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Bunching around a tax threshold: lessons from Scotland's small business bonus scheme

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Abstract

This article examines how thresholds in tax relief policies can create incentives for businesses to strategically sort around eligibility cut-offs. We study Scotland's Small Business Bonus Scheme, which provides full relief from business rates for non-domestic properties with rateable value below a fixed threshold, and partial relief above it. Using administrative data for the city of Glasgow (2009–2019), we estimate a regression discontinuity around the eligibility cut-off and find a higher concentration of active businesses below the 100% relief threshold. We then document a discontinuity in the distribution of periodic rateable value reassessments at the threshold, consistent with bunching. Indeed, while our regression discontinuity analysis indicates that the number of active businesses on either side of the cut-off differs in ways that could be suggestive of the policy's intended effects, these differences cannot be interpreted as clean causal effects because the identifying assumption of no manipulation is violated. The evidence instead points to strategic responses to policy design and highlights how hard thresholds in tax relief policies can incentivize manipulation around those thresholds and undermine regression discontinuity designs. Because eligibility here is based on administratively assessed property values, manipulation is less obviously expected than in settings where firms directly control the running variable, which makes the finding of bunching particularly significant. More broadly, the article highlights the challenges that threshold-based policies can pose for both policy implementation and empirical evaluation, with important implications for the design of similar tax policies.

Keywords Bunching · Tax thresholds · Tax relief policies · Small business taxation · Regression discontinuity design · Running variable manipulation

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1. Introduction

Governments frequently implement targeted tax relief schemes to support small businesses, stimulate local economic activity, and reduce compliance burdens (Sharma et al. 2025). These policies often rely on explicit eligibility thresholds that can lead otherwise similar businesses to fall into different tax treatment categories. Although administratively attractive, such thresholds can prompt strategic behavioral responses (Kleven 2016). This is because, when crossing a cut-off results in a jump in tax liability or the loss of a subsidy, businesses may have an incentive to take actions to prevent crossing the threshold and remain eligible for preferential treatment (Kuchumova et al. 2025; Harju and Rauhanen 2019; Best et al. 2015; Kleven and Waseem 2013). For instance, when eligibility for tax relief depends on an assessed variable, such as property value relative to a given threshold (as in the case study examined in this paper), business owners may have an incentive to hold off on renovations, upgrades, or maintenance that could raise the property's assessed value and bring it over the eligibility cut-off. Threshold-based tax relief policies and, more generally, policies with eligibility cut-offs can, therefore, distort the distribution of potentially eligible entities around these cut-offs and pose challenges for both policy implementation and the empirical evaluation of policy effects.

A growing literature studies this strategic behavior of businesses and individuals, focusing on "bunching," that is, whether economic agents cluster just below (or just above) tax or policy thresholds where incentives change discontinuously (for a review, see Kleven 2016). Most existing evidence comes from income taxation, value-added taxes, and taxable turnover thresholds, as well as policies in which firm size determines regulatory or tax treatment. Scholars document bunching by taxpayers (Kleven and Waseem 2013), business responses to size-dependent tax regimes and changes in the tax base (Best et al. 2015), and adjustments in reported R&D expenditures to qualify for tax advantages (Chen et al. 2021). Yet, one domain remains less explored: local business taxation. Business taxes are a major source of local government revenue in many countries and play a central role in financing municipal services. At the same time, local authorities frequently introduce exemptions and relief schemes to support smaller businesses, revitalize commercial districts, and promote local economic development, with consequences for business location decisions, entry, and survival (Rohlin et al. 2022, 2014; Feld and Kirchgässner 2003). Given the central role that small businesses play in local economies, understanding how these policies shape behavior is important for both economic outcomes and policy design.

Local business property taxation presents a particularly interesting setting for studying strategic responses to policy thresholds. Unlike income, sales, or turnover taxes, eligibility for relief is often determined by administratively assessed variables (property values in our case) rather than variables directly reported by firms. As a result, businesses cannot simply adjust factors like reported revenue or taxable income to remain eligible for preferential treatment. Any attempt to remain below or above a threshold may instead require more costly actions, such as foregoing property improvements, altering observable property characteristics, or pursuing formal appeals against an unfavorable assessment. Because this behavior is administratively burdensome and potentially costly, evidence of manipulation is less obviously expected than in many

of the settings examined in the bunching literature, where firms can directly control the running variable.

This feature raises an important question: can threshold-based incentives generate meaningful distortions even when the assignment variable is determined through administrative assessment rather than direct firm reporting? If so, any observed bunching around the threshold would suggest that the benefits associated with eligibility are large enough to justify costly efforts to secure it. More broadly, this would imply that tax relief schemes based on assessed values may create distortions not only in business activity, but also in the valuation process itself. Understanding these responses is thus important not only for local business taxation but also for the broader design of tax systems that rely on assessed values and hard eligibility cut-offs.

The answer to this question has broader policy relevance because property valuation and business rates remain central features of the UK economy and political debate, as well as of many other countries. Threshold-based relief schemes are attractive to policymakers because they are transparent, easy to administer, and politically visible. However, if firms respond by taking (counterintuitive) actions to remain on the favorable side of the eligibility cut-offs, these policies may distort investment decisions, alter valuation processes, and undermine the intended goals of tax relief. Studying whether and how such responses occur, therefore, provides insight into both the effectiveness and the unintended consequences of threshold-based tax policy design.

This article investigates this question by leveraging the introduction of the "Small Business Bonus Scheme" (SBBS) in Scotland in 2008. The scheme was designed to support small businesses, revitalize local commercial activity, and encourage growth of smaller enterprises by reducing their tax burden (see, for instance, Barclay 2017). The SBBS grants full relief from non-domestic rates (also known as "business rates"), a tax on businesses levied by local councils and based on the assessed rental value of their premises, to eligible properties with a rateable value below a fixed threshold, and partial relief to properties above that threshold. The "rateable value" is an administrative estimate of annual rental value used to determine business rates liability. During the period we study (2009–2019), properties with a rateable value below £15,000 qualified for 100% relief (i.e., full exemption from business rates), while those above the threshold received only partial relief (25%). This creates a clear notch point: crossing the threshold implies a discrete increase in businesses' average tax burden.

Using administrative data on non-domestic properties in Glasgow from 2009 to 2019, we first estimate a sharp regression discontinuity (RD) around the £15,000 threshold. The results show a higher concentration of active businesses below the threshold than above it. However, upon further investigation, we document patterns consistent with strategic behavior around the full relief cut-off. Specifically, periodic revaluations of business properties, which determine where businesses fall relative to the SBBS threshold, show that assessed values cluster just below or exactly at £15,000. This pattern is consistent with bunching around the eligibility cut-off and suggests strategic responses to the policy, in particular sorting around the business tax exemption threshold and, more generally, manipulation of the running variable (rateable value estimates). Thus, while a sharp RD design reveals a higher concentration of active businesses below the threshold, potentially consistent with the policy's intended effects, these differences cannot be interpreted as clean causal effects of the

scheme. Because the assignment variable appears to be manipulated near the cut-off, businesses on either side are not comparable in the way required for regression discontinuity identification. The observed differences, therefore, cannot be disentangled from endogenous responses to the threshold and may be driven by strategic behavior rather than the causal effect of the policy.

Our results speak to several substantive, theoretical, and policy considerations. First, they suggest that threshold-based tax relief schemes can generate meaningful distortions even when eligibility depends on administratively assessed values rather than variables directly reported by businesses. This finding is notable because businesses do not directly determine their rateable values, and efforts to remain below the eligibility threshold may require costly and even counterintuitive actions, such as foregoing property improvements, delaying maintenance, or otherwise seeking favorable classification. Our evidence of bunching around the threshold, therefore, suggests that the benefits associated with eligibility can be sufficiently large to induce strategic responses despite these costs. More broadly, the findings highlight how hard eligibility thresholds can shape behavior not only through the tax relief they provide, but also through the incentives they create to secure eligibility itself. In this sense, threshold-based policies may distort both economic activity and the administrative processes through which eligibility is determined. These results are particularly relevant for tax systems and other policies that rely on assessed values, where policymakers may assume that administrative determination limits opportunities for strategic behavior.

Theoretically, this study extends the bunching literature to local business taxation and to settings in which eligibility depends on administratively assessed values rather than directly reported variables such as income or sales. Empirically, the findings illustrate how strategic responses to policy thresholds can undermine causal inference in regression discontinuity designs. When businesses sort around a threshold or influence the assignment variable, observed discontinuities may reflect endogenous responses to policy design rather than the causal effect of the policy. Finally, the results carry implications for policy design and implementation. While hard eligibility thresholds might be attractive, they can create incentives for businesses to secure eligibility and generate unequal treatment among otherwise similar firms. More gradual phase-outs may reduce these distortions, albeit potentially at the cost of greater administrative complexity. The remainder of the paper proceeds as follows. In the next section, we briefly review some literature on tax thresholds, businesses' strategic responses, and bunching. Next, we discuss the institutional context and the terms of the Small Business Bonus Scheme, the tax relief policy implemented in Scotland that we leverage as our case study. We then introduce the data, research design, and RD results. The following section assesses the validity of the research design and presents evidence on strategic behavior around the threshold by testing for manipulation of the running variable. The final section discusses the implications of our findings.

2. Tax Thresholds, Strategic Behavior, and Bunching

This article speaks to three related literatures: research on bunching around policy thresholds, studies of businesses' responses to threshold-based tax regimes, and

scholarship on causal inference in threshold-based designs. Together, these literatures highlight how seemingly simple eligibility rules can generate strategic responses by businesses and individuals, with implications for both behavior and empirical identification.

The literature on bunching studies how economic agents respond to discontinuities in incentives created by taxes, transfers, and regulation. A key distinction is between kink points, where marginal incentives change, and notch points, where crossing a threshold leads to a jump in total tax liability, that is, tax liability changes discretely (Kleven 2016). Earlier work has used bunching around kinks in the U.S. tax system to estimate taxable income elasticities (Saez 2010). Using Danish administrative tax data, Chetty et al. (2011) show that observed responses at these kinks may understate underlying structural elasticities because adjustment costs, frictions, and limited salience dampen short-run responses.

Subsequent work emphasizes that notches often generate especially strong responses in tax settings, as crossing a threshold leads to a jump in average tax burdens. Kleven and Waseem (2013) demonstrate that notches can create stronger incentives than kinks because even small movements across the cut-off may trigger large changes in average tax liabilities. More recent studies highlight that responses to thresholds extend beyond simple bunching. Kuchumova et al. (2025) show that businesses may split operations to remain eligible for preferential treatment. Using evidence from Russia's Simplified Tax System, the authors argue that standard bunching estimates may understate the full distortions created by threshold-based tax regimes. Similarly, Chen et al. (2021) document behavioral responses to a notch in corporate taxation in China, where businesses receive discrete tax cuts once reported R&D intensity crosses a fixed threshold. They show that many businesses adjust their behavior to qualify for tax advantages by increasing reported R&D through a combination of real investment and relabeling existing expenses.

Recent work shows that businesses respond strongly to tax and regulatory thresholds tied to firm size. Harju and Rauhanen (2019) show that simplified tax regimes can reduce enforcement costs while distorting behavior near eligibility cut-offs. Best et al. (2015) further demonstrate that businesses respond not only to tax liabilities, but also to the compliance and administrative burdens associated with crossing thresholds. Together, these findings suggest that threshold-based policies can shape businesses' behavior through multiple channels beyond statutory tax rates alone. This paper builds on that framework by examining a setting where threshold responses would be less obviously expected. While most studies focus on thresholds based on income, revenue, or employment, that is, variables that firms can directly influence, we analyze a policy in which eligibility depends on administratively assessed property values. Because businesses do not directly determine these values, securing eligibility may require more costly actions, including altering property characteristics, delaying investments, or pursuing administrative appeals. This setting provides an opportunity to examine whether threshold incentives generate distortions even when manipulation is indirect and potentially costly.

The bunching literature also intersects with methodological work on regression discontinuity designs. RD strategies exploit treatment assignment rules based on thresholds and rely on the assumption that units cannot precisely manipulate the run-

ning variable, that is, the variable (continuous or discrete) that determines treatment eligibility based on a specific cut-off. When sorting or manipulation occurs, comparisons near the threshold may reflect endogenous selection rather than causal treatment effects (e.g., McCrary 2008). Most scholarship treats bunching and regression discontinuity as related but distinct approaches. RD designs are strongest when assignment variables cannot be manipulated or are difficult to manipulate, whereas bunching approaches are informative when agents can respond to policy thresholds. This paper highlights the tension between these two frameworks in the context of threshold-based tax relief schemes. Policies built around salient eligibility cut-offs may invite causal evaluation through threshold comparisons while also undermining those strategies by inducing strategic behavior around the same cut-off.

Overall, this article advances the existing literature in three ways. First, it broadens the theoretical scope by analyzing a notch tied to administratively assessed property values rather than conventional measures such as income or sales. Second, it connects research on threshold-based taxation to municipal finance and local economic development policy. Third, it contributes methodologically by showing how threshold-based business relief schemes provide useful settings for studying the relationship between behavioral responses and causal identification strategies. More broadly, we highlight that the consequences of tax relief schemes depend not only on the generosity of benefits, but also on the thresholds through which those benefits are allocated. We now turn to the institutional context and describe the Small Business Bonus Scheme and the system of business rates in Scotland.

3. Non-Domestic Properties and Business Rates in Scotland

To investigate how threshold-based tax relief policies operate in practice, we focus on a relief scheme implemented by the Scottish Government in 2008. In the United Kingdom, there are two types of property tax: the "council tax," pertaining to domestic properties, and the business tax, formally known as "non-domestic rates" (NDR), paid by business owners. The levy originated in the 16^{th} century as part of the efforts to fund poor relief, and the foundations of the modern Scottish system were established with the Lands Valuation Act (Scotland) 1854. The revenue generated with these charges helps fund local council services, with returns pooled nationally and redistributed among Scottish local authorities in the form of government grants based on criteria such as population and need.

Designated independent city assessors calculate the rateable value, an estimate of the annual market rent for each non-domestic property (e.g., shops, offices, public houses, etc.). Within the period covered in our study (2009–2019), rateable values were re-evaluated twice, in 2010 and 2017.[1] Ratepayers can dispute these evaluations

[1] Since 1990, non-domestic revaluations in Scotland were generally conducted every 5 years (1995, 2000, 2005, and 2010). However, the 2015 revaluation was postponed, resulting in a 7-year interval before the 2017 revaluation. Under the Non-Domestic Rates (Scotland) Act 2020, the Scottish Government transitioned to a 3-year revaluation cycle. Although initially delayed by the COVID-19 pandemic, this new cycle commenced in 2023, with the subsequent revaluation scheduled for 2026.

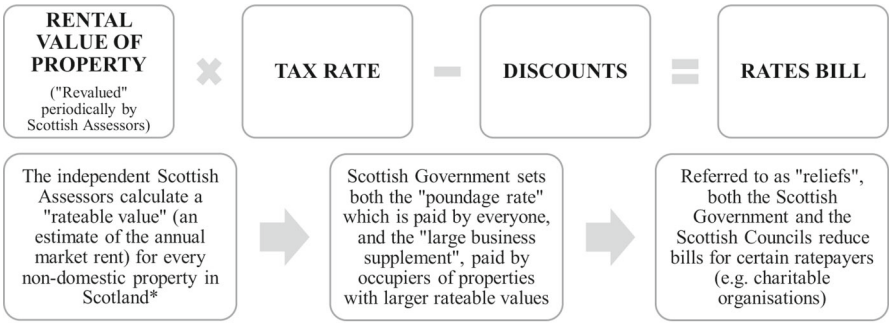

Fig. 1 How business rate bills are determined

Table 1 The small business bonus scheme

Rateable Value	NDR Relief
Up to £15,000	100%
£15,001–£18,000	25%
£18,001–£35,000	25%*

*Businesses with two or more properties with combined RV ≤ £35,000 qualify for a 25% discount on individual properties with RV ≤ £18,000

through a formal appeal process, a point we elaborate on later.[2] The actual tax liability is determined by multiplying the rateable value by the "poundage rate" set by the Scottish Government (48 pence in 2018/2019 for properties with a rateable value up to £51,000), as well as a "large business supplement" for higher-value properties, net of any reliefs introduced by national or local authorities. Figure 1 summarizes the calculation of non-domestic rates.

A tax relief scheme, the Small Business Bonus Scheme, was introduced by the Scottish Government in 2008. The policy provides that businesses with a cumulative rateable value up to £15,000 receive a 100% discount on non-domestic rates, effectively exempting them from the tax. Businesses with a rateable value between £15,001 and £18,000 receive a 25% discount instead. Finally, businesses with two or more properties with a combined rateable value of £35,000 or less qualify for a 25% relief on individual properties with a rateable value of £18,000 or below.[3]

Table 1 summarizes the terms of the SBBS during the period under study (2009–2019).

The SBBS setup is analytically important because it creates a discrete jump in average tax liability at £15,000. Businesses just below the threshold receive full relief, while those just above receive only partial relief. In the language of the bunching

[2] A description of the appeal process is available on the Scottish Assessors' Association website: https://www.saa.gov.uk/non-domestic-valuation/. Last accessed: 16 June 2026.

[3] The SBBS was reformed in 2023, introducing tapered relief for non-domestic properties with rateable value between £12,001 and £20,000 (with 100% relief only up to £12,000) and tightening eligibility, including the exclusion of certain property types (e.g., car parks).

literature, this constitutes a notch. At the same time, the institutional setting differs from many threshold-based tax policies studied in the existing literature because eligibility depends on rateable values assigned by independent assessors rather than on income, sales, or other variables directly reported by businesses. As a result, firms seeking to remain below the 100% discount threshold cannot simply adjust reported firm-level factors. Instead, any effort to secure eligibility must occur indirectly through actions that affect assessed property values or through formal administrative appeals. Consequently, evidence of bunching in this setting would suggest that the incentives created by the threshold are sufficiently strong to justify costly and even otherwise counterintuitive efforts to remain eligible for the full relief. We leverage this setup to examine whether business activity differs across the threshold and, subsequently, assess the extent to which any such differences may be driven by strategic responses around the cut-off.

4. Assessing the Impact of the Small Business Bonus Scheme

We begin with a standard regression discontinuity framework because the SBBS assigns treatment based on a sharp administrative threshold. However, as emphasized earlier, threshold-based tax policies may simultaneously invite causal evaluation and induce strategic behavior around the eligibility cut-off. Our empirical strategy proceeds in two steps: First, we estimate discontinuities in business activity; second, we assess whether the identifying assumptions required for causal interpretation are plausible, given the potential for strategic responses around the threshold documented in the literature.

We thus use a sharp regression discontinuity (RD) design to examine differences in business activity around the SBBS eligibility threshold. As anticipated, our design is "sharp" (as opposed to "fuzzy") because assignment to treatment is determined by a property's rateable value with certainty: businesses with a rateable value of £15,000 or less automatically receive a 100% discount (exemption) on non-domestic rates, while those above the threshold receive only partial relief. Our main data consist of administrative records on non-domestic rates for all properties operating in the Glasgow City area between 2009 and 2019. Between 2016 and 2019, approximately 82% of the net expenditure of the Glasgow City Council was funded by government grants (including, therefore, non-domestic rates).[4]

We focus on the case of Glasgow (rather than the other two major cities in Scotland, Edinburgh and Aberdeen) because of the city's relatively recent economic expansion, which makes it a comparatively attractive location for business activity. In addition, the Glasgow City Council maintains particularly detailed records, including information on active firms such as rateable value, location, age, and business property type. We compiled a dataset comprising all businesses with a rateable value between £12,000 and £18,000 for each year. This bandwidth allows us to focus on observations in the vicinity of the £15,000 threshold. We exclude properties benefiting from discounts

[4] Glasgow City Council Key Facts and Figures 2020-21: https://www.glasgow.gov.uk/media/6049/2020-21/pdf/Key_Facts_and_Figures_2020-21.pdf?m=1689328630780. Last accessed: 16 June 2026.

other than the SBBS (e.g., charitable organizations) to ensure a consistent treatment definition. Using postcodes, we match each property to one of the seven Westminster parliamentary constituencies within Glasgow, allowing us to compare business activity within consistent geographic units.[5]

We construct our outcome as the number of active businesses (i.e., properties recorded as occupied and liable for business rates) within £250 rateable value bins at the constituency-year level, which we refer to as "business activity." The unit of observation is thus the constituency-year-rateable value-bin cell, y_{ijk}, defined as the number of active businesses in bin k, constituency i, and year j.[6] This measure reflects the number of businesses observed as active in a given year, rather than firm-level entry, exit, or survival. Importantly, the administrative data provided by the Glasgow City Council includes only businesses that were active at the time of data extraction (2022). As a result, businesses that entered and exited prior to this date are not observed in the dataset. Accordingly, our outcome should be interpreted as a cross-sectional measure of business presence that may reflect a combination of entry and survival dynamics, but does not allow these components to be cleanly separated.

We examine differences in business activity across the SBBS eligibility threshold. Our dependent variable is the number of active businesses within each rateable value bin at the constituency-year level, as described above.[7] Eligibility for the 100% relief requires that a property's rateable value falls below £15,000. This threshold defines the cut-off separating the treatment group (businesses with rateable values between £12,000 and £15,000) from the control group (businesses with values between £15,001 and £18,000). Businesses in the treatment group, therefore, receive a full exemption from non-domestic rates, whereas those in the control group receive only partial relief (25%). Under the standard assumptions of a regression discontinuity design, a discontinuity in business activity at the cut-off could be interpreted as evidence of a causal effect of the policy. We first estimate this discontinuity and then examine whether the design's identifying assumptions hold in this setting.

Building on Blundell and Dias (2009), our formal setup is as follows. Under a sharp design, the treatment assignment at the cut-off is:

$$\begin{array}{l} \lim_{r \to r^{*-}} P(d = 1|r) = 1 \\ \lim_{r \to r^{*+}} P(d = 1|r) = 0 \end{array}, \tag{1}$$

where the limits are taken as the running variable r approaches the cut-off r^* from below and above, respectively. That is, the probability of being assigned to treatment (100% relief), conditional on a business' rateable value, changes discontinuously at r^* (£15,000), from 1 to 0. In our specific case, the running variable is the bin's rateable value interval, which determines where businesses in constituency i in year j fall relative to the SBBS threshold (r_{ijk}). Importantly, two assumptions are required for

[5] These are the constituencies used for UK Parliament general elections: Glasgow Central, Glasgow East, Glasgow North, Glasgow North East, Glasgow North West, Glasgow South, and Glasgow South West.

[6] See the Appendix for further details on the construction of the dataset.

[7] Ideally, one would consider more fine-grained measures such as birth/death ratio of small businesses, their survival rate, or their survival duration. However, such data are not available in our setting and cannot be obtained through a Freedom of Information (FOI) request.

identification. First, the continuity assumption requires that, in the absence of treatment, the outcome would evolve smoothly around the threshold, so that observations just above the cut-off provide a valid counterfactual for those just below it. In practice, this implies that businesses on either side of the threshold are comparable in their underlying characteristics, differing only in their eligibility for the tax relief. Second, assignment to treatment must be a deterministic function of the running variable r, and businesses must not be able to precisely manipulate their position relative to the threshold. In other words, eligibility for the 100% tax discount must be determined solely by r, without strategic sorting around the cut-off.

Considering the potential outcome framework, we have:

$$\begin{array}{l} y_{ijk}^{1} = \alpha + \tau_{ijk} + \epsilon \\ y_{ijk}^{0} = \alpha + \epsilon \end{array}, \tag{2}$$

where y_{ijk} represents our outcome, a count. As anticipated, this is the number of active businesses with a rateable value in bin k, in constituency i, in year j (business activity), and τ_{ijk} represents the treatment effect for active businesses in rateable value bin k, in constituency i, in year j. Put simply, each observation is: how many active businesses fall into rateable value bin k in constituency i in year j. Of course, these potential outcomes are not jointly observed. Instead, we observe:

$$y_{ijk} = d_{ijk} y_{ijk}^{1} + (1 - d_{ijk}) y_{ijk}^{0} \rightarrow y_{ijk} = \alpha + \tau_{ijk} d_{ijk} + \epsilon, \tag{3}$$

where d_{ijk} is the treatment indicator:

$$d_{ijk} = \begin{cases} 1 \text{ if } £12000 \leq r_{ijk} \leq £15000 \\ 0 \text{ if } £15001 \leq r_{ijk} \leq £18000 \end{cases}. \tag{4}$$

In practice, we group businesses into £250 rateable value bins (k) based on a business's assessed rateable value. As mentioned earlier, the running variable used in our RD models is, therefore, r_{ijk}: the bin's rateable value interval, which determines where businesses in constituency i in year j fall relative to the SBBS threshold. To be clear, the RD is not using firm-level outcomes directly as the running variable. It is using the binned rateable value scale that places each bin on one side or the other of the threshold. Figure 2 provides an initial descriptive illustration of the data. The dots represent the number of active businesses in each rateable value bin across the seven Westminster constituencies in Glasgow in 2019, while the fitted lines correspond to local regressions on either side of the £15,000 cut-off. The figure shows a clear discontinuity in business activity at the cut-off, with a higher number of active businesses below the threshold relative to above it. While this pattern might be consistent with the intended effects of the policy, it may also reflect strategic sorting or manipulation around the threshold. We next turn to formal regression discontinuity estimates before assessing whether the identifying assumptions of the design are satisfied in this setting.

We estimate regression discontinuity specifications to examine differences in business activity at the £15,000 eligibility threshold using the "rdrobust" R package

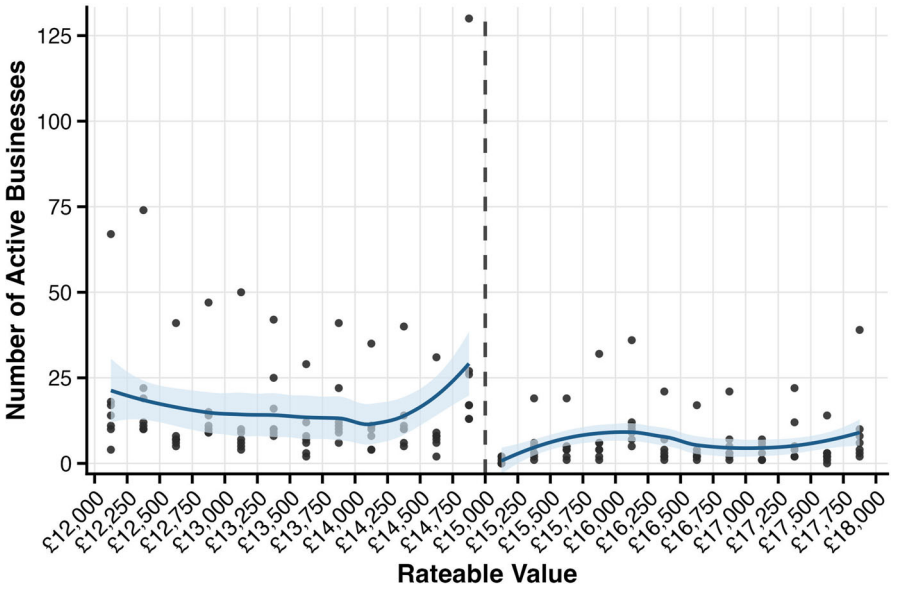

Fig. 2 Discontinuity in the Number of Active Businesses Around £15,000 in 2019. *Note*: The vertical dashed line marks the £15,000 cut-off (treatment threshold). Rateable values range from £12,000 to £18,000 in £250 intervals. Each point represents the number of active businesses within a given interval for one of the seven parliamentary constituencies in the city of Glasgow

developed by Calonico et al. (2015). The analysis is implemented using local polynomial regressions with a triangular kernel and coverage error-optimal bandwidth selection, and we report bias-corrected estimates with robust inference following Calonico, Cattaneo and Titiunik (Calonico et al. 2014, 2015), Calonico et al. (2019), and Calonico et al. (2020). To account for potential area-level heterogeneity, we include constituency dummies as covariates in the estimation. Figure 3 shows the estimated discontinuity in business activity at the £15,000 eligibility threshold for each year between 2009 and 2019, plotting the robust bias-corrected point estimates together with 90% confidence intervals. To provide a complete picture of the estimation results, Table 2 in the Appendix reports the conventional, bias-corrected, and robust numerical estimates, along with their corresponding standard errors and bandwidth choices for the full sample.[8]

A clear pattern emerges from the figure. In every year, the estimated discontinuity is negative, implying that the number of active businesses is systematically higher just below the threshold than just above it. Moreover, the magnitude of this difference increases over time. In 2009, the estimated gap at the cut-off was approximately 15 businesses, whereas by 2019, it exceeded 50 businesses. The confidence intervals also indicate that the discontinuity is statistically distinguishable from zero throughout the period. Taken together, the figure points to a persistent and increasingly pronounced concentration of business activity on the left-hand side of the threshold.

[8] For robustness, we also present estimates with standard errors clustered by constituency in Table 3 in the Appendix. The results are consistent.

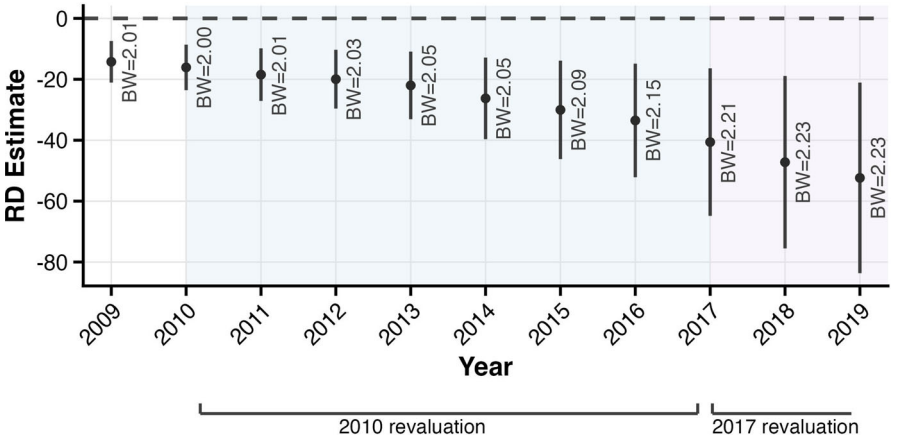

Fig. 3 RD Estimates by Year (2009–2019). *Note*: Robust bias-corrected, covariate-adjusted sharp RD estimates using local polynomial regression. The order of the local-polynomial used to construct the point-estimator is the rdrobust default $p = 1$ (local linear regression). The order of the local-polynomial used to construct the bias-correction is the rdrobust default $q = 2$ (local quadratic regression) (see Calonico et al. 2014, 2015, 2019). Triangular kernel. Bandwidths (BWs) are selected using one common coverage error rate (CER)-optimal bandwidth selector for the RD treatment effect estimator (see Calonico et al. 2014, 2020). Heteroskedasticity-robust nearest neighbor variance estimator. 90% confidence intervals

This pattern suggests that the threshold matters substantively. Businesses are much more concentrated on the side of the cut-off that qualifies for the 100% relief than on the side that qualifies only for the 25% discount, and this difference becomes larger over time. One possible interpretation is that the more generous tax relief increases business activity below the threshold by making it easier for small businesses to operate or survive. Another is that the threshold creates incentives for businesses, assessors, or both to secure or boost eligibility by keeping assigned rateable values just below £15,000. This would imply that the scheme may encourage strategic behavior around the eligibility rule rather than simply supporting business activity. Figure 3, therefore, shows a large and persistent difference in business activity at the threshold, but, on its own, it cannot tell us which of these explanations is driving the result. For that reason, in the next section, we turn to the identifying assumptions of the design.

5. Continuity and Manipulation Around the Treatment Threshold

This section shifts the focus from treatment effects to threshold responses, asking whether the policy altered the distribution of the running variable itself. A key identifying assumption of the regression discontinuity design is continuity of potential outcomes at the treatment threshold. In our setting, this means that, absent the policy, business activity should vary smoothly around the £15,000 cut-off, so that businesses just below and just above the threshold are comparable in their underlying characteristics. If this condition holds, any discontinuity in business activity at the threshold could, in principle, be attributed to the change in tax relief. If it does not hold, then

Fig. 4 Distribution of Businesses Across Constituencies by Rateable Value Band. *Note*: The top panels display the number of active businesses in each constituency by rateable value (RV) band in 2019 (counts in parentheses). The bottom panels show the distribution of business types within each constituency. Shares are calculated within constituency-RV bands. The six most common business types are shown; all remaining types are grouped under "Other"

the observed jump may instead reflect systematic differences between businesses on either side of the cut-off.

A natural concern is that businesses on either side of the threshold may differ in ways other than their eligibility for tax relief. Two particularly relevant dimensions are geography and business distribution. Location matters because business activity may vary systematically across different parts of Glasgow depending on factors such as proximity to the city center, local demand, or neighborhood characteristics. To address this, as explained above, we matched each property to one of Glasgow's seven Westminster constituencies and included constituency dummies in the regression discontinuity specifications. This allows us to account for broad spatial differences across the city, while recognizing that finer-grained location differences within constituencies may still remain.

A second concern is that the composition of businesses may differ across the threshold. Although the Glasgow City Council does not record business sector directly, the data do include brief property descriptions. Figure 4 reports the distribution of businesses across constituencies by rateable value band and, in the bottom panel, the share

of business types within each constituency-band cell. The figure suggests some variation in composition across constituencies and across the two bands, but it does not point to a sharp break in observable property types at the £15,000 threshold. Table 4 in the Appendix provides the corresponding descriptive statistics and shows that "office" and "shop" are the most common property descriptions on both sides of the cut-off. To further assess whether the main results are being driven by compositional differences, we re-estimate the regression discontinuity specifications using only shops and offices, the two most common property categories. As reported in Table 5 in the Appendix, the estimates are consistent with those obtained for the full sample. Taken together, these patterns reduce concern that the discontinuity is driven solely by differences in observable property composition around the threshold.

Another key concern in regression discontinuity designs is manipulation of the running variable. In our setting, this would mean that properties are disproportionately placed just below the £15,000 threshold that determines eligibility for the 100% relief. If that occurs, businesses just below and just above the cut-off are no longer comparable in the way required for a clean causal interpretation. The discontinuity in business activity could then reflect not only the effect of the policy, but also strategic sorting or administrative adjustment around the threshold. Our main dataset does not allow us to test this directly. In the regression discontinuity analysis, the outcome is the number of active businesses within rateable value bins, whereas the concern here is whether the running variable itself is unusually concentrated around the treatment threshold. To assess this, we obtained records of all revaluations conducted by the independent Scottish Assessors in 2017. This dataset allows us to examine whether assigned rateable values are disproportionately concentrated just below the eligibility cut-off.

To evaluate this possibility, we follow McCrary (2008) and implement manipulation testing using the local polynomial density estimators (Cattaneo and Ma 2020). We use the 2017 rateable value estimates to run a density test on a sample of business revaluations valued between £12,000 and £18,000. The intuition is straightforward: if assignment around the threshold is as-if random, the density of rateable values should be smooth at the cut-off. By contrast, a discontinuity in the density of rateable value revaluations at £15,000 would indicate that properties are disproportionately assigned to one side of the threshold. In our setting, such a pattern would be consistent with strategic sorting by businesses, discretionary assessment by assessors, or both.

Figure 5 displays the density of 2017 revaluations around the £15,000 threshold together with 95% uniform confidence bands alongside a histogram of the underlying data. We find a clear discontinuity at the cut-off, with excess mass at and just below £15,000. The null hypothesis of continuity is rejected ($p<0.001$), indicating that rateable values are not smoothly distributed around the threshold. This suggests that assignment to the 100% relief is unlikely to be as-if random and that the discontinuity in business activity cannot be given a clean causal interpretation.

The density result is thus substantively important in its own right. It suggests that the £15,000 threshold is not merely an administrative boundary, but a salient target around which businesses, assessors, or both may adjust behavior. Once eligibility for a 100% exemption is tied to falling just below a fixed cut-off, even small differences in assigned rateable value can carry meaningful financial consequences. In that setting, the policy

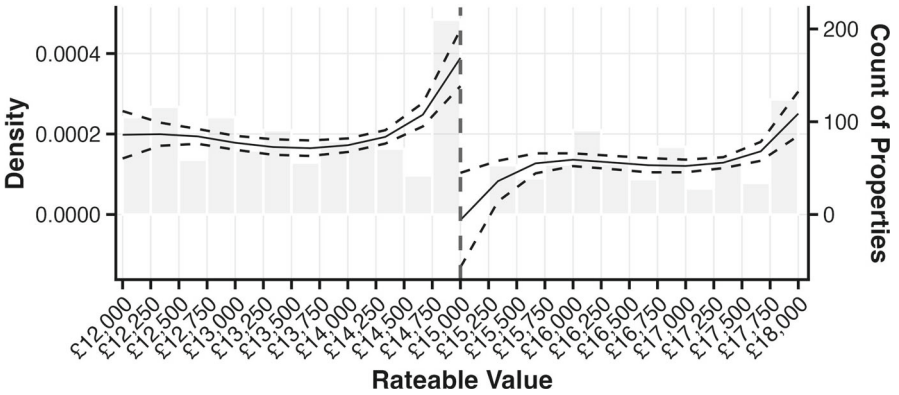

Fig. 5 Local Polynomial Density of 2017 Revaluations. *Note*: The solid line shows the local polynomial density estimate (Cattaneo and Ma 2020) on either side of the cut-off, with dashed lines indicating 95% uniform confidence bands obtained via simulation (2,000 replications) (Cattaneo and Ma 2022, 2024). The histogram displays the distribution of revaluations (count of properties) using £250 bins. The vertical dashed line marks the £15,000 eligibility threshold

may generate incentives not only to operate differently, but also to secure classification on the more favorable side of the threshold. The bunching we document, therefore, provides insight into how threshold-based tax relief schemes work in practice: They may shape outcomes not only through the relief they provide, but also through the strategic responses they might induce.

Several mechanisms could be behind this pattern. First, businesses themselves have incentives to remain below the threshold. Because eligibility for a full exemption depends on a discrete cut-off, even small differences in assigned rateable value can have large financial implications. This creates incentives not only to contest valuations through formal appeals but also to influence the inputs into the valuation process. In practice, this may involve holding off on renovations, upgrades, or maintenance that could raise the property's assessed value or, more generally, adjusting observable characteristics of the property in ways that could result in lower assessed values.

The appeals process provides one institutional channel through which businesses may affect their position relative to the threshold. We do not have statistics on appeals for the specific rateable value range considered in our study (£12,000 to £18,000). However, in the Glasgow area as a whole, 39% of properties appealed following the 2017 revaluation. As of September 2021, 22.4% of those appeals had resulted in a change in rateable value, with an average reduction of 10.3% relative to the original estimate. At the same time, the fact that 39% of the properties that appealed account for 75.6% of the total rateable value in Glasgow suggests that larger firms are the main drivers of these figures. This does not rule out a role for appeals, but it suggests some caution in attributing the observed pattern solely to this channel.[9]

Second, assessors may also play a role. Given that properties close to the threshold are more likely to generate appeals or disputes, assessors may face incentives to

[9] Non-Domestic Rates Revaluation Appeals Statistics: https://www.gov.scot/publications/non-domestic-rates-revaluation-appeals-statistics/. Last accessed: 16 June 2026.

avoid contentious classifications for knife-edge cases. In practice, this may lead to a tendency to assign borderline properties to the more favorable side of the cut-off, particularly when valuation involves some degree of judgment. More broadly, assessors operate within a local economic environment in which business owners play a central role. In such settings, there may be a general tendency to accommodate businesses in borderline cases, particularly when the classification of a property is not clear-cut. Additionally, because business owners are often cohesive and influential actors in local communities, this may create incentives and pressures to avoid assigning borderline properties to the less favorable side of the threshold. While we cannot directly observe such behavior, this provides one plausible mechanism consistent with the observed bunching below the cut-off.

Finally, it is worth noting that the first year in our sample (2009) precedes the 2010 revaluation. This suggests that the 2009 discontinuity is less likely to reflect adjustments in rateable value assignments associated with revaluation and assessors' incentives. However, because the SBBS was rolled out in 2008 and businesses were already exposed to the threshold, strategic responses may still have been present, and the 2009 estimate cannot be interpreted as completely free from manipulation.

6. Conclusion

This paper examines how threshold-based tax relief policies shape behavior around eligibility rules. Using a regression discontinuity design, we document a sizable and persistent difference in business activity at the £15,000 threshold that determines eligibility for full relief under Scotland's Small Business Bonus Scheme. However, we show that this discontinuity cannot be interpreted as a clean causal effect of the policy.

Evidence from the distribution of rateable value revaluations indicates a clear discontinuity at the eligibility cut-off, with excess mass at and just below £15,000. This pattern suggests that assignment to the tax exemption is not as-if random, but may instead reflect systematic responses to the incentives created by the threshold. As a result, the observed difference in business activity across the cut-off may capture not only the intended effects of the policy (if any), but also strategic responses to policy design.

The findings contribute to the literature on tax notches and bunching by extending the analysis to local business property taxation. Existing research has largely focused on income taxation, value-added taxes and taxable turnover thresholds, or policies where eligibility depends on revenues, profits, or employment. By contrast, the SBBS relies on administratively assessed property values. Our results suggest that even when treatment depends on characteristics determined by administrative assessment, salient cut-offs can create incentives to bunch just below the eligibility boundary. More broadly, consequences of tax relief schemes depend not only on the generosity of benefits, but also on the thresholds through which those benefits are allocated.

The paper also contributes methodologically. Threshold-based policies are often attractive settings for causal inference because treatment assignment is determined by clearly pre-specified rules. Yet, the same thresholds that make regression discontinuity

designs appealing may also induce strategic behavior that undermines their identifying assumptions. In this sense, bunching and regression discontinuity approaches are closely related but conceptually distinct. Our results highlight this tension and underscore the importance of testing for manipulation before interpreting discontinuities as causal effects.

These findings also carry implications for policy design. Hard eligibility thresholds are politically appealing because they are transparent, visible and easy to communicate, and straightforward to administer. Yet, they may create incentives for businesses to secure eligibility by remaining on the preferential side of a cut-off rather than by expanding productive activity. Our findings suggest that these distortions can arise even when eligibility depends on administratively assessed values that firms do not directly control, indicating that policymakers may overestimate the extent to which administrative assessment protects threshold-based policies from strategic responses. When many businesses cluster just below a threshold, nearly identical firms may face sharply different tax burdens depending on small differences in classification. This can reduce neutrality, distort economic decisions, and weaken the goals of the policy itself. Policymakers may, therefore, wish to consider smoother phase-outs or graduated relief schedules that preserve assistance while reducing incentives for strategic responses.

Finally, while our analysis provides evidence consistent with strategic behavior around the threshold, it cannot fully disentangle the relative importance of the mechanisms at play. Future research could explore these channels more directly. For example, linking administrative data on revaluations with more detailed information on appeals would allow researchers to assess the role of formal challenges in shaping outcomes near the cut-off. More granular data on property characteristics could help identify whether businesses adjust observable features and their operations in response to tax incentives. Additional work could also examine whether similar patterns arise in other settings, helping to establish how general these dynamics are. More broadly, understanding how administrative discretion interacts with policy design remains an important avenue for future research.

APPENDIX

Bunching Around a Tax Threshold: Lessons from Scotland's Small Business Bonus Scheme

Table 2 RD Estimates (Main Models)

	Conventional	Bias-corrected	Robust	BW Est	BW Bias
2009	−13.14*** (3.75)	−14.25*** (3.75)	−14.25*** (4.15)	2.01	4.95
2010	−14.86*** (4.11)	−16.09*** (4.11)	−16.09*** (4.54)	2.00	4.95
2011	−17.07*** (4.74)	−18.47*** (4.74)	−18.47*** (5.25)	2.01	4.96
2012	−18.43*** (5.31)	−19.96*** (5.31)	−19.96*** (5.87)	2.03	4.96
2013	−20.29*** (6.12)	−22.00*** (6.12)	−22.00*** (6.75)	2.05	4.99
2014	−24.21*** (7.37)	−26.26*** (7.37)	−26.26*** (8.14)	2.05	4.96
2015	−27.71*** (8.90)	−30.03*** (8.90)	−30.03*** (9.83)	2.09	4.97
2016	−31.07*** (10.30)	−33.51*** (10.30)	−33.51*** (11.34)	2.15	5.07
2017	−37.64*** (13.39)	−40.61*** (13.39)	−40.61*** (14.73)	2.21	5.11
2018	−43.93*** (15.66)	−47.22*** (15.66)	−47.22*** (17.21)	2.23	5.13
2019	−48.71*** (17.32)	−52.37*** (17.32)	−52.37*** (19.02)	2.23	5.15
Constituency Dummies (Ref. Glasgow Central)	✓	✓	✓		
Observations	168	168	168		

Conventional/bias-corrected/robust, covariate-adjusted sharp RD estimates using local polynomial regression. The order of the local-polynomial used to construct the point-estimator is the rdrobust default $p = 1$ (local linear regression). The order of the local-polynomial used to construct the bias-correction is the rdrobust default $q = 2$ (local quadratic regression) (see Calonico et al. 2014, 2015, 2019). Triangular kernel. Heteroskedasticity-robust nearest neighbor variance estimator. Standard errors in parentheses. Bandwidths (BWs) are selected using one common coverage error rate (CER)-optimal bandwidth selector for the RD treatment effect estimator (see Calonico et al. 2014, 2020). ***p<0.01, **p<0.05, *p<0.10

Table 3 RD Estimates (Standard Errors Clustered by Constituency)

	Conventional	Bias-corrected	Robust	BW Est	BW Bias
2009	−13.14*** (3.95)	−14.17*** (3.95)	−14.17*** (4.26)	2.17	5.48
2010	−14.86*** (4.40)	−15.97*** (4.40)	−15.97*** (4.74)	2.17	5.51
2011	−17.07*** (5.12)	−18.35*** (5.12)	−18.35*** (5.52)	2.18	5.49
2012	−18.43*** (5.72)	−19.79*** (5.72)	−19.79*** (6.16)	2.20	5.52
2013	−20.29*** (6.61)	−21.73*** (6.61)	−21.73*** (7.11)	2.29	5.57
2014	−24.21*** (8.09)	−26.07*** (8.09)	−26.07*** (8.72)	2.23	5.47
2015	−27.71*** (9.69)	−29.81*** (9.69)	−29.81*** (10.46)	2.21	5.48
2016	−31.07*** (11.25)	−33.17*** (11.25)	−33.17*** (12.12)	2.30	5.56
2017	−37.64** (14.73)	−40.22*** (14.73)	−40.22** (16.01)	2.25	5.57
2018	−43.93** (17.32)	−46.74*** (17.32)	−46.74** (18.79)	2.30	5.58
2019	−48.71** (19.07)	−51.63*** (19.07)	−51.63** (20.50)	2.40	5.67
Constituency Dummies (Ref. Glasgow Central)	✓	✓	✓		
Observations	168	168	168		

Note: Conventional/bias-corrected/robust, covariate-adjusted sharp RD estimates using local polynomial regression. The order of the local-polynomial used to construct the point-estimator is the rdrobust default $p = 1$ (local linear regression). The order of the local-polynomial used to construct the bias-correction is the rdrobust default $q = 2$ (local quadratic regression) (see Calonico et al. 2014, 2015, 2019). Triangular kernel. Heteroskedasticity-robust nearest neighbor variance estimator. Standard errors clustered by constituency in parentheses. Bandwidths (BWs) are selected using one common coverage error rate (CER)-optimal bandwidth selector for the RD treatment effect estimator (see Calonico et al. 2014, 2020). ***p<0.01, **p<0.05, *p<0.10

Table 4 Descriptive Statistics by Property Description (2009–2019)

£12,000 ≤ Rateable Value ≤ £15,000					£15,001 ≤ Rateable Value ≤ £18,000				
Property Description	Min	Max	Mean	Count	Property Description	Min	Max	Mean	Count
ADVERTISING STATION	12240	14900	13247.00	5	ADVERTISING STATION	15550	17650	16600.00	2
BANK	12400	14400	13428.57	7	BANK	15700	17000	16350.00	2
BETTING OFFICE	12500	15000	14150.00	14	BETTING OFFICE	15400	18000	16628.57	7
CAFE	12500	15000	14433.33	6	CAFE	15800	18000	16866.67	6
CAR PARK	12000	15000	13500.00	2	CAR PARK	15200	17600	16400.00	2
CAR SPACE	12000	14400	13425.00	4	CAR SPACE	18000	18000	18000.00	1
CAR SPACES	12000	15000	13088.00	25	CAR SPACES	15400	18000	16445.00	20
CAR WASH	12000	12000	12000.00	5	CHURCH	16500	17500	17066.67	3
CAR WASH ETC	12000	12000	12000.00	1	COMMUNITY CENTRE	15200	18000	16333.33	3
CHURCH	12000	14900	13433.33	3	DAY NURSERY	16200	17900	17250.00	4
CHURCH ETC	13700	14800	14250.00	2	FACTORY	17400	18000	17800.00	3
CLINIC	12300	12300	12300.00	1	FACTORY ETC	17600	17600	17600.00	1
CLUB	12400	13000	12675.00	4	FILLING STATION	16100	16100	16100.00	1
CRECHE	12000	12000	12000.00	1	GARAGE	15600	15600	15600.00	1
DAY NURSERY	12800	15000	13783.33	6	GARAGE ETC	15400	15400	15400.00	1
DEPOT	12800	13300	13050.00	2	GUEST HOUSE	15300	15300	15300.00	1
DISTRICT HEATING FACILITY	13000	13000	13000.00	1	GYMNASIUM	17300	17300	17300.00	1
FACTORY	12000	13400	12600.00	4	HALL ETC	16600	16600	16600.00	1
FOOTBALL GROUND ETC	14300	14300	14300.00	1	HOSTEL	18000	18000	18000.00	1
GARAGE	12400	14900	13637.50	8	KIOSK	15500	16500	16000.00	2
GARAGE ETC	12300	14700	13566.67	3	LICENSED RESTAURANT	15400	17900	16761.11	9
GUEST HOUSE	12000	12000	12000.00	1	MARKET	16900	16900	16900.00	1

Table 4 continued

£12,000 ≤ Rateable Value ≤ £15,000					£15,001 ≤ Rateable Value ≤ £18,000				
Property Description	Min	Max	Mean	Count	Property Description	Min	Max	Mean	Count
GYMNASIUM	12700	14800	13700.00	3	**OFFICE**	**15400**	**18000**	**16698.15**	**108**
HALL	12100	14700	13650.00	4	OFFICE ETC	17600	17900	17750.00	2
HALL ETC	14600	14600	14600.00	1	OFFICES	16500	17700	17220.00	5
HOME	12000	13300	12650.00	2	OFFICES ETC	15600	15600	15600.00	1
HOTEL	15000	15000	15000.00	1	PLAY BARN	18000	18000	18000.00	1
KIOSK	12500	12500	12500.00	1	PUBLIC HOUSE	15300	18000	16770.00	20
LABORATORY	12600	14000	13300.00	2	RESTAURANT	15400	18000	16814.29	7
LAUNDRY	12800	12800	12800.00	1	SALON	15900	15900	15900.00	1
LICENSED RESTAURANT	12000	15000	13796.43	28	SERVICE STATION	16200	16200	16200.00	1
LICENSED RESTAURANT ETC	13300	13300	13300.00	1	**SHOP**	**15100**	**18000**	**16820.63**	**160**
OFFICE	**12000**	**15000**	**13565.60**	**266**	SHOWHOUSE	15100	15100	15100.00	1
OFFICE ETC	13800	14900	14325.00	4	SHOWROOM	16100	18000	17200.00	4
OFFICES	12000	14900	13690.91	11	SHOWROOM ETC	15500	16500	16000.00	2
POLICE STATION	14200	14200	14200.00	1	SITE OF AUTOTELLER	16250	17500	16386.36	55
PUBLIC HOUSE	12000	15000	13979.17	24	STORE	15400	18000	16700.00	25
PUBLIC TOILET	13600	13600	13600.00	1	STORE ETC	16000	17200	16666.67	3
RELIGIOUS CENTRE	13600	13600	13600.00	1	STUDIO	15400	18000	16700.00	2
RESTAURANT	12400	15000	13264.29	14	SURGERY	15700	17300	16466.67	9
SALON	12700	14400	13650.00	4	TRAINING CENTRE	17500	17500	17500.00	1
SELF CATERING UNIT	14000	14000	14000.00	1	WAREHOUSE	15400	18000	16778.26	23
SHOP	**12000**	**15000**	**13519.19**	**297**	WORKSHOP	15400	18000	16590.63	32

Table 4 continued

£12,000 ≤ Rateable Value ≤ £15,000					£15,001 ≤ Rateable Value ≤ £18,000				
Property Description	Min	Max	Mean	Count	Property Description	Min	Max	Mean	Count
SHOP ETC	12200	15000	13558.33	6	WORKSHOP ETC	16100	17800	16833.33	3
SHOWROOM	12000	15000	13785.71	7	YARD	15800	17300	16400.00	3
SHOWROOM ETC	12000	12000	12000.00	1	YARD ETC	16600	16600	16600.00	1
SITE OF AUTOTELLER	14625	14625	14625.00	2					
SITE OF STALL	15000	15000	15000.00	1					
SNOOKER CLUB	13900	13900	13900.00	1					
STORE	12000	15000	13702.33	86					
STORE ETC	12400	15000	13500.00	4					
STORES ETC	12400	14900	13266.67	3					
STUDIO	12700	15000	13820.00	10					
SURGERY	12100	15000	13547.37	19					
SURGERY ETC	12400	12400	12400.00	1					
TRAINING CENTRE	12300	14200	13250.00	2					
WAREHOUSE	12000	15000	13764.10	39					
WAREHOUSE ETC	12900	15000	13660.00	5					
WORKSHOP	12000	15000	13686.02	93					
WORKSHOP ETC	12000	14400	13384.62	13					
YARD	12500	14600	13871.43	7					
YARD ETC	13800	13900	13850.00	2					
Total	12000	15000	13581.03	1076	Total	15100	18000	16702.39	543

Note: Property description as recorded by the Glasgow City Council. All properties with RV between £12,000 and £18,000 are included

Table 5 RD Estimates (Shops and Offices)

	Conventional	Bias-corrected	Robust	BW Est	BW Bias
2009	−10.07*** (2.90)	−11.00*** (2.90)	−11.00*** (3.23)	1.97	4.84
2010	−11.50*** (3.24)	−12.53*** (3.24)	−12.53*** (3.60)	1.98	4.87
2011	−13.79*** (3.85)	−15.01*** (3.85)	−15.01*** (4.28)	1.98	4.87
2012	−14.71*** (4.27)	−16.03*** (4.27)	−16.03*** (4.74)	2.00	4.90
2013	−16.86*** (5.12)	−18.43*** (5.12)	−18.43*** (5.67)	2.02	4.93
2014	−20.57*** (6.16)	−22.51*** (6.16)	−22.51*** (6.83)	2.00	4.89
2015	−22.86*** (6.94)	−25.08*** (6.94)	−25.08*** (7.71)	1.96	4.82
2016	−25.57*** (8.04)	−27.91*** (8.04)	−27.91*** (8.89)	2.02	4.92
2017	−30.71*** (10.72)	−33.55*** (10.72)	−33.55*** (11.82)	2.10	5.01
2018	−35.93*** (12.57)	−39.20*** (12.57)	−39.20*** (13.85)	2.10	5.03
2019	−40.64*** (14.26)	−44.30*** (14.26)	−44.30*** (15.69)	2.11	5.05
Constituency Dummies (Ref. Glasgow Central)	✓	✓	✓		
Observations	168	168	168		

Note: Conventional/bias-corrected/robust, covariate-adjusted sharp RD estimates using local polynomial regression. The order of the local-polynomial used to construct the point-estimator is the rdrobust default $p = 1$ (local linear regression). The order of the local-polynomial used to construct the bias-correction is the rdrobust default $q = 2$ (local quadratic regression) (see Calonico et al. 2014, 2015, 2019). Triangular kernel. Heteroskedasticity-robust nearest neighbor variance estimator. Standard errors in parentheses. Bandwidths (BWs) are selected using one common coverage error rate (CER)-optimal bandwidth selector for the RD treatment effect estimator (see Calonico et al. 2014, 2020). ***p<0.01, **p<0.05, *p<0.10

Data Construction and Cleaning Procedures

This appendix describes in detail how the final dataset was constructed from the raw administrative records provided by Glasgow City Council. The goal of the data preparation process was to generate a dataset of business properties in Glasgow to examine differences in business activity around the £15,000 eligibility threshold of Scotland's Small Business Bonus Scheme (SBBS). The final outcome variable used in the empirical analysis is the number of active businesses within rateable value bins, by parliamentary constituency and year.

Raw Administrative Data

The original source data consist of annual administrative records on non-domestic properties liable for business rates in Glasgow between 2009 and 2019. Each record corresponds to a business property rather than a firm-level corporate entity. The raw files contain information on:

- Property address and postcode
- Rateable value
- Relief status and discount category
- Occupancy status
- Property description/type (office, shop, etc.)
- Year of observation
- Additional billing and classification variables

Because the data are property-based administrative records, a business operating multiple premises may appear more than once. Conversely, the dataset does not contain businesses that entered and exited before the extraction date if they were no longer active in the administrative register. Accordingly, the final dataset should be interpreted as a snapshot of observed active businesses rather than a complete universe of firm histories.

Restricting the Sample to Relevant Properties

Because the empirical analysis focuses on behavior around the SBBS threshold, the sample was restricted to observations close to the policy cut-off. We retained only business properties with rateable values between:

$$£12{,}000 \leq \text{Rateable Value} \leq £18{,}000$$

This bandwidth captures properties sufficiently close to the £15,000 threshold while maintaining observations on both the treatment side (full relief) and control side (partial relief). Properties far from the threshold were excluded because they are less comparable and less relevant for local identification.

Defining Eligible and Non-Eligible Properties

The SBBS assigns relief based on rateable value. Using the administrative records, properties were coded into treatment categories as follows:

- **Treatment group:** £12,000 $\leq$ Rateable Value $\leq$ £15,000, eligible for 100% relief.
- **Control group:** £15,001 $\leq$ Rateable Value $\leq$ £18,000, eligible only for partial relief (25% discount).

Properties receiving other forms of relief unrelated to the SBBS (for example, charitable exemptions or special-purpose discounts) were excluded to maintain a consistent comparison between units affected by the same policy rule.

Constructing the Active Business Measure

The raw files include administrative status indicators identifying whether a property was occupied and liable for non-domestic rates in a given year. A business property was classified as *active* when it is:

1. Recorded as occupied
2. Liable for business rates during the relevant year

Vacant properties, inactive properties, or properties removed from the rates register were excluded from the count of active businesses. This measure captures business presence in the local commercial property stock rather than business births or deaths directly. It, therefore, reflects a combination of business entry, continued operation, and survival.

Geographic Matching

Each property postcode was matched to one of Glasgow's seven Westminster parliamentary constituencies:

- Glasgow Central
- Glasgow East
- Glasgow North
- Glasgow North East
- Glasgow North West
- Glasgow South
- Glasgow South West

This geographic coding allows the analysis to compare business activity within stable sub-city areas and include constituency dummies in the regression discontinuity models.

Construction of Rateable Value Bins

To reduce noise and align with the regression discontinuity design, individual properties were grouped into £250 rateable value intervals. Examples include:

- £12,000–£12,249
- £12,250–£12,499
- £14,750–£15,000
- £15,001–£15,250
- £17,750–£18,000

Each property was assigned to its corresponding rateable value bin in each year. This aggregation smooths idiosyncratic property-level variation and creates the running variable cells used in the analysis.

Aggregation to Final Dataset

The final dataset was constructed at the level of:

$$\text{Rateable Value Bin} \times \text{Constituency} \times \text{Year}.$$

For each observation, we computed:

- Total number of active businesses
- Mean rateable value within the bin
- Treatment indicator (below/above threshold)
- Year identifier
- Constituency identifier

Thus, the dependent variable used in the paper is the number of active businesses in each £250 rateable value bin within a given constituency and year. This is the outcome used in all regression discontinuity estimations.

Final Sample Size

After cleaning, filtering, and aggregation, the final dataset contains annual observations for the years 2009–2019 across:

- Seven Glasgow constituencies
- Rateable value bins between £12,000 and £18,000
- Annual number of active businesses

The final regression dataset contains 168 observations per yearly specification, consistent with the estimation tables presented above.

Interpretation

Because the underlying administrative records capture businesses that were active at the time of data extraction, the final outcome should not be interpreted as a direct mea-

sure of net business creation. Rather, it is best understood as a measure of observed business presence near the SBBS threshold, reflecting both entry and survival dynamics. This limitation does not affect the central purpose of the paper, which is to study discontinuities and bunching around the threshold rather than examining business demography directly.

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