	920637|86455	920637|86455	920637|86455	920637|86455	920637|86455	920637|86455	920637|86455
Effective observations	211199|82848	157311|78647	110267|85638	157311|78647	157311|78647	211199|82848	157311|78647
A [SAP 92] τ	0.104	0.024	0.092	0.005	0.083*	0.106	0.062
	(0.036)	(0.004)	(0.037)	(0.019)	(0.021)	(0.038)	(0.020)
Robust 95% CI	-0.056|0.296	-0.305|0.406	-0.066|0.179	-0.064|0.114	0.010|0.150	-0.051|0.298	-0.003|0.113
Robust p-value	0.180	0.781	0.366	0.578	0.024	0.164	0.062
BW estimate (h)	3.686|3.686	2.327|2.327	3.226|4.933	3.063|3.063	3.704|3.704	3.654|3.654	3.490|3.490
BW bias (b)	6.206|6.206	6.502|6.502	5.277|5.951	6.549|6.549	6.109|6.109	6.251|6.251	6.018|6.018
Observations	86455|421	86455|421	86455|421	86455|421	86455|421	86455|421	86455|421
Effective observations	817|346	455|301	817|382	817|346	817|346	817|346	817|346
BW selection	MSE-Optimal	MSE-Optimal	Two MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Uniform	Triangular	Triangular	Triangular	Triangular	Triangular
Property FE				Yes			Yes
Area FE					Yes		Yes
Date FE						Yes	Yes

Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: N= 3,732,862.

B.2.4 Total Floor Area

Figure B5: Total Floor Area (m^2) – SAP Rating



Notes: This figure plots average total floor area (m^2) bins for each SAP rating unit. N=4,881,291.

Table B11: Local Linear RD Estimates for Total Floor Area

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
F [SAP 21] τ	1.304	1.947*	1.270	0.568	1.068	1.293	0.543
	(0.849)	(1.009)	(0.834)	(0.899)	(0.855)	(0.852)	(0.874)
Robust 95% CI	-0.375|3.004	0.185|5.371	-0.283|2.318	-1.461|2.207	-0.689|2.712	-0.400|3.016	-1.420|2.164
Robust p-value	0.127	0.036	0.125	0.690	0.244	0.133	0.684
BW estimate (h)	5.156|5.156	3.217|3.217	5.081|4.741	5.314|5.314	5.047|5.047	5.147|5.147	5.341|5.341
BW bias (b)	7.731|7.731	5.980|5.980	9.359|6.353	8.196|8.196	7.704|7.704	7.724|7.724	8.227|8.227
Observations	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167	60808|239167
Effective observations	20202|40545	12824|24642	20202|32253	20202|40545	20202|40545	20202|40545	20202|40545
E [SAP 39] τ	0.235	0.464	0.211	-0.085	-0.015	0.259	-0.174
	(0.256)	(0.080)	(0.242)	(0.138)	(0.260)	(0.255)	(0.133)
Robust 95% CI	-0.258|1.010	-0.006|1.525	-0.270|0.836	-0.407|0.334	-0.375|0.650	-0.239|1.036	-0.484|0.246
Robust p-value	0.245	0.052	0.316	0.847	0.599	0.220	0.524
BW estimate (h)	5.177|5.177	3.805|3.805	4.922|4.293	6.156|6.156	6.357|6.357	5.161|5.161	6.158|6.158
BW bias (b)	7.329|7.329	5.469|5.469	8.784|5.970	10.017|10.017	9.797|9.797	7.344|7.344	9.901|9.901
Observations	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784	239167|990784
Effective observations	110618|233133	72323|141765	92187|185700	127152|285192	127152|285192	110618|233133	127152|285192
D [SAP 55] τ	0.783***	0.809***	0.728***	0.451***	0.738***	0.787***	0.428***
	(0.096)	(0.099)	(0.129)	(0.097)	(0.085)	(0.096)	(0.086)
Robust 95% CI	0.903|1.184	0.806|1.215	0.858|1.193	0.602|0.844	0.807|1.167	0.909|1.191	0.627|0.820
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	3.350|3.350	2.635|2.635	3.476|4.916	3.413|3.413	3.281|3.281	3.342|3.342	3.349|3.349
BW bias (b)	4.913|4.913	4.880|4.880	5.053|5.689	4.897|4.897	4.968|4.968	4.915|4.915	4.958|4.958
Observations	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103	990784|2357103
Effective observations	297781|529425	205917|384020	297781|683250	297781|529425	297781|529425	297781|529425	297781|529425
C [SAP 69] τ	0.752***	0.439***	0.721***	0.886***	0.818***	0.747***	0.856***
	(0.038)	(0.164)	(0.047)	(0.143)	(0.055)	(0.036)	(0.155)
Robust 95% CI	0.770|0.978	0.394|0.862	0.757|0.958	0.501|0.715	0.795|1.118	0.768|0.969	0.461|0.695
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	3.203|3.203	4.400|4.400	3.434|3.929	5.110|5.110	3.167|3.167	3.201|3.201	5.254|5.254
BW bias (b)	5.475|5.475	5.053|5.053	5.655|5.640	6.331|6.331	5.510|5.510	5.461|5.461	6.219|6.219
Observations	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132	2357103|1139132
Effective observations	593851|629750	788324|734771	593851|629750	978811|821323	593851|629750	593851|629750	978811|821323
B [SAP 81] τ	-1.615	-2.629	-1.911	-1.885**	-1.648	-1.646	-1.930**
	(0.727)	(1.113)	(1.099)	(0.390)	(0.705)	(0.728)	(0.372)
Robust 95% CI	-0.479|0.930	-1.043|1.175	-0.217|1.219	-2.567|-0.581	-0.782|0.750	-0.512|0.883	-2.529|-0.649
Robust p-value	0.530	0.907	0.172	0.002	0.967	0.602	0.001
BW estimate (h)	4.425|4.425	4.198|4.198	3.717|7.389	3.930|3.930	4.483|4.483	4.427|4.427	3.903|3.903
BW bias (b)	6.825|6.825	6.126|6.126	5.204|5.686	6.401|6.401	6.804|6.804	6.863|6.863	6.348|6.348
Observations	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583	1139132|93583
Effective observations	180116|84097	180116|84097	124580|92258	124580|76039	180116|84097	180116|84097	124580|76039
A [SAP 92] τ	21.220**	22.124*	19.463**	11.141*	20.148**	21.149**	9.125*
	(1.137)	(2.260)	(1.249)	(5.417)	(1.010)	(1.084)	(5.133)
Robust 95% CI	8.193|45.984	6.016|48.762	8.579|45.720	1.754|27.096	7.932|44.044	7.539|45.851	0.152|23.015
Robust p-value	0.005	0.012	0.004	0.026	0.005	0.006	0.047
BW estimate (h)	2.680|2.680	2.601|2.601	2.502|5.153	3.211|3.211	2.679|2.679	2.672|2.672	3.369|3.369
BW bias (b)	5.686|5.686	5.752|5.752	5.293|5.799	6.180|6.180	5.623|5.623	5.725|5.725	6.294|6.294
Observations	93583|714	93583|714	93583|714	93583|714	93583|714	93583|714	93583|714
Effective observations	740|488	740|488	740|654	1325|571	740|488	740|488	1325|571
BW selection	MSE-Optimal	MSE-Optimal	Two MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Uniform	Triangular	Triangular	Triangular	Triangular	Triangular
Property FE				Yes			Yes
Area FE					Yes		Yes
Date FE						Yes	Yes

Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: N=4,881,291.

B.3 EE Rating Band Increases Before a Sale

Table B12: Local Linear RD Estimates for Price Discontinuities Including Properties with Rating Band Increases

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
F [SAP 21] τ	0.024***	0.026***	0.024***	0.019***	0.020**	0.023***	0.017**
	(0.000)	(0.001)	(0.000)	(0.002)	(0.009)	(0.001)	(0.008)
Robust 95% CI	0.020|0.034	0.020|0.034	0.021|0.031	0.014|0.024	0.006|0.041	0.019|0.033	0.005|0.036
Robust p-value	0.000	0.000	0.000	0.000	0.010	0.000	0.008
BW estimate (h)	3.704|3.704	4.454|4.454	3.769|3.977	5.269|5.269	5.709|5.709	3.725|3.725	5.427|5.427
BW bias (b)	6.871|6.871	7.073|7.073	7.403|7.590	8.589|8.589	7.535|7.535	6.747|6.747	7.777|7.777
Observations	60808|240746	60808|240746	60808|240746	60808|240746	60808|240746	60808|240746	60808|240746
Effective observations	12824|25014	16634|32719	12824|25014	20202|41088	20202|41088	12824|25014	20202|41088
E [SAP 39] τ	0.017***	0.017***	0.017***	0.014***	0.015***	0.014***	0.008***
	(0.004)	(0.005)	(0.004)	(0.004)	(0.002)	(0.004)	(0.001)
Robust 95% CI	0.010|0.028	0.007|0.028	0.010|0.027	0.007|0.027	0.013|0.023	0.007|0.024	0.007|0.015
Robust p-value	0.000	0.001	0.000	0.001	0.000	0.000	0.000
BW estimate (h)	4.535|4.535	3.434|3.434	4.516|4.596	3.841|3.841	3.968|3.968	4.653|4.653	3.525|3.525
BW bias (b)	6.370|6.370	5.619|5.619	6.629|5.926	6.016|6.016	6.187|6.187	6.467|6.467	5.753|5.753
Observations	240746|1002156	240746|1002156	240746|1002156	240746|1002156	240746|1002156	240746|1002156	240746|1002156
Effective observations	92488|189285	72551|144673	92488|189285	72551|144673	72551|144673	92488|189285	72551|144673
D [SAP 55] τ	0.012***	0.014***	0.011***	0.011***	0.011***	0.011***	0.009***
	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)
Robust 95% CI	0.008|0.019	0.011|0.021	0.009|0.018	0.010|0.018	0.011|0.016	0.008|0.019	0.009|0.013
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	3.913|3.913	2.905|2.905	3.922|4.295	3.698|3.698	3.935|3.935	3.883|3.883	3.564|3.564
BW bias (b)	5.661|5.661	5.174|5.174	7.069|5.303	5.391|5.391	6.043|6.043	5.636|5.636	5.508|5.508
Observations	1002156|2411210	1002156|2411210	1002156|2411210	1002156|2411210	1002156|2411210	1002156|2411210	1002156|2411210
Effective observations	300081|546924	207462|397112	300081|705010	300081|546924	300081|546924	300081|546924	300081|546924
C [SAP 69] τ	0.005***	0.005***	0.004***	0.006***	0.001***	0.004***	0.000*
	(0.001)	(0.001)	(0.002)	(0.001)	(0.000)	(0.001)	(0.000)
Robust 95% CI	0.005|0.012	0.004|0.014	0.004|0.012	0.004|0.011	0.003|0.008	0.003|0.011	0.000|0.005
Robust p-value	0.000	0.001	0.000	0.000	0.000	0.000	0.022
BW estimate (h)	3.858|3.858	3.434|3.434	3.659|5.089	3.787|3.787	3.651|3.651	3.912|3.912	3.526|3.526
BW bias (b)	5.533|5.533	5.622|5.622	5.858|5.156	6.071|6.071	5.275|5.275	5.545|5.545	5.176|5.176
Observations	2411210|1185556	2411210|1185556	2411210|1185556	2411210|1185556	2411210|1185556	2411210|1185556	2411210|1185556
Effective observations	602818|662430	602818|662430	602818|861361	602818|662430	602818|662430	602818|662430	602818|662430
B [SAP 81] τ	0.000*	0.002	-0.001***	0.002	-0.001	-0.001**	-0.001
	(0.003)	(0.003)	(0.003)	(0.001)	(0.002)	(0.003)	(0.002)
Robust 95% CI	-0.009|-0.001	-0.011|0.002	-0.010|-0.002	-0.004|0.006	-0.007|0.004	-0.009|-0.002	-0.007|0.003
Robust p-value	0.016	0.189	0.001	0.700	0.578	0.005	0.457
BW estimate (h)	4.377|4.377	4.219|4.219	3.430|7.391	3.934|3.934	3.873|3.873	4.467|4.467	4.501|4.501
BW bias (b)	6.880|6.880	6.091|6.091	5.200|6.126	6.209|6.209	6.348|6.348	6.877|6.877	6.443|6.443
Observations	1185556|98920	1185556|98920	1185556|98920	1185556|98920	1185556|98920	1185556|98920	1185556|98920
Effective observations	182935|88396	182935|88396	126386|97273	126386|79904	126386|79904	182935|88396	182935|88396
A [SAP 92] τ	0.037	0.020	0.038	-0.007	0.034**	0.036	0.001
	(0.009)	(0.002)	(0.010)	(0.003)	(0.008)	(0.009)	(0.006)
Robust 95% CI	-0.029|0.064	-0.144|0.210	-0.027|0.053	-0.020|0.044	0.008|0.058	-0.027|0.065	-0.026|0.021
Robust p-value	0.453	0.717	0.516	0.461	0.010	0.425	0.847
BW estimate (h)	3.560|3.560	2.770|2.770	3.435|4.450	3.114|3.114	3.773|3.773	3.512|3.512	3.140|3.140
BW bias (b)	5.938|5.938	6.606|6.606	5.397|6.017	6.593|6.593	5.899|5.899	5.896|5.896	5.718|5.718
Observations	98920|967	98920|967	98920|967	98920|967	98920|967	98920|967	98920|967
Effective observations	1647|773	900|664	1647|855	1647|773	1647|773	1647|773	1647|773
BW selection	MSE-Optimal	MSE-Optimal	Two MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Uniform	Triangular	Triangular	Triangular	Triangular	Triangular
Property FE				Yes			Yes
Area FE					Yes		Yes
Date FE						Yes	Yes

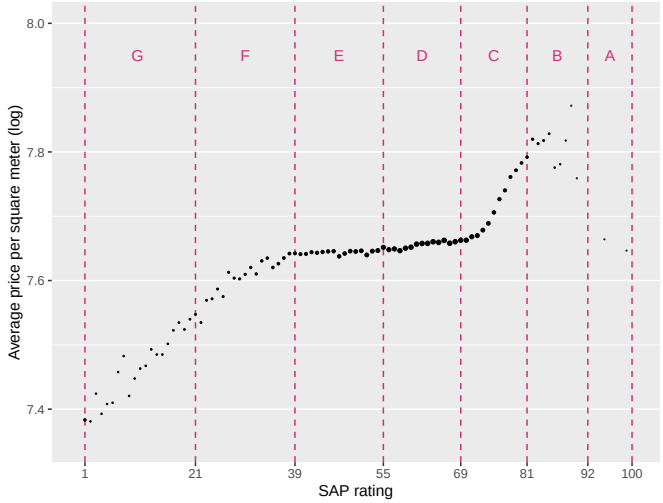
Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: N=5,000,363.

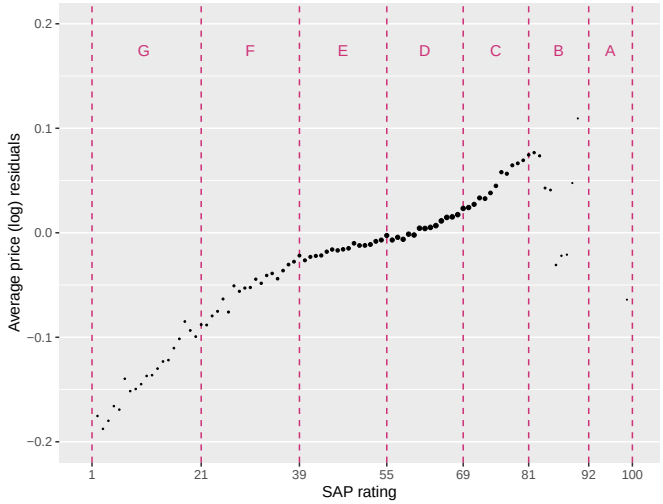
B.4 Counter Factual Scenario

Figure B6: Price Per Square Meter (Log) – SAP Rating Sale Transactions Before April 2012

Panel A. Price per Meter Log – SAP Rating for Existing Properties



Panel B. Price Residuals – SAP Rating for Existing Properties



Notes: This figure plots average price per square meter (log) bins for each SAP rating unit for sales between October 2008 and March 2012. N=1,406,436.

Table B13: Local Linear RD Estimates for Sale Transactions Before April 2012

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
F [SAP 21] τ	-0.003	-0.002	-0.003	-0.005	0.019***	-0.003	0.019***
	(0.009)	(0.011)	(0.010)	(0.008)	(0.005)	(0.009)	(0.003)
Robust 95% CI	-0.022|0.020	-0.021|0.025	-0.025|0.025	-0.023|0.016	0.023|0.040	-0.023|0.021	0.019|0.042
Robust p-value	0.933	0.874	0.981	0.728	0.000	0.946	0.000
BW estimate (h)	5.967|5.967	4.258|4.258	3.858|7.221	5.521|5.521	4.098|4.098	6.071|6.071	3.822|3.822
BW bias (b)	8.790|8.790	7.921|7.921	7.112|10.624	8.615|8.615	6.309|6.309	8.913|8.913	6.161|6.161
Observations	34001|110010	34001|110010	34001|110010	34001|110010	34001|110010	34001|110010	34001|110010
Effective observations	10016|19894	8272|15878	6385|29132	10016|19894	8272|15878	11593|24262	6385|12197
E [SAP 39] τ	-0.008***	-0.007***	-0.008***	-0.009***	0.001	-0.008***	0.000
	(0.001)	(0.000)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Robust 95% CI	-0.016|-0.009	-0.017|-0.005	-0.017|-0.008	-0.021|-0.013	-0.008|0.007	-0.017|-0.008	-0.007|0.001
Robust p-value	0.000	0.000	0.000	0.000	0.912	0.000	0.163
BW estimate (h)	3.399|3.399	2.698|2.698	3.434|5.217	3.366|3.366	3.718|3.718	3.428|3.428	4.358|4.358
BW bias (b)	7.091|7.091	6.957|6.957	7.257|9.346	6.307|6.307	6.104|6.104	7.124|7.124	6.453|6.453
Observations	110010|354610	110010|354610	110010|354610	110010|354610	110010|354610	110010|354610	110010|354610
Effective observations	32057|58996	22279|42482	32057|95875	32057|58996	32057|58996	32057|58996	40965|76770
D [SAP 55] τ	0.002	0.003	0.003	0.000	0.004	0.002	0.002
	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Robust 95% CI	-0.006|0.006	-0.010|0.010	-0.001|0.008	-0.008|0.007	-0.003|0.008	-0.005|0.006	-0.004|0.008
Robust p-value	0.984	0.999	0.156	0.877	0.404	0.924	0.490
BW estimate (h)	4.277|4.277	2.350|2.350	4.979|4.701	4.022|4.022	3.952|3.952	4.238|4.238	3.989|3.989
BW bias (b)	6.405|6.405	4.935|4.935	9.647|5.316	6.251|6.251	5.824|5.824	6.328|6.328	6.108|6.108
Observations	354610|586607	354610|586607	354610|586607	354610|586607	354610|586607	354610|586607	354610|586607
Effective observations	119739|189073	63108|108714	119739|189073	119739|189073	92313|148333	119739|189073	92313|148333
C [SAP 69] τ	0.002	0.001	-0.003	0.002	0.001	0.002	0.003***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)
Robust 95% CI	-0.002|0.008	-0.001|0.008	-0.007|0.006	-0.004|0.006	-0.000|0.006	-0.002|0.008	0.002|0.006
Robust p-value	0.298	0.161	0.800	0.595	0.068	0.303	0.001
BW estimate (h)	4.884|4.884	4.745|4.745	2.855|6.721	3.873|3.873	4.156|4.156	4.945|4.945	4.049|4.049
BW bias (b)	5.560|5.560	5.774|5.774	5.220|5.328	5.658|5.658	6.202|6.202	5.575|5.575	6.374|6.374
Observations	586607|294660	586607|294660	586607|294660	586607|294660	586607|294660	586607|294660	586607|294660
Effective observations	178687|176281	178687|176281	87447|223561	133002|147832	178687|176281	178687|176281	178687|176281
B [SAP 81] τ	-0.001	0.002	0.006	-0.006	0.004**	-0.001	0.005*
	(0.008)	(0.010)	(0.008)	(0.005)	(0.008)	(0.008)	(0.008)
Robust 95% CI	-0.005|0.008	-0.006|0.010	-0.004|0.009	-0.009|0.005	0.002|0.013	-0.005|0.008	0.000|0.011
Robust p-value	0.602	0.599	0.399	0.580	0.006	0.714	0.042
BW estimate (h)	6.455|6.455	5.626|5.626	2.734|6.993	5.001|5.001	6.541|6.541	6.515|6.515	7.290|7.290
BW bias (b)	6.763|6.763	6.184|6.184	5.060|6.089	5.975|5.975	6.520|6.520	6.755|6.755	6.391|6.391
Observations	294660|26526	294660|26526	294660|26526	294660|26526	294660|26526	294660|26526	294660|26526
Effective observations	93105|26303	71099|25837	21768|26303	71099|25837	93105|26303	93105|26303	118379|26475
BW selection	MSE-Optimal	MSE-Optimal	Two MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Uniform	Triangular	Triangular	Triangular	Triangular	Triangular
Property FE				Yes			Yes
Area FE					Yes		Yes
Date FE						Yes	Yes

Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: N=1,406,436. The results for the threshold B-A are not included as there is only 22 properties with rating band A.

Appendix C Seller Investment Behaviour Robustness Analysis Results

C.1 Empirical Specification

Table C1: Local Linear RD Estimates with Different Bandwidths

	BW = 2		BW = 3		BW = 4		BW = 5	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
F [SAP 21] τ	0.012***	0.013***	0.011***	0.012***	0.001***	0.001***	-0.001	0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.005)	(0.005)	(0.005)	(0.005)
Robust 95% CI	0.006|0.006	0.006|0.006	0.030|0.030	0.031|0.031	0.029|0.031	0.030|0.032	-0.008|0.025	-0.009|0.026
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.323	0.323
BW estimate (h)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
BW bias (b)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
Observations	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881
Effective observations	7,779|15,863	7,779|15,863	11,334|21,889	11,334|21,889	14,758|28,710	14,758|28,710	17,942|36,069	17,942|36,069
E [SAP 39] τ	-0.009***	-0.009***	-0.009***	-0.009***	-0.008***	-0.008***	-0.008***	-0.008***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Robust 95% CI	-0.008|-0.008	-0.008|-0.008	-0.012|-0.012	-0.012|-0.012	-0.012|-0.011	-0.012|-0.011	-0.011|-0.005	-0.011|-0.005
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
BW bias (b)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
Observations	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082
Effective observations	45,126|89,316	45,126|89,316	64,682|124,591	64,682|124,591	82,257|162,878	82,257|162,878	98,713|204,104	98,713|204,104
D [SAP 55] τ	-0.005***	-0.005***	-0.005***	-0.005***	-0.003***	-0.003***	-0.003***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Robust 95% CI	-0.005|-0.005	-0.005|-0.005	-0.008|-0.008	-0.008|-0.008	-0.008|-0.007	-0.008|-0.007	-0.007|-0.004	-0.007|-0.004
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
BW bias (b)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
Observations	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099
Effective observations	172,065|322,499	172,065|322,499	249,402|442,979	249,402|442,979	318,459|569,763	318,459|569,763	382,441|703,551	382,441|703,551
C [SAP 69] τ	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Robust 95% CI	-0.002|-0.002	-0.002|-0.002	-0.001|-0.001	-0.001|-0.001	-0.001|-0.001	-0.001|-0.001	-0.001|0.000	-0.001|0.000
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.061	0.057
BW estimate (h)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
BW bias (b)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
Observations	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395
Effective observations	307,644|402,117	307,644|402,117	463,988|501,905	463,988|501,905	617,403|585,021	617,403|585,021	768,864|653,892	768,864|653,892
B [SAP 81] τ	0.001***	0.001***	0.002***	0.002***	0.000***	0.000***	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Robust 95% CI	0.000|0.000	0.000|0.000	0.004|0.004	0.004|0.004	0.004|0.004	0.004|0.004	-0.001|0.004	-0.001|0.004
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.174	0.158
BW estimate (h)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
BW bias (b)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
Observations	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629
Effective observations	59,917|52,496	59,917|52,496	99,068|62,095	99,068|62,095	143,176|68,490	143,176|68,490	194,278|72,136	194,278|72,136
A [SAP 92] τ	-0.032***	-0.029***	-0.031***	-0.025***	-0.028***	-0.021***	-0.027***	-0.020***
	(0.000)	(0.000)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Robust 95% CI	-0.026|-0.026	-0.024|-0.024	-0.038|-0.038	-0.033|-0.033	-0.039|-0.036	-0.034|-0.030	-0.036|-0.025	-0.030|-0.017
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
BW bias (b)	2.000|2.000	2.000|2.000	3.000|3.000	3.000|3.000	4.000|4.000	4.000|4.000	5.000|5.000	5.000|5.000
Observations	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515
Effective observations	487|349	487|349	864|413	864|413	1,677|452	1,677|452	3,493|468	3,493|468
BW selection	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular
Property FE		Yes		Yes		Yes		Yes
Area FE		Yes		Yes		Yes		Yes
Date FE		Yes		Yes		Yes		Yes

Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: N= 3,999,153.

Table C2: Local Linear RD Estimates for Falsification Tests

	TH -3		TH -2		TH -1		TH +1		TH +2		TH +3	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
F [SAP 21] τ	-0.010*	-0.012*	0.009*	0.009*	-0.006	-0.006	-0.010**	-0.009***	0.001	0.001	0.015***	0.015***
	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Robust 95% CI	-0.026|-0.001	-0.030|-0.003	0.001|0.021	0.001|0.021	-0.022|0.003	-0.022|0.003	-0.018|-0.004	-0.017|-0.004	-0.004|0.012	-0.005|0.012	0.012|0.026	0.012|0.025
Robust p-value	0.037	0.017	0.025	0.032	0.122	0.145	0.002	0.001	0.352	0.418	0.000	0.000
BW estimate (h)	3.305|3.305	3.208|3.208	4.159|4.159	4.338|4.338	4.404|4.404	4.363|4.363	5.584|5.584	6.500|6.500	4.742|4.742	4.691|4.691	4.192|4.192	4.215|4.215
BW bias (b)	6.021|6.021	5.868|5.868	7.198|7.198	7.383|7.383	6.595|6.595	6.711|6.711	9.784|9.784	11.668|11.668	6.769|6.769	6.731|6.731	6.984|6.984	6.766|6.766
Observations	44,218|224,215	44,218|224,215	47,773|220,660	47,773|220,660	51,571|216,862	51,571|216,862	60,454|207,979	60,454|207,979	65,687|202,746	65,687|202,746	71,415|197,018	71,415|197,018
Effective observations	9,529|16,236	9,529|16,236	13,084|23,642	13,084|23,642	13,961|25,870	13,961|25,870	19,660|39,304	22,844|48,335	17,914|34,071	17,914|34,071	19,844|37,374	19,844|37,374
E [SAP 39] τ	0.003**	0.003***	-0.001	-0.001	-0.003	-0.003	0.002*	0.002**	0.004	0.004	-0.002*	-0.002*
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Robust 95% CI	0.001|0.004	0.001|0.004	-0.005|0.002	-0.005|0.002	-0.008|0.001	-0.008|0.001	0.002|0.012	0.002|0.012	0.000|0.011	0.000|0.011	-0.006|0.000	-0.006|0.000
Robust p-value	0.009	0.001	0.289	0.317	0.168	0.166	0.011	0.010	0.054	0.067	0.027	0.030
BW estimate (h)	4.765|4.765	4.186|4.186	6.085|6.085	6.198|6.198	7.720|7.720	7.658|7.658	3.389|3.389	3.424|3.424	3.613|3.613	3.568|3.568	2.839|2.839	2.873|2.873
BW bias (b)	7.466|7.466	6.858|6.858	7.480|7.480	7.804|7.804	10.196|10.196	10.050|10.050	5.183|5.183	5.198|5.198	5.332|5.332	5.289|5.289	5.615|5.615	5.652|5.652
Observations	148,199|911,764	148,199|911,764	167,755|892,208	167,755|892,208	189,563|870,400	189,563|870,400	239,966|819,997	239,966|819,997	269,722|790,241	269,722|790,241	302,197|757,766	302,197|757,766
Effective observations	62,097|121,523	62,097|121,523	93,839|208,004	93,839|208,004	115,647|272,521	115,647|272,521	72,211|135,793	72,211|135,793	80,159|147,263	80,159|147,263	62,231|114,788	62,231|114,788
D [SAP 55] τ	-0.001	-0.001	-0.001	-0.001	0.001	0.001	0.002*	0.002*	0.000	0.000	0.001	0.001
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Robust 95% CI	-0.003|0.000	-0.002|0.000	-0.002|0.002	-0.002|0.002	-0.001|0.004	-0.001|0.004	0.001|0.005	0.001|0.005	-0.004|0.003	-0.003|0.003	-0.002|0.002	-0.002|0.003
Robust p-value	0.173	0.159	0.840	0.789	0.222	0.223	0.010	0.016	0.816	0.875	0.745	0.684
BW estimate (h)	4.146|4.146	4.612|4.612	3.734|3.734	3.738|3.738	5.020|5.020	4.987|4.987	4.600|4.600	4.988|4.988	3.710|3.710	3.957|3.957	2.766|2.766	2.803|2.803
BW bias (b)	6.880|6.880	7.383|7.383	5.441|5.441	5.476|5.476	8.429|8.429	8.353|8.353	7.208|7.208	7.893|7.893	6.937|6.937	7.105|7.105	5.896|5.896	5.881|5.881
Observations	597,680|2,150,501	597,680|2,150,501	675,017|2,073,164	675,017|2,073,164	758,600|1,989,581	758,600|1,989,581	949,405|1,798,776	949,405|1,798,776	1,055,995|1,692,186	1,055,995|1,692,186	1,169,581|1,578,600	1,169,581|1,578,600
Effective observations	248,485|458,315	248,485|458,315	210,376|380,978	210,376|380,978	353,414|658,245	293,959|531,461	351,725|601,228	351,725|601,228	297,395|494,638	297,395|494,638	220,176|381,052	220,176|381,052
C [SAP 69] τ	0.000	0.000	0.000	0.000	0.000	0.000	0.002***	0.001***	0.002*	0.001*	0.000*	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Robust 95% CI	-0.001|0.001	-0.001|0.001	-0.001|0.001	-0.001|0.001	0.000|0.001	0.000|0.001	0.001|0.003	0.001|0.002	0.000|0.002	0.000|0.002	-0.002|0.000	-0.002|0.000
Robust p-value	0.678	0.627	0.604	0.844	0.439	0.496	0.000	0.000	0.046	0.029	0.029	0.022
BW estimate (h)	4.563|4.563	4.336|4.336	3.945|3.945	3.978|3.978	4.636|4.636	4.388|4.388	3.872|3.872	3.850|3.850	4.212|4.212	4.325|4.325	3.813|3.813	3.807|3.807
BW bias (b)	6.198|6.198	6.227|6.227	5.695|5.695	6.284|6.284	5.926|5.926	6.038|6.038	5.575|5.575	5.729|5.729	6.372|6.372	6.832|6.832	6.350|6.350	6.626|6.626
Observations	1,437,111|1,370,383	1,437,111|1,370,383	1,593,455|1,214,039	1,593,455|1,214,039	1,749,597|1,057,897	1,749,597|1,057,897	2,050,042|757,452	2,050,042|757,452	2,184,698|622,796	2,184,698|622,796	2,303,216|504,278	2,303,216|504,278
Effective observations	595,621|747,587	595,621|747,587	461,220|591,243	461,220|591,243	617,362|653,407	617,362|653,407	456,587|436,078	456,587|436,078	591,243|428,518	591,243|428,518	402,117|310,000	402,117|310,000
B [SAP 81] τ	0.000	0.000	0.001***	0.001***	-0.002***	-0.002***	0.001**	0.001**	-0.002***	-0.002***	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Robust 95% CI	-0.001|0.001	-0.001|0.001	0.001|0.002	0.001|0.002	-0.003|-0.001	-0.003|-0.001	0.001|0.004	0.001|0.004	-0.004|-0.001	-0.004|-0.001	-0.001|0.003	-0.001|0.002
Robust p-value	0.669	0.832	0.000	0.000	0.000	0.000	0.005	0.005	0.000	0.000	0.589	0.556
BW estimate (h)	3.819|3.819	3.882|3.882	2.982|2.982	2.870|2.870	3.953|3.953	4.081|4.081	3.888|3.888	3.879|3.879	3.244|3.244	3.134|3.134	4.332|4.332	4.367|4.367
BW bias (b)	5.224|5.224	5.337|5.337	5.600|5.600	5.730|5.730	6.380|6.380	6.384|6.384	6.322|6.322	6.338|6.338	5.534|5.534	5.498|5.498	6.036|6.036	6.277|6.277
Observations	807,327|174,697	807,327|174,697	846,478|135,546	846,478|135,546	879,457|102,567	879,457|102,567	928,242|53,782	928,242|53,782	945,666|36,358	945,666|36,358	958,891|23,133	958,891|23,133
Effective observations	153,435|120,915	153,435|120,915	83,259|81,764	83,259|81,764	116,238|79,434	167,340|89,033	81,764|46,643	81,764|46,643	66,209|32,865	66,209|32,865	79,434|22,269	79,434|22,269
A [SAP 92] τ	0.006	0.003	-0.002	-0.001	0.000	0.001	0.026*	0.028**	0.000	-0.014	0.015	0.015*
	(0.002)	(0.001)	(0.003)	(0.002)	(0.006)	(0.004)	(0.002)	(0.002)	(0.008)	(0.007)	(0.005)	(0.005)
Robust 95% CI	-0.004|0.011	-0.003|0.008	-0.010|0.000	-0.006|0.001	-0.010|0.004	-0.004|0.005	0.007|0.062	0.008|0.062	-0.017|0.028	-0.033|0.011	0.000|0.038	0.002|0.033
Robust p-value	0.342	0.413	0.050	0.096	0.413	0.748	0.013	0.010	0.619	0.322	0.056	0.028
BW estimate (h)	3.543|3.543	3.252|3.252	2.958|2.958	2.882|2.882	5.333|5.333	5.464|5.464	2.380|2.380	2.299|2.299	3.309|3.309	3.097|3.097	3.681|3.681	3.551|3.551
BW bias (b)	6.907|6.907	6.397|6.397	5.163|5.163	5.179|5.179	6.079|6.079	6.236|6.236	5.477|5.477	5.272|5.272	6.362|6.362	6.188|6.188	6.649|6.649	6.690|6.690
Observations	74,765|1,379	74,765|1,379	75,142|1,002	75,142|1,002	75,427|717	75,427|717	75,790|354	75,790|354	75,887|257	75,887|257	75,978|166	75,978|166
Effective observations	6,275|1,025	6,275|1,025	1,190|648	1,190|648	6,937|654	6,937|654	363|252	363|252	460|210	460|210	349|141	349|141
BW selection	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular
Property FE		Yes		Yes		Yes		Yes		Yes		Yes
Area FE		Yes		Yes		Yes		Yes		Yes		Yes
Date FE		Yes		Yes		Yes		Yes		Yes		Yes

Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: N= 3,999,153.

Table C3: Local Linear RD Estimates for Placebo Tests

	(1)	(2)
SAP 10 τ	0.007	0.004
	(0.003)	(0.003)
Robust 95% CI	-0.008|0.019	-0.011|0.017
Robust p-value	0.401	0.655
BW estimate (h)	3.170|3.170	3.213|3.213
BW bias (b)	5.395|5.395	5.402|5.402
Observations	22,435|3,976,718	22,435|3,976,718
Effective observations	5,820|9,460	5,820|9,460
SAP 20 τ	-0.007	-0.007
	(0.004)	(0.004)
Robust 95% CI	-0.020|0.002	-0.020|0.002
Robust p-value	0.097	0.112
BW estimate (h)	4.916|4.916	4.941|4.941
BW bias (b)	7.242|7.242	7.412|7.412
Observations	51,571|3,947,582	51,571|3,947,582
Effective observations	13,961|25,870	13,961|25,870
SAP 30 τ	-0.002	-0.002
	(0.002)	(0.001)
Robust 95% CI	-0.006|0.001	-0.006|0.001
Robust p-value	0.125	0.126
BW estimate (h)	6.316|6.316	5.482|5.482
BW bias (b)	16.304|16.304	13.101|13.101
Observations	118,667|3,880,486	118,667|3,880,486
Effective observations	47,252|104,640	41,226|85,084
SAP 40 τ	-0.003	-0.003
	(0.003)	(0.003)
Robust 95% CI	-0.007|0.005	-0.007|0.005
Robust p-value	0.663	0.738
BW estimate (h)	7.501|7.501	7.346|7.346
BW bias (b)	10.857|10.857	10.794|10.794
Observations	295,518|3,703,635	295,518|3,703,635
Effective observations	140,431|322,110	140,431|322,110
SAP 50 τ	-0.001	-0.001
	(0.001)	(0.001)
Robust 95% CI	-0.002|0.001	-0.002|0.001
Robust p-value	0.445	0.533
BW estimate (h)	6.471|6.471	6.953|6.953
BW bias (b)	10.898|10.898	12.090|12.090
Observations	733,074|3,266,079	733,074|3,266,079
Effective observations	301,763|591,354	301,763|591,354
SAP 60 τ	0.000	0.000
	(0.000)	(0.000)
Robust 95% CI	-0.001|0.000	-0.001|0.001
Robust p-value	0.401	0.657
BW estimate (h)	3.990|3.990	4.300|4.300
BW bias (b)	6.834|6.834	7.425|7.425
Observations	1,685,278|2,313,875	1,685,278|2,313,875
Effective observations	360,850|562,472	467,440|713,933
SAP 70 τ	0.002***	0.001***
	(0.000)	(0.000)
Robust 95% CI	0.001|0.003	0.001|0.002
Robust p-value	0.000	0.000
BW estimate (h)	3.983|3.983	3.945|3.945
BW bias (b)	5.796|5.796	5.927|5.927
Observations	3,165,557|833,596	3,165,557|833,596
Effective observations	456,587|436,078	456,587|436,078
SAP 80 τ	-0.001**	-0.002**
	(0.000)	(0.000)
Robust 95% CI	-0.003|-0.001	-0.003|-0.001
Robust p-value	0.002	0.002
BW estimate (h)	5.191|5.191	5.109|5.109
BW bias (b)	7.143|7.143	7.168|7.168
Observations	3,896,071|103,082	3,896,071|103,082
Effective observations	225,565|95,428	225,565|95,428
SAP 90 τ	-0.002	-0.001
	(0.003)	(0.002)
Robust 95% CI	-0.010|0.001	-0.007|0.002
Robust p-value	0.117	0.263
BW estimate (h)	2.987|2.987	2.905|2.905
BW bias (b)	5.859|5.859	6.016|6.016
Observations	3,998,151|1,002	3,998,151|1,002
Effective observations	1,190|648	1,190|648
BW selection	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Triangular
Property FE		Yes
Area FE		Yes
Date FE		Yes

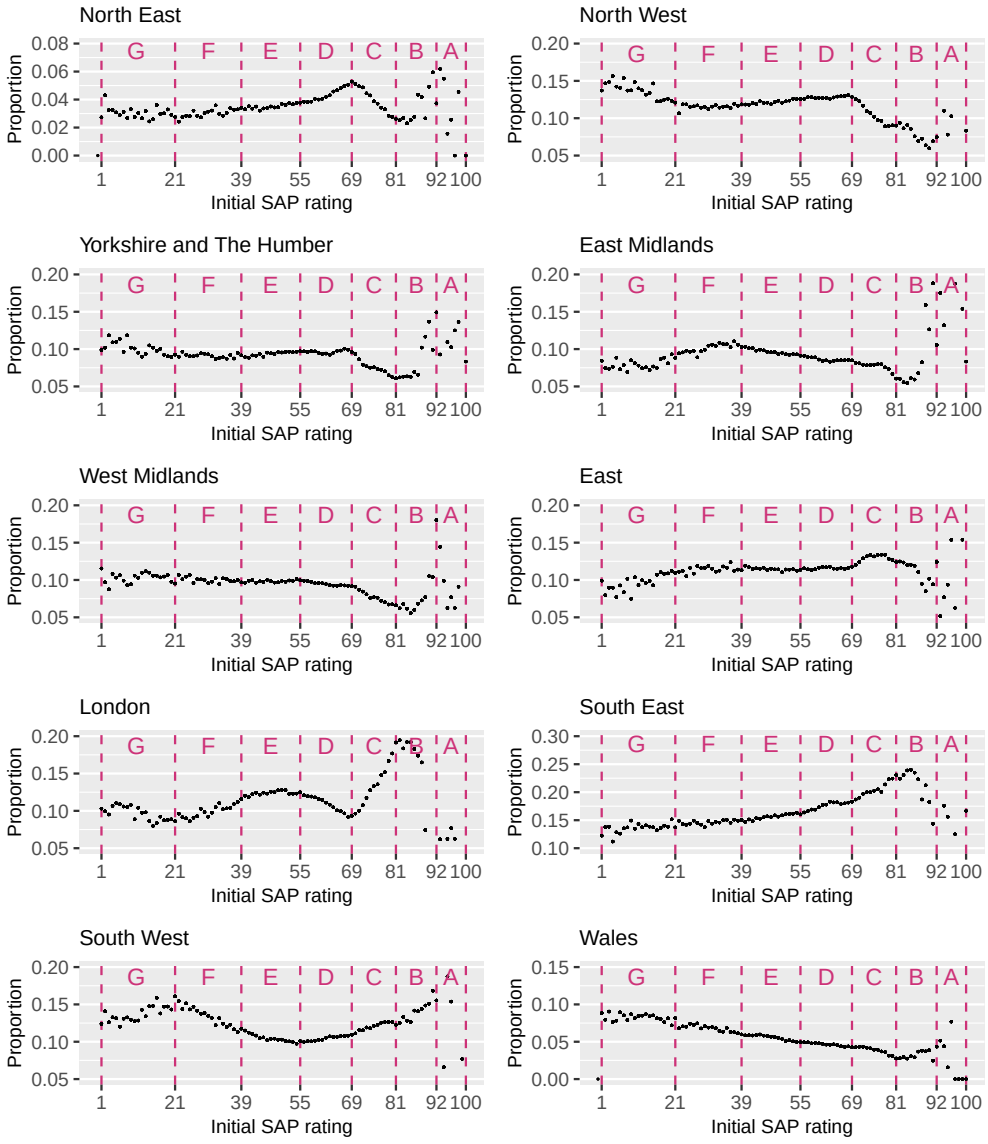
Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: N= 3,999,153.

C.2 Baseline Covariates

C.2.1 Location

Figure C1: Region Proportion – SAP Rating



Notes: N=3,999,153.

Table C4: Local Linear RD Estimates for Area Covariate Proportions

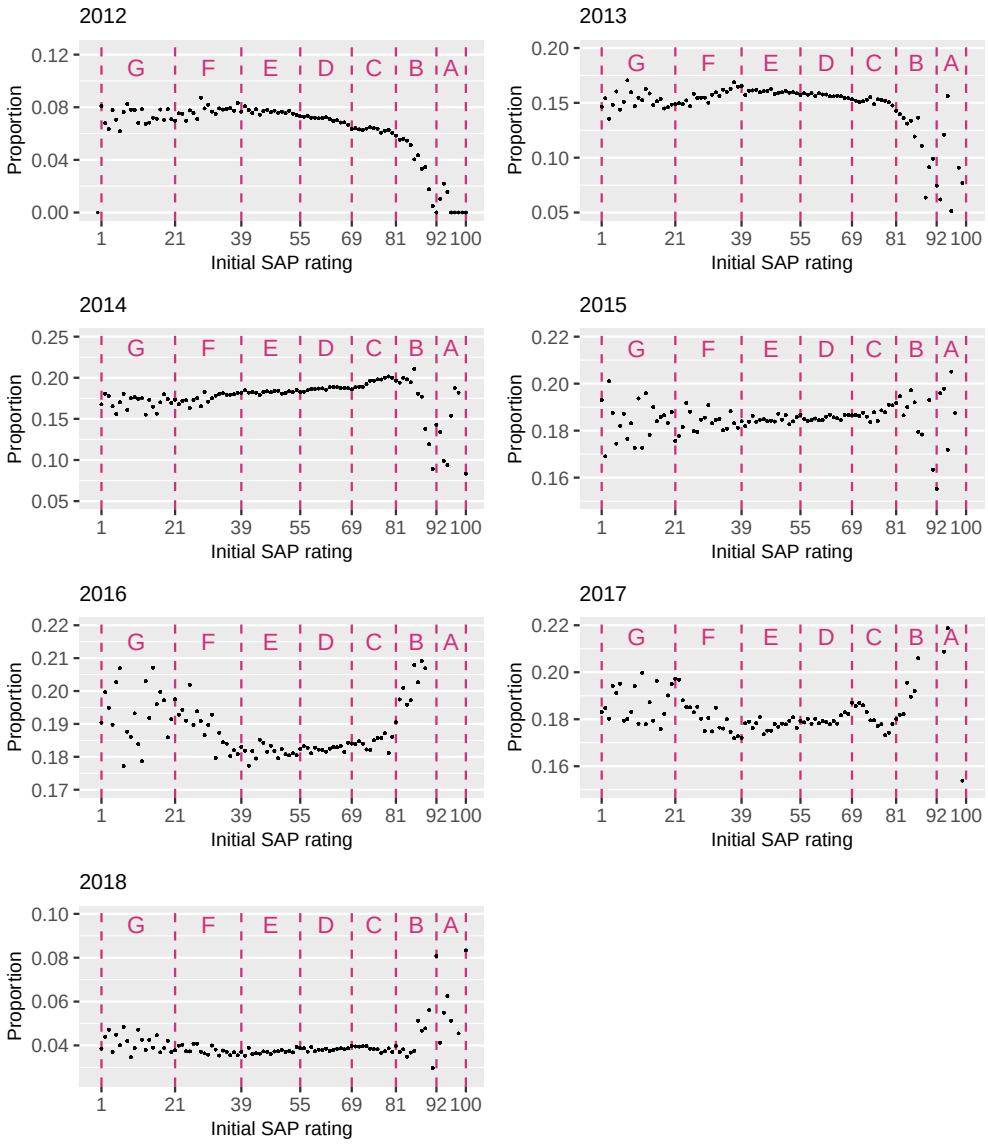
	North East	North West	Yorkshire and The Humber	East Midlands	West Midlands	East of England	London	South East	South West	Wales	Urban
F [SAP 21] τ	-0.003	-0.008	0.006*	-0.003	0.001	-0.003	0.002	-0.015***	0.014***	0.007	-0.014***
	(0.002)	(0.005)	(0.002)	(0.004)	(0.005)	(0.001)	(0.004)	(0.005)	(0.003)	(0.005)	(0.005)
Robust 95% CI	-0.008|0.003	-0.022|0.001	0.000|0.010	-0.015|0.006	-0.005|0.012	-0.006|0.002	-0.006|0.013	-0.030|-0.010	0.006|0.025	-0.000|0.019	-0.030|-0.009
Robust p-value	0.359	0.069	0.046	0.409	0.477	0.351	0.469	0.000	0.001	0.058	0.000
BW estimate (h)	6.041|6.041	5.228|5.228	4.585|4.585	4.543|4.543	5.939|5.939	4.460|4.460	4.556|4.556	4.400|4.400	4.737|4.737	4.450|4.450	5.538|5.538
BW bias (b)	10.565|10.565	8.314|8.314	6.653|6.653	7.282|7.282	7.288|7.288	9.111|9.111	7.906|7.906	6.547|6.547	8.218|8.218	7.103|7.103	7.594|7.594
Observations	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881
Effective observations	20,863|44,206	17,942|36,069	14,758|28,710	14,758|28,710	17,942|36,069	14,758|28,710	14,758|28,710	14,758|28,710	14,758|28,710	14,758|28,710	17,942|36,069
E [SAP 39] τ	0.001	-0.000	-0.006*	-0.004	-0.002	0.005	0.001	-0.001	0.009***	-0.000	-0.010**
	(0.001)	(0.001)	(0.003)	(0.003)	(0.001)	(0.004)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
Robust 95% CI	-0.003|0.003	-0.004|0.003	-0.015|-0.001	-0.012|0.004	-0.005|0.001	-0.004|0.018	-0.004|0.001	-0.006|0.005	0.007|0.015	-0.003|0.002	-0.015|-0.002
Robust p-value	0.822	0.637	0.028	0.344	0.209	0.227	0.228	0.794	0.000	0.833	0.006
BW estimate (h)	4.315|4.315	5.178|5.178	4.247|4.247	3.654|3.654	5.623|5.623	3.715|3.715	3.616|3.616	4.166|4.166	3.332|3.332	4.292|4.292	3.420|3.420
BW bias (b)	9.256|9.256	9.099|9.099	6.794|6.794	6.669|6.669	9.720|9.720	6.391|6.391	7.789|7.789	7.243|7.243	5.969|5.969	10.616|10.616	5.864|5.864
Observations	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082
Effective observations	82,257|162,878	98,713|204,104	82,257|162,878	64,682|124,591	98,713|204,104	64,682|124,591	64,682|124,591	82,257|162,878	64,682|124,591	82,257|162,878	64,682|124,591
D [SAP 55] τ	0.000	-0.001	0.001	-0.001*	-0.003***	0.001	0.001	-0.004***	0.005***	0.001	-0.000
	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
Robust 95% CI	-0.001|0.002	-0.002|0.002	-0.000|0.002	-0.003|-0.000	-0.005|-0.002	-0.002|0.004	-0.003|0.003	-0.006|-0.003	0.004|0.006	-0.001|0.002	-0.001|0.002
Robust p-value	0.757	0.770	0.132	0.017	0.000	0.403	0.941	0.000	0.000	0.427	0.747
BW estimate (h)	3.811|3.811	3.848|3.848	4.761|4.761	3.161|3.161	3.839|3.839	5.710|5.710	3.794|3.794	3.404|3.404	3.831|3.831	3.276|3.276	5.066|5.066
BW bias (b)	6.660|6.660	5.485|5.485	7.768|7.768	5.732|5.732	6.260|6.260	9.430|9.430	6.363|6.363	5.985|5.985	5.815|5.815	7.307|7.307	6.521|6.521
Observations	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099
Effective observations	249,402|442,979	249,402|442,979	318,459|569,763	249,402|442,979	249,402|442,979	382,441|703,551	249,402|442,979	249,402|442,979	249,402|442,979	249,402|442,979	382,441|703,551
C [SAP 69] τ	0.001***	-0.002***	-0.003	-0.002***	0.000	0.001	0.005***	0.000*	0.001	-0.002***	0.002
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
Robust 95% CI	0.001|0.002	-0.003|-0.002	-0.004|0.001	-0.002|-0.001	-0.000|0.001	-0.001|0.002	0.006|0.008	-0.003|-0.000	-0.000|0.002	-0.003|-0.002	-0.000|0.005
Robust p-value	0.000	0.000	0.334	0.000	0.222	0.560	0.000	0.012	0.194	0.000	0.104
BW estimate (h)	6.781|6.781	5.125|5.125	3.670|3.670	5.471|5.471	5.451|5.451	4.247|4.247	3.462|3.462	3.109|3.109	4.265|4.265	3.017|3.017	3.396|3.396
BW bias (b)	8.329|8.329	6.303|6.303	5.653|5.653	5.226|5.226	5.777|5.777	5.952|5.952	5.357|5.357	5.477|5.477	5.888|5.888	5.363|5.363	5.560|5.560
Observations	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395
Effective observations	916,239|712,117	768,864|653,892	463,988|501,905	768,864|653,892	768,864|653,892	617,403|585,021	463,988|501,905	463,988|501,905	617,403|585,021	463,988|501,905	463,988|501,905
B [SAP 81] τ	0.001	-0.000	0.003***	-0.002	-0.001	0.001	0.003	-0.001	-0.004***	-0.001	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.000)	(0.001)	(0.001)
Robust 95% CI	-0.000|0.004	-0.007|0.002	0.002|0.006	-0.001|0.003	-0.004|0.001	-0.001|0.007	-0.005|0.006	-0.010|0.009	-0.004|-0.002	-0.003|0.003	-0.010|-0.005
Robust p-value	0.106	0.278	0.000	0.408	0.213	0.170	0.901	0.968	0.000	0.811	0.000
BW estimate (h)	4.660|4.660	3.938|3.938	4.086|4.086	4.050|4.050	3.762|3.762	3.879|3.879	3.889|3.889	3.624|3.624	4.140|4.140	3.809|3.809	4.270|4.270
BW bias (b)	7.140|7.140	6.768|6.768	6.595|6.595	7.409|7.409	6.256|6.256	5.758|5.758	6.767|6.767	5.948|5.948	6.619|6.619	6.578|6.578	7.004|7.004
Observations	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629
Effective observations	143,176|68,490	99,068|62,095	143,176|68,490	143,176|68,490	99,068|62,095	99,068|62,095	99,068|62,095	99,068|62,095	143,176|68,490	99,068|62,095	143,176|68,490
A [SAP 92] τ	-0.033***	-0.003	0.047	-0.084*	0.061***	0.011	0.004	-0.025	-0.005	0.034***	0.145**
	(0.004)	(0.010)	(0.021)	(0.027)	(0.007)	(0.018)	(0.007)	(0.006)	(0.020)	(0.001)	(0.034)
Robust 95% CI	-0.058|-0.017	-0.028|0.015	-0.005|0.121	-0.158|-0.021	0.041|0.078	-0.021|0.029	-0.070|0.055	-0.062|0.025	-0.049|0.029	0.023|0.051	0.054|0.237
Robust p-value	0.000	0.549	0.069	0.011	0.000	0.748	0.813	0.409	0.630	0.000	0.002
BW estimate (h)	3.090|3.090	3.860|3.860	3.565|3.565	3.733|3.733	5.923|5.923	4.476|4.476	3.110|3.110	3.131|3.131	4.575|4.575	2.984|2.984	3.506|3.506
BW bias (b)	6.187|6.187	5.739|5.739	6.360|6.360	6.285|6.285	6.899|6.899	5.738|5.738	5.815|5.815	5.642|5.642	5.890|5.890	5.652|5.652	5.868|5.868
Observations	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515
Effective observations	864|413	864|413	864|413	864|413	3,493|468	1,677|452	864|413	864|413	1,677|452	487|349	864|413
BW selection	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular

Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes:3,999,153.

C.2.2 Sale Date

Figure C2: Sale Year Proportion – Initial SAP Rating



N=3,999,153.

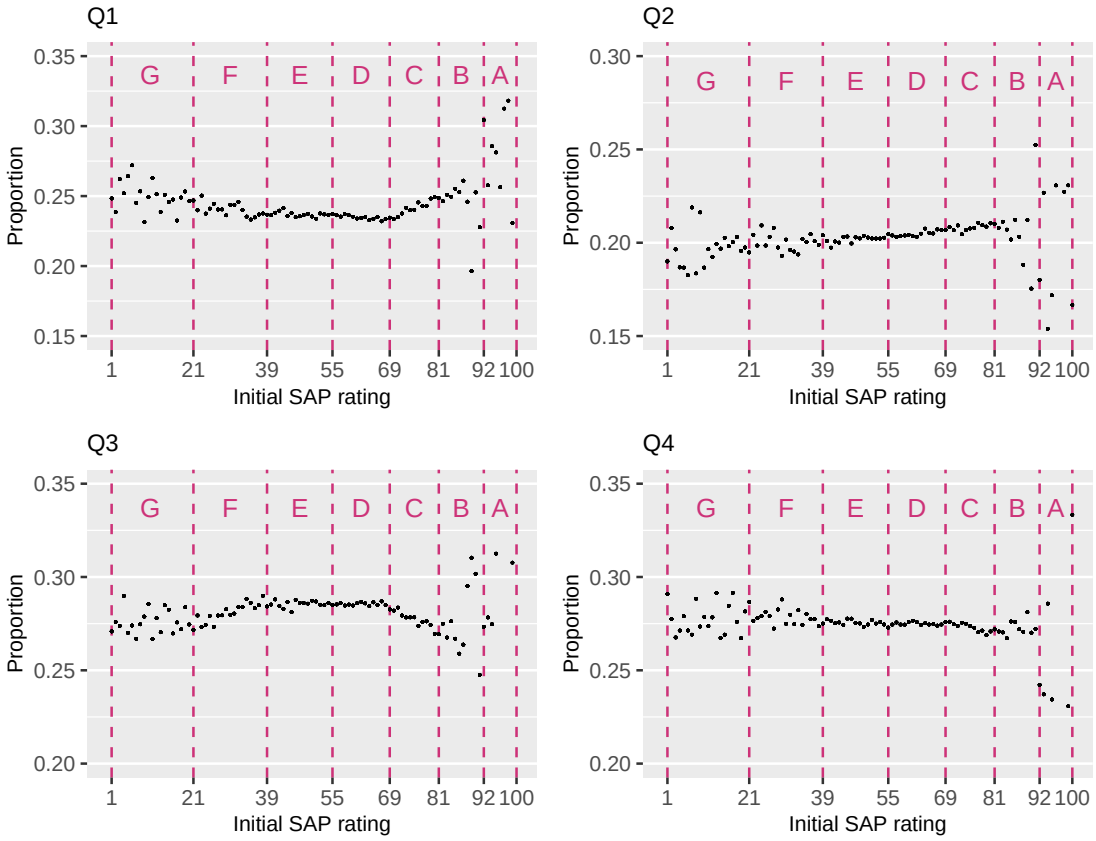


Figure C3: Sale Quarter Proportion – Initial SAP Rating

Notes: N=3,999,153.

Table C5: Local Linear RD Estimates for Date Covariate Proportions

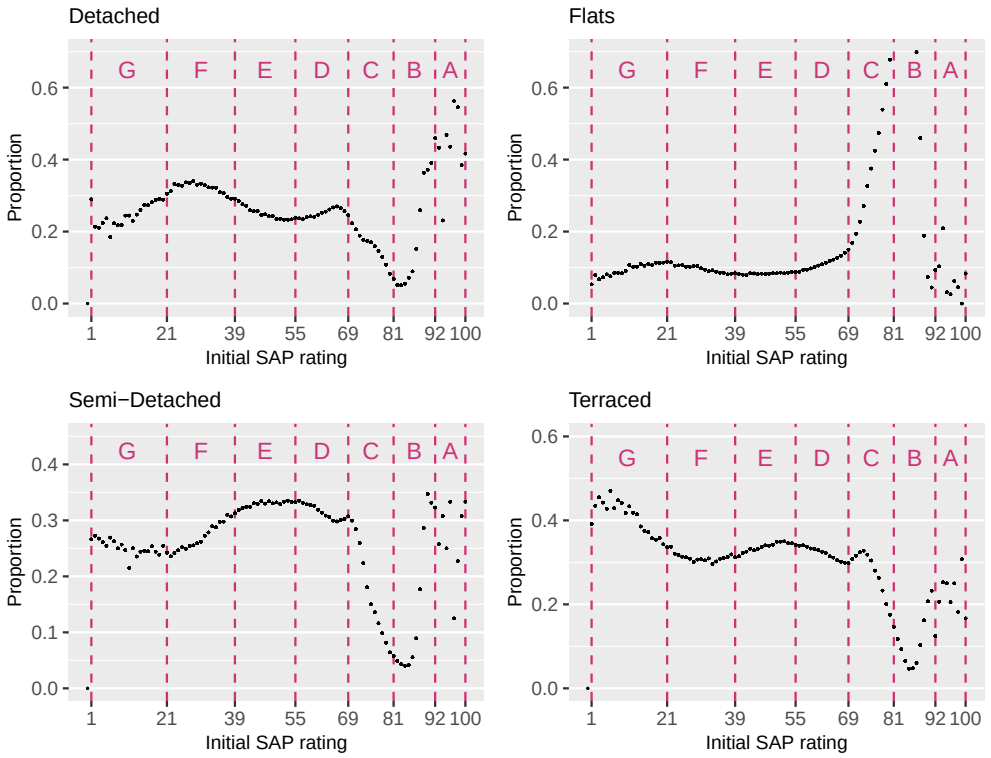
	2012	2013	2014	2015	2016	2017	2018	Q1	Q2	Q3	Q4
F [SAP 21] τ	0.001	0.001	0.004	-0.008**	0.009*	-0.004*	0.001	-0.006	0.002	-0.003	0.007
	(0.003)	(0.002)	(0.003)	(0.003)	(0.004)	(0.001)	(0.002)	(0.005)	(0.003)	(0.004)	(0.009)
Robust 95% CI	-0.005|0.011	-0.007|0.006	-0.004|0.017	-0.015|-0.002	0.000|0.023	-0.015|-0.000	-0.004|0.007	-0.022|0.006	-0.005|0.010	-0.013|0.008	-0.012|0.030
Robust p-value	0.488	0.878	0.244	0.009	0.044	0.037	0.552	0.260	0.467	0.611	0.421
BW estimate (h)	4.903|4.903	4.373|4.373	4.693|4.693	7.747|7.747	5.503|5.503	4.880|4.880	5.728|5.728	5.802|5.802	4.676|4.676	7.973|7.973	5.075|5.075
BW bias (b)	8.472|8.472	7.341|7.341	9.057|9.057	12.803|12.803	10.468|10.468	8.007|8.007	9.269|9.269	10.599|10.599	6.742|6.742	12.573|12.573	8.779|8.779
Observations	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881
Effective observations	14,758|28,710	14,758|28,710	14,758|28,710	23,657|53,237	17,942|36,069	14,758|28,710	17,942|36,069	17,942|36,069	14,758|28,710	23,657|53,237	17,942|36,069
E [SAP 39] τ	-0.005*	-0.006	-0.000	0.005	0.002	0.003	0.001	-0.003***	0.007***	-0.004	0.004***
	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Robust 95% CI	-0.012|-0.002	-0.013|0.002	-0.004|0.001	-0.000|0.013	-0.002|0.005	-0.002|0.007	-0.000|0.004	-0.006|-0.002	0.007|0.013	-0.011|0.001	0.002|0.009
Robust p-value	0.012	0.134	0.169	0.055	0.397	0.272	0.089	0.001	0.000	0.075	0.000
BW estimate (h)	5.127|5.127	7.822|7.822	3.630|3.630	3.820|3.820	4.072|4.072	4.396|4.396	4.925|4.925	4.622|4.622	3.394|3.394	5.718|5.718	4.326|4.326
BW bias (b)	7.907|7.907	11.009|11.009	6.670|6.670	7.511|7.511	5.875|5.875	6.300|6.300	7.579|7.579	5.459|5.459	5.585|5.585	9.316|9.316	7.271|7.271
Observations	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082
Effective observations	98,713|204,104	126,779|297,839	64,682|124,591	64,682|124,591	82,257|162,878	82,257|162,878	82,257|162,878	82,257|162,878	64,682|124,591	98,713|204,104	82,257|162,878
D [SAP 55] τ	0.000	-0.001	-0.004***	-0.001*	0.002**	0.005***	-0.002***	0.001	0.002	-0.002	-0.001
	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
Robust 95% CI	-0.001|0.003	-0.002|0.001	-0.008|-0.002	-0.005|-0.001	0.001|0.004	0.004|0.011	-0.005|-0.002	-0.002|0.003	0.001|0.002	-0.004|-0.002	-0.002|0.001
Robust p-value	0.179	0.745	0.000	0.013	0.003	0.000	0.000	0.546	0.000	0.000	0.584
BW estimate (h)	3.787|3.787	4.030|4.030	3.670|3.670	3.593|3.593	3.389|3.389	3.379|3.379	3.298|3.298	3.517|3.517	5.432|5.432	2.838|2.838	3.880|3.880
BW bias (b)	7.123|7.123	5.841|5.841	5.278|5.278	5.800|5.800	5.624|5.624	5.664|5.664	5.276|5.276	7.558|7.558	7.668|7.668	5.713|5.713	5.573|5.573
Observations	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099
Effective observations	249,402|442,979	318,459|569,763	249,402|442,979	249,402|442,979	249,402|442,979	249,402|442,979	249,402|442,979	249,402|442,979	382,441|703,551	172,065|322,499	249,402|442,979
C [SAP 69] τ	-0.002*	-0.000	-0.001*	0.000	-0.003*	0.003**	0.001	0.000	0.001	-0.002	0.002*
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
Robust 95% CI	-0.003|-0.000	-0.001|0.001	-0.002|-0.000	-0.003|0.002	-0.008|-0.001	0.001|0.006	-0.000|0.002	-0.003|0.005	-0.003|0.003	-0.004|0.001	0.000|0.002
Robust p-value	0.027	0.808	0.044	0.912	0.012	0.005	0.100	0.754	0.977	0.368	0.028
BW estimate (h)	3.710|3.710	3.969|3.969	4.311|4.311	2.915|2.915	2.665|2.665	4.377|4.377	3.059|3.059	3.215|3.215	2.791|2.791	3.565|3.565	3.700|3.700
BW bias (b)	6.586|6.586	5.048|5.048	5.761|5.761	5.095|5.095	5.077|5.077	6.814|6.814	5.281|5.281	5.601|5.601	5.895|5.895	6.036|6.036	5.950|5.950
Observations	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395
Effective observations	463,988|501,905	463,988|501,905	617,403|585,021	307,644|402,117	307,644|402,117	617,403|585,021	463,988|501,905	463,988|501,905	307,644|402,117	463,988|501,905	463,988|501,905
B [SAP 81] τ	-0.002	-0.002*	-0.005**	0.000	0.004	-0.001	0.002	-0.004**	-0.000	0.003*	0.002
	(0.001)	(0.000)	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Robust 95% CI	-0.005|0.001	-0.002|-0.000	-0.006|-0.001	-0.003|0.003	-0.005|0.011	-0.007|0.001	-0.000|0.004	-0.009|-0.002	-0.003|0.003	0.000|0.008	-0.001|0.003
Robust p-value	0.190	0.023	0.006	0.989	0.447	0.105	0.115	0.005	0.962	0.049	0.410
BW estimate (h)	3.914|3.914	3.439|3.439	4.128|4.128	4.948|4.948	3.276|3.276	3.769|3.769	5.676|5.676	3.916|3.916	4.289|4.289	4.602|4.602	4.593|4.593
BW bias (b)	6.287|6.287	6.187|6.187	6.107|6.107	7.360|7.360	5.967|5.967	6.228|6.228	7.369|7.369	6.980|6.980	6.625|6.625	7.044|7.044	7.196|7.196
Observations	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629
Effective observations	99,068|62,095	99,068|62,095	143,176|68,490	143,176|68,490	99,068|62,095	99,068|62,095	194,278|72,136	99,068|62,095	143,176|68,490	143,176|68,490	143,176|68,490
A [SAP 92] τ	0.010**	-0.035***	0.081***	0.023	-0.033**	-0.084**	0.074***	0.098*	-0.144**	0.075**	-0.030***
	(0.001)	(0.003)	(0.004)	(0.002)	(0.005)	(0.022)	(0.004)	(0.005)	(0.007)	(0.006)	(0.005)
Robust 95% CI	0.003|0.023	-0.088|-0.022	0.072|0.111	-0.004|0.078	-0.083|-0.011	-0.142|-0.025	0.043|0.118	0.002|0.170	-0.261|-0.060	0.028|0.153	-0.040|-0.013
Robust p-value	0.009	0.001	0.000	0.074	0.011	0.005	0.000	0.044	0.002	0.004	0.000
BW estimate (h)	3.300|3.300	2.292|2.292	4.167|4.167	2.545|2.545	2.793|2.793	3.527|3.527	2.957|2.957	2.594|2.594	2.488|2.488	3.032|3.032	3.205|3.205
BW bias (b)	5.897|5.897	5.715|5.715	6.100|6.100	6.063|6.063	5.682|5.682	5.792|5.792	5.347|5.347	5.915|5.915	5.675|5.675	6.310|6.310	5.855|5.855
Observations	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515
Effective observations	864|413	487|349	1,677|452	487|349	487|349	864|413	487|349	487|349	487|349	864|413	864|413
BW selection	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular	Triangular
Property FE											
Area FE											
Date FE											

Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes:3,999,153.

C.2.3 Property Type

Figure C4: Property Type Proportion – Initial SAP Rating



N=3,999,153.

Table C6: Local Linear RD Estimates for Property Covariate Proportions

	Detached	Flat	Semi-Detached	Terraced	Leasehold
F [SAP 21] τ	0.015***	0.003	-0.014	-0.001	-0.007*
	(0.005)	(0.001)	(0.008)	(0.005)	(0.002)
Robust 95% CI	0.011|0.023	-0.001|0.008	-0.034|0.000	-0.012|0.013	-0.017|-0.002
Robust p-value	0.000	0.086	0.055	0.971	0.012
BW estimate (h)	6.284|6.284	3.639|3.639	5.010|5.010	4.523|4.523	3.955|3.955
BW bias (b)	6.883|6.883	5.807|5.807	7.615|7.615	6.551|6.551	6.055|6.055
Observations	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881	55,552|212,881
Effective observations	20,863|44,206	11,334|21,889	17,942|36,069	14,758|28,710	11,334|21,889
E [SAP 39] τ	0.007***	0.002	0.001	-0.010***	0.001
	(0.001)	(0.001)	(0.003)	(0.001)	(0.002)
Robust 95% CI	0.005|0.013	-0.004|0.004	-0.004|0.008	-0.015|-0.007	-0.007|0.004
Robust p-value	0.000	0.917	0.546	0.000	0.655
BW estimate (h)	4.188|4.188	4.383|4.383	7.386|7.386	5.282|5.282	4.086|4.086
BW bias (b)	9.213|9.213	6.086|6.086	10.195|10.195	6.618|6.618	5.877|5.877
Observations	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082	212,881|847,082
Effective observations	82,257|162,878	82,257|162,878	126,779|297,839	98,713|204,104	82,257|162,878
D [SAP 55] τ	0.004**	-0.002	-0.001	-0.001	-0.003**
	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)
Robust 95% CI	0.001|0.005	-0.004|0.000	-0.004|0.004	-0.004|0.002	-0.005|-0.001
Robust p-value	0.003	0.118	0.923	0.627	0.003
BW estimate (h)	5.887|5.887	5.817|5.817	5.316|5.316	4.822|4.822	3.838|3.838
BW bias (b)	6.119|6.119	9.119|9.119	6.508|6.508	5.642|5.642	5.843|5.843
Observations	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099	847,082|1,901,099
Effective observations	382,441|703,551	382,441|703,551	382,441|703,551	318,459|569,763	249,402|442,979
C [SAP 69] τ	-0.005**	-0.006	0.005	0.005	-0.007
	(0.001)	(0.008)	(0.003)	(0.002)	(0.007)
Robust 95% CI	0.001|0.005	-0.004|0.001	-0.004|0.001	-0.003|0.002	-0.006|0.001
Robust p-value	0.004	0.335	0.188	0.806	0.124
BW estimate (h)	3.769|3.769	7.396|7.396	4.208|4.208	5.436|5.436	6.991|6.991
BW bias (b)	4.860|4.860	5.870|5.870	5.195|5.195	6.830|6.830	5.902|5.902
Observations	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395	1,901,099|906,395
Effective observations	463,988|501,905	1,059,609|763,219	617,403|585,021	768,864|653,892	916,239|712,117
B [SAP 81] τ	0.003***	-0.013***	0.010***	0.001	-0.009***
	(0.005)	(0.007)	(0.004)	(0.003)	(0.008)
Robust 95% CI	0.013|0.016	-0.041|-0.025	0.008|0.015	-0.005|0.012	-0.035|-0.021
Robust p-value	0.000	0.000	0.000	0.456	0.000
BW estimate (h)	4.659|4.659	4.820|4.820	8.077|8.077	4.992|4.992	5.114|5.114
BW bias (b)	6.744|6.744	6.334|6.334	7.241|7.241	5.269|5.269	6.300|6.300
Observations	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629	906,395|75,629
Effective observations	143,176|68,490	143,176|68,490	404,490|75,142	143,176|68,490	194,278|72,136
A [SAP 92] τ	0.060***	0.102	-0.000	-0.149***	0.120
	(0.013)	(0.022)	(0.009)	(0.019)	(0.022)
Robust 95% CI	0.053|0.151	-0.075|0.052	-0.032|0.107	-0.203|-0.125	-0.047|0.071
Robust p-value	0.000	0.725	0.289	0.000	0.679
BW estimate (h)	2.894|2.894	3.142|3.142	2.965|2.965	5.407|5.407	3.160|3.160
BW bias (b)	5.754|5.754	5.369|5.369	5.406|5.406	6.115|6.115	5.394|5.394
Observations	75,629|515	75,629|515	75,629|515	75,629|515	75,629|515
Effective observations	487|349	864|413	487|349	3,493|468	864|413
BW selection	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Triangular	Triangular	Triangular	Triangular
Property FE					
Area FE					
Date FE					

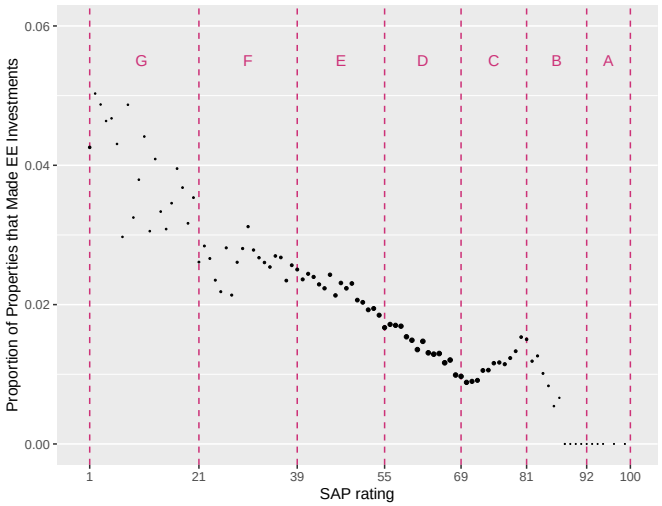
Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: N=3,999,153.

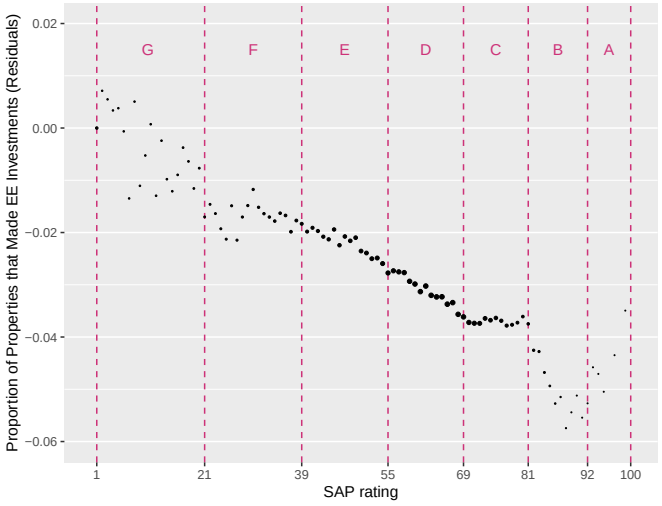
C.3 Counter Factual Scenario

Figure C5: Proportion of Properties that Made EE Investments – Initial SAP Rating for Existing Properties
Sale Transactions Before April 2012

Panel A. Proportion – Initial SAP Rating



Panel B. Proportion Residuals – Initial SAP Rating



Notes: N=1,418,826.

Table C7: Local Linear RD Estimates for Sale Transactions Before April 2012

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
F [SAP 21] τ	-0.006	-0.008**	-0.007**	-0.006	-0.006	-0.006	-0.006
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Robust 95% CI	-0.011|0.001	-0.015|-0.003	-0.012|-0.002	-0.011|0.001	-0.011|0.001	-0.011|0.001	-0.011|0.001
Robust p-value	0.093	0.004	0.004	0.100	0.096	0.073	0.073
BW estimate (h)	5.413|5.413	6.419|6.419	7.151|5.714	5.370|5.370	5.375|5.375	5.560|5.560	5.537|5.537
BW bias (b)	9.824|9.824	11.212|11.212	12.399|7.819	9.352|9.352	9.370|9.370	9.797|9.797	9.189|9.189
Observations	35,191|112,306	35,191|112,306	35,191|112,306	35,191|112,306	35,191|112,306	35,191|112,306	35,191|112,306
Effective observations	10,304|20,388	11,925|24,834	13,484|20,388	10,304|20,388	10,304|20,388	10,304|20,388	10,304|20,388
E [SAP 39] τ	-0.001	0.000	-0.001	-0.002	-0.001	-0.002	-0.002
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Robust 95% CI	-0.005|0.003	-0.004|0.005	-0.006|0.002	-0.006|0.002	-0.005|0.003	-0.006|0.002	-0.006|0.002
Robust p-value	0.614	0.824	0.421	0.326	0.541	0.337	0.294
BW estimate (h)	3.739|3.739	3.012|3.012	3.267|5.974	3.213|3.213	3.561|3.561	3.225|3.225	3.235|3.235
BW bias (b)	6.273|6.273	5.741|5.741	6.032|8.449	5.950|5.950	6.138|6.138	5.967|5.967	5.878|5.878
Observations	112,306|359,705	112,306|359,705	112,306|359,705	112,306|359,705	112,306|359,705	112,306|359,705	112,306|359,705
Effective observations	32,620|60,350	32,620|60,350	32,620|97,894	32,620|60,350	32,620|60,350	32,620|60,350	32,620|60,350
D [SAP 55] τ	-0.001**	-0.001**	-0.001*	-0.001**	-0.001**	-0.001**	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Robust 95% CI	-0.002|-0.001	-0.003|-0.001	-0.002|-0.000	-0.002|-0.001	-0.002|-0.000	-0.002|-0.001	-0.002|-0.000
Robust p-value	0.002	0.003	0.013	0.002	0.005	0.003	0.004
BW estimate (h)	3.854|3.854	3.248|3.248	3.292|3.915	3.822|3.822	4.037|4.037	3.758|3.758	3.762|3.762
BW bias (b)	6.104|6.104	5.692|5.692	5.528|5.022	6.184|6.184	6.034|6.034	6.193|6.193	6.284|6.284
Observations	359,705|589,870	359,705|589,870	359,705|589,870	359,705|589,870	359,705|589,870	359,705|589,870	359,705|589,870
Effective observations	93,033|150,542	93,033|150,542	93,033|150,542	93,033|150,542	120,724|191,689	93,033|150,542	93,033|150,542
C [SAP 69] τ	0.002*	0.002*	0.001*	0.002*	0.002*	0.002*	0.002*
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Robust 95% CI	0.001|0.005	0.000|0.004	0.000|0.004	0.000|0.005	0.001|0.005	0.000|0.005	0.000|0.005
Robust p-value	0.014	0.031	0.026	0.021	0.014	0.016	0.021
BW estimate (h)	2.952|2.952	2.808|2.808	3.092|4.662	2.880|2.880	2.911|2.911	2.934|2.934	2.862|2.862
BW bias (b)	5.036|5.036	5.085|5.085	5.192|5.216	5.032|5.032	5.020|5.020	5.031|5.031	5.024|5.024
Observations	589,870|295,206	589,870|295,206	589,870|295,206	589,870|295,206	589,870|295,206	589,870|295,206	589,870|295,206
Effective observations	87,106|116,625	87,106|116,625	132,590|177,242	87,106|116,625	87,106|116,625	87,106|116,625	87,106|116,625
B [SAP 81] τ	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Robust 95% CI	-0.004|-0.002	-0.004|-0.002	-0.004|-0.002	-0.004|-0.002	-0.004|-0.002	-0.004|-0.002	-0.004|-0.002
Robust p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
BW estimate (h)	3.796|3.796	3.013|3.013	3.250|6.613	3.970|3.970	3.794|3.794	3.793|3.793	3.979|3.979
BW bias (b)	6.881|6.881	6.443|6.443	5.253|6.252	6.843|6.843	6.894|6.894	6.891|6.891	6.880|6.880
Observations	295,206|26,526	295,206|26,526	295,206|26,526	295,206|26,526	295,206|26,526	295,206|26,526	295,206|26,526
Effective observations	35,448|22,714	35,448|22,714	35,448|26,311	35,448|22,714	35,448|22,714	35,448|22,714	35,448|22,714
BW selection	MSE-Optimal	MSE-Optimal	Two MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal	MSE-Optimal
Kernel	Triangular	Uniform	Triangular	Triangular	Triangular	Triangular	Triangular
Property FE				Yes			Yes
Area FE					Yes		Yes
Date FE						Yes	Yes

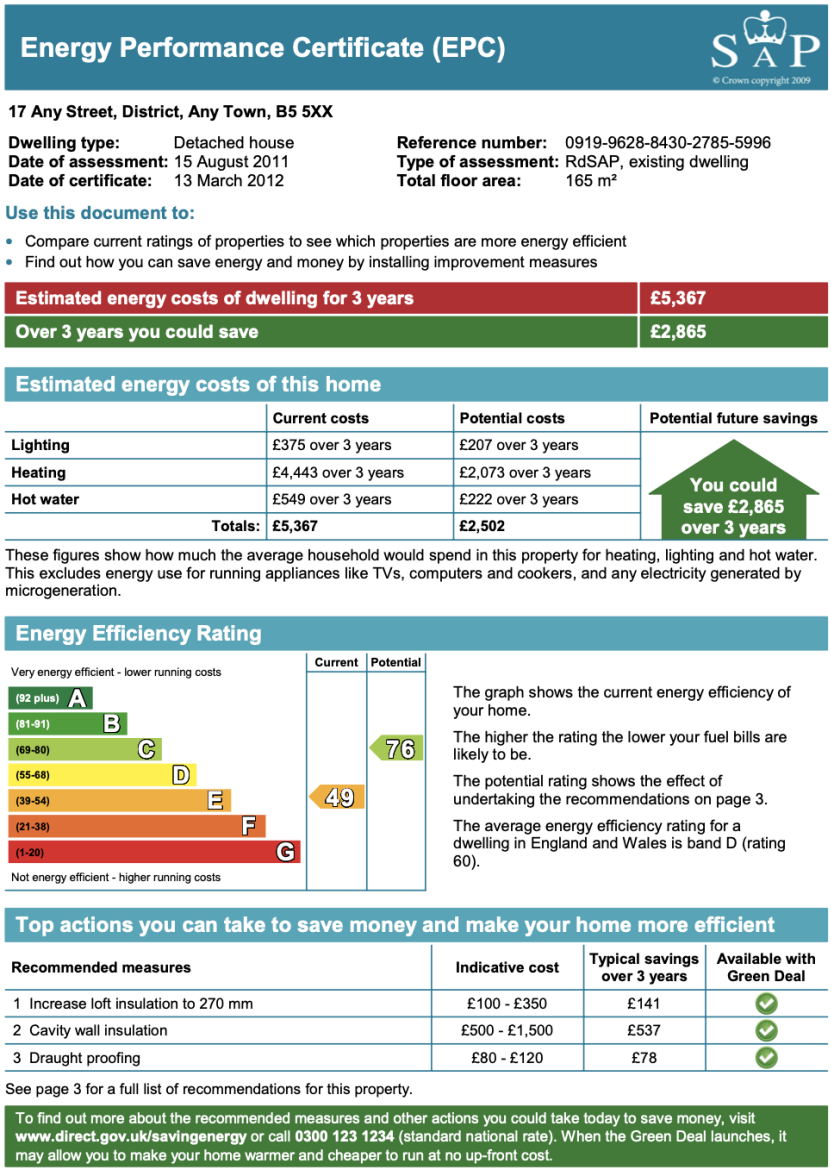
Standard errors in parentheses.
Significance of the robust bias-corrected p-value: *** at 0.1% level, ** at 1% level, * at 5% level.

Notes: N=1,418,826. The results for the threshold B-A are not included as there is only 22 properties with rating band A.

Appendix D Address Matching

Appendix E Example Energy Performance Certificate (EPC)

Figure E1: Example First Page of an Energy Performance Certificate



Energy Performance Certificate (EPC)

SAP
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17 Any Street, District, Any Town, B5 5XX

Dwelling type: Detached house
Date of assessment: 15 August 2011
Date of certificate: 13 March 2012
Reference number: 0919-9628-8430-2785-5996
Type of assessment: RdSAP, existing dwelling
Total floor area: 165 m²

Use this document to:

- Compare current ratings of properties to see which properties are more energy efficient
- Find out how you can save energy and money by installing improvement measures

Estimated energy costs of dwelling for 3 years	**£5,367**
Over 3 years you could save	**£2,865**

Estimated energy costs of this home

	Current costs	Potential costs	Potential future savings
Lighting	£375 over 3 years	£207 over 3 years	You could save £2,865 over 3 years
Heating	£4,443 over 3 years	£2,073 over 3 years	
Hot water	£549 over 3 years	£222 over 3 years	
Totals:	**£5,367**	**£2,502**	

These figures show how much the average household would spend in this property for heating, lighting and hot water. This excludes energy use for running appliances like TVs, computers and cookers, and any electricity generated by microgeneration.

Energy Efficiency Rating

	Current	Potential
Very energy efficient - lower running costs		
(92 plus) A		
(81-91) B		
(69-80) C		76
(55-68) D		
(39-54) E	49	
(21-38) F		
(1-20) G		
Not energy efficient - higher running costs		

The graph shows the current energy efficiency of your home.

The higher the rating the lower your fuel bills are likely to be.

The potential rating shows the effect of undertaking the recommendations on page 3.

The average energy efficiency rating for a dwelling in England and Wales is band D (rating 60).

Top actions you can take to save money and make your home more efficient

Recommended measures	Indicative cost	Typical savings over 3 years	Available with Green Deal
1 Increase loft insulation to 270 mm	£100 - £350	£141	✓
2 Cavity wall insulation	£500 - £1,500	£537	✓
3 Draught proofing	£80 - £120	£78	✓

See page 3 for a full list of recommendations for this property.

To find out more about the recommended measures and other actions you could take today to save money, visit **www.direct.gov.uk/savingenergy** or call **0300 123 1234** (standard national rate). When the Green Deal launches, it may allow you to make your home warmer and cheaper to run at no up-front cost.