The Equilibrium Effects of Regulating Junk Fees: Evidence from the Rental Brokerage Market*

Jan David Bakker† and Nikhil Datta‡

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Hidden "junk" fees have the potential to distort competition, creating high costs to consumers. However, regulating them can lead to adverse effects, especially in complex markets with intermediaries where they are most prevalent. To explore the equilibrium adjustments of regulating hidden fees, we leverage a unique matched landlord-broker dataset and a recent policy reform capping non-salient broker fees charged to tenants in the UK rental market. To guide our empirical analysis we first develop a conceptual framework of imperfectly competitive two-sided markets with non-salient price components. We estimate pass-throughs of the broker-tenant fee price cap to broker-landlord fees and advertised rental prices, examine demand responses, and net exit of both brokers and landlords. In line with imperfect competition, brokers absorb 75% of the regulation and landlords the remaining 25%. There is no market exit of landlords or brokers. Combining our reduced-form estimates and the theoretical framework we find that the policy saved tenants £376 per tenancy (equivalent to 4% of median yearly rent), landlords lost £74, and brokers lost £288. The policy induced an aggregate welfare gain of £14 per tenancy as it reallocated market shares from less to more productive intermediaries. If the fee had been fully salient, consumer savings would be almost halved, and reallocated to landlords. Our results highlight the importance of economic analysis for designing consumer protection regulation.

JEL codes: R28, D91, L51, L85

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†Bocconi University & Centre for Economic Performance, jan.bakker@unibocconi.it

‡University of Warwick & Centre for Economic Performance, nikhil.datta@warwick.ac.uk

1 Introduction

At the point of purchase, many consumers find themselves faced with additional costs which were not originally advertised. These hidden fees are particularly commonplace for goods and services where an intermediary connects consumers and producers.[1] These additional costs have the scope to undermine price transparency and stifle competition. The United States Council of Economic Advisors estimates they cost consumers $90 billion a year. As a result, policies aimed at regulating hidden "junk" fees or "drip" pricing are becoming commonplace.[2] While there is ample evidence on how non-salience affects consumer choice, very little is known about how regulating non-salient price components affects firm behavior and equilibrium outcomes.

This paper leverages unique micro data combined with variation from a policy regulating junk fees to provide the first such empirical evidence on all equilibrium outcomes and the underlying mechanisms. We study the UK rental market where brokers charge fees to both landlords and tenants. While landlords are aware of the brokerage prices they pay when hiring a broker ("landlord fees"), tenants search for properties on online rental platforms that advertise rents but do not advertise brokerage fees charged to tenants ("tenant fees"). Hence, these tenant fees are non-salient price components when searching for a property. Capping these tenant fees can lead to a number of equilibrium adjustments. A cap can generate price pass-through to landlords, as brokers may respond to this loss in revenue by increasing the landlord fee, and landlords may then in turn increase rental prices to tenants. It can additionally lead to demand effects, where landlords switch brokers if their fees increase, and tenants switch properties, if landlords increase their rental prices or they are demand sensitive to the tenant fee. Lastly, the regulation can induce net market exit effects for both brokers and landlords, who may see their profits fall. To evaluate the welfare effects of regulating non-salient price components set by firms it is therefore crucial to not only focus on the direct effects on consumers, but estimate the equilibrium adjustments along three margins: price pass throughs, demand effects, and net market exit.

We are the first paper to provide empirical estimates on the complete impact of consumer protection legislation regulating a non-salient price component on prices, demand and market exit, and can quantify its welfare impacts across all market participants. To guide our empirical analysis we develop a theoretical framework in which the effects of the regulation depend on both the degree of salience of the tenant fee, and the degree of competition in the landlord-broker and the landlord-tenant market. We combine this framework with a novel price regulation capping tenant fees, in conjunction with a newly-constructed dataset on the UK rental market to evaluate the impacts of the policy, which allows us to identify key model objects from regression analysis. In this setting, there are two well-defined sides to the market: the tenant-landlord market and the landlord-broker market, as tenants cannot choose the broker for a given property. The richness of the data allows us to explore impacts across prices, demand and net market exit in both of these markets.[3]

The housing market presents a unique opportunity to study the impact of price regulation on so-called junk-fees, in a quantitatively important, thick two-sided market with many landlords and brokers, which at first glance, appears competitive. Housing constitutes the largest expenditure for most households,

[1] Examples include entertainment ticketing markets, brokerage markets, online marketplaces, ride-sharing and delivery platforms, and hospitality platforms.

[2] In the US, ten states have implemented or are considering bills on hidden fees, including California's Honest Pricing Law, which came into effect in July 2024, while the FTC has proposed rules on omitting fees from advertised prices. In the UK, the DMCC Bill banned dripped prices in 2024.

[3] This is similar to a number of other two-sided markets where the consumer has little choice over the intermediary, given a particular product, such as entertainment ticketing, the sales brokerage market and postage handling in online sales.

and this is even more pronounced for those with low incomes. It is a market where intermediaries are commonplace, and it features non-salient fees that are not included in advertised prices. In 2019, the UK enacted the Tenant Fees Act (TFA) which capped tenant fees, i.e. the fees charged by letting brokers to tenants at the start and renewal of a tenancy, at £50. As fees could be as high as £1000, higher than a month of the median rental price in the UK, the policy represented a sizeable price cap and negative revenue shock to brokers.[4] A key motivation for the policy was the hidden nature of the fees charged by brokers, and that the act would enable consumers to "see, at a glance, what a given property will cost them in the advertised rent with no hidden costs" (Ministry of Housing, Communities and Local Government, 2019). Unlike rental prices, fees were not listed on online rental search platforms, the sole place prospective renters search for rental properties. This feature generalises to two-sided markets where fees charged by intermediaries are common and only revealed after buyers make consumption choices, such as online travel agencies, short term rental platforms, event ticket-selling websites, financial services apps, e-commerce platforms and delivery apps.

Given the large number of adjustment margins and the resulting ex-ante uncertainty regarding the effects of the policy,[5] we develop a conceptual framework of the connected markets, that allows for a wide array of outcomes in terms of price pass-through, demand changes, and broker and landlord exit to guide our empirical analysis. We show that the effects of the policy depend crucially on both the degree of monopolistic competition on both sides of the market, as well as the degree of salience of the regulated fee. In the perfect competition benchmark, the policy is passed perfectly back through to rental prices, even if the regulated fee is non-salient. Under monopolistic competition, this pass-through is determined by two channels. First, brokers increase landlord fees which increases the marginal cost of landlords. Second, banning the broker fees to the tenant reduces the total cost of renting for tenants and hence shifts the demand curve faced by landlords outward. The magnitude of this second effect is increasing in the salience of the fee: if the fee was perfectly non-salient tenants would not account for the reduction in the cost of renting and the demand curve faced by landlords would be unaffected. The magnitudes of both effects depend on the demand elasticity and curvature with respect to price in both markets. Hence, even if the tenant fee was salient there will likely be imperfect pass-through. This result is specific to the two-sided market structure with brokers, as in any model where landlords set two perfectly salient prices there would be perfect pass-through of the policy into rental prices even under imperfect competition. Pass-through to rental prices is lowest when the fee is perfectly non-salient and the associated demand curves are both concave, such that only the first of the aforementioned mechanisms is at play, and both demand curves are cost-absorbing.

Our analysis leverages newly collected data on the full schedule of fees charged by brokers to both tenants and landlords matched with a listings dataset of rental properties covering the near universe of the UK rental market. Exploiting variation in exposure to the policy across brokers and local markets for identification, we examine impacts on the key six variables of interest: prices, quantities, and net market exit of brokers and landlords. Our results suggest that brokers passed approximately 20-25% of the revenue shock on to landlords, and in response, some landlords switched brokers. The elasticity of demand, estimated using a discrete choice framework that accounts for heterogeneous preferences across landlord types and leverages detailed landlord-broker choice set and decision data, is -2.1, with an implied curvature of 6.4. This suggests a departure from the perfect competition benchmark, despite a large number

[4] A similar regulatory policy was recently passed by the New York City Council, where the standard fee is 15% of the annual rent, and has also been enacted in Spain and Argentina.

[5] The potential effects of the policy were subject to a fierce public debate with industry representatives arguing that the policy was likely going to have unintended consequences such as pass-through back to tenants or market exit of landlords and intermediaries (Arla Propertymark, 2024).

of active brokers, and strong local concavity of demand. Landlords who did not change broker passed through 6% of the regulation back to tenants via higher rental prices, but this estimate is not statistically different from zero. We find no changes in demand by renters. The combination of two reduced-form estimates allows us to pin down a salience parameter for broker fees charged to the tenants. Specifically, the lack of pass-through to rental prices suggest that tenants are locally price sensitive to the advertised price, while the lack of demand changes by tenants in response to the policy-induced reduction of the broker-tenant fee suggests the fee was perfectly non-salient. We find no market exit of either brokers or landlords suggesting the existence of supra-normal profits. Welfare analysis suggests that tenants saved £376 per tenancy (equivalent to 4% of median yearly rent), landlords lost £74, and brokers lost £288. Overall, there was an aggregate welfare gain of £14 per tenancy, amounting to a lower-bound aggregate gain of £16.4 million per year,[6] which arose from the policy reallocating market shares from less to more productive brokers. In the absence of non-salience of the fee, tenant savings would be almost halved, and reallocated to landlords, who would have seen their demand curve shift out. While this type of hard consumer protection regulation – limiting firms choices – can naturally reduce welfare in a broad set of environments, we instead document positive welfare gains from pro-competitive effects that have been discussed extensively in the theoretical literature (see Heidhues and Kőszegi, 2018, for a review).

Literature This paper relates to several strands of literature in behavioural public and industrial organization, real estate, and urban economics. First, we contribute to the literature on optimal regulation in markets with complex pricing and imperfect salience (Bordalo et al., 2022). There is ample evidence that consumers are less sensitive to non-salient price components such as omitted sales tax (Chetty et al., 2009) or shipping and handling charges (Hossain and Morgan, 2006) and that it can be optimal for firms to shroud true prices by engaging in obfuscation (Ellison and Ellison, 2009; Gabaix and Laibson, 2006) or engage in drip pricing (Blake et al., 2021). There is a large literature documenting the direct welfare costs to consumers from non-salient product attributes and complex pricing (Kroft et al., 2024; Rodemeier, forthcoming; Taubinsky and Rees-Jones, 2018; Tran et al., 2024). Nevertheless, regulatory interventions in such settings are not necessarily welfare enhancing and depend on the optimal responses of firms and general equilibrium adjustments (Armstrong and Vickers, 2012; Heidhues et al., 2016, 2021; Spiegler, 2006). We are the first paper to provide a comprehensive welfare analysis to a policy reform regulating a non-salient price component, studying not only the direct effect on consumers but also the equilibrium adjustment of firms. Our empirical evidence is based on a well-identified causal setting similar to the work by Agarwal et al. (2015). In our setting we can go beyond the direct effects of the regulation, but also provide evidence on the general equilibrium adjustments in terms of net exit, price and quantity adjustments across two connected markets. In a closely related literature, Grubb (2015) and Grubb and Osborne (2015) estimate the equilibrium effects of regulating bill shocks on consumer choices, firm adjustments and welfare.

We additionally contribute to the literature on two-sided markets, with a focus on the real estate market. Some two-sided markets feature strong network effects and often result in dominant (or monopoly) intermediaries (Rysman, 2009), such as payment card providers, video games and online retail platforms and there is a rich literature in regulating such markets (Wang and Wright, 2024; Gomes and Mantovani, 2024). Our setting, however, studies a two-sided market where there are a large number of intermediaries, such that measures of concentration suggest strong competition between intermediaries, as is the case with many different types of brokerage markets. Closely related to our work on the interaction of

[6] This number is based on the number of new tenancies in a year that we observe in our data, and therefore does not account for renewals.

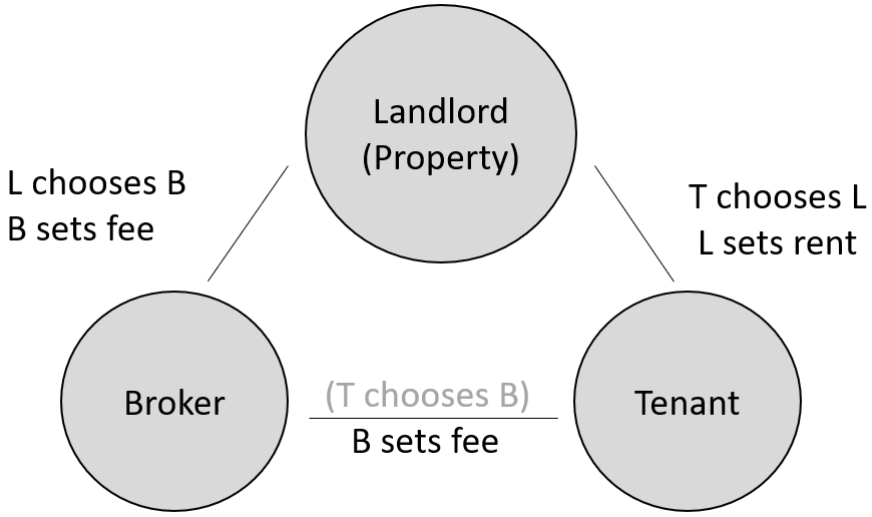
price salience and market structure in two-sided markets is the theoretical work by Johnen and Somogyi (2024), who study the incentive structure underlying shrouding decisions of intermediaries. Complementary to this, our paper is the first to analyse empirically the effects of regulation in a two-sided market with non-salient price components. This contributes to the existing literature on the waterbed effect of regulation in two-sided markets Genakos and Valletti (2011); Inderst and Valletti (2011) and on the inefficiencies and uncompetitive features in the real estate sales market (Gilbukh and Goldsmith-Pinkham, 2023; Barwick and Wong, 2019; Niedermayer and Wang, 2018; Barwick and Pathak, 2015; Hsieh and Moretti, 2003), where we add first empirical evidence on the letting market based on a credible identification strategy.

Third, we contribute to the study of imperfect competition, the role of demand structure for price pass-through (Mrázová and Neary, 2017; Weyl and Fabinger, 2013) and an emerging literature examining its relevance for the real estate market. While there is a large literature documenting tax incidence and its determinants (e.g. Benzarti et al., 2020), we are the first to study the pass-through of regulating fees in a two-sided market. Closely related to our setting is the work by Watson and Ziv (2024), who focus on the pass-through of cost shocks in the landlord-tenant side of the market. We contribute a study of both sides of the market and are able to identify the demand elasticity and curvature and relate this directly to implications of price regulation. As such, we are the first paper to highlight the degree of concavity in the demand curve in the rental market using a well identified natural experiment, joining similar work on the sales side of the market by Guren (2018). We provide empirical evidence on the role of salience and information frictions for price obfuscation and price-unresponsive demand (Ellison, 2016; Ellison and Ellison, 2009).

Fourth, we contribute to a large literature that evaluates the effects of different government interventions in the housing and rental market. Diamond et al. (2019) show that the introduction of rent control in the Bay Area led to a reduction in tenant mobility and in the supply of rental properties likely increasing rents in the long run. Mense et al. (2019, 2023) also find a reduction in tenant mobility and an increase in the rent for unregulated properties after the introduction of rental caps in Germany. Studying the rental cap in Catalonia Jofre-Monseny et al. (2023) and Monras et al. (2022) find a reduction in rental prices but conflicting evidence on the presence of supply responses. Carozzi et al. (2024) show that Help to Buy - a UK policy that subsidized first-time buyers - increased prices by more than the value of the subsidy and did not increase the supply of housing in supply-constrained locations. Overall, the literature has documented that the standard housing policy tools tend not to achieve their aims or are accompanied by substantial unintended consequences. We contribute to this literature on the efficacy of housing policy by contributing first evidence on the effects of a new type of policy – regulating the fees intermediaries can charge – that is gaining popularity among policymakers and document that, unlike any other policy (Hilber and Schöni, 2022), it reduces the cost of renting without any adverse effects.

The remainder of this paper is structured as follows: In section 2.1 we discuss the institutional setting of the market and the features of the Tenant Fees Act, that guide the conceptual framework we develop in section 2.2. Section 3 describes the various datasets we utilise. The empirical approach is introduced in section 4 and the main results are presened in 5. In section 6 we combine the model and our empirical results to quantify the welfare implications of the policy. Section 7 discusses the policy implications of our results and concludes.

Figure 1: The Rental Market



Notes: *The above figure gives a visual representation of the typical two-sided rental market with three actors, Landlords, Letting brokers and Tenants, and depicts their interconnectedness through prices and purchase decisions.*

2 Institutional setting and conceptual framework

2.1 The UK rental market and the Tenant Fees Act

Our study on the regulation of junk fees in two-sided markets focuses on the UK rental market, which possesses several generalisable features of such markets, offers a recent policy change that allows us to estimate causal impacts along a number of important margins, and is itself a quantitatively important market for a well-functioning economy.

Housing is the largest expenditure of most households and the role of the rental market has been increasing significantly over recent years in the UK. Since the year 2000 the proportion of renters in the UK has almost doubled, from 16.8% to 29.7% in 2021, such that nearly 6 million households in the UK are now renters. This rise is largely driven by an increase in house prices relative to earnings. Over the same period, the average house price increased from £84,620 to £268,000, representing a 217% increase, while median wages only increased by 70%. The percentage of income spent on rent is as high as almost 40% in London.

The UK rental market, like all two-sided markets, has three main actors (see figure 1 for an overview). Landlords choose a letting broker to rent out their property and set a rental price. Letting brokers act as intermediaries between landlords and tenants and charge fees to both of them (figures B.1 and B.2 in the appendix provide examples of these landlord and tenant fees respectively that brokers advertise on their websites). Tenants choose a property to live in that is associated with the letting broker chosen by the landlord. When hired by a landlord, brokers will at a minimum list the property on various online platforms and show prospective tenants around the property.[7] Depending on the service purchased, they may also manage rent collection, property maintenance issues, and inspections. Since only brokers can post adverts on online platforms, landlords are essentially forced to use a broker. This is likely in line with landlords' preferences, as most are passive investors that use rental properties as investments (see

[7] Examples of such platforms include Zillow in the US, Rightmove and Zoopla in the UK and Idealista in Italy.

figure B.7 in the appendix).

Tenants predominantly search for a property using the major online platforms and choose a property based on it's non-pecuniary attributes, the rental price and the fees. Importantly, while rental price and amenities are clearly advertised on the platform, the tenant fees are not listed (see figures B.3 and B.4 in the appendix) and learning about the tenant fee would require prospective tenants to additionally search on the broker's websites. Having found a suitable property tenants contact the relevant broker in order to view the property. Conditional on choosing it, the broker then carries out several checks on the prospective tenant such as Right to Rent,[8] affordability, credit and reference. Once these are complete the prospective tenant will receive the contract at which point they are also charged the tenant fee. Unless they have actively searched for the specific broker's tenant fees prior to this stage, they only find out about the tenant fee at this stage. If tenants decide that they do not want to rent the property given the tenant fee, they need to incur the additional cost of re-starting their search. Similarly, borkers face the additional cost of showing the property to additional prospective tenants and re-doing the paperwork. The standard rental contract lasts for one year, such that renewals and moves are more common in the UK rental market compared to more regulated markets such as Germany or France.

Two important features of this search process have the scope to generate non-salience of intermediary fees to consumers. First, the search platforms only show the monthly rental price, payable to landlords, and there is no option to include the fee tenants must pay the intermediary. Second, while tenants could find the relevant fees on the associated broker's website, they were often not clearly advertised, required costly search to be located and when found, consistent of many different components making it difficult to calculate the final fee.[9] As a result of these two factors, many tenants only find out about the fee they are required to pay to brokers in the final stage of the search process. This is typical of drip pricing and junk fees in other two-sided markets where consumers find out about add-on fees some way into the search and purchase process. Two examples of this, one from the entertainment industry and one from hospitality are shown in figure B.6 in the appendix.

While policy interventions in the rental market are commonplace, traditional rental policies have focused on regulating the price that landlords charge tenants (i.e. rental caps).[10] The Tenancy Fee Act (TFA) on the other hand regulated the price that letting brokers could charge tenants. Specifically, it capped it at £50 per tenancy (and tenancy renewal), while previously tenant fees had been as high as £1200, considerably higher than the median monthly rental price of £783. Typically these tenant fees could make up a wide array of fees such as referencing fees, contract fees, setup fees and inventory fees, and are detailed in detail in section 3. The bill passed both houses of Parliament in February 2019 and came into force on 1 June 2019, which marks the begin of the post-treatment period in our empirical analysis.

The policy's main objective were to deliver a "fairer, more competitive, more affordable and more transparent market" (Perks, 2018). In particular, issues surrounding transparency of tenancy fees, which are not listed on online rental platforms where people typically search for properties, and their disproportionate amount were highlighted. The Association of Residential Lettings Agents (ARLA), who represent 80% of the UK's Letting Brokers, commissioned their own impact assessment which claimed that the fees reflected the true amount of work undertaken by letting brokers, and thus those costs would need to be recovered (Capital Economics, 2017). Specifically, they predicted that most up-front fees would be

[8] These are legal requirements to verify the immigration status of all adult tenants.

[9] During manual scraping of the fees from approximately 2500 brokers websites it became apparent that it could take some minutes to find them on each website, and in some cases difficult to calculate the actual final fee.

[10] The UK rental market was relatively unregulated, with little renter protection, and no rental caps prior to the policy.

passed back to renters in the form of higher rents, and broker closures would result in 4,000 people out of work.

Underlying these different assessments are implicit assumptions about the microstructure of the market and whether the competitive mechanisms work well. Empirically, the market of letting agencies is characterized by a very low amount of concentration. Figure B.8 in the appendix plots the Herfindahl-Hirschman Index (HHI) of the market for letting brokers by postal area. With a median of 0.015 and only very few markets with an HHI above 0.1 most local markets would be considered very competitive by the US Antitrust Division. The market structure in the rental market is similarly competitive with more than 70% of landlords, representing more than 50% of tenancies, having four or fewer properties (see figure B.9).

2.2 Conceptual framework

To understand the potential effects of the Tenant Fees Act and to guide our empirical analysis, we first set up a theoretical framework of the market for letting broker services and the market for rental properties. We then derive sharp predictions for various special cases of the model that highlight how the effects of the reform can vary between no effect at all, and significant distributional and aggregate consequences depending on the market structure and the saliency of tenant fees.

2.2.1 General framework

There are three types of agents: Landlords, letting brokers and tenants (see figure 1 for a simple overview of the market structure). We model the markets as a sequence of static environments of a local market, where all agents simultaneously make their optimal decisions. In every period a large number of new prospective tenants and landlords with empty properties – drawn from a constant distribution – are active in the market, such that we abstract from strategic interaction and restrict our analysis to the cases of perfect and monopolistic competition.

Optimization problems Landlord L sets a rent and chooses a broker to rent out their property in order to maximize their utility,[11] which is given by:

$$\max_{p_L,b} U_L = \max\left\{(p_L - f_b^L - c_L) \times Pr_{fill}(p_L + \delta f_b^T) + \phi_b + \epsilon_{Lb}, Y_L\right\} \tag{1}$$

where p_L is the rent charged by landlord L,[12] ϕ_b is the quality of broker b, f_b^L is the fee the broker charges to landlords. ϵ_{Lb} is an idiosyncratic broker-landlord match quality, c_L is the variable cost of renting out the property and Y_L is the outside option of landlord L. Pr_{fill} is the probability that the rental property gets filled with a tenant, f_b^T is the tenant fee of broker b and $\delta \in [0, 1]$ is the share of tenants that are aware of tenant fees, i.e. a salience measure of tenant fees from the perspective of tenants.

As described in detail in section 2.1, tenants are not necessarily aware of the tenant fee charged by brokers when initially deciding which property to rent but learn about it once they need to sign the tenancy agreement. Therefore, they face a two-stage decision problem that might imply they are not making utility maximizing choices. Tenant i's utility from choosing property L that is associated with

[11] Landlords are modelled as utility maximisers, but there is an isomorphic representation with landlords as profit maximisers where the idiosyncratic match quality is an idiosyncratic match cost.

[12] We assume that each landlord just has one property to rent such that landlords and properties are synonymous.

broker b is given by:

$$U_{iLb} = -p_L + \theta_L - f_b^T - c_s + \epsilon_{iL} \tag{2}$$

where θ_L is the quality of property L, p_L is the rental price and f_b^T is the tenant fee of broker b associated with the property, c_s is the cost of searching, and ϵ_{iL} is the idiosyncratic match quality between tenant i and property L, which we assume to be distributed extreme value iid.[13] Their choice problem instead is given by the following two steps. In the first step they choose a property, potentially imperfectly accounting for the tenant fees associated with that property, where they maximize:

$$\max_L \tilde{U}_{iLb} = -p_L + \theta_L - \delta_i f_b^T + \epsilon_{iL} \tag{3}$$

where $\delta_i \in \{0, 1\}$ is the salience parameter that measures whether tenant i is aware of tenant fees when first choosing a property, a key parameter we will be able to estimate below. In the second step, after they have chosen a property to rent, the tenants initially unaware of tenant fees learn about the fee in the process of setting up the tenancy agreement. At this point they can decide to rent the property or to search again and find a different property to rent. Based on the level of the tenant fee, prospective tenants decide to search for an alternative property only if the tenant fee is above their threshold value ($\bar{f}^T$, i.e. their willingness to pay for broker services).Intuitively, this second step puts an upper bound on the level of tenant fees brokers can charge even for low levels of $\delta = E(\delta_i)$, i.e. when most tenants do not pay attention to tenant fees. The resulting expected utility of tenants is then given by:

$$V_i = P(f_b^T \leq \bar{f}^T) U_{iLb}^* + \left(1 - P(f_b^T \leq \bar{f}^T)\right) V_{i,-L} - c_S \tag{4}$$

where $U_{iLb}^* = \max \tilde{U}_{iLb}$.[14] This two-step decision process is motivated by the structure of the tenants' search process outlined in section 2.1, that makes tenant fees a potentially insalient price component. If tenants decide to reject the property they incur the search cost c_s more than once, as they will need to search again in the next period where a different set of properties is available.[15]

Letting broker b chooses the fees they charge to tenants (f_b^T) and landlords (f_b^L) in order to maximize profits that are given by:

$$\max_{f_b^T, f_b^L} \pi_b = \max\left\{ \sum_L \left(f_b^L + f_b^T - c_b(f_b^T)\right) Pr_{fill}(p_L + \delta f_b^T) Pr_{job}(f_b^L, Pr_{fill}(p_L + \delta f_b^T)), Y_b \right\} \tag{5}$$

where Pr_{fill} is the probability that the letting broker fills the property conditional on getting the contract from the landlord and Pr_{job} is the probability that the letting broker is chosen by the landlord to rent out the property. Brokers are heterogenous in the cost of doing business which is given by $c_b = \bar{c}_b + \frac{c_b^r}{1 - Pr_{rej}(f_b^T)}$ and depends on a generic cost ($\bar{c}_b$) and an additional cost (c_b^r), that is incurred each time a tenant gets to the second stage of choosing property L. In practice this reflects additional costs that are incurred each time a tenant rejects such as having to take more tenants for viewings and subsequent tenant checks (see section 2.1 for a more detailed discussion). Thus, if tenants reject the rental contract in the second stage (which happens with probability $Pr_{rej}(f_b^T)) = P(f_b^T > \bar{f}^T))$ then this cost is incurred multiple times. Brokers do not know the exact reservation tenant fee but have expectations given by $\bar{f}^T - \kappa_b$

[13] Given that we cannot study the entry/exit margin of tenants empirically we abstract from an outside option for them.

[14] As we will document below (section 5), our empirical results are consistent with an equilibrium where brokers set high fees but low enough such that tenants do not reject the rental contract at this stage. Therefore we abstract from issues related to repeated rejections in the second stage, such as potential changes to δ_i after deciding to reject a property due to high tenant fees or whether a tenant can go back to an initially rejected property.

[15] We assume that in each period the distribution of available properties and tenants is identical.

where $\kappa_b \sim F_b,$ with support $\kappa_b \in [0, \infty)$.[16] Y_b is the outside option of the broker such that they decide to exit the market if profits fall below that level.

Optimal choices The first order conditions for the optimal landlord fees and rental prices are given as follows:

$$f_b^L = \frac{\varepsilon_{JL}}{\varepsilon_{JL}+1}\left(c_b - f_b^T\right) \tag{6}$$

$$p_L = \frac{\varepsilon_{FP}}{\varepsilon_{FP}+1}\left(c_L + f_b^L\right) \tag{7}$$

where $\varepsilon_{JL} \equiv {}^{\partial Pr_{job}}/_{\partial f_b^L f_b^L}/_{Pr_{job}}$ is the demand elasticity of landlords with respect to a broker's landlord fees and $\varepsilon_{FP} \equiv {}^{\partial Pr_{fill}}/_{\partial p_L p_L}/_{Pr_{fill}}$ is the demand elasticity of tenants with respect to rental prices.
While optimal landlord fees and rental prices are determined by standard mark-up equations, the optimal tenant fee is a more complicated object reflecting the two-stage decision problem of tenants – first finding a property and then potentially not signing the contract when learning about the tenant fee and is given by:

$$f_b^T = \begin{cases} \frac{\delta\varepsilon_{FP}(1+\varepsilon_{JF})}{\delta\varepsilon_{FP}(1+\varepsilon_{JF})+\frac{p_L}{f_b^T}}\left(c_b - f_b^L\right), & \text{if} \quad 0 < f_b^T < \bar{f}^T - \kappa_b, \\ \bar{f}^T - \kappa_b, & \text{otherwise.} \end{cases} \tag{8}$$

where we have already re-written the demand elasticity of tenants with respect to tenant fees ($\varepsilon_{FT} = \delta\varepsilon_{FP}\frac{f_b^T}{p_L}$) and $\varepsilon_{JF} \equiv {}^{\partial Pr_J}/_{\partial Pr_f}{}^{Pr_f}/_{Pr_J}$ is the demand elasticity of landlords with respect to the probability of finding a tenant. For high levels of δ the corresponding mark-ups are going to be low such that the limit of tenants' willingness to pay for broker services is not binding and pricing is determined by the standard mark-up equation. For low levels of δ mark-ups become very high and the demand elasticities could become smaller than one (in absolute value) such that pricing occurs according the expectations about tenants reservation fee ($\bar{f}^T$).

The expressions for the optimal discrete choices of landlords choosing brokers and tenants choosing properties depend on the additional assumptions on the idiosyncratic terms ($\epsilon_{Lb}, \epsilon_{iL}$) that we will specify in the analysis of different market structures and the salience of fees below. The participation constraint of landlords and brokers is given by $U_L^* \geq Y_L$ and $\pi_b^* \geq Y_b$, respectively.

The Tenant Fees Act and its effects We model the policy as a restriction on the decision of the brokers that can no longer freely set the tenant fee but are restricted to charging £50. The negative revenue shock from the policy to broker b will therefore be equivalent to $f_b^T - 50$. The model provides guidance on the endogenous variables that might adjust to the policy and we can trace out the overall effect of this policy by studying the following six margins of adjustments:

1. Changes in the landlord fees f_b^L that letting brokers set
2. Landlords changing the letting broker (b) they choose to rent out the property
3. Landlords changing the rental price (p_L) they set
4. Tenants choosing different properties (L)
5. Net exit of letting brokers

[16] This assumption is a reduced-form way to capture two features of the data: The tenant fees are low enough for tenants not to reject a property in the second stage and tenant fees are heterogeneous across agencies.

6. Net exit of landlords

Following an exogenous change in tenant fees, brokers will adjust the landlord fee they set, yielding the following absolute pass-through:

$$\rho_{LT} \equiv \frac{\partial f_b^L}{\partial f_b^T} = \frac{1}{1 + \frac{1}{\varepsilon_{JL}}\left[1 - \varepsilon_{JL}^s\right]} \tag{9}$$

which is the first key equation we will bring to the data. It links the pass-through to landlord fees (ρ_{LT}) to the demand elasticity of landlords with respect to a broker's landlord fees ($\varepsilon_{JL} \equiv {}^{\partial Pr_{job}}/_{\partial f_b^L f_b^L / Pr_{job}}$) and the curvature of this demand function ($\varepsilon_{JL}^s = {}^{\partial \varepsilon_{JL}}/_{\partial f_b^L f_b^L / \varepsilon_{JL}}$). Second, we can derive the change in demand for broker b's services as a function of changes in tenant fees:

$$\Delta_{JT} = \varepsilon_{JL}\rho_{LT}\frac{f_b^T}{f_b^L} \tag{10}$$

which depends on the pass-through from tenant into landlord fees and the elasticity of landlord demand with respect to landlord fees.

In the market for rental properties we get a similar set of equations, where the pass-through from tenant fees into rental prices (ρ_{PT}) depends on the pass-through to landlords (ρ_{LT}) and the elasticity ($\varepsilon_{FP} = {}^{\partial Pr_{fill}(p_L, f_b^T)}/_{\partial p_L p_L / Pr_{fill}(p_L, f_b^T)}$) and curvature ($\varepsilon_{FP}^s = {}^{\partial \varepsilon_{FP}}/_{\partial p_L p_L / \varepsilon_{FP}}$) of tenant demand:

$$\rho_{PT} = \frac{\rho_{LT}}{1 + \frac{1}{\varepsilon_{FP}}(1 - \varepsilon_{FP}^S)} + \frac{\delta(\frac{Pr_{fill}Pr''_{fill}}{Pr'^2_{fill}} - 1)}{1 + \frac{1}{\varepsilon_{FP}}(1 - \varepsilon_{FP}^S)} \tag{11}$$

where Pr'_{fill} and Pr''_{fill} indicate the first- and second-order derivative with respect to rental prices. Intuitively the first part of the pass-through into rental prices comes through the pass-through into landlord fees that increase the cost to landlords. The second part of the equations works through the demand side - a reduction in tenant fees ceteris paribus shifts outward the demand functions that landlords are facing when setting rental prices as it reduces the cost of renting a property for tenants. Note that the extent of the outward shift depends on the slope and curvature of the demand curve, as well as the salience of tenant fees. Intuitively, if tenants don't base their rental decisions on tenant fees ($\delta = 0$) this demand side effect disappears. Lastly, tenant demand for property i reacts as follows:

$$\Delta_{FT} = \varepsilon_{FP}\frac{f_b^T}{p_L}(\rho_{PT} + \delta) \tag{12}$$

which depends on the price elasticity of tenant demand and works through two channels: A direct effect of reduced tenant fees that depends on the saliency of fees (δ) and an indirect effect through rental prices that depend on the pass through of the change in tenant fee via changes in landlord fees to rental prices (ρ_{PT}).

To make these changes in property demand amenable to our empirical analysis we focus on time of the market (ToM) instead of the probability of filling a property, which – given that we model time just as a repetition of our static model – is just the inverse of probability of filling a property ($M = 1/Pr_f$). The change in time on the market for a property in response to the tenant fee is therefore given by:

$$\Delta_{ToM} = -\frac{1}{\mathrm{Pr}_f^2}\varepsilon_{FP}\frac{f_b^T}{p_L}(\rho_{PT} + \delta) \tag{13}$$

Broker and landlord exit is driven by the mass of brokers and landlords whose profit or utility falls below the participation constraints:

$$(\pi_b^{pre})^* + \Delta\pi_b^* < Y_b \tag{14}$$

$$(U_L^{pre})^* + \Delta U_L^* < Y_L \tag{15}$$

2.3 Pass-throughs under different market structures

Perfect competition and salient tenant fees ($\delta = 1$)

There are no idiosyncratic match qualities (the variances of ϵ_{Lb} and ϵ_{iL} are zero ($\sigma_{\epsilon_{iL}} = \sigma_{\epsilon_{Lb}} = 0$)) and tenants are fully informed about tenant fees ($\delta = 1$).[17] Brokers' optimization yields the following three first-order conditions:

$$p_L + f_b^T = \theta_L = c_L \qquad f_b^L + f_b^T = c_b \qquad p_L - f_b^L + c_b = c_L \tag{16}$$

Note that these are three unknowns (p_L, f_b^T, f_b^L) and three equations, but the equations are linearly dependent such that we cannot pin down the level of all three prices. While we can determine the total payments received by each broker, there are infinitely many price combinations that can result in those payments. Intuitively letting brokers do not care whether they earn money through tenant or landlord fees and tenants do not care whether they pay via rent or via tenant fee, while landlords do not care whether they have high rents and high landlord fees or low rents and low landlord fees but just about the difference between the two. Banning tenant fees will therefore lead to perfect pass-through into landlord fees and rental prices such that there are no real effects of regulation.

Perfect competition and non-salient tenant fees ($\delta = 0$)

In a model with perfect competition in all markets but where tenant fees are not salient the above set of equations (16) still describe the equilibrium payments. However, the level of the tenant fee is now fully determined at the highest point below the threshold level, which in turn uniquely pins down landlord fees that are consistent with marginal cost pricing of agencies and rental prices that are consistent with marginal cost pricing of landlords. Banning tenant fees in this context leads to perfect pass-through into landlord fees and into rental prices, such that total payment of all brokers remain unchanged. The presence of nonsalient prices, hence, does not affect the outcomes of the policy under perfect competition.

Monopolistic competition and salient tenant fees ($\delta = 1$)

Under monopolistic competition and downward sloping demand functions ($\varepsilon < \infty, \quad \forall\varepsilon$) and salient tenant fees ($\delta = 1$), pass-throughs are a function of the slope and the curvature of the demand functions of landlords for letting broker services and of tenants for rental properties (see equations 9 and 11). The pass-through is determined by two forces: First, letting brokers increase landlord fees which increases the marginal cost of landlords. Second, a reduction in tenant fees reduces the cost of renting for tenants and hence shifts the demand curve faced by landlords outward. Interestingly, the associated demand shift is reflected in pass-through terms equivalent to a cost shock for landlords, and is amplified under a concave demand function (i.e. where Pr''_{fill} is negative). This imperfect pass-through is an implication of the two-sided market structure as in a world where landlords were setting both tenant fees and rental

[17] To make the model well behaved under perfect competition we additionally need to homogenize the quality-cost ratio of producers. To do so we assume $\phi_b = c_b$ and $\theta_L = c_L$ implying any differences in quality are driven by differences in costs (e.g. a broker is better because it pays its workers more and a higher quality property has higher opportunity costs because it could be sold at a higher price). Alternatively we could also just abstract from any heterogeneity in terms of cost and quality.

prices, even a model of imperfect competition would predict perfect pass-through of the policy into rental prices.

Monopolistic competition and non-salient tenant fees ($\delta = 0$)

In a setting with finite demand elasticities and non-salient fees pass-throughs and the corresponding welfare effects are also determined by the demand elasticities and curvatures. The key implication of non-salient fees is that the demand curve faced by landlords does not shift outward following the regulation, which leads to a lower pass-through into rents compared to a model with salient tenant fees (equation 11).

Table 1: Pass-through into rental prices (ρ_{PT}) under different scenarios

	Perfect Salience ($\delta = 1$)	**Non-salience** ($\delta = 0$)
Perfect Competition	-1	-1
Imperfect Competition	$\frac{\rho_{LT}}{1+\frac{1}{\varepsilon_{FP}}(1-\varepsilon^{S}_{FP})} + \frac{\frac{Pr_{fill}Pr''_{fill}}{Pr'^{2}_{fill}}-1}{1+\frac{1}{\varepsilon_{FP}}(1-\varepsilon^{S}_{FP})}$	$\frac{\rho_{LT}}{1+\frac{1}{\varepsilon_{FP}}(1-\varepsilon^{S}_{FP})}$

3 Data

To study the impact of the policy and the underlying structure of the market, we combine data from four different sources.

First, we utilise a proprietary dataset on rental listings for the period 2015-2020 which covers the near universe of rental properties for the UK from a major online rental plattform. The dataset includes the exact address of the property, the letting broker which listed it, the initial date of listing, the date the tenancy was agreed upon, the initial listing price and any subsequent changes to the price, details about the property such as number of bedrooms, property type (e.g. detached house, apartment), whether it's a student property and whether it was furnished or not.

Second, we utilise a unique dataset that contains manually scraped data on tenant fees and landlord fees from letting brokers' websites. For the pre-treatment period tenant fee data and landlord fee data were collected in December 2018, prior to the bill passing the UK Parliament, and landlord fee data was collected in February 2020 for the post-treatment period.[18] Since letting brokers are required by law (see the Consumer Rights Act 2015) to display details of all fees and charges, this data is accessible online for all agencies. Data had to be manually scraped rather than automated as the fee data was unstructured, generally not presented in a similar manner across agencies, and often agencies placed their tenant fees in more obscure parts of their websites, such that they were often hard to find. Figure B.1 in the appendix presents an example set of tenant fees from a broker's website. As can be seen, renting a property incurs a variety of fees. For the interest of tractability and comparison across agencies in our analysis we aggregate all necessary fees to rent out a property let by the broker for two people into one single tenant fee. Necessary fees across different agencies include fees such as tenant set up fees, contract setup fees, administration fees, referencing fees, additional applicant fees, check-in fees, check-out fees, inventory check fees, deposit fees and right-to-rent check fees. In the example set of fees that would come to £666 in total across 4 different fees. Given the high costs of manually collecting fees from websites,

[18] The Tenant Fees Act came into force on 1 June 2019, which is the beginning of the post-treatment period.

we only collected data for a randomly chosen subsample of agencies active on the rental search platform. In total we collected 2500 tenant fees, which in turn represented approximately 34.3% of the universe of rental properties.

Figure B.2 in the appendix presents a set of example fees for landlords. As is typical in the market this broker offers two products, one which involves only finding the tenant, and another which is "fully managed" where this includes collecting rent from the tenants, being the first point of call for the tenants if there are any issues with the property, undertaking inspections and arrange repairs with approved contractors.[19]

Third, we use data from HM Land Registry which contains data on every single housing sale in the UK. It contains the precise address of the property which was sold, the date of sale, and the associated price. This data covers from 2015 up till 2023 allowing us to analyse more long-run effects for the market exit of landlords.

These three datasets combined offer an incredibly powerful tool for analysing the impacts of the policy as well as the underlying structure of the market. The tenant fees give a value of initial exposure to the regulation at the broker level, and combined with landlord fees allows us to analyse the pass-through of regulating tenant fees onto landlord fees. The fee data combined with the listings data allow us to analyse the pass-through to rental prices, for both the initial listing price, as well as the last listing price. This means we can see both the initial attempt at passing through to rental prices, as well as the final listing price. Furthermore, using time on the market from the listings data we are able to examine tenant demand responses to changes in cost of renting, while using the property-broker match information from the listings data we are able to examine landlord demand for broker services in response to the change in landlord fees. The listings data also gives information on broker entry and exit, while the HM Land Registry data gives information on sales, which allows us to learn about landlord exit.

Since we only observe tenant fees once in the pre period, we exploit an additional dataset to offer information both on the landlord and tenant side of broker performance, for a longer panel during the pre (and post) period. Specifically, we use scrapped data from the leading online review platform of letting brokers (https://www.allagents.co.uk/) to enable us to evaluate the effect of the Tenant Fees Act on reviews from tenants and landlords. This data enables us to perform two important robustness checks. First, it is informative for the level of tenant fees over a longer period, as it contains a variable, "lettings fee satisfaction", based on customer reviews. Using this variable we are able to check the parallel trends assumption underlying part of the identification discussed in the next section. Second, it also contains landlord reviews on brokers, which is informative of quality, which is an important margin for the exclusion restriction in the demand estimation to hold, which is further detailed in section 4.2.

4 Empirical framework

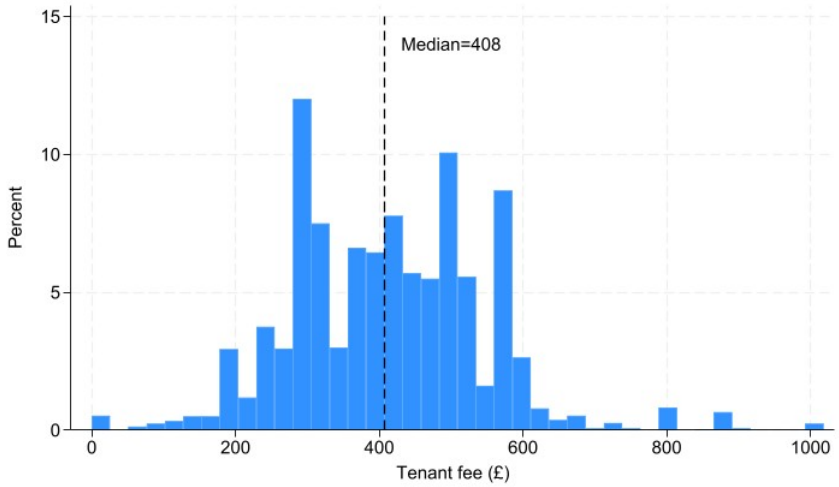
4.1 Identification

The empirical framework exploits differential exposure to the Tenant Fee Act (TFA) due to differences in tenant fees across letting brokers prior to the introduction of the price cap to identify the causal effects

[19] While tenant fees were advertised in currency (£s), landlord fees were sometimes in percent of the underlying rent and combined with components in pounds. We convert all landlord fees into pounds based on the rental prices of the properties of a broker in the pre-treatment period.

of the policy. This exposure measure bares resemblance to those commonly used in the minimum wage literature where researchers use a similar "bite" measure calculated based on the proportion of workers within a firm or area that are exposed to the minimum wage change, or the existing wage gap of workers in the firm relative to the upcoming level of the minimum wage (see Dustmann et al., 2022; Cengiz et al., 2019; Datta et al., 2019). In our theoretical framework it arises due to different values of κ_b for low values of δ and due to differences in c_b for high values of δ. This identification strategy relies on a parallel trends assumption between firms more and less exposed to the TFA, i.e. that firms less exposed to the TFA act as a reasonable counterfactual for those more exposed. We provide evidence on these parallel trends using event studies and placebo exercises for the different specifications throughout and in a dedicated section below (section 4.4), where we also employ an alternative identification strategy relying on variation across the English-Scottish border, as the policy change only applied to England. Figure 2 presents the distribution of tenant fees prior to the introduction of the reform and shows considerable variation in pre-reform fees.

Figure 2: Tenant Fee Distribution Pre Reform



Notes: *The figure presents a histogram of Tenant fees, for a 2 person rental contract, prior to the introduction of the Tenant Fees Act. The sample is based on the 2500 scraped fees described in section 3.*

As discussed in section 2.2 the aggregate and distributional effects of the policy are ex-ante quantitatively and qualitatively ambiguous and depend on the structure of the market for letting broker services and rental properties. Guided by the conceptual framework we estimate three key objects for each market to evaluate the effects of the policy: The price pass-through, the demand and the net exit as a consequence of the policy. We will now discuss each of these six specification in turn.

As highlighted in the modelling section 2.2, the reform has the scope to affect several margins, and we are exploiting only one source of variation for identification of a number of reduced-form effects and key structural parameters. As such, there will often be interdependence between the empirical estimates across different specifications which require discussion for interpretation, and especially so for estimating demand effects and eliciting the salience parameter δ. For example, the extent of the pass-through to rental prices, will determine whether the reform affects tenants only through a reduction in tenant fees or also an increase in rental prices and thereby change the interpretation of the coefficient on how a change in the overall cost of renting affects tenant demand. To do justice to these interdependencies, we make

them and their implications clear at every step of our empirical strategy, coupled with a discussion at the end of the results, mapping the empirical results to the model (section 5.4). Additionally, table 2, at the bottom of this section, links our estimating equations the to relevant model objects, offers intuition on the connection between the two, and documents which additional model parameters can be backed out.

4.2 The market for letting broker services

Pass-through into landlord fees We estimate the pass-through of the banned tenant fees into landlord fees based on a standard two-way fixed effects diff-in-diff specification:

$$LF_{bt} = \beta_1 TF_{bt} + \gamma_b + \gamma_{lt} + \varepsilon_{bt} \tag{17}$$

where LF_{bt} and TF_{bt} are the landlord and the tenant fee of broker b at time t, and γ_b and γ_{lt} are broker and postal area $\times$ time fixed effects.[20] Given the available data, t is either the period before the reform or the period after, TF_{bt} is constructed to represent the exposure, and thus is equal to pre-reform fee in the post period, and set to £50 in the pre-period. Defining it this way implies that our pass-through estimates will be positive (higher exposure leads to higher landlord fees). Under the assumptions discussed in section 4.1, $\hat{\beta}_1$ estimates the causal pass-through of the reform into landlord fees (ρ_{LT} as defined in equation 9 in our conceptual framework). We also estimate a version more akin to a standard two-way fixed effects specification, using only time fixed effects for transparency, but the stricter γ_{lt} ensures that our pass-through results are not driven by differences in fee structure across space, but instead identified from differences across agencies in the same local area. More generally we utilise time varying area-specific fixed effects of this nature in all specifications to ensure local time-varying shocks correlated with treatment intensity across space do not bias our results.

Landlord demand elasticity for letting broker services To complement the results on the price pass-through, we estimate the demand elasticity of landlords with respect to the price of letting broker services (i.e. landlord fees). We use an estimation approach akin to that in Bayer et al. (2007), based on a McFadden (1973) style random utility model. The approach bears some resemblance to a BLP (Berry et al., 1995) type estimator, albeit using matched landlord-broker micro data, with fully observable choice sets, and an instrumental variable from a "natural experiment" for identification. This approach nests the different market structures explored theoretically in section 2.3, while allowing for a tractable estimation procedure.

The indirect utility of a landlord L, staying in the market and choosing broker b in period t is[21]

$$V_{Lbt} = \chi_{bt} + \lambda_{Lbt} + \varepsilon_{Lbt} \tag{18}$$

where χ_{bt} is the mean indirect utility that broker b provides to landlords in period t, and λ_{Lbt} are period-varying interactions between landlord and broker characteristics, that allow for heterogeneous preferences of landlords over agencies. The mean indirect utility provided by broker b in turn is given by:

$$\chi_{bt} = \beta_{0x} X_b - \beta_{0p} f_{bt}^L + \xi_{bt} \tag{19}$$

[20] There are 124 postal areas in the UK.

[21] This formulation follows from 1 where $\epsilon_{Lb} = \lambda_{Lb} + \varepsilon_{Lb}$ and $\phi_b = \beta_{0x} X_b + \xi_b$ and we explicitly introduced a time dimension to map the model to the empirical setting. Furthermore, we drop the dependence of the landlord choice on the tenant fee, pre-empting the later results which demonstrate that $\delta = 0$.

where X_b are observable broker characteristics, f_{bt}^L are prices (landlord fees) and ξ_{bt} is a broker-level shock akin to broker-specific unobserved quality. In estimation, X_b includes the proportion of student let properties which is fixed to the pre-period value to avoid endogenous responses to the policy. λ_{Lbt} is given by

$$\lambda_{Lbt} = \left(\sum_{k=1}^{K} \beta_{kX} Z_{kL} X_b\right) - \left(\sum_{k=1}^{K} \beta_{kp} Z_{kL} f_{bt}^L\right) \tag{20}$$

where Z_L are demeaned landlord-level characteristics including number of bedrooms, type of property (e.g. bungalow, apartment, etc), quality quartiles of the property as determined by its price relative to the local market, and whether it's a student house. All landlord characteristics are fixed over time. λ_{Lbt} therefore controls for heterogeneous preferences across landlords for broker characteristics, including price. The reason for demeaning these landlord characteristic variables is to ensure that χ_{bt} actually captures the mean indirect utility provided by broker choice b, which is our main object of interest.

We assume ϵ_{Lb} in equation 18 follows an extreme value type 1 distribution[22] such that the probability that landlord L chooses broker b (P_{jb}) is given by the following logit expression:

$$P_{Lb} = \frac{exp(\chi_{bt} + \lambda_{Lbt})}{\sum_m exp(\chi_{mt} + \lambda_{Lmt})} \tag{21}$$

The first step in the estimation process is to estimate equation 21 for the pre- and post-reform periods separately which in turn gives us estimates of mean indirect utility $\hat{\chi}_{bt}$ where $t \in \{pre, post\}$. The second step then involves an IV estimation of the form

$$\hat{\chi}_{bt} = \beta_2 LF_{bt} + \gamma_b + \gamma_{lt} + \varepsilon_{bt} \tag{22}$$

where LF_{bt} is instrumented with TF_{bt}, such that the first-stage mirrors the pass-through estimation in equation 17. The estimation procedure is therefore in many ways, as transparent as a typical IV. The first stage logit estimation simply allows us to control for heterogeneous preferences while also acknowledging the discrete nature of the choice problem. Estimating the logit model provides estimates of indirect utilities so that we can estimate the effect of landlord fees on the utility from a broker using our instrument. For the exclusion restriction to hold in this setting we require that the change of the tenant fee only affects the landlord decision via the change in landlord fees. In particular, in the instance where tenant fees have a strong effect on the tenant decision, this will likely affect the fill rate of a property, and therefore the landlord choice of broker. A sufficient condition for the exclusion restriction to hold with respect to that margin in this IV is therefore that $\delta = 0$, which later estimates show to be true. We further show below that there are no changes to the review quality that landlords give to brokers, which is indicative that there is no adjustment to broker's service quality, which allows us to rule out endogenous quality adjustment as a potential violation of the exclusion restrictions. The broker-level own price elasticities are then calculated according to

$$\eta_{bb} = \frac{\sum_L P_{Lb} \beta_2 f_b^L (1 - P_{Lb})}{\sum_j P_{Lb}} \tag{23}$$

where P_{Lb} are the probabilities of landlord L choosing broker b and come from the estimated logit model. Aggregating η_{bb} provides an estimate of ε_{JL} (see equation 10). Choice sets for the logit estimator in equation 21 are constructed such that they include all agencies that operate in the local area that the landlord-property is located in.[23] In practice the average choice set has 21 options.

[22] This imposes a log-concave demand structure, consistent with the first set of results in the next section suggesting imperfect pass-through.

[23] Specifically all agencies which operate in the postal district the property is located in, there are 2,979 postal districts

Letting broker exit To fully characterize the effect of the policy on the market for letting broker services we lastly look at whether the reform induced brokers to exit the market, as the reform potentially reduced their profits. To estimate broker exit, we run the following specification:

$$\mathbb{1}_t[\#\text{ Listings} > 0]_{bt} = \beta_3 TF_{bt} + \gamma_{lt} + \varepsilon_{bt} \tag{24}$$

where $\mathbb{1}_t[\#\text{ Listings} > 0]_{bt}$ is a dummy equal to one if broker b has any listings in any month equal to or greater than month t.[24] TF_{bt} is defined as in equation 17. γ_{lt} are postal area $\times$ time fixed effects. As in earlier specifications, the latter fixed effects control for time-varying shocks at the postal area, such that identification comes only from differences in exposure to the tenant fee shock across agencies within a local area. A negative value of β_3 would indicate that firms with higher exposure to the reform are more likely to exit (less likely to keep participating in the market), measuring the extent to which changes in brokers' profits push them below the participation constraint in our framework (equation 14).

4.3 The market for rental properties

Next, we turn to the market for rental properties where landlords decide wehther to stay in the market and if so set the rent, and tenants decide which property to rent.

Pass-through into rents First, we estimate the pass-through of the reform-induced reduction in tenant fees into rents, using a similar design as before:

$$\text{rent}_{pblt} = \beta_4 TF_{bt} + \gamma_p + \gamma_{lt} + \gamma_b + \varepsilon_{pblt} \tag{25}$$

where rent_{pblt} is the rent asked by the landlord for property p advertised by broker b in location (postal district) l in month t.[25] TF_b is the same measure of exposure to the Tenant Fees Act used previously. γ_p, γ_{lt} and γ_b are respectively property, location-month and broker fixed effects. The property fixed effects implies that we are restricting the sample to properties observed before and after the reform and identify off differential price changes of properties advertised by brokers with different pre-reform tenant fees and therefore differential exposure to the reform. The second, γ_{lt}, are time varying-postal district fixed effects, as in previous specifications these control for local area, time varying shocks, while the third, γ_b controls for broker-specific fixed effects. The reason we include γ_b in addition to γ_p is because, as has already been alluded to, properties can change broker.

The main coefficient of interest β_4 identifies the pound-for-pound pass-through of a reform-induced change in tenant fees into rental prices (ρ_{PT} from equation 11 in the conceptual framework). There is a valid question regarding inference for the property-level regressions of this form. Traditionally researchers have clustered standard errors at the level of variation (here the broker-period). However, recent evidence has suggested that when using proportionally large samples of the population this is likely to result in conservative estimates of standard errors (Abadie et al., 2023). While there is no obvious alternative (solutions suggested in Abadie et al. (2023) are unsuitable for our setting) we opt for transparency and present both the standard errors clustered at the level of variation, as well as the heteroskedastic robust (unclustered) standard errors.

in the UK.

[24] This dummy variable is therefore an absorbing state if set equal 0, denoting exit, as a result broker level fixed effects are not used.

[25] Note that this is an unbalanced panel, as different properties appear as vacant at different times depending on tenant exit from a property.

Tenant demand for rental properties We then turn to the demand of tenants and how it is affected by tenant fees, which we estimate as follows:

$$\text{Time on market}_{pblt} = \beta_5 TF_{bt} + \gamma_p + \gamma_{lt} + \gamma_b + \varepsilon_{pblt} \tag{26}$$

where $\text{Time on market}_{pblt}$ is the months property p is advertised by broker b in location l in month t (which is based on the date the advert is made public) before it is rented out. The specification uses the same fixed-effects as the pass-through estimating equation (equation 25). β_5 identifies the causal effect of changes in tenant fees on tenant demand for a property measured as time on the market (it identifies Δ_{ToM} in our framework). As can be seen from equation (13), this effect depends on two channels: a direct effect and an indirect effect via the pass-through into rents. Hence, β_5 is a function of the pass through to rental prices (ρ_{PT}), the demand-elasticity with respect to rents (ε_{FP}), and the degree of saliency of tenant fees (δ) and allows us to learn about these structural parameters. In particular, in a world with no pass through to rental prices (i.e. $\rho_{PT} = 0$ and therefore $\beta_4 = 0$) and tenant fees are perfectly non-salient ($\delta = 0$), we would expect $\beta_5 = 0$.

Landlord exit Lastly, we estimate the effect of the reform on the net exit of landlords from the rental market, as the reform might have induced a reduction in the return to rental properties (violating landlords' participation constrain (equation 15)). To do so we look at different indicators of landlord net exit at the market level and regress them on the market-level exposure to the Tenant Fees Act, based on the following specification:

$$y_{lt} = \beta_6 \left[\mathbb{1}_t[Post_t = 1] \times \sum_b \frac{N_{bl}}{N_l} TF_b \right]_{lt} + \gamma_l + \gamma_{rt} + \varepsilon_{\ell pblt} \tag{27}$$

where y_{lt} are different measures informative of market net exit in postal area l in month t. In particular, we look at the average rent and average sales prices of residential properties. We measure the market-level exposure to the reform as the weighted average pre-reform tenant fee of the active brokers where the weights are the market shares of the brokers. We further control for postal area fixed effects (γ_l) as well as region $\times$ month fixed effect (γ_{rt}).[26] The idea behind this estimation is that in the presence of landlord net exit, we would expect average rental prices to increase (as rental supply drops) and for transaction sales prices to go down (as sales supply increases). While sales prices are beyond the scope of the conceptual framework, such that we rely on general economic intuition on this point and treat it more as a robustness check, the effect on rental prices is evident from equation (7): The optimal rental price set by a landlord is a function of their price-elasticity (ε_{FP}) which is given by (under the logit assumption we make for estimation):

$$\varepsilon_{FP} = -\alpha(1 - Q_L)p_L \tag{28}$$

where Q_L is the logit probability of picking property L, and α is the inverse of the scale of the Gumbel-distributed preference shocks. When landlords exit a market, choice sets become smaller, and therefore Q_L decreases, which in turn reduces the demand elasticity, ε_{FP} and increases prices.

[26] There are 12 regions in the UK. The reason why we use a more aggregated time $\times$ location fixed effect here is because the level of variation is at a more aggregated level.

Estimating model objects			
Object of interest	**Model object**	**Estimating equation**	**Intuition**
Pass-through into landlord fees (ρ_{TL})	$\rho_{LT} \equiv \frac{\partial f_b^L}{\partial f_b^T} = \frac{1}{1+\frac{1}{\varepsilon_{JL}}\left[1-\varepsilon_{JL}^s\right]}$ (9)	$LF_{bt} = \beta_1 TF_{bt} + \gamma_b + \gamma_{lt} + \varepsilon_{bt}$ (17)	β_1 provides an estimate of ρ_{LT}
Pass-through into rental prices (ρ_{PT})	$\rho_{PT} = \frac{\rho_{LT}}{1+\frac{1}{\varepsilon_{FP}}(1-\varepsilon_{FP}^S)} + \frac{\delta(\frac{Pr_{fill}Pr''_{fill}}{Pr'^2_{fill}}-1)}{1+\frac{1}{\varepsilon_{FP}}(1-\varepsilon_{FP}^S)}$ (11)	$\text{rent}_{pblt} = \beta_4 TF_{bt} + \gamma_p + \gamma_{lt} + \gamma_b + \varepsilon_{pblt}$ (25)	β_4 provides an estimate of ρ_{PT}
Landlord demand elasticity w.r.t. broker services (ε_{JL}) Change in demand for brokers Δ_{JT}	$\Delta_{JT} = \varepsilon_{JL}\rho_{LT}\frac{f_b^T}{f_b^L}$ (10)	$\hat{\chi}_{bt} = \beta_2 LF_{bt} + \gamma_b + \gamma_{lt} + \varepsilon_{bt}$ (22)	β_2 provides an estimate of ε_{JL}, via equation (23) Combining ε_{JL} and ρ_{LT} provides an estimate of Δ_{JT}
Tenant demand elasticity w.r.t. tenant fees ($\varepsilon_{FT} = \delta\varepsilon_{FP}$)	$\Delta_{ToM} = -\frac{1}{\text{Pr}_f^2}\varepsilon_{FP}\frac{f_b^T}{p_L}(\rho_{PT}+\delta)$ (13)	$\text{ToM}_{pblt} = \beta_5 \text{TF}_{bt} + \gamma_p + \gamma_{lt} + \gamma_b + \varepsilon_{pblt}$ (26)	β_5 provides an estimate for Δ_{ToM} Combining Δ_{ToM} and ρ_{PT} provides a bound for δ (see below)
Backing out additional model parameters			
Saliency of tenant fees (δ)	Equations (9), (11) and (13)	-	Combining estimates of Δ_{ToM}, ρ_{LT} and ρ_{PT}, and given that $\varepsilon_{FP} < 0$, we can bound δ and point-identify it at $\delta = 0$ if $\Delta_{ToM} = 0$
Curvature of landlord demand (ε_{JL}^s)	Equations (9) and (10)	-	Using the estimates for ρ_{LT} and ε_{JL}, we back out ε_{JL}^s from the definition of ρ_{LT}
Measuring entry and exit			
Broker exit	$\mathbb{1}[(\pi_b^{pre})^* + \Delta\pi_b^* \geq Y_b]$ (14)	$\mathbb{1}_t[\#\text{ Listings} > 0]_{bt} = \beta_3 TF_{bt} + \gamma_{lt} + \varepsilon_{bt}$ (24)	β_3 estimates whether there is a significant number of brokers whose post-reform profits violate the participation constrain (PC)
Landlord exit	$\mathbb{1}[(U_L^{pre})^*(\varepsilon_{FP}) + \Delta U_L^*(\varepsilon_{FP}) \geq Y_L]$ (15), $\varepsilon_{FP} = -\alpha(1-Q_L)p_L$ (28)	$\log(\overline{rent}_{lt}) = \beta_6\left[\mathbb{1}_t[Post_t = 1] \times \sum_b \frac{N_{bl}}{N_l} TF_b\right]_{lt} + \gamma_l + \gamma_{rt} + \varepsilon_{\ell pblt}$ (27)	β_6 estimates whether rental prices increase following the reform as predicted by a lower demand elasticity due to landlords falling below the PC and exiting.

Table 2: Linking the conceptual framework and estimating equations

4.4 Robustness

A key assumption underlying the empirical specifications in the previous two subsections is that of parallel trends. Specifically, to obtain causal estimates, we must assume that, in the absence of the policy change, the outcome variables of interest of agencies more exposed to the Tenant Fees Act would have evolved in a similar manner to those less exposed. In this section, we present a variety of robustness checks, including event studies and placebo estimates, as well as associated descriptive statistics to support this assumption.

For the pass-through into rents (specification 25) and tenant demand for rental properties (specification 26) we perform placebo exercises. These placebo estimates are taken by running the baseline estimating equation on only the pre-period, and then varying the policy date. We perform this for 4 placebo dates, in each specification. The reason for estimating these placebos instead of traditional event studies is that the baseline estimates utilise a property level fixed effect, and properties do not become vacant and therefore listed particularly often. Therefore, an event study specification suffers from severe compositional issues in the unbalanced panel, which are largely mitigated when running a long difference-in-difference just over the pre-period sample.

As a robustness check for letting market exit we also exploit the variation between England (treated) and Scotland (control)[27] and perform an event study of the form:

$$Participation_{bt} = \sum_{j \neq -1} \beta_{7,j} \left[\mathbb{1}_t[t = j] \times England_b \right] + \gamma_b + \gamma_t + \varepsilon_{bt} \tag{29}$$

Lastly, we want to test whether tenant fees were evolving in parallel between the more and less exposed groups. Such a test is necessary in particular to check for anticipatory changes to tenant fees prior to the reform, or more generally if they developed differently across brokers in the pre period, as this would pose identification issues. Since we only observe tenant fees once in the pre period, we exploit the scraped online broker review data from allagents and evaluate the effect of the Tenant Fees Act on reviews from tenants. This is informative for the level of tenant fees if they are are a driver of unfavourable reviews. Indeed, in the pre-period, when tenant fees existed allagents gave a "lettings fee satisfaction" based on customer reviews, and the average satisfaction rate across agencies in our sample is only 42%, suggesting that tenant fees were an important driver of tenant satisfaction with broker services. If tenant fees drive reviews we would expect a positive effect on reviews for agencies with higher initial fees in the post period. If at the same time there are parallel pre trends in reviews this is indicative of paralell trends in tenant fees. To operationalize this reasoning we run the following event study:

$$y_{blt} = \sum_{j \neq -1} \beta_{8,j} \left[\mathbb{1}_t[t = j] \times TF_{bt} \right] + \gamma_{lt} + \gamma_b + \varepsilon_{blt} \tag{30}$$

where y_{bet} is the average review score (from 1 to 5 stars) of broker b located in postal area l in period t by tenants. We calculate the quality score of a broker by aggregating reviews to yearly intervals.[28] To provide evidence in favour of the parallel evolution of tenant fees prior to the policy we require $\beta_8 > 0$ for the post period and $\beta_8 = 0$ for the years prior to the TFA.

[27] Scotland banned tenant fees already in 2012, so forms a suitable control group for our time period as any dynamic treatment effects on broker exit should have dissipated after 7 years.

[28] To coincide with the timing of the reform we aggregate the intervals June - May.

We further perform a similar estimation for landlord reviews, as a key assumption underlying the exclusion restriction in the demand estimation in section 4.2 is that the TFA only affects broker choices via the impact on landlord fees, and for example, does not change quality.

5 Results

We now turn to the results documenting the adjustment in the market for letting broker services and the rental market to the reform along the three dimensions: price pass-through, demand sensitivity and market entry and exit.

5.1 The market for letting brokers

We find that the forced reduction of tenant fees is passed through imperfectly into landlord fees (see table 3). Columns (1) and (2) present results from equation 17 and indicate that for the managing a property service the pass-through is just below 20p on the pound while it is 25p for the service to find a tenant. Both estimates are highly statistically significant, with implied F-statistics of 43.6 and 20.5 when used as instruments in the associated demand IV estimation.

Table 3: Pass through to Landlords and landlord demand for letting agent services

	(1)	(2)	(3)
	First Stage - Passthrough		Reduced Form - Demand
	Managed fees$_{bt}$	Find fees$_{bt}$	$\hat{\delta_{bt}}$
TF_{bt}	0.198***	0.252***	-0.00031***
	(0.0300)	(0.0552)	(0.000087)
Agent FEs	Yes	Yes	Yes
Postarea X Period FEs	Yes	Yes	Yes
Observations	4104	4104	4104
Implied Median Elasticity ($P_{50}(\eta_{bb})$)	-2.7	-1.3	

Note: *The table presents estimates for $\hat{\beta}_1$ from equation (17) in columns (1) and (2) and the estimate of $\hat{\beta}_2$ from the reduced form version of equation (22) in column (3). Standard errors are reported in parentheses and clustered at agency × period level. The independent variable TF_{bt} measures the forced reduction in tenant fee implied by the reform of broker b. The dependent variables in columns (1) and (2) are landlord fees charged by these brokers such that the estimated coefficients represent pass-through rates of the cost shock into prices. The dependent variable in column (3) is the mean utility ($\hat{\delta_{bt}}$) provided by broker b, such that the resulting coefficient is a reduced-form estimate corresponding to an IV specification that instruments changes in landlord fees with the cost shock from the reform to estimate the demand elasticity of broker services. The bottom row calculates the median of this implied elasticity of demand dividing column (3) with the respective first-stage estimate (from column 1 and 2) as calculated based on equation 23.* * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

These low pass-through rates are already indicative that brokers face some degree of competitive pressure in the market for letting broker services. These findings are corroborated by our estimates of the landlord demand elasticity. Column (3) in table 3 presents the reduced form version of equation 22 (i.e. with the right hand side variable as the tenant fee), and the bottom row presents the implied median elasticity of demand ($\bar{\eta}_{bb}$) as calculated by equation (23) where $\hat{\beta}_2$ is calculated by dividing the coefficient in column (3) with the associated first stage coefficient. The results indicate that landlords are relatively sensitive to prices but the market departs strongly from perfect competition. Survey evidence suggests that approximately 60% of landlords use a Fully Managed service while the remaining 40% use a Find only service. Therefore taking a weighted average this implies a pass-through of approximately 22% and an elasticity of -2.1. For reference, if we assumed a constant elasticity the estimate would imply a markup of 1.91. Table A.2 in the appendix presents the counterpart standard difference in difference version with only period (rather than postarea x period) fixed effects. The pass-through results are almost

identical, and the implied elasticities are quantitatively similar. Table A.1 in the appendix presents the accompanying heterogeneous preferences estimates of $\hat{\beta}_{kX}$ and $\hat{\beta}_{kp}$ from the first stage logit estimation in equation 21.

Lastly, we provide evidence on the exit of letting brokers (table 4 based on equation 24), note that the dependent variable is market participation. There is no statistically significant effect of exposure to the reform on market exit and the estimated coefficient is also small in economic terms suggesting that an average exposure to the reform is associated with a 0.62 percentage point increase in participation.

Table 4: Market Participation

	(1)
TF_{bt}	-0.00000143
	(0.0000429)
Sample	Full
Postarea x Year-Month FEs	Yes
Obs.	99892

Note: *The table presents estimates for $\hat{\beta}_3$ from equation (24). Standard errors are reported in parentheses and clustered at broker × period.* * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.2 The rental market

First, we study the pass-through of the changes in tenant fees into rental prices (equation 25, table 5). As we have data on both the initial ask price, all changes in ask price over time, and the final ask price we exploit this feature of the data. Column (1) displays the average pass-through into the initial advertised ask price that is statistically indistinguishable from 0 but estimated somewhat imprecisely. Column (2) displays the effect on the final ask price where the coefficient becomes economically smaller and turns negative. We then restrict the sample to those properties that do not change the advertising brokers, since landlords that change broker might face a lower or no increase in costs that they need to pass on. For the initial ask price we now find a larger estimate that is statistically significant at the 5% level (column 3) when using robust standard errors. When looking at the final ask price the estimate again becomes smaller and not statistically different from zero (column 4). These results suggest that landlords attempt to pass some costs through to tenants in the form of higher rental prices, but struggle to do so and thus have to drop prices as they are unable to fill the vacant property. This inability to increase rental prices is indicative of a highly competitive market with respect to rental prices. This effect is more pronounced for those landlords that don't switch. Column (2) however represents the final average pass-through to rental prices, suggesting renters keep all the monetary benefits from the policy.

Next, we estimate the effect of the change in the tenant fee, due to the reform, on the demand of tenants as measured by the time a property is on the market (equation 26, table 6). Given the lack of pass-through of tenant fees into rental prices as documented in table 5, these estimates are informative about the elasticity of tenants with respect to tenant fees, which is simply the demand elasticity with respect to rents, multiplied by the salience parameter.[29] We find a precisely estimated zero impact of the reform on tenant demand, as measured by time on the market. The result implies that a property with the median tenant fee (£400) is listed for approximately 1.7 less days as a result of the reform. To put this into context, if the demand sensitivity of rental price had a similar estimate, it would suggest increasing

[29] If there was incomplete pass-through of tenant fees to rental prices, the cost of renting would have changed as a result of changes to both rental prices and tenant fees, implying we wouldn't be pinning down the elasticity to only one of the prices, but a mixture of the two as made clear in equation (13).

Table 5: Pass-through into rents

	Rental price			
	(1)	(2)	(3)	(4)
	Initial ask	Last ask	Initial ask	Last ask
TF_{bt}	0.00854	-0.0227	0.111	0.0696
clustered	(0.0837)	(0.0775)	(0.0759)	(0.0738)
robust	(0.0620)	(0.0587)	(0.0561)**	(0.0543)
Property FEs	Yes	Yes	Yes	Yes
District x Year-Month FEs	Yes	Yes	Yes	Yes
Agency FEs	Yes	Yes	Yes	Yes
Sample	All	All	No agency change	
Observations	1297888	1297888	968152	968152

Note: *The table presents estimates for $\hat{\beta}_4$ from equation (25) with the dependent variable $rent_{palt}$ as the initial advertised ask price and the final ask price. In columns (1) and (2), the regressions are performed on the entire sample. In columns (3) and (4), the sample is restricted to properties that do not change advertising agents. Two sets of standard errors are reported in parentheses, heteroskedatstic-robust and clustered at agency × period.* * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

rent by £100 a month (about 12.5% of average rental prices) would increase the time it takes to fill the property by 5.1 days - a decision any profit maximising landlord would take.

Table 6: Time on market impacts

	Listing time in months	
	(1)	(2)
TF_{bt}	-0.000147	-0.000128
	(0.000107)	(0.0000981)
Property FEs	Yes	Yes
District x Year-Month FEs	Yes	Yes
Broker FEs	Yes	Yes
Sample	All	No agency change
Obs	1297888	968152

Note: *The table presents estimates for $\hat{\beta}_5$ from equation (26). In column (1) the regression is performed on the entire sample. In columns (2), the sample is restricted to properties that do not change advertising agents. Standard errors are reported in parentheses and clustered at broker × period.* * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Lastly, we look at whether market-level exposure to the reform affects the net exit of landlords (equation 27, table 7). Column (1) looks at the impact on average rental price and column (2) on the average price of sales in an area. In the presence of market exit by landlords we would expect average rent to increase and sales prices to go down. We find the opposite in both cases with small effect sizes and statistically insignificant coefficients. The specifications in column (2) is able to use longer panels, as they rely on the HMLR transaction data which is updated frequently, capturing more longer run effects up to 3 years after the reform.

5.3 Robustness

We now turn to the robustness checks as outlined in section 4.4. Figure 3 presents the parameters estimates from the event study specification 29 exploiting variation to exposure across England and Scotland. The results demonstrate parallel pre-trends and a relatively precise null result.

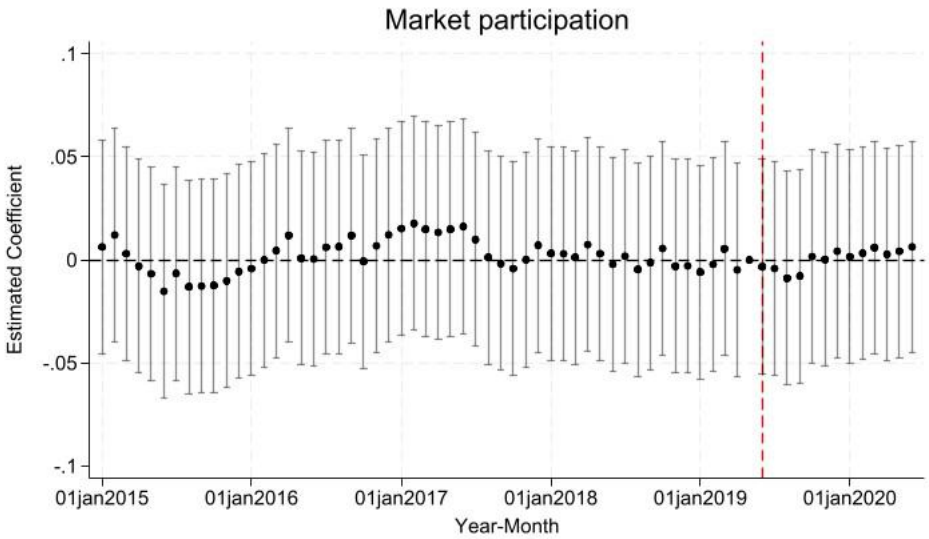
Table A.3 in the appendix presents placebo tests for the pass-through into last ask rental prices using different treatment dates and dropping the post period sample, while table A.4 presents the same for time on the market. Both sets of results report null results for all specifications, in support of the parallel trend assumption.

Table 7: EQ adjustments landlords

	(1) Log avg rent	(2) Log avg price
TF area X Post	-0.0000352	0.0000590
	(0.0000729)	(0.0000113)
Area FEs	Yes	Yes
Region x Year-Month FEs	Yes	Yes
Observations	7295	9730
Sample Period	2015-2020	2015-2023.5

Note: *The table presents estimates for $\hat{\beta}_7$ from equation (27) with the dependent variable y_{et} as the log average rent and average price in area e at time t. The table reports the sample period for each regression. Standard errors are reported in parentheses and clustered at area × period.* * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 3: Market Participation Event Study



Notes: *The figure presents estimates of $\hat{\beta}_{4,j}$ from equation 29, where the bars represent 95% confidence intervals.*

Figure 4: Broker reviews from tenants

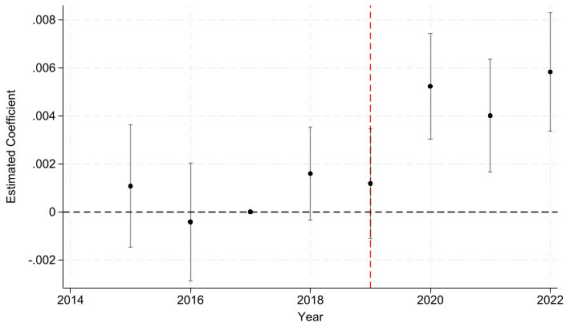
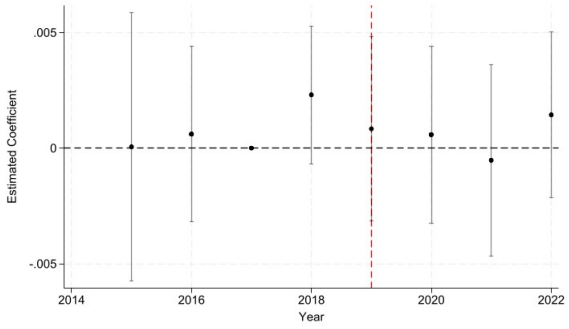


Figure 5: Broker reviews from landlords



Notes: *The figures present event study estimates of $\hat{\beta}_{8,j}$ from an equivalent event study specification to equation 30 for reviews by tenants and landlords, respectively. The bars represent 95% confidence intervals.*

Lastly, figure 4 presents the event study estimates from specification 30 for the impact of the TFA on broker reviews by tenants. The results show that in the 5 years preceding the implementation of the policy the evolution of broker reviews from tenants was uncorrelated with the exposure to the policy, while after the introduction of the policy there was a sharp, consistent and statistically significant improvement in broker reviews. For a broker with a tenant fee of £408 (the median), the counterpart difference-in-difference estimates in table A.5 imply their score would have increased by 1.37 out of 5 on average. We interpret this as demonstrating parallel trends in tenant fees prior to the policy, along with a lack of anticipatory effects by brokers (i.e. adjusting fees in advance). Figure 5 displays the results for the reviews by landlords as dependent variable. The parallel pre trends in this specification are further corroborating evidence that more and less exposed agencies where not on differential trends prior to the reform. The lack of treatment effect suggests that there is no endogenous adjustment of service quality (see table A.5 for the corresponding difference-in-differences estimate). A change in service quality of brokers towards landlords following the reform would have been a violation of the exlusion restriction for the demand estimation (see section 4.2 for a more detailed discussion).

5.4 Implications for the conceptual framework

The results in sections 5.1 and 5.2 map directly to the theoretical framework and its key parameters laid out in section 2.2. A summary of these links can be found in table 2. The pass-through (ρ_{LT}) to landlord fees of 22% and elasticity of landlord service demand (ε_{JL}) of -2.1 can be combined through equation 9 to back out the second order elasticity of landlord demand for letting broker services. The resulting curvature of 6.4 implies strong local concavity in the landlord-broker demand curve. The lack of exit of letting brokers after they absorb around 78% of the negative revenue shock suggests the existence of supernormal profits prior to the reform.

The fact that landlords do not pass-through anything into rental prices ($\rho_{PT} \approx 0$) suggests there must be strong local concavity in demand for rental properties coupled with a low salience parameter for fees, δ. The estimate of time on the market (demand) on the tenant fee in equation 26 suggests that $\delta = 0$, and therefore ρ_{PT} is given by $\frac{\rho_{LT}}{1+\frac{1}{\varepsilon_{FP}}(1-\varepsilon^S_{FP})}$ as per the bottom right cell in table 1. As $\rho_{LT} = 0.22$, using the estimate in column (4) of table 5, where the final price pass-through for non-changers is 7% (though not statistically different from zero), it suggests $\frac{1}{1+\frac{1}{\varepsilon_{FP}}(1-\varepsilon^S_{FP})} \approx 0.3$. These two facts combined

imply that tenants are very locally responsive to rental price changes, but very insensitive to tenant fees. Furthermore, as we find no market exit for landlords, this suggests there must exist some supernormal profits or large exit costs, as we know they are absorbing approximately 22% of the reform revenue shock.

6 Welfare Impacts and Salience Counterfactual

6.1 Welfare Impacts

We now turn to quantifying the aggregate and distributional welfare effects of the regulation, combining the model structure and our reduced-form estimates.

6.1.1 Methodology

Our reduced form estimates allow us to simplify the model as we know that several margins of potential adjustment were not active: There was no pass through into rental prices, no exit of letting agents, no exit of landlords, no changes to property fill rates and no changes in broker service quality (see table 5, 4, 7, 6, and A.5 respectively).

Tenants As tenants do not adjust their optimal housing choice and there were no changes in rental prices, the money metric counterfactual to their utility is trivially given by:

$$U_{iLb}^{post} - U_{iLb}^{pre} = f_{bL}^{T,Pre} - f_{bL}^{T,Post} \tag{31}$$

Landlords Under the assumption that ϵ_{Lb} are IID EV type 1 distributed (consistent with the estimation strategy from section 4.2) changes to the landlord welfare can be estimated using the standard compensating variation formula such that the expected utility of landlord L is given by $E[U_{L,j}] = ln(\sum_b exp(V_{jb}))$. Thus the landlord specific welfare change can be calculated according to:

$$CV_L = \frac{1}{\hat{\beta}_{0p}} \left[ln(\sum_b exp(\hat{V}_{jb,post})) - ln(\sum_b exp(\hat{V}_{jb,pre})) \right] \tag{32}$$

where $\hat{V}_{jat} = \hat{\chi}_{bt} + \hat{\lambda}_{jbt}$ (see equation 18). $\hat{\chi}_{bt}$ and $\hat{\lambda}_{jbt}$ are calculated based on equations 19 and 20. To ensure we only capture the impacts of the policy, we calculate expected utility based on pre-period choice sets and on a predicted landlord fee based on the pass-through estimates: $\hat{f}_{b,post}^{L} = f_{b,pre}^{L} + \hat{\beta}_1 * f_{b,Pre}^{T}$. Thus, the values of $\hat{\chi}_{b,post}$ and $\hat{\lambda}_{jb,post}$ are calculated using the estimated pass-through from tenant fees to landlord fee from section 5.1. The relevant parameter estimates for the calculation, $\hat{\beta}_{0p}$, $\hat{\beta}_{kX}$, $\hat{\beta}_{kp}$ are taken from the demand estimates from section 5.1. Given the IV strategy in estimating $\hat{\beta}_{0p}$, the methodological approach outlined in section 4.2 doesn't actually produce an estimate for $\hat{\beta}_{0x}$. We thus estimate it according to

$$\hat{Y}_{b,pre} = \beta_{0x} X_a + \xi_{b,pre} \tag{33}$$

where $\hat{Y}_{b,pre} = \hat{\chi}_{b,pre} + \hat{\beta}_{0p} f_{b,pre}^{L}$, which then allows us to calculate CV_L.

Brokers Changes to broker profits as a result of the policy are given by:

$$\pi_b^{post} - \pi_b^{pre} = \sum_j \left((f_{b,post}^{L} + f_{b,post}^{T}) - c_b \right) Pr_{job}(f_{b,post}^{L}) - \sum_j \left((f_{b,pre}^{L} + f_{b,pre}^{T}) - c_b \right) Pr_{job}(f_{b,pre}^{L}) \tag{34}$$

As done with the landlord welfare changes, we utilise the pre-period choice sets to ensure we don't capture any changes over time that are unrelated to the policy. We impose changes to tenant fees that are consistent with the policy, $f^T_{b,post} = min\{50, f^T_{b,pre}\}$ and changes to the landlord fees are calculate based on the pass-through estimate $f^L_{b,post} = f^L_{b,pre} + \hat{\beta}_1 * f^{T,Pre}_{bL}$. Demand estimates, Pr_{job} for the pre period are taken from the logit estimates in section 5.1, and for the post-period are simulated according to

$$\hat{P}_{Lb,post} = \frac{exp(\chi_{b,post} + \lambda_{Lb,post})}{\sum_M exp(\chi_{m,post} + \lambda_{mb,post})} \tag{35}$$

where $\chi_{b,post}$ and $\lambda_{Lb,post}$ are calculated according to the approach outlined in the landlord section above.

Lastly, we require an estimate of c_b. We estimate this using the optimal pricing equation for the broker (11) and the broker-specific demand elasticity as estimated in equation 23. Thus it's calculated according to

$$\hat{c}_b = \left(\frac{\hat{\eta}_{bb}}{\hat{\eta}_{bb} - 1}\right)^{-1} \frac{f^L_{b,pre}}{\hat{\mu}_b} + f^T_{b,pre} \tag{36}$$

6.1.2 Results

Table 8 presents the money metric change to utilities and profit at the mean and median amount for the associated broker. All reported values are presented on a per-tenancy calculation for ease of comparison.[30] The results suggest that at the median, tenants gained £376, landlords lost £74, and brokers lost £288. The policy was predominantly redistributive, but there was some minor aggregate gains from the policy. Based on our pre-period sample, of the near universe of rental properties in the UK, these aggregate welfare gains would have amounted to £16.4 million per year.

Table 8: Per Tenancy Welfare Changes (£)

Statistic	Tenant	Landlord	Broker	Aggregate
Mean	379	-88	-287	4
Median	376	-74	-288	14

While brokers lost substantially on average, our estimates suggest about 2% of brokers actually experience an improvement in profits as a result of the policy, and as shown in figure 6 this is most prevalent amongst those with lower tenant fees in the pre period. Intuitively, these less exposed brokers expanded the set of properties they are managing at the expense of brokers with high initial tenant fees that relatively increased their landlord fees following the reform. These demand increases outstripped the loss from tenant fees.

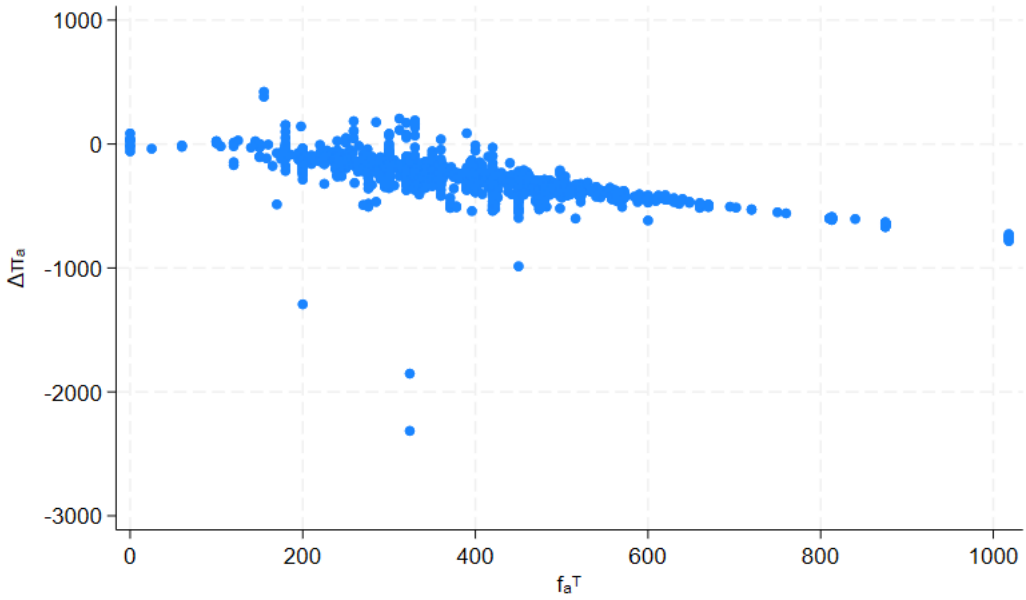
The very small aggregate welfare gains stem from the fact that brokers with higher pre-period tenant fees have a tiny, but precisely estimated, higher level of costs, $\hat{c}_a$. A regression of the form

$$f^T_{b,pre} = \beta_c \hat{c}_a + \epsilon_a \tag{37}$$

gives an estimate of $\hat{\beta}_c$ of 0.013 (0.004) suggesting that a broker with an additional marginal cost of £100, would charge an additional £1.30 tenant fee. The policy then in turn reallocated business away

[30] For the broker level calculations this is done by calculating the total profit change for the broker, and then dividing through by their pre-period demand quantity.

Figure 6: Broker Profit Changes and pre-period tenant fees ($f^T_{b,pre}$)



from less productive (higher cost) brokers, to more productive brokers.

6.2 Salience Counterfactual

Generating a true policy-counterfactual under $\delta = 1$ would require simulating the pre-period equilibrium under that assumption, as well as simulating the policy, which is beyond the scope of this paper.[31] However, the extent to which non-salience of tenant fees generates the success of the policy can be assessed via equation (11)

$$\rho_{PT} = \frac{\rho_{LT}}{1 + \frac{1}{\varepsilon_{FP}}(1 - \varepsilon^S_{FP})} + \frac{\delta(\frac{Pr_{fill}Pr''_{fill}}{Pr'^2_{fill}} - 1)}{1 + \frac{1}{\varepsilon_{FP}}(1 - \varepsilon^S_{FP})}$$

The results in section 5 are suggestive of concavities in the tenant-landlord demand function,[32] thus suggesting $Pr''_{fill} < 0$. Setting $\frac{Pr_{fill}Pr''_{fill}}{Pr'^2_{fill}} = 0$ and $\delta = 1$ would therefore give a lower-bound of the pass-through to rental prices under perfect salience such that

$$\rho_{PT} = \frac{\rho_{LT}}{1 + \frac{1}{\varepsilon_{FP}}(1 - \varepsilon^S_{FP})} - \frac{1}{1 + \frac{1}{\varepsilon_{FP}}(1 - \varepsilon^S_{FP})}$$

which suggests that the pass-through would be $\frac{1}{\rho_{LT}} + 1$ times larger in absolute terms. In our case where $\rho_{LT} = -0.2$, this implies that ρ_{PT} would be 6 times larger when $\delta = 1$, in comparison to the true value of $\delta = 0$. For those landlords where there is no broker change, table 5 suggests ρ_{PT} is equal to -7%. Therefore, we would expect under full salience of tenant fees $|\rho_{PT}| > 0.42$. The welfare changes reported in table 8 would in turn adjust such that the gains from the policy tenants experience would reduce, and reallocate to landlords, who would actually make a net gain from the policy.

[31] Given the lack of pass-through to prices, it is difficult to achieve given the underlying elasticity, ε_{FP}, and curvature, ε^S_{FP}, can't be estimated.

[32] Due to incomplete pass-through from the landlord cost shock to rental prices.

7 Conclusion and policy implications

Junk fees and drip pricing are omnipresent in modern economies and probably nowhere quantitatively as important for consumers as in the rental market. We study how banning drip pricing in the two-sided market of letting brokers affects the welfare of tenants, landlords and brokers in general equilibrium, providing important insights on the effectiveness of consumer protection policies in such a rich market environment.

We find that the policy successfully reduces the cost of renting for tenants by £376 per tenancy, largely at the expense of brokers, who lose £288 per tenancy, while landlords are less affected, losing £74 per tenancy. The policy produces modest aggregate welfare gains of £14 per tenancy by reallocating properties from less to more productive brokers. We show that the non-saliency of fees paid by tenants as well as the extent of competition are key for these results. If tenants were aware of tenant fees prior to the policy, we would observe a much greater pass-through into rents sucht that the reduction in the cost of renting of tenants would be much more modest. We show that in a world of competitive markets even in the presence of nonsalient price components the reform would not have any effects.

Our results highlight the importance of economic analysis when designing consumer protections policies, as the effects depend crucially on the market structure of the targeted markets as well as the salience of regulated price components and the interaction of these two forces.

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Appendix

A Additional Tables

Table A.1: First Stage Logit Estimates

Variable	Post	Pre
Broker Price x Bedrooms	0.0000132***	0.00000969***
	(0.00000196)	(0.00000086)
Broker Price x Bungalow	-0.0000648**	-0.0000208*
	(0.0000235)	(0.0000104)
Broker Price x Detached House	0.0000513***	0.0000877***
	(0.0000074)	(0.0000031)
Broker Price x Semi-Detached House	-0.0000591***	-0.00000341
	(0.00000667)	(0.00000307)
Broker Price x Terrace House	0.00000684	0.0000428***
	(0.00000458)	(0.00000199)
Broker Price x Quality 2	-0.00000427	-0.0000505***
	(0.00000571)	(0.00000253)
Broker Price x Quality 3	-0.0000364***	-0.0000997***
	(0.00000608)	(0.00000271)
Broker Price x Quality 4	0.0000737***	-0.000000239
	(0.00000661)	(0.00000299)
Broker Price x Student Let	0.0001368***	0.0000643***
	(0.00000789)	(0.00000392)
Student Let Share x Bedrooms	0.0521217	0.0521814***
	(0.020891)	(0.0108384)
Student Let Share x Bungalow	-1.151384	-1.808893***
	(0.5868213)	(0.2706259)
Student Let Share x Detached House	-1.221404**	-1.793269***
	(0.2121191)	(0.0974246)
Student Let Share x Semi-Detached House	-0.7227554**	-0.421873***
	(0.1435693)	(0.0657578)
Student Let Share x Terrace House	-1.221892***	-0.7092499***
	(0.0867401)	(0.0401533)
Student Let Share x Quality 2	-0.4142223***	-0.4004153***
	(0.0629306)	(0.031017)
Student Let Share x Quality 3	-0.4558422***	-0.5647575***
	(0.0715884)	(0.035397)
Student Let Share x Quality 4	-0.1110099	-0.3205259***
	(0.0615833)	(0.032159)
Student Let Share x Student Let	8.152181***	7.401305***
	(0.0569115)	(0.0319933)
Observations	1073450	5266046
Broker FEs	Yes	Yes

Note: *The table presents estimates for $\hat{\beta_k}x$ and $\hat{\beta_k}p$ from equation (21) for the pre and post period. Standard errors are reported in parentheses.* * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.2: Pass through to Landlords and landlord demand for letting agent services

	(1)	(2)	(3)
	First Stage - Passthrough		Reduced Form - Demand
	Managed fees	Find fees	$\hat{\delta_a}$
TF_{at}	0.185***	0.282***	0.00017**
	(0.0278)	(0.0514)	(0.000078)
Agent FEs	Yes	Yes	Yes
Period FEs	Yes	Yes	Yes
Observations	4104	4104	4104
Implied Median Elasticity ($P_{50}(\eta_{aa})$)	-1.6	-0.62	

Note: *The table presents estimates for $\hat{\beta}_1$ from equation (17) in columns (1) and (2) and the estimate of $\hat{\beta}_2$ from the reduced form version of equation (22) in column (3). Standard errors are reported in parentheses and clustered at agency × period level. The bottom row calculates the median implied elasticity of demand dividing column (3) with the respective first-stage estimate as calculated based on equation 23.* * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.3: Pass-through into rents placebo

	Rental price			
	Last ask	Last ask	Last ask	Last ask
	(1)	(2)	(3)	(4)
TF_{bt}	-0.0582	0.00424	-0.0774	-0.0464
clustered	(0.145)	(0.154)	(0.107)	(0.109)
robust	(0.0490)	(0.0500)	(0.0581)	(0.0851)
Property FEs	Yes	Yes	Yes	Yes
District x Year-month FEs	Yes	Yes	Yes	Yes
Broker FEs	Yes	Yes	Yes	Yes
Post date	June 2017	Dec 2017	June 2018	Dec 2018
Obs	981572	981572	981572	981572

Note: *The table presents estimates for $\hat{\beta}_5$ from equation (25) with the dependent variable $rent_{pblt}$ as the final ask price, but using various placebo treatment dates. The sample includes the pre-treatment period of observations. Two sets of standard errors are reported in parentheses, heteroskedatstic-robust and clustered at broker × period.* * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.4: Tenant demand sensitivity for property prices placebo

	Listing time in months			
	(1)	(2)	(3)	(4)
TF_{bt}	-0.000115	-0.0000427	-0.0000280	-0.0000713
	(0.0000790)	(0.0000819)	(0.0000886)	(0.0000930)
Property FEs	Yes	Yes	Yes	Yes
District x Year-Month FEs	Yes	Yes	Yes	Yes
Broker FEs	Yes	Yes	Yes	Yes
Post date	June 2017	Dec 2017	June 2018	Dec 2018
Obs	981646	981646	981646	981646

Note: *The table presents the reduced from equivalent estimates for $\hat{\beta}_6$ from equation (26), but using various placebo treatment dates. The sample includes the pre-treatment period of observations. Standard errors are reported in parentheses and clustered at broker × period.* * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.5: The effects of the Tenant Fees Act on broker reviews from tenants and landlords

	(1) Reviews by Tenants	(2) Reviews by Landlords
TF_{bt}	0.00338***	-0.000378
	(0.000635)	(0.00117)
Postarea x Period FEs	Yes	Yes
Broker FEs	Yes	Yes
Obs	2980	1341
Mean	3.173	4.067

Note: *The table presents estimates for $\hat{\beta}_8$ from the difference-in-difference version of equation (30) with the dependent variable y_{bet} as the tenant reviews for the broker b in area e at time t. Standard errors are reported in parentheses and clustered at broker × period.* * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

B Additional Figures

Figure B.1: Example Tenant Fees

Initial Fees

£315.00 + VAT (£378.00 inc VAT)	Referencing fee, set up fee and contribution to the tenancy agreement for 1 adult applicant
£100.00 + VAT (£120.00 inc VAT)	For each additional adult applicant
£105.00 + VAT (£126.00 inc VAT)	Check out fee
£415.00 + VAT (£498.00 inc VAT)	Referencing fee, set up fee and contribution to the tenancy agreement for a company tenant
£100.00 + VAT (£120.00 inc VAT)	For each guarantor, if applicable
£25.00 + VAT (£30.00 inc VAT)	For changing any terms that have already been agreed (e.g. changing tenancy start date)
£35.00 + VAT (£42.00 inc VAT)	For undertaking Right to Rent review checks where a time limit has been established

Please note all the charges above are non-refundable

Additional fees that may be payable during the tenancy term

General Fees - payable to Leaders

£35.00 + VAT (£42.00 inc VAT)	For any aborted pre-arranged visit to the property.
£35.00 + VAT (£42.00 inc VAT)	For supplying any written reference to any party.
£25.00 + VAT (£30.00 inc VAT)	Per additional account to allocate any refund of deposit to multiple accounts.
£25.00 + VAT (£30.00 inc VAT)	For any refund of a tenancy deposit by cheque; no charge is payable when the refund is made via BACS.
£25.00 + VAT (£30.00 inc VAT	For a replacement copy of the Inventory and Schedule of Condition.
£60.00 + VAT (£72.00 inc VAT)	For each or any Endorsement to the Tenancy Agreement.
£25.00 + VAT (£30.00 inc VAT)	For any refund of overpaid rent as a result of any failure by the tenant to cancel the standing order mandate.
£50.00 + VAT (£60.00 inc VAT)	For the first instruction to a contractor and supervision of works noted as tenant responsibility following tenancy check out
£25.00 + VAT (£30.00 inc VAT)	For each subsequent instruction to any contractor
£75.00 + VAT (£90.00 inc VAT)	For producing, subject to landlord consent, a new Tenancy Agreement where the tenant wishes to rescind a notice to surrender and remain in the property.
£175.00 + VAT (£210.00 inc VAT)	For any unlawful termination of the Tenancy Agreement.

Default Fees - payable in connection with any tenant default during the term of the tenancy

£35.00 + VAT (£42.00 inc VAT)	For any letter
£35.00 + VAT (£42.00 inc VAT)	For any payment reminder letter in respect of the No Deposit Option
£80.00 + VAT (£96.00 inc VAT)	For the service of any notice
£45.00 + VAT (£54.00 inc VAT)	For any visit to the property made by the staff of the landlord's agent
£55.00 + VAT (£66.00 inc VAT)	Per month for each month a tracing agent is instructed to locate any tenant who has vacated the property without providing a forwarding address. In addition, the tenant will be responsible to the agent for the fees charged by the tracing agent.

Notes: *The figure presents an example of a tenant fee schedule.*

Figure B.2: Example Landlord Fees

Managed Service

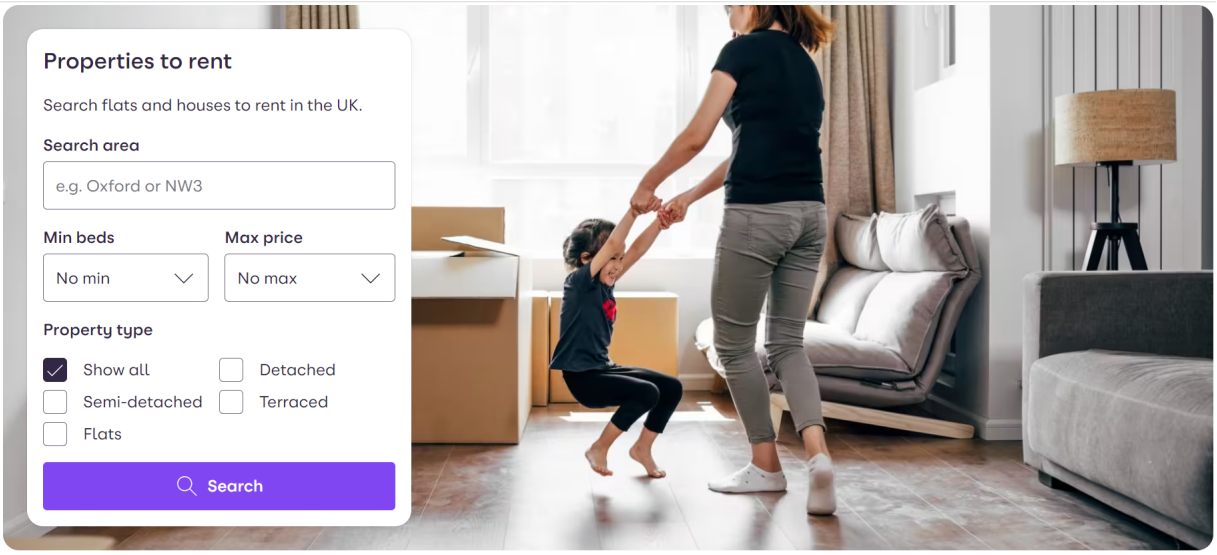
Description	Including VAT	Excluding VAT
Monthly service commission %	12.60%	10.5%
Tenancy set up	£420.00	£350
Gas safety check	£84.00	£70
Energy Performance certification	£78.00	£65
Electrical Installation Condition Report and Portable Appliance Test From	£158.40	£132
Tenancy renewal	£90.00	£75
Rent review	£36.00	£30
Floor plan	£54.00	£45
Move-In & Check-Out Inventory preparation per report:		
Studio/1 bed* From	£144.00	£120
2 bed*	£144.00	£120
3 bed*	£144.00	£120
4 bed*	£144.00	£120
5 bed*	£144.00	£120
Additional requested property visits (per visit)	£60.00	£50
Hourly rate for work not included in your service level (non-exhaustive list below):		
Early termination of management service with a sitting tenant	£450.00	£375
Administration fee for withdrawing from an offer of a tenancy	£180.00	£150
Cutting of keys (per key) From	£12.00	£10

Tenant Find Service

Description	Including VAT	Excluding VAT
Tenant Find fee	£450.00	£375
Gas safety check	£84.00	£70
Energy Performance certification	£78.00	£65
Electrical Installation Condition Report and Portable Appliance Test From	£158.40	£132
Tenancy renewal	£180.00	£150
Floor plan	£54.00	£45
Move-In & Check-Out Inventory preparation per report:		
Studio/1 bed* From	£144.00	£120
2 bed*	£144.00	£120
3 bed*	£144.00	£120
4 bed*	£144.00	£120
5 bed*	£144.00	£120
Additional requested property visits (per visit)	£90.00	£75
Hourly rate for work not included in your service level (non-exhaustive list below):		
Administration fee for withdrawing from an offer of a tenancy	£180.00	£150
Cutting of keys (per key) From	£12.00	£10

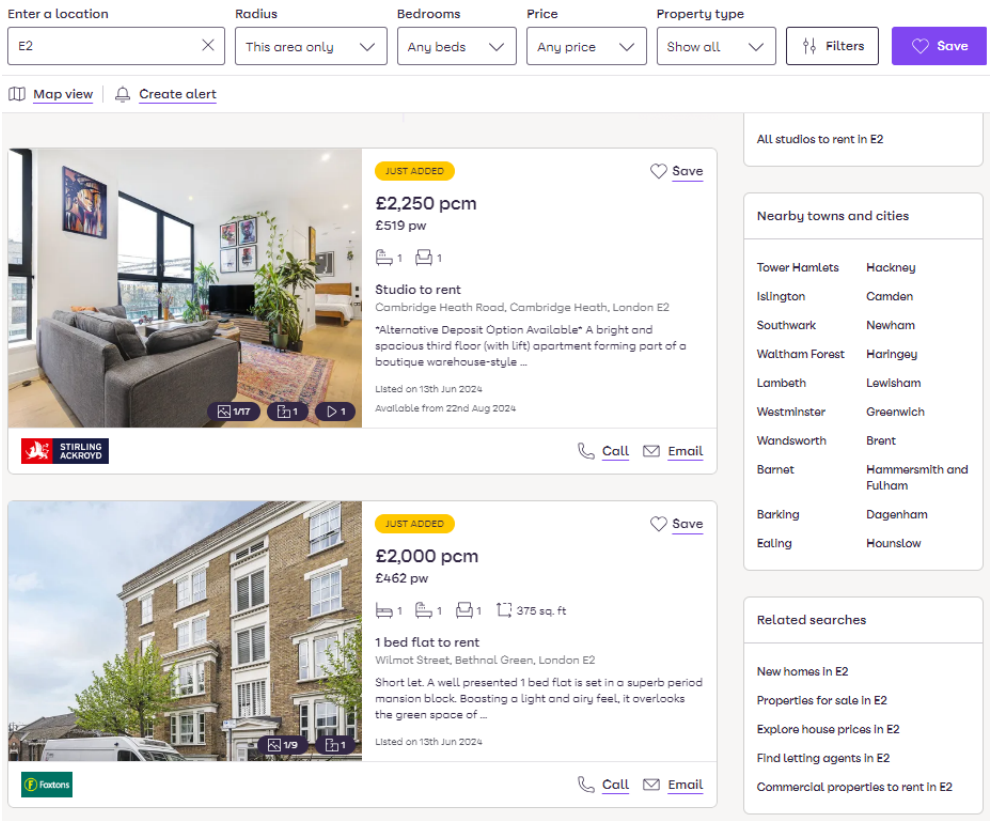
Notes: *The figure presents an example of a landlord fee schedule.*

Figure B.3: Property search interface for tenants



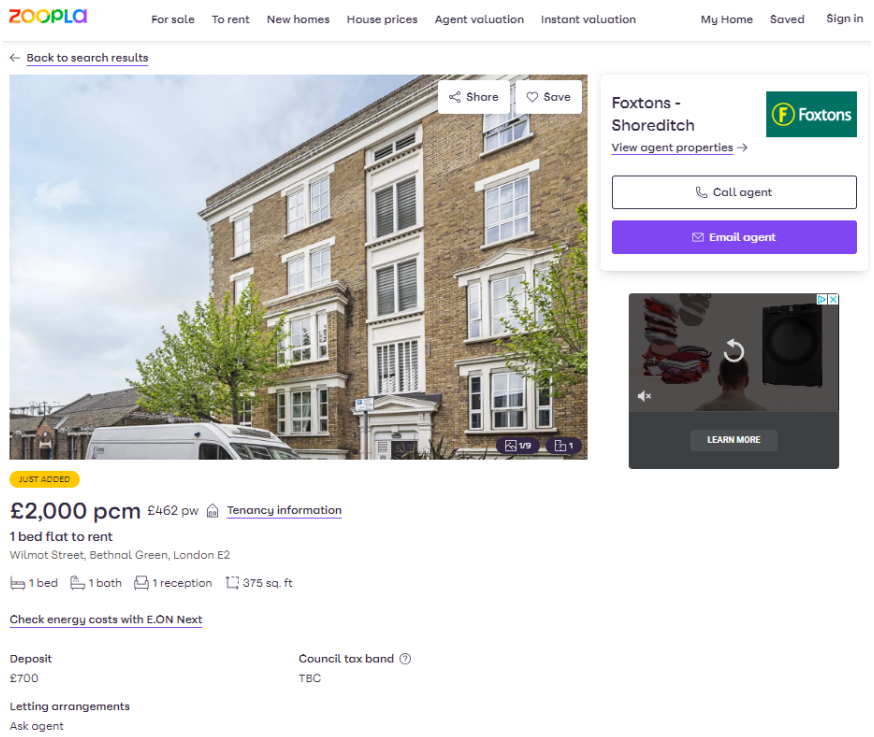
Notes: *The figure presents an example of the search process for a rental property.*

Figure B.4: Property search results overview page



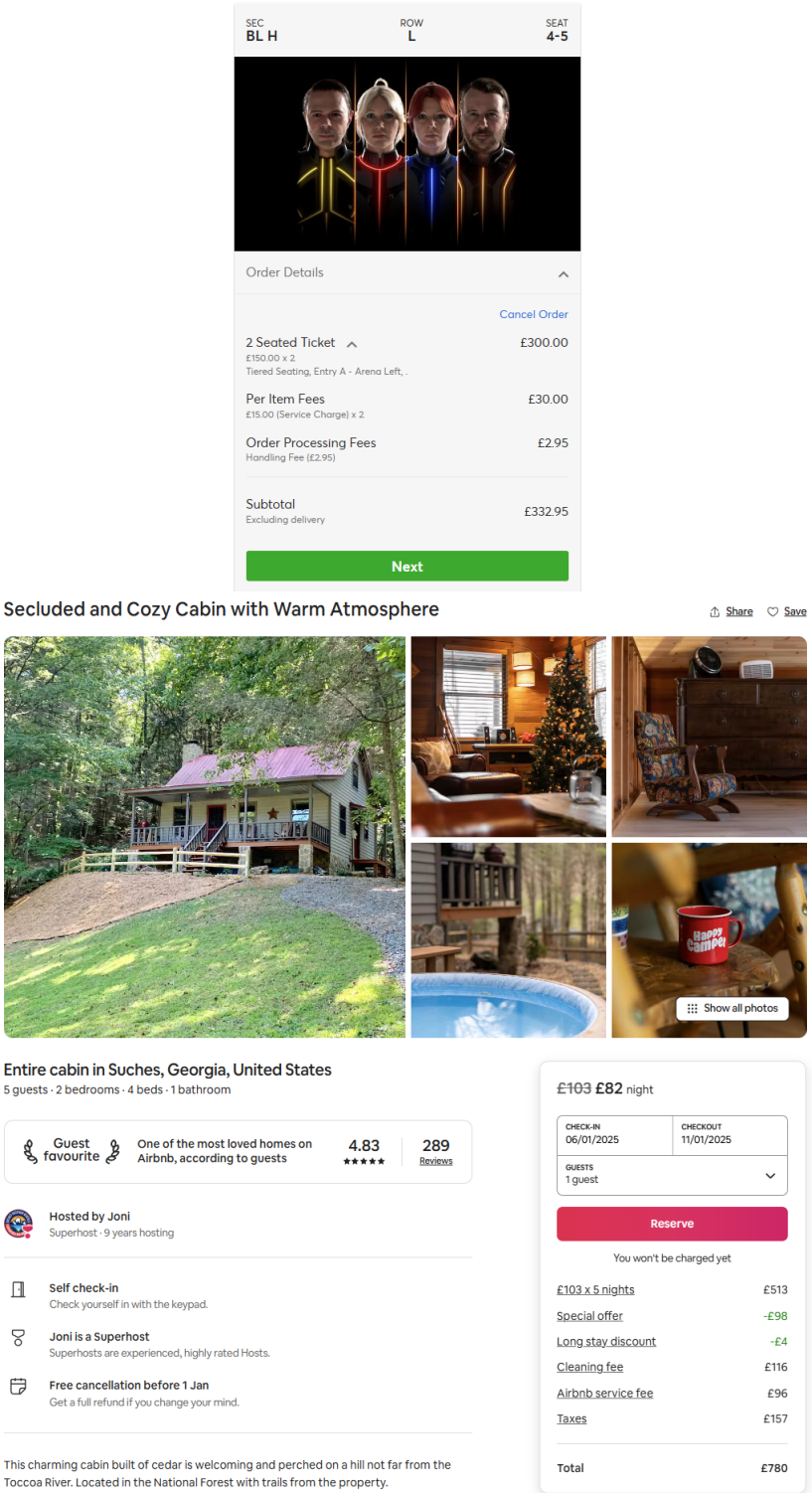
Notes: *The figure presents an example of the search process for a rental property.*

Figure B.5: Individual property page



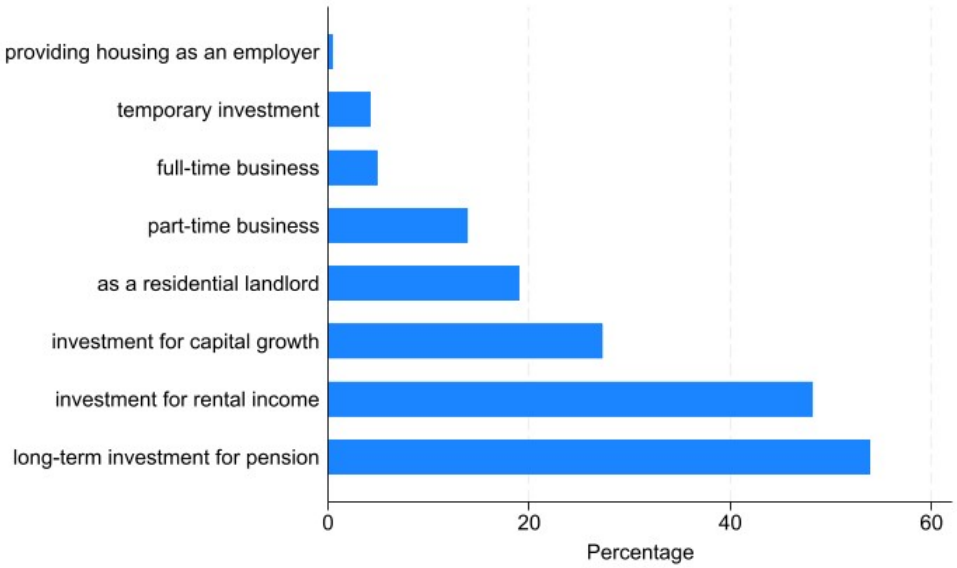
Notes: *The figure presents an example of the search process for a rental property.*

Figure B.6: Junk Fee Examples



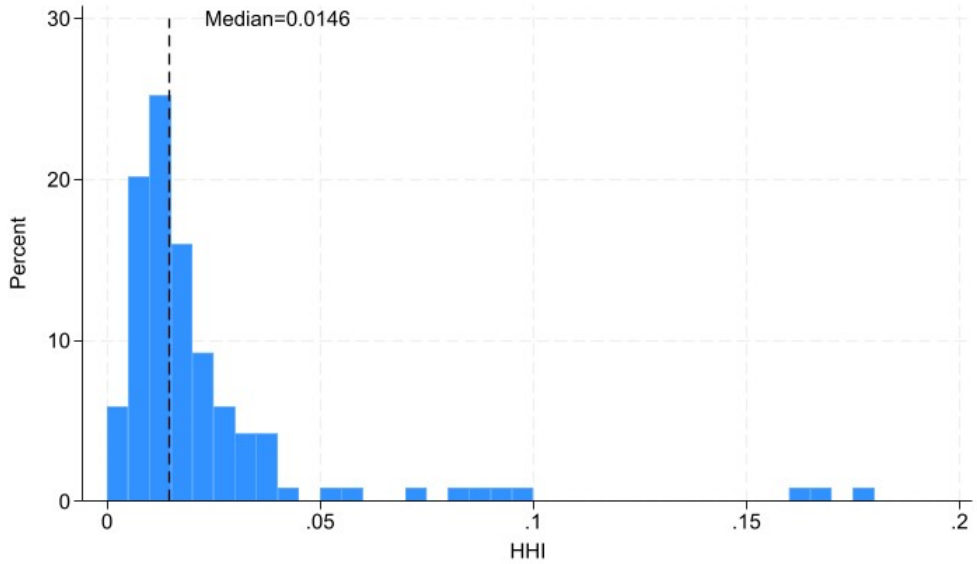
Notes: *The figure presents an example of junk fees when trying to book ABBA tickets, and when trying to book a cabin.*

Figure B.7: Landlord motives for renting out a property



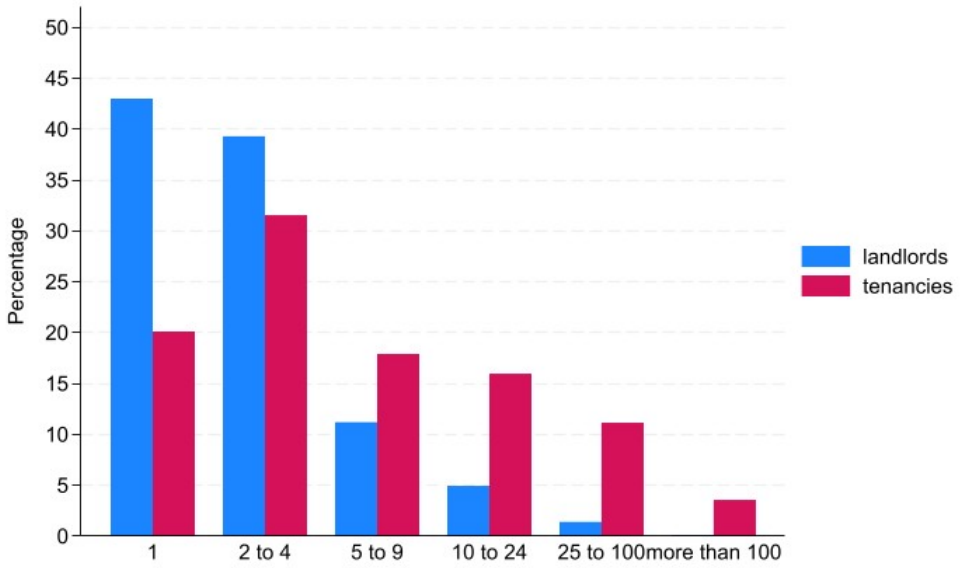
Notes: *The figure presents a bar chart on motives for being a landlord. Source: English Housing Survey.*

Figure B.8: Broker market structure



Notes: *The figure presents a histogram of Herfindahl–Hirschman Indices for the Lettings Brokers market calculated at the Postal Area level in the UK, based on the data described in section 3.*

Figure B.9: Landlord market structure



Notes: *The figure presents bar charts reflecting the market structure for landlords in England. The blue bars represent the proportion of landlords that fall into a particular bin of how many properties they own. The red bars represent the equivalent statistic, but from the perspective of tenancies. Data source: English Housing Survey*