Regulating Inaction: The Case of Price Walking*

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We develop a theoretical model and evaluate its predictions using granular search, choice, and insurer pricing data around the introduction of "price walking" regulation in the UK motor insurance market. Prior to the policy, insurers benefited from customer inaction by keeping prices low to attract new customers while raising prices for pre-existing customers. Post-regulation, introductory discounts to likely inactive customers fell, but insurers responded by proliferating products and segmenting the market more finely. The net effect is striking: Inactive customers continue to pay a substantial price penalty relative to active searchers, just through different mechanisms. These findings illustrate the difficulty of regulating markets with inertial consumers, because suppliers can redesign their product offerings in ways that undermine even well-designed interventions.

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1 Introduction

Many consumers are inert, failing to act even when the benefits of doing so are large. Firms profit from the behavior of these inert customers, who are often less educated and have lower incomes. In response, policymakers have applied a range of indirect remedies, including encouraging competition or "nudging" consumers through default options, though these remedies have sometimes delivered limited benefits for consumers. Increasingly, regulators are adopting a more muscular approach, directly regulating prices to protect customers. The goal of this paper is to investigate these issues—consumer inaction, firm behavior, and the impact of direct regulatory interventions in pricing—by studying a uniquely informative episode in the UK motor insurance market.

We study the impact of a fair pricing regulation introduced in the UK insurance market in 2022. The regulation banned "price walking," whereby insurers offer low introductory prices to attract new customers while progressively raising prices for existing customers. Because existing customers face no compulsion to search for alternative policies, they are potentially more likely to be inactive and thus face price increases. Consumer advocates recognized this dynamic and pressured regulators to act, culminating in the UK regulation, which shares a very similar design with direct price regulations recently introduced in insurance, energy, telecoms, and lending markets around the world.[1] More specifically, the regulation required firms to price consistently across their back books (i.e., the stock of existing customers) and their front books (i.e., the flow of new customers), creating a fundamental trade-off: raising prices to profit from the back book reduces their ability to attract new customers. We examine how insurers and customers navigated this trade-off and whether the regulation achieved its protective goals.

We begin by developing a theoretical framework to capture the effects of price walking regulation, modelling a market in which all consumers begin by actively choosing among firms' offered products, but a fraction becomes inert following these initial choices. Firms

[1] Appendix Table A.1 documents that concerns about price walking and related pricing practices are prevalent around the world. In the United States, 20 states have adopted measures restricting or prohibiting price discrimination (usually referred to as price optimization or elasticity-based pricing) in personal lines, including motor insurance. For example, a 2015 task force by the National Association of Insurance Commissioners concludes that state regulators should treat pricing based on demand elasticity, propensity to shop, and retention as inconsistent with the ban on unfair discrimination (`content.naic.org/sites/default/files/inline-files/committees_c_catf_related_price_optimization_white_paper.pdf`). In Europe, EIOPA's 2023 Supervisory Statement emphasizes that price walking carries a high risk of unfair outcomes and is not aligned with fair-treatment obligations.

face demand shocks in each period, capturing exogenous changes to their market shares, and set initial and renewal prices to maximize profits subject to prevailing regulation. We characterize the Markov Perfect Equilibria of this model, deriving a set of testable implications about firms' endogenous responses to both the announcement and implementation of the regulation. These responses include the reduction of teaser discounts on initial prices, prices that increase in the size of insurers' back books, and market shares that oscillate through time. Taken together, the model highlights a fundamental tension: regulations designed to protect inertial consumers can trigger supply-side responses that undermine their intended effects.

To test these predictions of the model, our analysis exploits a novel dataset on customer search, choice, and insurer pricing sourced from *Compare the Market*, the largest price comparison website in the UK motor insurance market. For 8 million insurance enquiries between 2019 and 2023, we observe the characteristics of customers that shop for car insurance, the set of different insurance products and prices that insurers offer them when they request a quote, and the product that they select.

We document five sets of facts about how insurer behavior changed following the implementation of this regulation in the UK, all of which are consistent with the model. First, insurers reduce the teaser rates they offer to customers who are more likely to be inactive. Customers who are younger, insure cheaper cars, shop for less comprehensive insurance, or are out of work due to sickness or disability are more likely to be inactive after initially searching for and taking out insurance. In the run-up to the policy, prices for these likely inactive customers rise significantly relative to those who are more likely to search.

Second, firms adjust pricing as a function of their back books. Following policy implementation, firms with products that have large back books of customers offer new, similar customers less competitive prices for these products. These effects are large: increasing a product's back book from 0 to the 99^{th} percentile decreases the probability that the product is the cheapest quoted one for a given customer by over ten times the unconditional mean.

Third, this pricing response causes market shares to oscillate through time. Before the policy, products popular in a given customer segment tend to remain popular the following year. After implementation, this autocorrelation reverses: firms with large back books raise prices to harvest existing customers, but the regulatory pricing constraint simultaneously makes them less competitive for new ones. Thus, products gaining market share in one period become less competitive in the next.

Fourth, the regulation triggers substantial product proliferation, concentrated among the most affected firms. By introducing new products, firms can reset their back book constraints, enabling them to simultaneously harvest existing customers and compete aggressively for new ones. The top third of firms by back book size increase their product offerings by 50% following the policy, while other firms leave their menus largely unchanged.

Fifth, despite the regulation, inactive customers continue to pay a substantial price penalty. Customers who do not switch their insurance product pay 40% above the cheapest available price post-regulation, with product proliferation emerging as a key mechanism through which insurers sustain this penalty.

These findings form a coherent picture. Our model and results show that banning direct price discrimination against passive customers does not ensure good outcomes. Prior to the policy, firms price walk their back books whilst keeping front book prices low to attract new customers. After the policy, firms can no longer charge differential prices, but adapt in two ways: they compete less aggressively for inert customers, whose relative attractiveness has fallen, and they introduce new products to more finely segment the market. The net result is that passive customers continue to pay a substantial price penalty relative to active searchers, just through different mechanisms. These findings speak to a broader challenge in consumer protection regulation: when suppliers can endogenously respond to regulatory constraints, even well-designed interventions may fail to deliver their intended benefits.

The rest of the paper is organised as follows. The remainder of this section discusses related literature. Section 2 describes the institutional setting and the 2022 regulation. Section 3 sets up and solves the model, and discusses testable implications. Section 4 introduces our data. Section 5 describes our empirical approach to testing the model's predictions and our results, and Section 6 concludes. The appendix contains model-related technical details and proofs of the model's propositions.

1.1 Related Literature

Our paper contributes to several strands of literature. First, we contribute to the large literature studying inertia and inattention in household finance and insurance markets (e.g., Madrian and Shea, 2001; Choi, Laibson, Madrian, and Metrick, 2003; Handel, 2013; Honka, 2014; Stango and Zinman, 2016; Ho, Hogan, and Scott Morton, 2017; Allen, Clark, and Houde, 2019; Andersen, Campbell, Nielsen, and Ramadorai, 2020; Gottlieb and Smetters, 2021; Heiss, McFadden, Winter, Wuppermann, and Zhou, 2021; Fisher, Gavazza, Liu, Ra-

madorai, and Tripathy, 2024; Allen and Li, 2025). Many of these papers study how inactive customers (who are often poorer and less financially sophisticated) pay higher prices than active customers for the same product, thereby benefiting firms. Handel (2013) shows that inertia and choice frictions mitigate adverse selection concerns; indeed, Chiappori and Salanié (2000) find no evidence of adverse selection in the French motor insurance market for young drivers. These findings motivate us to focus on how firms' dynamic pricing and product design aim to exploit customer inaction, even when regulation bans direct price discrimination against passive customers.

Second, we contribute to the literature on consumer protection regulations in financial product markets (Campbell, 2006; Campbell and Ramadorai, 2025; Cuesta and Sepúlveda, 2021). Agarwal, Chomsisengphet, Mahoney, and Stroebel (2015) and Nelson (2025) find that the CARD Act reduced credit card fees and interest rates, increasing consumer surplus. The regulation we study ties prices for existing customers to those for prospective customers. We show firms respond by expanding the product space and segmenting the market, such that inactive customers continue to pay more than active consumers. Alternative remedies such as encouraging competition (Hortaçsu, Madanizadeh, and Puller, 2017; MacKay and Remer, 2024) and nudges (Choi, Laibson, Cammarota, Lombardo, and Beshears, 2024) face similar challenges from endogenous supplier responses, highlighting the complexities of designing consumer protection regulation.

Third, we contribute to the literature on menu design and product proliferation. Prior papers study the proliferation of consumer options, with explanations including barriers to entry (Schmalensee, 1978), obfuscation (Ellison and Ellison, 2009), and price discrimination and screening (Rothschild and Stiglitz, 1976; Marone and Sabety, 2022). We demonstrate an alternative driver: supplier responses to regulatory pricing constraints, similar to some patterns documented in the market for Medicare Part D plans (Marzilli Ericson, 2014).

Fourth, our model contributes to the literature on behavior-based price discrimination. Armstrong (2006) and Fudenberg and Villas-Boas (2006) provide insightful surveys. Our benchmark model builds on the classic framework of Beggs and Klemperer (1992), with two new features. First, we introduce demand shocks to study the heterogeneous effect of back books on prices and market shares. Second, in line with regulatory concerns about consumer exploitation, we introduce consumers who do not anticipate the possibility of being locked into contracts due to inertia (Gabaix and Laibson, 2006; Heidhues, Koszegi, and Murooka, 2017; Grubb, 2015; Heidhues and Kőszegi, 2018)

Finally, we contribute to the empirical literature on motor insurance markets. Earlier research has mainly focused on reduced-form testing for asymmetric information, with mixed results (Puelz and Snow, 1994; Chiappori and Salanié, 2000; Dionne, Gouriéroux, and Vanasse, 2001; Abbring, Chiappori, and Pinquet, 2003). Recent structural work accounts for richer sources of heterogeneity beyond unobserved risk: Israel (2005) finds lock-in effects from consumer learning; Cohen and Einav (2007) show that unobserved risk aversion dominates unobserved risk; Honka (2014) and Honka and Chintagunta (2017) quantify substantial search and switching costs; and Rubinstein (2026) studies pass-through in commercial motor insurance. We contribute by using multi-insurer data with complete customer menus to characterize demand and supply responses, and by showing how firms dynamically adjust pricing and products to exploit inertia when regulation constrains direct price discrimination.

2 Institutional Setting: The UK Motor Insurance Market and the 2022 Price Regulation

In the UK, all vehicles must be insured by law, generating gross motor insurance premiums of £16.6 billion in 2021 (Association of British Insurers, 2021). Insurers offer three levels of coverage: third-party insurance is the legal minimum and covers damage to third parties; third-party, fire, and theft additionally insures against fire damage or theft of the insured vehicle; and comprehensive insurance further covers medical expenses and damage or theft of the vehicle's contents.

Compliance with mandatory insurance is high: The Motor Insurers' Bureau estimates that at most 4% of UK drivers are not insured.[2] This contrasts sharply with the United States, where 15-20% of drivers operate without insurance (Kluender, 2023). The near-universal coverage substantially limits adverse selection concerns on the extensive margin. Moreover, approximately 90% of consumers in our data purchase comprehensive coverage, the highest tier. This concentration in the top coverage level minimizes the cream-skimming issues that can arise when consumers sort across coverage tiers (Azevedo and Gottlieb, 2017).

Within each of the three levels of coverage described above, most insurers offer multiple insurance policies, which we henceforth refer to as insurance products. These products differ in their non-price characteristics, for example, whether insured drivers are covered when driving other cars. Table A.2 in the Appendix provides some examples of the product

[2] https://www.mib.org.uk/

offerings of a major UK insurance brand.

More than 70% of new customers for UK motor insurance buy their insurance through a price comparison website (Financial Conduct Authority, 2018). The remaining customers either contact insurers directly or use insurance brokers. A customer provides price comparison platforms with details on the characteristics of the drivers to be insured, the car to be insured, the drivers' driving habits, and the desired level of coverage. These intermediaries pass these details on to a set of insurers, which return quotes to the customer, presented in a menu ordered from the cheapest to the most expensive. Figure A.1 in the Appendix provides an example of how a price comparison website displays the menu to a customer.

Contracts usually last one year and must be renewed annually. When renewing, customers can (i) use a price comparison website (the primary source of our data); (ii) contact an insurer directly; or (iii) accept their existing policy's renewal offer. Renewal prices may change due to factors such as vehicle depreciation, accumulated driving experience, or changes in the customer's circumstances. However, as discussed below, before the 2022 regulation, insurers also systematically raised renewal prices as part of "price walking" strategies that exploited customer inertia.

The 2022 Pricing Regulation. "Price walking" is the term used to describe an insurer ratcheting up prices for its existing customers over time, with renewing customers charged increasingly higher prices relative to similar new customers. Price walking is common in many markets and was particularly prevalent in the UK insurance market before 2022.[3]

In January 2022, the Financial Conduct Authority (FCA) implemented rules to combat price walking. It sought to end the "customer loyalty penalty," by requiring that the price insurers offered renewing customers for a product be no higher than the "equivalent new business price," which is the price they would offer a hypothetical equivalent new customer. The rules did not provide a definition of equivalence, for example by defining a set of demographic characteristics within which insurers could not discriminate based on tenure. Instead, the regulator required insurers to attest that they were complying with "both the spirit and letter of the requirements," and committed to collecting data to monitor compliance going forward.[4] The regulations are perhaps best understood, then, as requiring that insurers amend their pricing models—whatever they may be—such that they do not discriminate based on tenure.

[3] https://www.ft.com/content/03bde15c-323b-48eb-a392-d3a874001307

[4] https://www.fca.org.uk/publication/policy/ps21-5.pdf

The regulation applies regardless of the channel through which customers purchase insurance, covering policies sold through price comparison websites, directly by insurers, and through brokers. This policy implementation followed a few years of public consultation on pricing practices in insurance. This began in 2018 when a consumer protection body complained to UK regulators about price walking in insurance markets.[5] Regulators responded by warning insurers to address these issues, and began the research and consultation process that culminated in the rule change in January 2022 (Financial Conduct Authority, 2018). The policy could therefore be anticipated several years in advance of implementation.

3 Model

We develop a simple model to derive the implications of price walking regulation in a market where some consumers exhibit inertia.

Setup. Overlapping generations of consumers populate the market. A unit mass of new consumers joins each period and stays for two periods, purchasing a good ("insurance") in each period.

Two horizontally differentiated firms ($i = 0, 1$) compete on a Hotelling line. Firms face stochastic demand shocks that shift their locations: firm 0 moves to $\ell = \varepsilon_t^0$ and firm 1 to $\ell = 1 - \varepsilon_t^1$, where higher shocks move firms closer to the center and thus increase demand. Demand shocks have support in $[0, \bar{\varepsilon}]$ with $\bar{\varepsilon} < 1/2$, ensuring firm i remains closest to endpoint i. We denote the shock difference as $\Delta_t := \varepsilon_t^0 - \varepsilon_t^1$, and assume shocks are i.i.d. across firms and time, and are publicly observed before firms set prices.

Consumers are distributed uniformly on the unit interval with linear transportation costs. A consumer's location captures brand preferences, and we normalize marginal costs to zero (we allow for negative prices so firms can lock in consumers). Firms cannot distinguish new joiners from switchers.[6] At each date t, firm i sets a new-customer price p_t^i and a renewal price r_t^i.

Consumer behavior. All consumers actively choose a firm in their first period, selecting the firm offering the highest utility net of price and transportation costs. We assume

[5] `https://www.gov.uk/cma-cases/loyalty-penalty-super-complaint`

[6] This assumption captures that firms cannot identify "shoppers" (who regularly seek the best deal) from consumers forced to shop due to circumstances like buying a new car.

consumers are myopic, ignoring the possibility of becoming locked in through inertia.[7] A consumer at location ℓ who buys from firm 0 receives utility:

$$V - c(\ell - \varepsilon_t^0) - p_t^0, \tag{1}$$

where gross surplus V is large enough that everyone buys and $c > 0$ parametrizes product differentiation through transportation costs. Buying from firm 1 yields:

$$V - c(1 - \varepsilon_t^1 - \ell) - p_t^1. \tag{2}$$

Equating (1) and (2) determines the indifferent consumer's location $\ell_t^* = \frac{1+\Delta_t}{2} - \frac{p_t^0 - p_t^1}{2c}$. Using the uniform distribution, we obtain firm 0's market share among active consumers:

$$s(\mathbf{p}_t; \Delta_t) := \left[\frac{1 + \Delta_t}{2} + \frac{p_t^1 - p_t^0}{2c}\right]_0^1, \tag{3}$$

where $[z]_0^1 := \max\{0, \min\{z, 1\}\}$ truncates z to $[0, 1]$, and $\mathbf{p}_t := (p_t^0, p_t^1)$.

In the second period, a fraction λ of consumers remain with their original firm ("passive"), independent of location. A regulatory price cap $K > c$ limits prices firms can charge.[8] Without regulation, firms set the maximum renewal price: $r_t^i = K$. Under price walking regulation, firms must set the same price for joiners and renewers: $p_t^i = r_t^i$. The remaining fraction $1 - \lambda$ are "active" consumers who shop every period.

Active consumers and new joiners return to the market each period, choosing the firm offering the highest utility. Without regulation, each period sees mass 1 of new customers buying and mass $1 - \lambda$ of active consumers switching to exploit lower new-customer prices (since equilibrium requires $p_t^i \leq r_t^i = K$).

3.1 No Price Walking Regulation

Without regulation, firm i sets new-customer price p_t^i and renewal price r_t^i each period. We characterize the Markov Perfect Equilibria (MPE) of the game. Since no payoff-relevant connection links prices across periods without regulation, states are degenerate. Firms always

[7] This assumption aligns with "naive" passive consumers who believe they will switch in the next period. Active consumers may not be myopic: since they switch in the second period, this belief is correct for them.

[8] Without a price cap, firms would charge infinitely high renewal prices to passive buyers, eliminating equilibrium existence.

charge passive customers the maximum: $r_t^i = K$.

Let $\delta \in (0,1)$ denote the firms' discount factor. Firm 0's profits from a cohort joining in period t equal:

$$\Pi_t^0 := \underbrace{s(\mathbf{p}_t, \Delta_t) p_t^0}_{\text{First period}} + \delta \left[\underbrace{\lambda s(\mathbf{p}_t, \Delta_t) K}_{\text{Second period passive}} + \underbrace{(1-\lambda)\, E_t \left[s(\mathbf{p}_{t+1}, \Delta_{t+1}) p_{t+1}^0 \right]}_{\text{Second period active}} \right]. \tag{4}$$

The first term captures first-period profits when all consumers actively choose. The second term captures second-period profits from the λ fraction of consumers who passively remain and pay K. The third term captures profits from the $1-\lambda$ fraction of active consumers who return to the market.

When setting period-t price, firm 0 faces a total demand of $2-\lambda$ (mass 1 of new joiners plus mass $1-\lambda$ of active customers from the previous period), attracting the proportion $s(\mathbf{p}_t, \Delta_t)$. In the following period, a fraction λ of these customers become passive and pay K (discounted by δ). Firm 0 maximizes:

$$\underbrace{(2-\lambda) s(\mathbf{p}_t; \Delta_t)}_{\text{Active demand at } t} \cdot p_t^0 + \delta \cdot \underbrace{\lambda s(\mathbf{p}_t; \Delta_t)}_{\text{Passive demand at } t+1} \cdot K. \tag{5}$$

Each firm's profit function is strictly concave in its own price. The MPE is interior, and first-order conditions yield:

$$p_U^0(\Delta_t) = c - \frac{\delta\lambda}{2-\lambda} K + \frac{c}{3}\Delta_t, \qquad p_U^1(\Delta_t) = c - \frac{\delta\lambda}{2-\lambda} K - \frac{c}{3}\Delta_t. \tag{6}$$

Forward-looking firms charge lower first-period prices to build market share, exploiting it in the second period by charging the maximum price K. The discount increases in the gain from exploiting passive consumers (higher λ, K, or δ). In equilibrium, all firms cut prices equally, leaving market shares unchanged. Equilibrium market shares are:[9]

$$s_U^0(\Delta_t) = \frac{1}{2} + \frac{\Delta_t}{6}, \qquad s_U^1(\Delta_t) = \frac{1}{2} - \frac{\Delta_t}{6}. \tag{7}$$

Without regulation, prices and market shares are i.i.d. across time. Thus, any serial correlation in our model stems from price walking regulation.

[9] Since $|\Delta_t| \leq \bar{\varepsilon} < \frac{1}{2}$, market shares lie in $(0,1)$, confirming the equilibrium is interior.

3.2 Price Walking Regulation

Regulation requires firms to charge the same price to joiners and renewers, eliminating the ability to hike renewal prices to K while offering lower new-customer prices. We impose a mild condition ensuring an interior equilibrium:[10]

$$\bar{\varepsilon} \leq \frac{6 - 7\lambda + \sqrt{9(2-\lambda)^2 - 8\delta\lambda^2}}{2(2-\lambda)}.$$

We also assume K is large enough that equilibrium prices stay below the cap.[11]

Define firm 0's market share in period $t-1$ as $x_t := s(\mathbf{p}_{t-1}, \Delta_{t-1})$.[12] Firm 0's period-$t$ demand equals:

$$\underbrace{(2-\lambda)s(\mathbf{p}_t; \Delta_t)}_{\text{Active at } t} + \underbrace{\lambda x_t}_{\text{Passive at } t}.$$

Under regulation, firms charge the same price to all customers, so firm 0's period-t profits equal:

$$\widehat{\Pi}_t^0(\mathbf{p}_t, \Delta_t, x_t) := [(2-\lambda)s(\mathbf{p}_t; \Delta_t) + \lambda x_t]\, p_t^0.$$

Previous prices affect current profits only through the back book sizes: λx_t for firm 0, $\lambda(1-x_t)$ for firm 1. Following Maskin and Tirole (2001), we identify Markov states by previous-period market shares. For notational convenience, we work with deviations from means:

$$y_t := s(\mathbf{p}_{t-1}, \Delta_{t-1}) - \frac{1}{2}. \tag{8}$$

A Markovian strategy $p^i : [-\frac{1}{2}, \frac{1}{2}] \times [-\bar{\varepsilon}, \bar{\varepsilon}] \to \mathbb{R}$ specifies firm i's price as a function of state y_t and current shock Δ_t (Appendix D contains all proofs).

[10] Since $\bar{\varepsilon} < \frac{1}{2}$, this holds if $\lambda < 0.946$. When the share of passive consumers is higher, it requires the discount rate not to be too high.

[11] Formally: $c\left[\frac{2}{2-\lambda(1-\delta)} + a\bar{\varepsilon} + \frac{b}{2}\right] \leq K$.

[12] We assume arbitrary initial share $x_0 \in [0,1]$. Extensions allowing simultaneous entry with zero initial shares yield identical results.

Proposition 1. *The game has a unique MPE, in which firms choose the pure strategies:*

$$p_R^0(y_t, \Delta_t) = c\left[\frac{2}{2-\lambda(1-\delta)} + a\Delta_t + by_t\right], \tag{9}$$

$$p_R^1(y_t, \Delta_t) = c\left[\frac{2}{2-\lambda(1-\delta)} - a\Delta_t - by_t\right] \tag{10}$$

where $a := \frac{1}{2} \cdot \frac{2-\lambda+\sqrt{9(2-\lambda)^2-8\delta\lambda^2}}{3(2-\lambda)+\sqrt{9(2-\lambda)^2-8\delta\lambda^2}} \in (0, \frac{1}{2})$ *and* $b := \frac{3(2-\lambda)-\sqrt{9(2-\lambda)^2-8\delta\lambda^2}}{2\delta\lambda} \in (0,1)$.

Firms follow symmetric linear strategies. Prices increase with product differentiation (c) and positive demand shocks ($a > 0$). Unlike without regulation, prices now depend on back books: firms trade off revenue from back books against competitiveness for active customers. Larger back books incentivize higher prices.

The pass-through a from demand shocks to prices decreases in δ and λ, whereas the pass-through b from back books to prices increases in both. As passive consumers become more prevalent, reducing current prices to invest in future back books grows more profitable, lowering current shock sensitivity and raising back-book sensitivity.

Proposition 2. *States follow a stable, oscillating AR(1) process:* $y_{t+1} = -by_t + \left(\frac{1}{2} - a\right)\Delta_t$, *where* $a \in (0, \frac{1}{2})$ *and* $b \in (0,1)$ *are defined in Proposition 1.*

Firms increase prices by a factor a in response to demand shocks. Because rivals decrease prices by less ($|a| < \frac{1}{2}$), market share increases. This builds a larger back book, which firms exploit by charging higher prices next period. Market shares oscillate as firms with large back books charge higher prices, reducing future back books. Oscillations intensify when firms are more patient (δ high) or face more passive consumers (λ high).

3.3 Comparing Markets

We compare prices and welfare across regulatory regimes.

Proposition 3. *The average new-policy price is higher under regulation. Moreover, the price increase is larger for consumer groups with higher inertia (λ).*

The model predicts new-policy prices increase following regulation. Without regulation, firms offer discounts to attract passive customers, then charge maximum price K at renewal. Regulation reduces renewal prices, eliminating discount incentives. Price increases are larger for more passive groups because discounts to attract them are more profitable.

We now examine total surplus effects. Since all consumers purchase coverage, total surplus depends only on allocative efficiency (transportation costs). Price differences merely transfer surplus between customers and firms.

Total surplus maximization requires each customer to buy from the closest firm, achieved when firms charge identical prices. Neither regime achieves this. Without regulation, firms tilt prices in response to location shocks, inducing misallocation—the standard market-power distortion.

Regulation reduces this by dampening shock pass-through, but introduces a new inefficiency: prices depend on back books, distorting allocation away from firms with large back books. The net effect depends on inertia (λ) and patience (δ):

Proposition 4. *A cutoff $\delta^*_\lambda \in (\frac{1}{2}, 1]$ (increasing in λ) exists such that regulation increases total surplus if and only if $\delta > \delta^*_\lambda$. Moreover, regulation always reduces surplus if $\lambda > 0.554$.*

Regulation helps when firms are sufficiently patient or when active customers dominate. However, if over 55.4% of customers are passive, regulation always harms surplus by creating large allocative inefficiencies as firms exploit back books.

Regulation's profit effects are ambiguous: it raises new-policy prices but lowers renewal prices. Without regulation, firms extract high surplus from passive consumers, leading to intense competition for new customers via cheap policies. Regulation reduces passive-consumer surplus extraction, weakening competition for new customers and raising prices.

When firms can charge sufficiently high prices, surplus extraction dominates:

Proposition 5. *A threshold $\bar{K}_{\delta,\lambda} > 0$ exists such that expected profits are higher without regulation if and only if $K \geq \bar{K}_{\delta,\lambda}$.*

Without regulation, profits increase linearly in K since all passive consumers pay it. With regulation, profits are independent of K. Thus, for high enough K, regulation reduces profits.

When firms are sufficiently patient, competition effects dominate:

Proposition 6. *A threshold $\bar{\delta}_{K,\lambda} < 1$ exists such that expected profits are higher with regulation whenever $\delta > \bar{\delta}_{K,\lambda}$.*

Since our data covers only new policies, Proposition 3 provides our most relevant prediction. Propositions 5 and 6 determine overall price effects (since average prices equal average profits).

3.4 Anticipated Regulation

We now analyze announcing the policy before implementation. A regulator announces price walking regulation in period T, credibly starting at $T+1$. The announcement is unanticipated, so prices until T follow Subsection 3.1.

We characterize the MPE starting at the announcement period T. Firms can still charge different prices to joiners and renewers in period T, but know they must charge uniform prices from $T+1$ onward (including to customers who purchase in T and remain).

Proposition 7. *The game has a unique MPE with strategies:*

$$\begin{aligned} p_A^0(y_t, \Delta_t) &= \begin{cases} c\left[1 - \frac{2\delta\lambda}{(2-\lambda)[2-\lambda(1-\delta)]} + a\Delta_T\right] & \text{if } t = T \\ c\left[\frac{2}{2-\lambda(1-\delta)} + a\Delta_t + by_t\right] & \text{if } t > T \end{cases}, \\ p_A^1(y_t, \Delta_t) &= \begin{cases} c\left[1 - \frac{2\delta\lambda}{(2-\lambda)[2-\lambda(1-\delta)]} - a\Delta_T\right] & \text{if } t = T \\ c\left[\frac{2}{2-\lambda(1-\delta)} - a\Delta_t - by_t\right] & \text{if } t > T \end{cases}, \end{aligned} \tag{11}$$

where a and b are defined in Proposition 1.

Average new-policy prices increase at the announcement by $\frac{\delta\lambda}{2-\lambda}\left(K - \frac{2c}{2-\lambda(1-\delta)}\right) > 0$ and at the implementation by $\frac{\lambda}{2-\lambda}c > 0$. Prices rise on both dates. Without regulation, firms charge low initial prices to attract passive customers, then charge K at renewal. Announcement dampens these incentives: firms anticipate charging lower future renewal prices, reducing today's investment value. However, they can still charge separate prices today. At the implementation date $T+1$, firms face dampened incentives and cannot charge separate prices, forcing them to sacrifice back-book profits to price competitively for new customers. This further raises prices.

3.5 Model Summary

We now summarize the model's key features and testable predictions.

Assumptions. We assumed consumers live for two periods to simplify the exposition. The results extend naturally to $N \geq 2$ periods: the MPE remains unique and linear with $(N-1)$-dimensional states (the market shares of each cohort). Regulation increases prices, with jumps increasing in λ, and induces stable, oscillating $AR(N-1)$ dynamics in market shares.

Our model abstracts from adverse selection, focusing instead on how firms exploit consumer inertia. Our empirical setting justifies our focus: UK motor insurance exhibits minimal adverse selection concerns due to the near-universal compliance with mandatory coverage;[13] the concentration of demand in comprehensive coverage, which limits cream-skimming incentives (Azevedo and Gottlieb, 2017); the high degree of consumer inertia, which attenuates risk-based sorting (Handel, 2013); and the ability of insurers to flexibly adjust prices based on the driving history of consumers.

Economic Mechanisms. The central feature of our model is the share of customers who remain with the same firm. This share comprises two distinct types of consumers: passive customers (fraction λ) who remain with their original firm due to switching frictions, and active customers with strong preferences for the firm's product (those located close to the firm on the Hotelling line). This distinction parallels the classic econometric decomposition between state dependence and preference heterogeneity since at least Heckman (1981). Both sources account for the observed persistence in consumer choices and for firm market power, although they have different implications for pricing and welfare.

Without regulation, firms "invest" in building large back books by offering low joiner prices today, then exploit passive customers tomorrow by charging the maximum renewal price K. Active customers with strong brand preferences cannot be exploited in this way—they switch if renewal prices rise too high. Thus, the profitability of the investment strategy depends critically on the fraction of passive customers λ: a larger λ makes the back book more valuable and justifies deeper initial discounts.

Under regulation, firms can no longer charge different prices to joiners and renewers, fundamentally changing how they monetize their back books. The inherited back book now creates a trade-off: raising prices extracts more revenue from price-insensitive, passive customers but simultaneously reduces competitiveness for active customers (both new joiners and existing customers willing to switch). Thus, firms price products with large back books less competitively post-regulation, as firms tilt toward harvesting their existing passive base rather than investing in future growth.

Importantly, regulation does not eliminate search gains. Prices respond to demand shocks and back books, with market shares oscillating as high-share products become expensive next period, turning over the identity of the cheapest offer. Moreover, firms can introduce new

[13] In markets with active extensive margins, regulation would further reduce surplus: higher joining prices reduce quantity.

products to reset back-book states, relaxing the pricing constraint and enabling simultaneous back-book harvesting and aggressive new-business investing.

3.5.1 Testable Predictions

Our model delivers five testable predictions that we evaluate in Section 5:

1. **Price Discounts to passive consumers** (Proposition 3): Average new-policy prices increase at both announcement and implementation, with larger increases for groups with more passive consumers (λ), as the regulation reduces the value of attracting them. We test this prediction in Section 5.1, constructing proxies for consumer inertia λ.

2. **Back-book pricing** (Proposition 1): Post-regulation, insurers price products with larger back books less competitively, as they trade off back-book revenue against competitiveness for new customers. We document this pattern in Section 5.2.

3. **Market share dynamics** (Proposition 2): Post-regulation, market shares follow a stable, oscillating process, with products gaining share in one period becoming less competitive in the next. Section 5.3 confirms this prediction.

4. **Product proliferation**: The regulation creates stronger proliferation incentives for firms with large back books, as new products reset the back-book constraint for new consumers. We show substantial product proliferation by high-back-book firms in Section 5.4.

5. **Persistent gains to search**: Despite regulation, prices continue responding to demand shocks and back books, maintaining substantial search benefits for active consumers. Section 5.5 documents that switching costs remain large post-regulation.

4 Data

Our primary dataset comes from *Compare the Market*, the largest price comparison website for UK motor insurance.[14] We obtain a random sample of 8 million motor insurance enquiries from January 2019 to December 2023. For each enquiry, we observe three types

[14] https://www.actuarialpost.co.uk/article/compare-the-market-top-pcw-despite-most-expensive-quotes-22034.htm

of information: (i) customer characteristics (demographics, driving history, vehicle details, coverage type); (ii) the complete menu of quotes each customer receives, including prices, product identifiers, and insurers; and (iii) product choices for customers who click through to purchase.[15]

This granular data structure allows us to test our model's predictions. We observe menus offered to individual customers, enabling us to absorb customer characteristics with fixed effects and compare prices that different firms offer the same customer. We observe the same products offered to different customers, allowing within-product analysis of how firms vary prices across customer types while holding contract features constant. Aggregating consumer choice data through time, we construct proxies of insurers' back books. Finally, the 2022 regulatory shift provides variation across regulatory regimes.

We supplement these data with *Consumer Intelligence* survey data from individuals who renewed car insurance during July 2019 to December 2023. Respondents report their renewal price changes, whether they shopped around, potential savings from switching, and whether they switched insurers. Appendix B describes these data in more detail and characterizes customers' search and switching decisions as a function of price changes at renewal and customer characteristics.

4.1 Summary Statistics

Table 1 summarizes customer characteristics and offered menus. The median customer is 29 years old, has held a driving license for 7 years, and insures a car worth £4,855. Insurance prices vary substantially with these characteristics: young drivers face high prices that decline sharply with experience, and different cars command different premiums. We absorb this variation using 'car' fixed effects for each brand-model-year combination, following Argyle, Nadauld, and Palmer (2022).

Customers face large menus: the median customer receives 64 quotes from 26 insurers (10th percentile: 16 quotes; 90th percentile: 103 quotes). We treat products as firm-specific, so two firms offering similar contracts represent distinct products. Product fixed effects will absorb this product-level variation in our analysis.

Price variation across and within customers is substantial. The median customer receives a cheapest quote of £681, but the 90th percentile customer faces prices over three

[15]Customers who purchase through other channels (e.g., phone) do not appear as sales in our data. Appendix Table B.1 compares our sample demographics to the UK driver population.

Table 1: Summary Statistics

	Mean	Median	Std. dev.	10th pctile	90th pctile
Customer characteristics					
Driver age	35	29	16	19	58
Years with licence	11	7	10	0	25
Car value (£)	8459	4855	14319	900	19900
Annual mileage	7508	6000	6950	3000	10000
Offered menu					
Numb. products	62	64	33	16	103
Numb. firms	25	26	13	5	41
Offered prices and dispersion within menu (£)					
Cheapest quote	1266	681	2818	242	2445
2nd − cheapest	246	33	1584	1	416
3rd − cheapest	421	72	2228	9	722
4th − cheapest	536	101	2554	16	922
5th − cheapest	623	127	2890	23	1106
Worst − cheapest	6957	4006	17051	1075	15633
Offered prices and dispersion within menu (% car value)					
Cheapest quote	55	15	186	3	126
2nd − cheapest	11	1	121	0	15
3rd − cheapest	19	2	167	0	28
4th − cheapest	24	2	190	0	38
5th − cheapest	29	3	206	0	47
Worst − cheapest	302	87	814	12	738

Notes: This table reports summary statistics on customer characteristics and offered menus. Prices as a % of car value equal the annual premium divided by the insured car's value.

times larger. A regression of the price of insurance on product-date fixed effects gives an R^2 of only 12%, highlighting the large variation in prices across customers for the same insurance product. Even conditional on the car insured, price variation remains enormous. Within-customer variation is also large: the median difference between the 5th cheapest and cheapest offers exceeds £100, with some customers facing dispersion an order of magnitude larger. A regression of the price of insurance on enquiry fixed effects gives an R^2 of 37%, indicating that a large proportion of variation in prices is within-menu variation. This variation stems from firms' differing cost assessments, product feature differences, and customer-insurer relationships.

Table 2 summarizes choice and search patterns. 11% of enquiries result in purchases,

Table 2: Summary Statistics: Search and Choice

	Percent of sample
Selected a product	11
Customer chose:	
cheapest product	43
top 2 products	62
top 3 products	72
top 4 products	78
top 5 products	83
Customer searched:	
in one year only	36
in multiple years	64
once in year	47
multiple times in year	53

Notes: This table summarizes choice and search behavior in our sample.

which we aggregate through time to construct back book proxies (described below). Customers overwhelmingly choose cheap options: fewer than 20% select outside the five cheapest products. Lower-ranked choices reflect non-price product characteristics, such as brand reputation, claims service quality, or add-ons (Table A.2 shows products with more features cost more).

Approximately two-thirds of customers search in multiple years. We use prior-year search behavior to proxy search propensity in Section 5. About half of customers who search in a given year search multiple times, potentially "shopping across terms" by adjusting enquiries to find better prices.

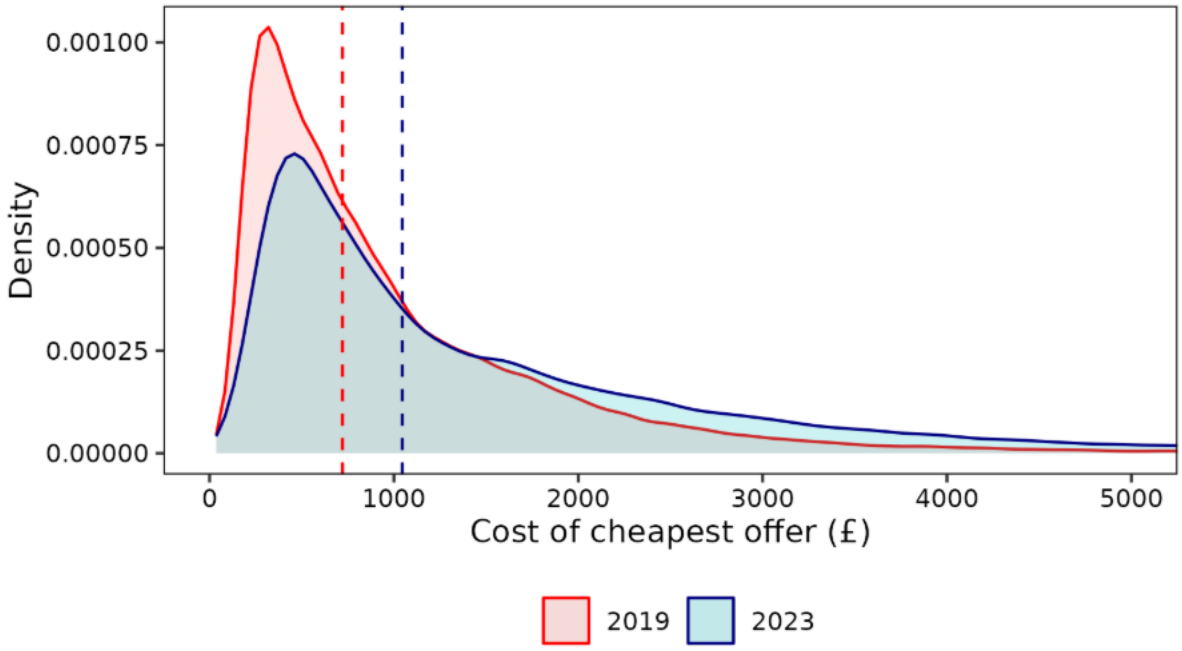
Motor insurance costs increased substantially over our sample period. Figure 1 shows the distribution of the cheapest quotes in 2019 and 2023. Median prices rose by 30% between these years, partly reflecting post-Covid inflation and supply-chain disruptions that increased insurers' costs.[16] Hence, our identification strategy relies on granular cross-sectional variation rather than these aggregate time-series trends.

4.2 Insurer Back Books

The 2022 regulation links prices firms charge new customers to prices charged to their existing back books. We construct two back book proxies using customer choice data.

[16] `https://www.ft.com/content/04a7ba0b-9ed1-4191-819c-9f88faa20a34`

Figure 1: Price of Insurance, 2019 and 2023



Notes: This figure shows cheapest-quote distributions in 2019 and 2023. Dashed lines show medians.

Our first proxy is granular, closely following the regulation's structure. Price-walking rules operate at the firm-product-customer type level: firms cannot offer the same product at a higher price to existing customers than they charge to prospective customers who are otherwise equivalent. As recounted in Section 2, the regulations do not prescriptively define "equivalence"; rather, compliance with the regulations implies some convergence between the prices offered to a prospective customer and existing customers who are similar along other dimensions. We define similarity based on three key inputs into underwriting models: the age of the driver, the value of the collateral, and the level of coverage offered; our discussions with market participants and policymakers confirm that these definitions are reasonable. In particular, we define customer types based on (a) the driver's birth year; (b) car value quintile; and (c) coverage level.

At each time t, we measure customers of a given type likely to renew a specific product using choice data from one and two years prior. For example, consider a customer born in 1980 with a car valued in the bottom quintile and whose policy expires on September 5, 2023. We compute the firm's back book for this product by counting customers of this type

Table 3: Back Books: Summary Statistics

	Mean	Median	90th pctile	99th pctile
Product-segment back book				
Count	1	0	2	71
Share	0.006	0.000	0.018	1.000
Aggregate firm back book				
Count	9052	2365	28681	68752
Share	0.017	0.004	0.054	0.129

Notes: This table summarizes proxies of insurer back books defined in Section 4.2. Segment-specific back books cover the whole sample; aggregate back books are measured as of December 2021.

who purchased the same product in the 30 days around September 5, 2022 and September 5, 2021. Unless they switched, these customers renew around September 5, 2023, when the firm attracts new customers of the same type. Regulation ties new-customer prices to renewal prices for these customers. We convert counts to shares by dividing by the sum across all firms and products within each type.

Our second proxy aggregates to the firm level. Product launch/retirement decisions occur at the firm level, requiring a broader measure. For firm f at time t, we count all customers who purchased from the firm before t, dividing by total contracts across all firms over the same period to obtain a share.

Table 3 summarizes both measures. The first two rows show product-level back books. Fine-grained product and customer type definitions combined with two-month measurement windows yield small average back books, but substantial cross-product and cross-segment variation. Section 5.2 exploits this variation to study how firms condition pricing on product back books. The third and fourth rows show aggregate firm back books. The average insurer attracted thousands of customers over our sample, but this distribution is highly skewed: small or new firms have minimal back books, whereas the largest captured over 10% of aggregate business.

5 Empirical Results

The model in Section 3 predicts a set of testable implications about the transition dynamics in the market around the announcement and introduction of the price walking regulation in a range of outcome variables, placing an important role on insurers' back books as well as

consumer characteristics in explaining cross-sectional variation in these outcomes. In this section, we uncover five main patterns in the *Compare the Market* data that illustrate how the 2022 pricing regulations have affected the motor insurance market. Overall, we find that these empirical results line up well with the model's main predictions.

5.1 Price Discounts to Passive Consumers

We begin our analysis by studying patterns in the initial price discounts offered to customers around the 2022 pricing regulations. The model in Section 3 predicts that these discounts are increasing in the likely level of inertia of customers, and thus customers more likely to be inert should experience larger price increases due to the regulation. In this section, we show that this is corroborated in the data: Customers who are ex ante more likely to be inactive experience steeper pre-2022 increases in the cheapest available quote, with no additional relative change once the rule comes into force.

Testing this hypothesis requires us to identify consumers who are likely to be passive. To do so, we leverage our data on repeat searches by customers. We restrict the sample to those customers in our sample of searchers who selected a product to purchase. We then estimate probit regressions to predict the likelihood that these same customers *do not* search again twelve months later (i.e., behave as passive rather than active customers) as a function of the observed customer characteristics.

Table 4 shows the marginal effects from these regressions. Conditional on having searched once, the likelihood of searching again is lower for customers who have cheaper cars, shop for non-comprehensive insurance (presumably in an effort to keep costs down), are out of work due to sickness or disability, and are young.[17] We use the estimates from Table 4 to compute a predicted level of inertia for every enquiry in our sample.

We should point out that the conditioning event of having searched and purchased in year 0 may not be equally selective across customer types. For young drivers taking out their first policy, year-0 search is likely non-discretionary, so the sample of year-0 searchers is close to the full population of young drivers. For established drivers, by contrast, year-0

[17]This finding may appear at odds with the fact that the customers actively searching for car insurance tend to be younger, as Table 1 reports. The reconciliation lies in the distinction between unconditional and conditional search probabilities. Unconditionally, young drivers search more frequently, as they enter the market in large numbers and have no existing policy to renew. Conditionally on having searched and purchased, however, they are less likely to search again, because the older drivers who also searched in year 0 are positively selected on being active types. Table B.2 in Appendix B uses the *Consumer Intelligence* dataset to confirm that young drivers search more frequently in the unconditional sense.

Table 4: Inertia and Customer Characteristics

Dependent variable:	Inert next year
	(1)
Age <20	0.353***
	(0.005)
Age 20-29	0.223***
	(0.003)
Age 30-39	0.198***
	(0.003)
Age 40-49	0.170***
	(0.003)
Age 50-59	0.136***
	(0.003)
Age 60-69	0.090***
	(0.004)
Insuring cheap car	0.057***
	(0.002)
Disabled	0.066***
	(0.010)
Third-party, fire & theft cover	0.045***
	(0.005)
Third-party cover	0.036***
	(0.009)
Unemployed	-0.035***
	(0.006)
Observations	592,734
Pseudo R-squared	0.019
Mean dependent variable	0.38
Std. dev. dependent variable	0.49

Notes: This table shows how the likelihood that a customer does not search a second time (conditional on having searched and selected a product) varies with demographics. The reported estimates are average marginal effects from probit regressions of a dummy for whether a customer searched twelve months after taking out insurance, for customers taking out insurance at least one year before the end of our sample. A car is cheap if it is in the bottom 20% of car values. 'Disabled' denotes a driver who is out of work due to illness or disability. The omitted age category is over-70. The omitted coverage category is comprehensive insurance.

search is a choice, and those who make it are positively selected on being active types: the most passive established drivers auto-renew without visiting a price comparison website and never appear in our estimation sample. Accordingly, our probit estimates in Table 4 need not match the relationship between inertia and age in the population. In Appendix C, we perform several robustness checks on our measurement of inertia, and show that our findings are robust along various dimensions. We therefore interpret our inertia index as a valid proxy for revealed future search propensity, correlated with the model's λ parameter.

We regress the cheapest offer on the menu for each enquiry on this inertia proxy, allowing the coefficient on inertia to vary through time. Given that our measure of inertia correlates with other customer characteristics that affect risk (for example, younger drivers tend to be riskier as well as more inert), we refrain from interpreting the level of its correlation with prices. Hence, we focus our test on the *time-varying* relationship between prices and the index. Table 5 reports the coefficient estimates of this regression, for differing control variables, with the reference period being 2022, the first year in which the policy is in place. Across each specification, the coefficient on the inertia proxy increases each period until 2021, when the policy was finalized, and changes little thereafter. In Figure 2 we plot the results of a monthly version of the third regression, with January 2022 as the reference period. There is a linear increase in the coefficient of inertia in the years leading up to the policy, and little change afterwards.

This striking pattern—a relative increase in prices in the run-up to the policy with no further change thereafter—suggests that the regulation reduces the desirability of inactive customers. The selection concern described above does not threaten this inference: The mechanism whereby passive established drivers are absent from the year-0 search sample is approximately time-invariant, and cannot generate the smooth pre-trend followed by stabilisation precisely at the regulation date that Figure 2 documents. The model predicts that the regulation should affect prices on announcement as well as on implementation. As explained in Section 2, the thrust of the policy could be anticipated years in advance of its implementation. Three years before the policy, in 2019, inactive customers could still be price-walked for a period of time without any cost in terms of competitiveness for new business. As the year of implementation approaches and the nature and timing of the regulation becomes clear,[18] the benefit of attracting new inactive customers shrinks, as there are fewer years in

[18]The regulatory process followed a standard and predictable process from its inception in 2018, with the price walking ban being floated as an option in 2019, consulted on in 2020, finalized in 2021, and implemented in 2022 (Financial Conduct Authority, 2021).

Table 5: Pricing and Customer Inertia

	(1)	(2)	(3)
Inertia	5.605***	3.457***	3.724***
	(0.076)	(0.052)	(0.057)
Inertia × {Year = 2019}	-0.421***	-0.733***	-0.615***
	(0.086)	(0.054)	(0.063)
Inertia × {Year = 2020}	-0.267***	-0.387***	-0.345***
	(0.079)	(0.054)	(0.060)
Inertia × {Year = 2021}	-0.089	0.063	0.094
	(0.081)	(0.057)	(0.063)
Inertia × {Year = 2023}	0.007	-0.026	0.039
	(0.074)	(0.051)	(0.054)
Fixed effects			
Month	Yes	Yes	Yes
Product	No	Yes	Yes
Car	No	No	Yes
Observations	7,282,117	7,282,113	7,265,715
R-squared	0.29	0.54	0.63
Mean dep. var.	6.61	6.61	6.61
Std. dev. dep. var.	0.92	0.92	0.92

Notes: The table shows the relationship between the price of insurance and the enquirer's inertia proxy over time. We estimate the inertia proxy using the fitted values from the probit regressions summarized in Table 4. We then regress the log of the cheapest offer of insurance for enquiry i on this inertia proxy, allowing the slope coefficient to vary by year. Car fixed effects are indicator variables for a given combination of vehicle model and year of production. Bootstrap standard errors are clustered at the level of the enquirer. Signif. Codes: ***: 0.01, **: 0.05, *: 0.1.

which they can be "costlessly" price walked. Post-policy, there is no further change to how desirable inactive customers are relative to searchers.

5.2 Back-book Pricing

We next study how the regulation affected insurers' pricing of their available products as a function of their back books. The model predicts that once price walking is banned, products with large back books should be less competitively priced. In this section we combine our empirical measure of insurer back books with pricing behaviour around the introduction of the regulation to test this prediction.

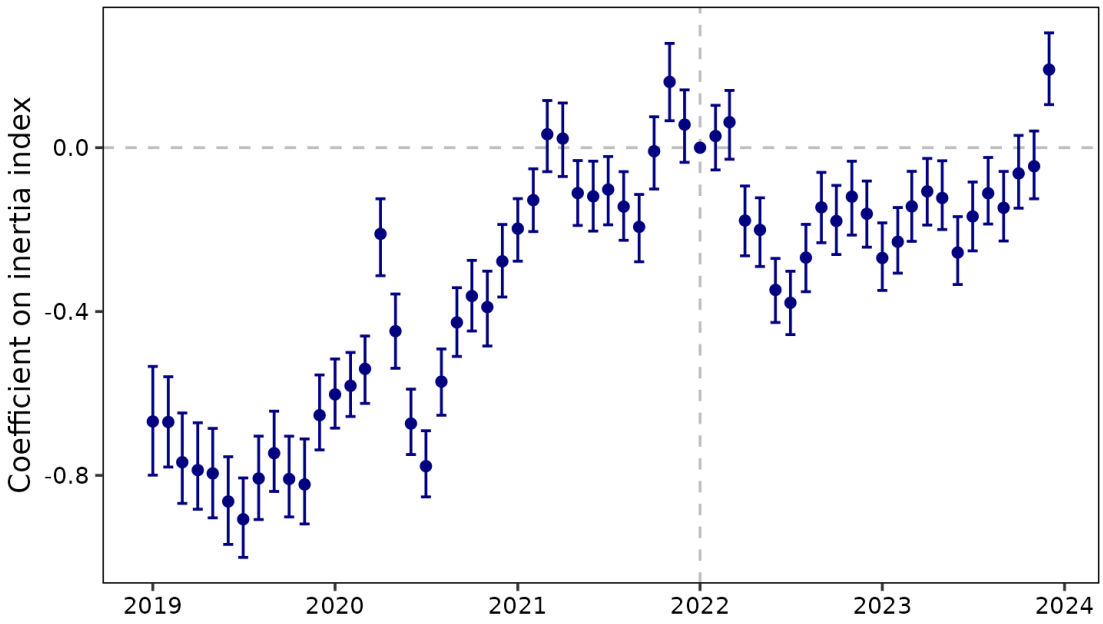


Figure 2: Pricing and Customer Inertia Through Time

Notes: The figure displays, through time, the relationship between the price of insurance and the enquirer's predicted level of inertia. We estimate a version of the third column of Table 5 where we allow the coefficient on inertia to vary by months. The reference month is January 2022. Error bars show 95% confidence intervals based on bootstrapping, where standard errors are clustered at the level of the enquirer.

Firms can adjust their quoting behaviour for a particular product and a particular customer in two ways: they can change the price at which they offer a product to the customer, or they can choose not to offer that particular customer the product at all. If firms with large back books are unable to compete for new customers, they may quote them a high price, or may simply not offer them a quote. To capture the latter behaviour, we must define the set of potential products that could be offered to a customer. To do so, we create an expanded menu for each customer containing all products that were offered to any customer in the month of the enquiry, regardless of whether it was offered to that specific customer.[19]

We relate how competitive a firm's quotes to customers are to the firm's back book of customers of the same type (i.e., using the different proxies of the back book described earlier). We measure competitiveness based on whether a firm was at the top of the menu a customer faces (recall that Table 2 shows that top-of-menu products have a 43% likelihood of being chosen).

[19]Clearly, for products not offered to the specific customer, we do not see what the price would have been, had it been offered.

More precisely, we run different specifications of the following difference-in-difference linear-probability regression:

$$\text{top}_{ijt} = \beta_0 \text{BB}_{\theta(i)jt} + \beta_1 \text{Post}_t \text{BB}_{\theta(i)jt} + X_{ijt}\Gamma + \epsilon_{ijt}, \tag{12}$$

where the dependent variable top_{ijt} is an indicator variable equal to 1 if product j gives the cheapest quote in response to customer i's enquiry at time t, and 0 otherwise; $\text{BB}_{\theta(i)jt}$ denotes product j's back book for the type $\theta(i)$ of customer i at time t; Post_t is an indicator variable equal to 1 after the implementation of the pricing regulation in January 2022, and 0 otherwise; X_{ijt} is a vector of controls, including time fixed effects; and ϵ_{ijt} is an unobservable.

The different specifications allow for more or less aggregation of our dependent variable, for example whether j is the cheapest product in a customer's full menu, or if it is just the cheapest offered by firm f in that menu. Moreover, because we observe menus for each individual enquiry, we can perform our analysis within an individual customer enquiry. That is, our most stringent regressions compare the quotes that different insurers offer to *the same individual*. Additionally, we allow the coefficient on the back book to vary across firms—i.e., we look within individual firms to evaluate how much the effect of having a large back book on quoting behaviour changes following the implementation of the policy.[20]

Table 6 reports the coefficient estimates of these different specifications of regression (12). Columns (1)–(3) report the results for the specifications with the dependent variable defined across all firms—i.e., top_{ijt} equals 1 if product j is the cheapest quote in response to customer i's enquiry at time t, and 0 otherwise. Specifications (1) and (2) are similar, although (2) is more stringent as it includes enquiry fixed effects. Specification (3) features firm-level slopes. Across all three specifications, the key difference-in-difference coefficient of interest (i.e., the effect of the back book after the policy relative to before the policy) is negative, meaning that firms with large back books price less competitively after the policy change.

The results are economically large. According to the estimates in columns (3), moving from the 1$^{\text{st}}$ to the 99$^{\text{th}}$ percentile of the back book (Table 3) implies a decrease in the probability of a product giving the cheapest quote of 9 percentage points. This is over ten times the average unconditional probability that a given product is the cheapest quote.

The left panel of Figure 3 shows results of a time-varying version of the regression in

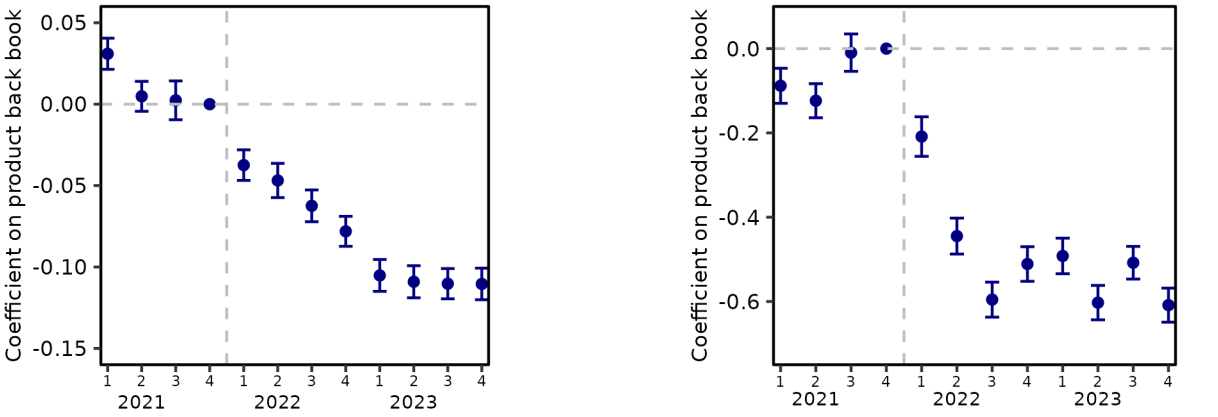
[20] Anecdotally, a minority of firms did not engage in price walking even before the policy.

Table 6: Competitiveness and Back Books

	Cheapest in menu			Cheapest in firm		
	(1)	(2)	(3)	(4)	(5)	(6)
Product back book	0.065***	0.065***		0.293***	0.318***	
	(0.00182)	(0.00182)		(0.00986)	(0.00721)	
Product back book × post	-0.091***	-0.091***	-0.090***	-0.388***	-0.423***	-0.451***
	(0.00232)	(0.00232)	(0.00257)	(0.01085)	(0.00849)	(0.00886)
Fixed effects						
Segment-month	Yes	No	No	Yes	No	No
Segment-product	Yes	Yes	Yes	Yes	Yes	Yes
Product-month	Yes	Yes	Yes	Yes	Yes	Yes
Enquiry	No	Yes	Yes	No	No	No
Firm-enquiry	No	No	No	No	Yes	Yes
Varying slopes						
Firm back book	No	No	Yes	No	No	Yes
Mean dep. var.	0.007	0.007	0.007	0.184	0.184	0.184
Observations	729,584,529	729,584,529	729,584,529	729,584,529	729,584,529	729,584,529

Notes: This table reports the coefficient estimates of different specifications of regression (12). Standard errors are clustered at the product-segment-month level. Signif. Codes: ***: 0.01, **: 0.05, *: 0.1.

Figure 3: Pricing and Back Books



(a) Across-Firm Pricing & Back Books **(b) Within-Firm Pricing & Back Books**

Notes: The figures show, through time, the relationship between how competitively a product is quoted and its back book. The left panel displays the coefficients of the regression $\text{top}_{ijt} = \beta_t \text{BB}_{\theta(i)jt} + X_{ijt}\Gamma + \epsilon_{ijt}$, where all variables are defined in the text and the controls are those in the third column of Table 6. The right panel shows results of the regression $\text{top}_{ijt} = \beta_t \text{BB}_{\theta(i)jt} + X_{ijt}\Gamma + \epsilon_{ijt}$, where variables are as defined in Section 5.2 and controls are those in the sixth column of Table 6.

Column (3) in Table 6, with quarterly coefficients on the back book, the main variable of interest. The effect on pricing kicks in sharply at the time the policy is introduced. There are no significant pre-trends. This is intuitive: in Section 5.1 we showed that firms reduced their teaser rates for inert customers in anticipation of the policy's implementation, as the expected present value of attracting an inert customer decreased. However, the ability of firms with large back books to price competitively for new business only fell when the policy was actually implemented, and firms had no incentive to act prior to this implementation.

Columns (4)–(6) of Table 6 report the estimates of the specifications in which the dependent variable is more disaggregated—i.e., top_{ijt} equals 1 if product j is the cheapest amongst all products offered by firm f in response to customer i's enquiry at time t, and 0 otherwise. In each specification, after the policy change, products with large back books become less likely to be the cheapest product offered by a firm. The magnitudes are again economically large, though slightly smaller than the across-firm results of Columns (1)–(3). Moving from the 1$^{\text{st}}$ to the 99$^{\text{th}}$ percentile of the back book (Table 3) implies a decrease in the probability that a product is a firm's cheapest offer of 45 percentage points. This is around 2.5 times the average probability that a given product is the cheapest a firm offers.

The right panel of Figure 3 shows results of a time-varying version of the most stringent product-level regression (Column (6) in Table 6). Once again, the effect coincides with the introduction of the policy, and there are no significant pre-trends.

These results confirm the model's predictions regarding pricing and back books in Proposition 1. Products that have attracted a large amount of a particular type of customer in the past are now less competitive when competing for new customers of this type. This operates across all products: products with large back books are less likely to appear at the top of a customer's menu than products with no back book after the regulation. It also operates within firms: firms adjust prices across the products they offer in response to each product's back book, such that if a given product becomes uncompetitive by virtue of having a large back book, the firm can steer consumers to alternative products by pricing them competitively.

5.3 Market Share Dynamics

We now test the model's prediction that the policy introduces negative autocorrelation in insurance product market shares. To test this in the data, we first define a product's market share at the month-segment level. That is, for each product j quoted to customer type θ (as defined in Section 4.2) in month t, we compute its market share $s_{j\theta t}$ as the number of times product j was selected by that type, as a share of all product selections by that type.

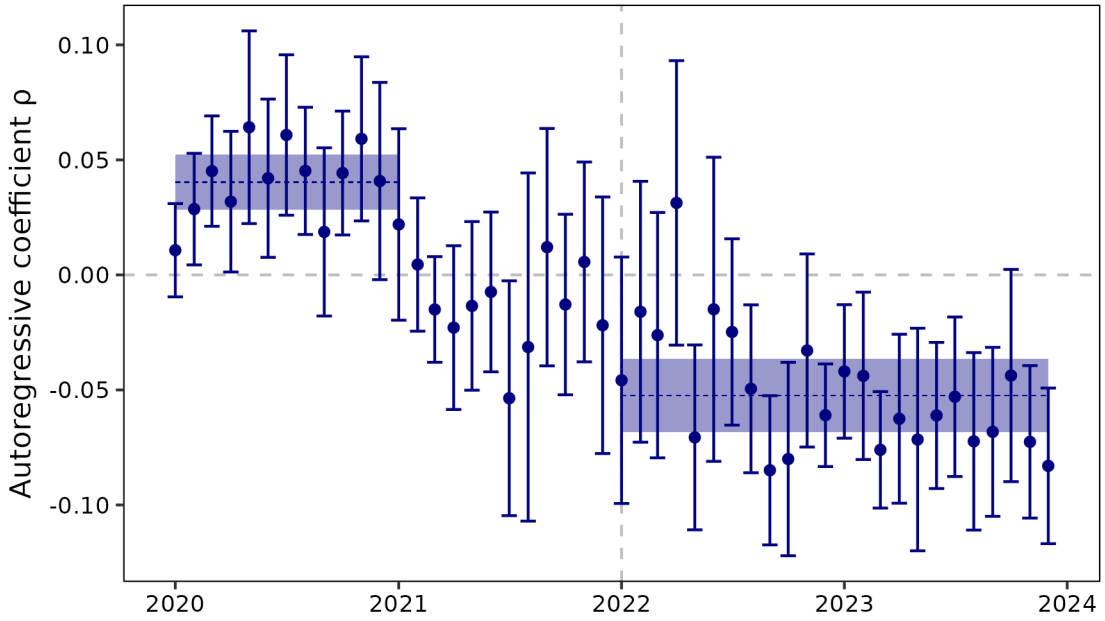
We then relate these market shares $s_{j\theta t}$ to market shares 12 months earlier $s_{j\theta t-12}$, using the following autoregressive specification:

$$s_{j\theta t} = \rho_t s_{j\theta t-12} + \delta_{j\theta} + \epsilon_{j\theta t}, \tag{13}$$

where ρ_t is the autoregression coefficient, which we allow to vary across time, $\delta_{j\theta}$ are product-type fixed effects, and $\epsilon_{j\theta t}$ is an unobservable. We plot the results of this regression in Figure 4. The points show monthly estimates of ρ_t, whilst the horizontal lines show their average level at the beginning of our sample period and after the introduction of the policy.

The patterns are striking. Initially market shares exhibit positive autocorrelation—products that are popular in a given segment in one year are more likely to be popular the following year. As the policy is anticipated and then implemented, the autocorrelation reverses sign, such that being in greater demand one year is associated with being less popular the following year.

Figure 4: Oscillating Market Shares



Notes: This figure shows the results of the autoregressive specification in Equation 13. Points show the estimated autoregressive coefficients ρ_t for each month, with error bars showing 95% confidence intervals. The dashed horizontal lines show the estimates when this parameter is allowed to vary only before vs. after the policy's implementation, with the ribbons showing 95% confidence intervals. Standard errors are clustered by type θ and product j.

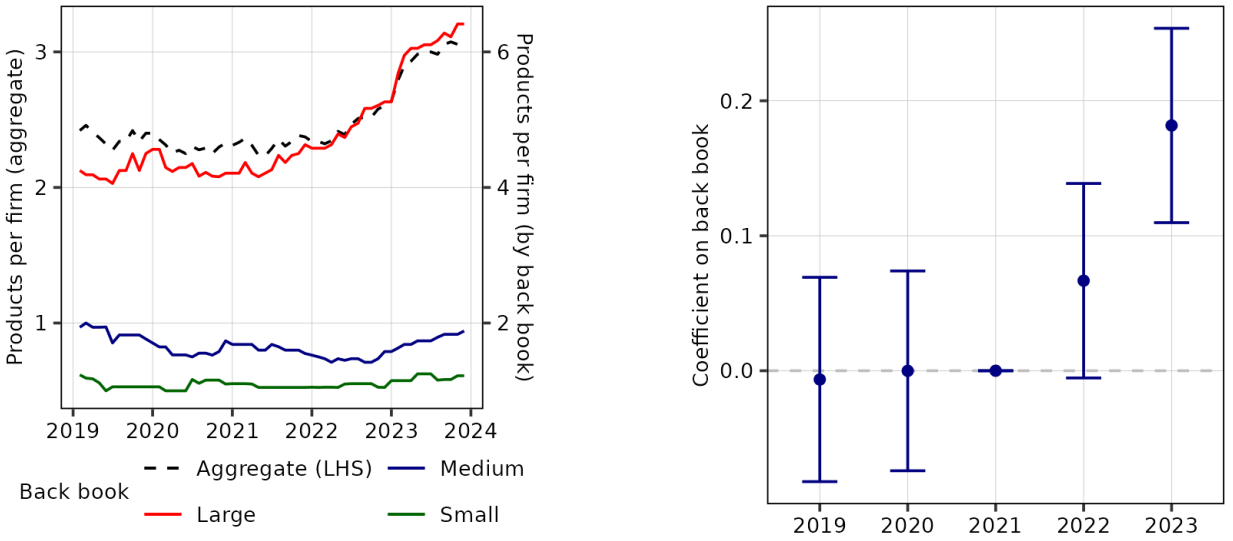
These results confirm the prediction of Proposition 2 regarding the impact of pricing regulation on competition. As we found in Section 5.2, after the policy the presence of a large back book inhibits a product's competitiveness. As shown in Figure 4, this pattern in pricing causes the market shares of products to oscillate through time after the policy.

5.4 Product Proliferation

We now study the introduction of new products around the change in regulation. As explained in Section 3.5, the regulation introduces an incentive for firms to introduce new products, and this incentive is stronger for firms with large back books. We find support for this prediction in the data: following the change in regulation in 2022, the number of products offered by insurers increased sharply, and more so for firms with large back books.

As a warm-up to more tightly identified evidence, the left panel of Figure 5 displays some interesting aggregate effects. The black dashed line shows that the average firm had 25% more products on offer at the end of our sample period than it did at the beginning.

Figure 5: Products per Insurer, 2019–2023



(a) Trends by Back Book **(b) Difference-in-Difference**

Notes: These figures show the number of products offered by insurers through time and by the size of the firm's back book. The black dashed line in the left panel shows the aggregate number of products offered each month by all insurance firms, divided by the total number of firms. The colored lines in the left panel show the average number of products per insurance firms according to the size of the firm's back book. Back books are defined as in Section 4.2 and are grouped into tertiles. The right panel shows the coefficients on a firm's back book in the two-way fixed effects regression relating a firm's products to its back book shown in equation 14. The points show the coefficients on the back book each year, with 95% confidence intervals.

We now disaggregate this pattern of product proliferation across firms. The left panel of Figure 5 displays the number of products offered per firm for groups of firms with back books of different sizes. We focus on firm-level (rather than segment-specific or product-specific) back books because, once a product is introduced, it is generally introduced to many different segments.[21] We focus on the back book over the whole prior sample period, rather than just those contracts renewing in a given month, as once a firm introduces a product it tends to offer this product for a long period of time.[22]

We find that firms with large back books fully account for the increase in the total number of products on offer after the policy. The largest (top-tercile) firms with the largest back books increased the number of products they offered by approximately 50% after the policy,

[21] On average, a product returns a quote in 43% of enquiries.

[22] For example, of the products quoted in 2019, the first year of our sample, two-thirds were still being quoted in 2023.

from approximately 4 to 6. All other firms left their product offerings broadly unchanged.

We formalize this result in a difference-in-difference regression. We relate the total number of products a firm offers in a given month prods_{ft} to its back book BB_{ft}, using the following regression:

$$\text{prods}_{ft} = \beta_t \text{BB}_{ft} + \delta_t + \delta_f + \epsilon_{ft}, \tag{14}$$

where δ_t and δ_f are year and firm fixed effects, respectively. As explained in Section 4.2, a firm's aggregate back book share in a given month is defined as all customers who shopped with that firm in all prior months, as a percentage of the total customers across all firms in the same period.

The right panel of Figure 5 displays the estimates of the coefficients β_t. These estimates formalise the intuition from the time series evidence. There is no evidence of any pre-trends. After the policy implementation, we observe a sharp increase in the size of menus offered by the firms with the most incentive to expand their menus—those with large back books.[23]

5.5 Persistent Gains to Search

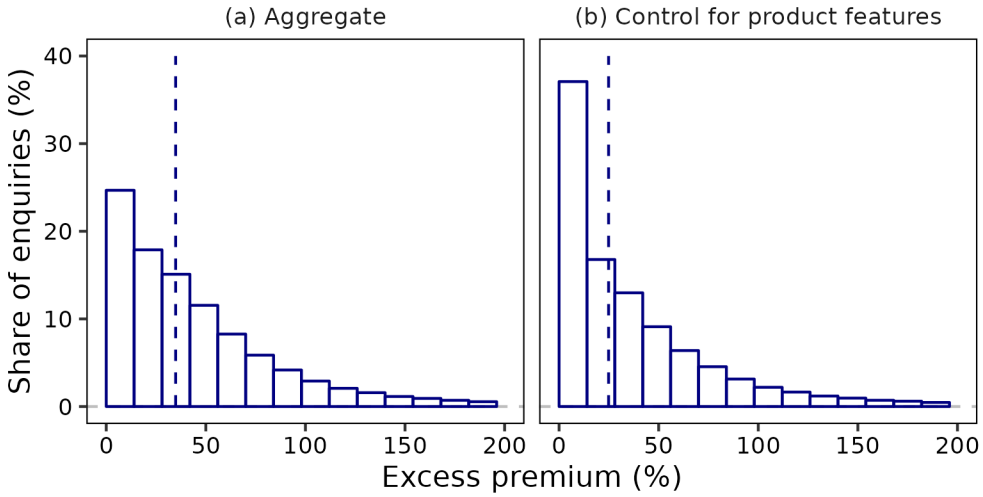
The 2022 pricing regulations aimed to eliminate direct price discrimination between passive and active consumers. The model predicts that these regulations will not eliminate the gains to search, as prices will still increase for inactive customers. This section confirms this prediction, providing evidence that the regulation did not eliminate customers' benefits from searching for and switching across insurers, which remained large.

To show this, we construct a simple proxy measure of the benefits from switching insurance products. We leverage the fact that we observe a subset of customers who purchase an insurance product one year, and then search again in the following year. When they subsequently search, we compare the price of their original product one year on—to which they would automatically renew—to the price they could get if they switched products instead.

More precisely, we restrict our sample to customers who purchase a product in a given year and search again the following year, and for whom the product chosen in the first year appears in the menu in the second year. We then compute the savings they would get if they switched to the cheapest product in the menu rather than renewing the insurance policy

[23] The magnitudes of the coefficients in the right panel of Figure 5 are smaller relative to the magnitudes in the left panel, because the largest firms fully account for the increase in product offerings—i.e., the effect is non-linear—whereas equation (14) is linear in the back book.

Figure 6: Costs of Inertia



Notes: This figure shows the distribution of the excess cost of a customer's chosen product one year after they chose it. We take the subset of customers that purchase a product and search again the following year. We define the incumbent product as the product purchased in the first year. The excess cost equals the extra percentage cost of the incumbent product in year two relative to the cheapest offer in the customer's menu in year two. The left panel shows the distribution of total excess costs. The right panel repeats this calculation, then subtracts the excess cost that the customer paid the previous year, and takes the maximum of this number and zero. Dashed vertical lines show medians.

they chose initially.[24,25]

The left panel of Figure 6 shows the distribution of these savings across customers, as a percentage of the price of the cheapest option in a customer's menu. It shows that the median customer would pay 40% more by renewing their existing product rather than switching to the cheapest available online quote.

The right panel in Figure 6 controls for differences in the non-price features of different

[24]This approach assumes that the quote a customer receives from their existing insurer when renewing their policy is the same if they search online as if they do nothing, and passively auto-renew. This need not be the case pre-policy, as insurers can offer a lower price when a customer searches than they did in their renewal offer, and indeed have an economic incentive to do so in order to retain them. The policy, however, requires that auto-renewing customers cannot be discriminated against relative to otherwise equivalent customers shopping via the same channel by which the customer initially shopped. This means the price we observe in our data cannot be below their auto-renewal price, whilst insurers typically have little incentive to set it above the auto-renewal price. Hence, we show these gains to search only for the period after the policy's implementation.

[25]Naturally, this is not a representative subsample. Intuitively, one would expect the gains to search for the population as a whole, who are on average more inert than these repeat-searchers, to be larger than for this subsample.

products. Customers may pick a product that is not the cheapest if it has some desirable non-price characteristics. We account for this in Figure 6 by subtracting the initial difference in price between the product chosen and the cheapest product available at that time. Thus, if a customer chose a product 20% more expensive than the cheapest in one year, and a year later the product remains 20% more expensive than the cheapest, we would compute their savings as 0.

These non-price characteristics explain some of the savings from switching products, but even after controlling for them, the median customer pays over 20% more than they need to a year after taking out insurance. This 20% represents the customer's chosen product becoming more expensive relative to alternative products the customer was offered, but opted not to purchase.

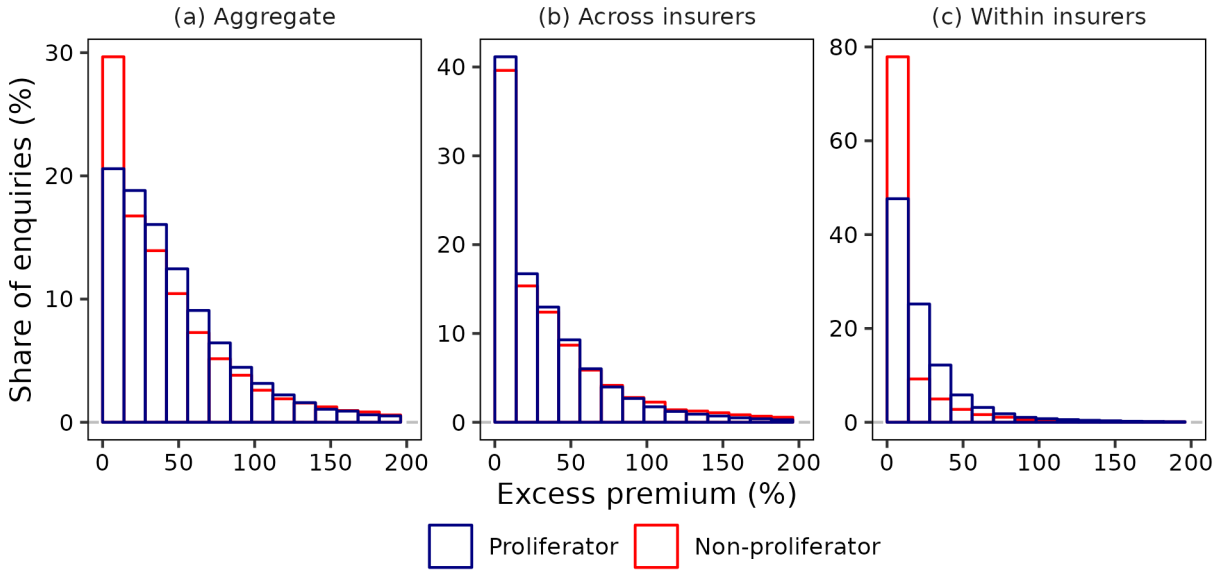
Overall, these patterns are consistent with insurers continuing to profit from inert customers, even when they are prevented by the price-walking regulations from directly discriminating against their existing customers.

We now study heterogeneity in these gains to search across insurers. As discussed in Section 3.5, insurers can ease the trade-offs imposed on them by the regulation by introducing new products, which enables them to raise prices for their back book whilst competing for new business with new products. In the first panel of Figure 7 we show how the gains to search vary depending on whether a customer's initial insurer introduced a new product onto their menu the following year. The gains from search are significantly larger than for those insurers that did ("proliferators") than those that did not.

We further explore this difference by disaggregating a customer's gains to search into a within-insurer component and an across-insurer component. Within-insurer gains to search are defined as the difference in price between the customer's incumbent product and the cheapest product offered by the customer's incumbent insurer. Across-insurer gains to search are the difference between the cheapest product offered by the incumbent insurer, and the cheapest option on the menu overall. We express both these measures as a percentage of the cheapest offer on the menu, such that they sum to our measure of aggregate gains to search.

The second and third panels of Figure 7 show within-insurer and across-insurer gains to search, split once again according to whether the customer's insurer was a proliferator or not. The across-insurer gains are similar for proliferators and non-proliferators, consistent with the two types being equally able to compete for new business. The within-insurer gains to search are significantly larger for proliferators. Thus whilst the proliferating firm can set

Figure 7: Costs of Inertia and Product Proliferation



Notes: This figure shows the distribution of the excess cost of a customer's chosen product one year after they chose it, separated according to whether their chosen insurer introduced a new product in the meantime. As in Figure 6, we take the subset of customers who purchase a product and search again the following year. We define the incumbent product as the product purchased in the first year. The excess premium equals the extra percentage cost of the incumbent product in year two relative to the cheapest offer in the customer's menu in year two. The blue bars in the first panel show the distribution of total excess costs for those customers whose insurer introduced a new product in the year since they initially shopped ('proliferators'). The red bars repeat the computation for those whose insurers did not ('non-proliferators'). The second panel repeats these calculations for across-insurer gains to search, defined as the difference between the incumbent insurer's cheapest product and the cheapest offer on the customer's menu, as a percentage of the cheapest offer. The third panel repeats these calculations for within-insurer gains to search, defined as the difference between the customer's incumbent product and their insurer's cheapest product, as a percentage of the cheapest offer on their menu.

a minimum price as low as that of other firms, its existing customers pay significantly more than this minimum.

Together, the patterns in Figure 7 highlight the role of product proliferation in the regulatory arbitrage at play here. Proliferation is a way by which insurers can continue to compete for new business, whilst increasing the prices paid by their back book.

6 Conclusion

The central question of this paper is whether direct regulatory intervention can protect consumers in markets where inertia is widespread and suppliers can adapt their behavior. We study this question through the lens of a uniquely informative natural experiment: the 2022 UK regulation banning "price walking" in motor insurance, whereby insurers kept prices low for new customers while systematically raising them for existing ones.

We develop a theoretical framework that captures the key trade-off regulation imposes on firms: charging higher prices to exploit their existing customer base makes them less competitive for new business. The model generates five testable predictions about firm behavior. We find strong empirical support for all five using granular search, choice, and pricing data from *Compare the Market*, the largest price comparison website in the UK motor insurance market.

The findings tell a coherent and multifaceted story about how firms adapted. First, as the regulation approached, insurers reduced the price discounts they offered to customers most likely to be inert—that is, the very customers the regulation was designed to protect. Second, once the regulation took effect, firms with large back books priced their established products less competitively, steering new customers toward alternative offerings. Third, this pricing behavior caused market shares to oscillate over time, as products that gained customers in one period became expensive in the next. Fourth, firms with the largest back books responded by substantially expanding their product offerings, increasing their menus by approximately 50%, thereby enabling them to harvest their existing customer base while remaining competitive for new business. Fifth, and most consequentially, the gains from actively searching and switching remained large throughout: Post-regulation, the median customer still pays around 40% above the cheapest available price by not switching, with product proliferation emerging as one of the key mechanisms sustaining this penalty.

Taken together, these results indicate that regulating markets with inertial consumers is complex: When direct price discrimination is banned, sophisticated suppliers find indirect routes to the same outcome. Prior research has shown that softer interventions, such as encouraging competition and nudging consumers toward better choices, often fail to overcome the combination of consumer inertia and strategic firm behavior. Our findings suggest that more muscular approaches, which directly constrain how firms can price across their customer base, face similar challenges, because firms respond by restructuring their product offerings to exploit inertia. Indeed, our finding on the oscillation of market shares through

time—as different firms alternately exploit their back books and price competitively to attract customers to subsequently exploit—creates a transient and elusive target for regulators following the imposition of muscular regulation. Designing regulation that is robust to these endogenous supplier responses remains an open and important problem for consumer protection policy.

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Online Appendix for "Regulating Inaction: The Case of Price Walking"

A Additional Tables and Figures

Table A.1 reports price regulations in different jurisdictions similar to UK's price-walking regulations.

Table A.2 provides an example of the products offered by a large insurer.

Figure A.1 displays the menu of products presented by a price comparison website.

Table A.1: Regulatory Actions on Pricing Practices — Global Timeline

Adoption	Jurisdiction	Competent Authority	Scope
2013	Netherlands	Netherlands Authority for the Financial Markets (AFM)	Lending
2014	South Korea	Korea Communications Commission (KCC)	Telecom
2014	United States	State insurance departments	Insurance
2019	Australia	Australian Energy Regulator (AER)	Energy
2020	New Zealand	Electricity Authority (EA)	Energy
2021	Australia	Australian Securities and Investments Commission (ASIC)	Insurance add-ons
2022	United Kingdom	Financial Conduct Authority (FCA)	Insurance
2022	Ireland	Central Bank of Ireland (CBI)	Insurance
2025	Colombia	Comisión de Regulación de Comunicaciones (CRC)	Telecom
2026	Canada–Ontario	Financial Services Regulatory Authority of Ontario (FSRA)	Insurance

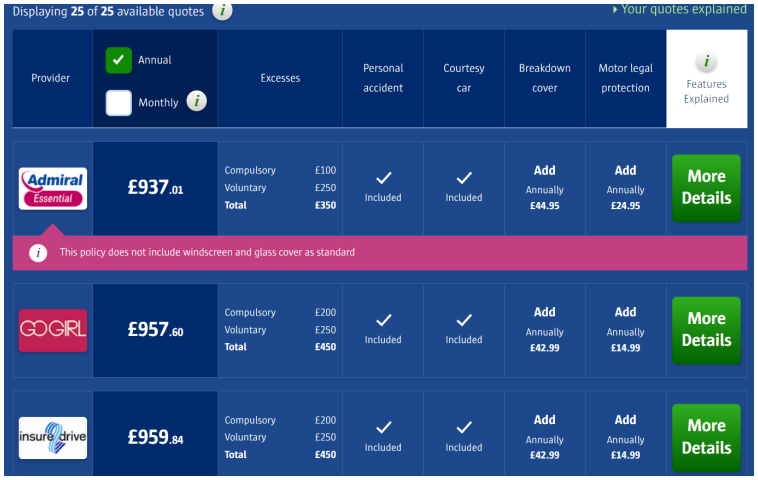
Notes: In the United States, 20 states have adopted measures on pricing practices since the first adoption by Maryland on 31-10-2014. Jurisdictions include (postal abbreviations): MD, OH, CA, NY, FL, VA, VT, WA, IN, PA, DC, ME, MT, RI, DE, CO, MN, CT, AK, MO, MI.

Table A.2: Major Insurer's Products

Feature	Platinum	Gold	Standard	Essential
Motor legal protection	✓	✓	optional	optional
Roadside breakdown cover	✓	optional	optional	optional
Personal belongings cover	£300	£300	£200	×
Windscreen cover	✓	✓	✓	×
New car replacement	✓	✓	✓	×
Driving other cars (conditional)	✓	✓	✓	×
European cover for up to 90 days	✓	✓	✓	×
Audio equipment cover (aftermarket)	✓	✓	✓	×
Onward travel	✓	✓	×	×
Cost for indicative quote	£884.69	£840.55	£816.04	£750.76

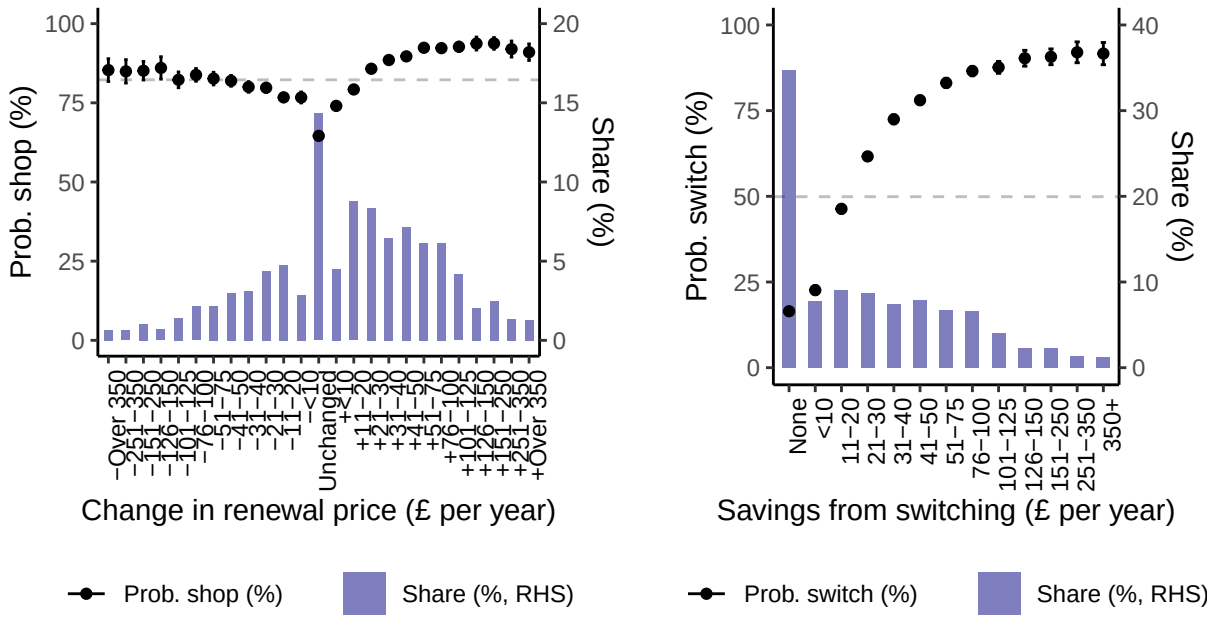
Notes: This table shows the four products offered by a major UK car insurer. Products are vertically differentiated, with a higher price charged for policies with extra features.

Figure A.1: Example of Price Comparison Website Menu



Notes: This figure shows the top of a menu of quotes for an insurance enquiry made via Compare the Market.

Figure B.1: Search and Switching



Notes: The left panel plots shopping probability against renewal price changes. Bars show the customer distribution across buckets; points show the fraction shopping in each bucket with 95% confidence intervals; the dashed line shows the average shopping probability. The right panel plots switching probability against potential savings for customers who shopped. Bars show the customer distribution; points show switching rates with 95% confidence intervals; the dashed line shows the average switching probability.

B Consumer Intelligence Survey Data

In this Appendix, we use *Consumer Intelligence* survey data to examine search and switching decisions at renewal. The survey covers individuals who renewed car insurance during July 2019 to December 2023. Respondents report their renewal price changes, whether they shopped around, potential savings from switching, and whether they switched insurers.

Figure B.1 summarizes search and switching patterns. The left panel shows how renewal price changes affect search decisions. Around 80% of customers report shopping around to some extent, though the survey does not reveal how comprehensively they search. Search responds to renewal price changes: customers facing large price increases are over 20 percentage points more likely to search. Surprisingly, customers receiving large price decreases also search slightly more.

The right panel shows how switching decisions depend on potential savings. Conditional on searching, around 50% of customers switch insurers. Switching rates increase steeply with savings: customers facing savings over £45 per year are over three times as likely to switch as those facing savings under £5.

Table B.1: Datasets: shares by age

Age group	Compare the Market	Consumer Intelligence	Population
16-29	50	11	14
30-39	16	16	17
40-49	11	17	18
50-59	9	21	19
60-69	11	22	15
70+	3	13	17

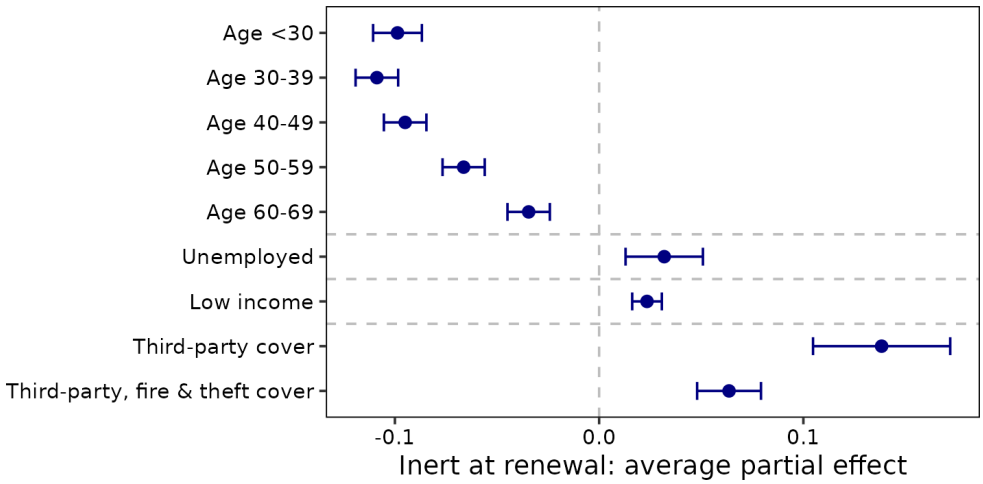
Notes: This table shows the sample shares by age group for our main dataset (Compare the Market), our renewals survey data (Consumer Intelligence) and the population of England & Wales based on national survey data.

The *Consumer Intelligence* sample differs from our main *Compare the Market* data. Table B.1 shows that *Compare the Market* includes younger drivers relative to both *Consumer Intelligence* and the UK driver population. We therefore cannot directly translate these survey responses into precise switching frequencies for our main sample. Nonetheless, the data support two conclusions: search and switching involve substantial frictions, yet customers' search and switching decisions respond to price incentives.

Figure B.2 summarizes search decisions as a function of customer demographics. We run probit regressions for whether a customer reported that they *did not* shop around at their last renewal as a function of their demographics, and plot the estimated average partial effects. The likelihood that a customer did not shop at their most recent renewal is higher for older customers, unemployed customers, low-income customers, and those shopping for non-comprehensive insurance.

Figure B.2 studies the *unconditional* probability of inertia across customer groups. Table 4, by contrast, studies the probability of inertia *conditional* on having searched at least once. Together, these results are consistent with older customers being less likely to search on average, but those older drivers who do search being more likely to do so every year.

Figure B.2: Survey Evidence on Customer Inertia



Notes: This figure summarizes survey evidence on customer inertia. The reported estimates are average marginal effects from probit regressions of a dummy for whether a customer reported not shopping around at their last renewal, based on *Consumer Intelligence* survey data. A customer is low-income if their income is in the bottom 20% of reported incomes. The omitted age category is over-70. The omitted coverage category is comprehensive insurance.

C Robustness

In Section 5.1 we construct proxies for customer inertia based on their demographics. To do so, we take all customers who search for and take out insurance in our data, and regress the likelihood that they *do not* search again 12 months later on their demographics. For example, a customer who takes out inertia in December 2019 is inert if they do not search again in December 2020. We find that this conditional likelihood of inertia is greater for young customers, disabled customers, those who are insuring cheap cars, and those who are searching for non-comprehensive insurance.

Figure C.1 shows the robustness of these patterns. Marginal effects from our baseline specification, as in Table 4, are shown in blue. We re-compute these marginal effects under the following assumptions:

1. We expand our definition of inertia to include every year after a customer initially shops. Thus if a customer searchers in December 2019, they are inert if and only if they are not seen to search in any subsequent December in our sample. We show these results in red.

2. We define a customer to be inert if they do not search again from one month after they initially take out insurance. So a customer who takes out insurance in December 2019 would be considered inert if and only if they do not search in any period from January 2020 onwards. We show these results in yellow.

3. We restrict the sample to initial searches that are in some sense discretionary, as they are not triggered by a customer buying a new car or newly acquiring a license. We show these results in brown.

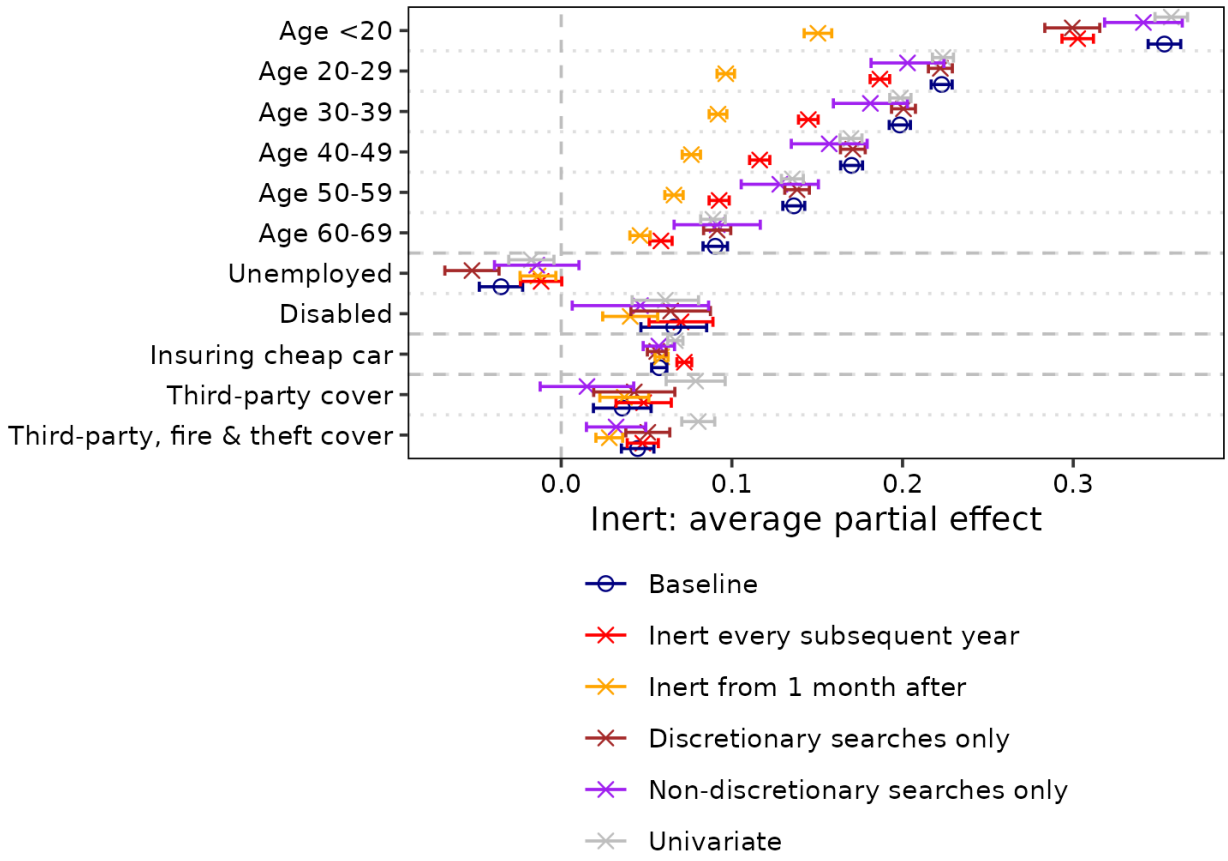
4. We restrict the sample to initial searches that are *non-discretionary*, as they are follow a customer buying a new car or newly acquiring a license. That is, we include only those customers who were excluded in the previous test. We show these results in purple.

5. We include the demographics one-by-one in univariate regressions, rather than all together in a multivariate regression. We show these results in grey.

Across each of these specifications, the key patterns shown in Table 4 continue to hold.

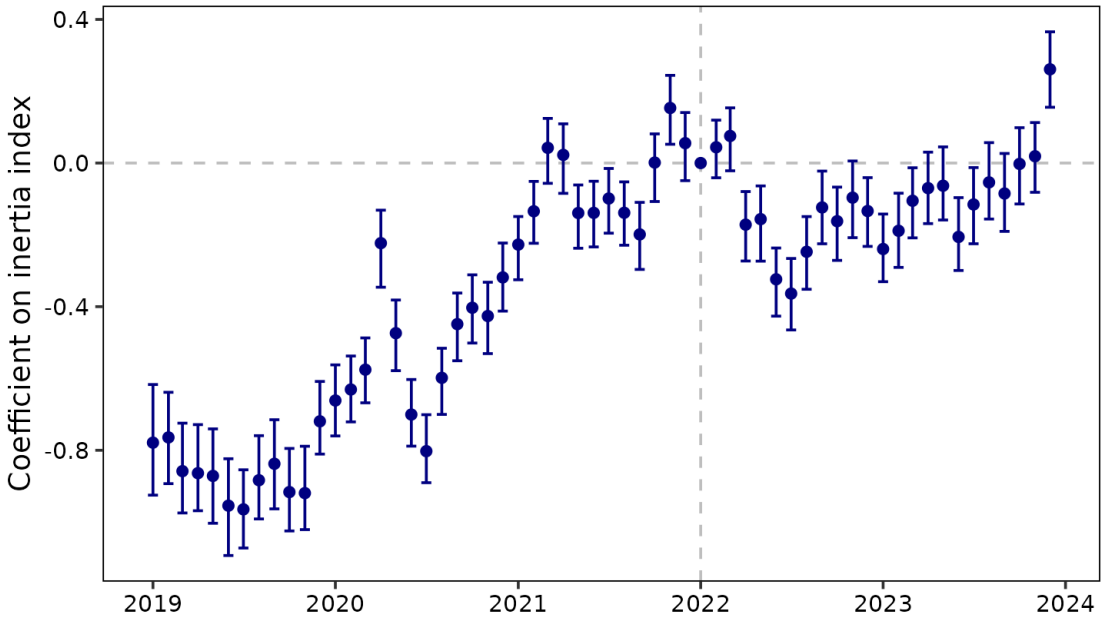
For completeness, we also replicate Figure 2 for the robustness test where we include only non-discretionary searches (purple points in Figure C.1). We show the results of this in Figure C.2 below. The results are very similar to the baseline, highlighting that the robustness of the relationship between inertia and demographics carries over into the relationship between prices and inertia.

Figure C.1: Inertia and Customer Characteristics: Robustness



Notes: This figure shows the robustness of our results on customer inertia as a function of customer characteristics. The reported estimates are average marginal effects from probit regressions of a dummy for whether a customer is inert after taking out insurance, for customers taking out insurance at least one year before the end of our sample. A car is cheap if it is in the bottom 20% of car values. 'Disabled' denotes a driver who is out of work due to illness or disability. The omitted age category is over-70. The omitted coverage category is comprehensive insurance. Our baseline results, as shown in Table 4, are in blue. The remaining colors show results under various robustness tests, as described in Section C.

Figure C.2: Pricing and Customer Inertia Through Time: Robustness



Notes: This figure shows the robustness of our results on the price of insurance and customer inertia, shown in Figure 2. We estimate customer inertia based only on initial searches that were non-discretionary, as described in Section C and shown in purple in Figure C.1. We then replicate the regression shown in Figure 2, where points show the coefficient on inertia each month. The reference month is January 2022. Error bars show 95% confidence intervals based on bootstrapping, where standard errors are clustered at the level of the enquirer.

D Proofs

Proof of Proposition 1.

We assume the equilibrium is interior and verify that this is the case later. Let

$$x_t := s(\mathbf{p}_{t-1}, \Delta_{t-1})$$

denote the Markov state in period t. We will later rescale x_t to express it in terms of deviations from the mean.

Firm 0's Bellman equation is:

$$V_0(x_t; \Delta_t) = \max_{p_t^0, x_{t+1}} \left[(2-\lambda)\left(\frac{1+\Delta_t}{2} + \frac{p_t^1 - p_t^0}{2c}\right) + \lambda x_t\right] p_t^0 + \delta E_t\left[V_0\left(x_{t+1}, \Delta_{t+1}\right)\right]$$

subject to

$$x_{t+1} = \frac{1+\Delta_t}{2} + \frac{p_t^1 - p_t^0}{2c}.$$

Standard arguments from dynamic programming (boundedness, discounting, and strict concavity of the "per-period utility" in p_t^0) give the first-order ("FOC") and envelope conditions:

$$\left[(2-\lambda)\left(\frac{1+\Delta_t}{2} + \frac{p_t^1 - p_t^0}{2c}\right) + \lambda x_t\right] - \frac{2-\lambda}{2c} p_t^0 - \frac{\delta}{2c} E_t\left[\frac{\partial V_0}{\partial x}\left(\frac{1+\Delta_t}{2} + \frac{p_t^1 - p_t^0}{2c}, \Delta_{t+1}\right)\right] = 0,$$

$$\frac{\partial V_0}{\partial x}(x_t; \Delta_t) = \lambda p_t^0.$$

Substitute the envelope at $t+1$ at FOC to obtain firm 0's Euler condition:

$$\left[(2-\lambda)\left(\frac{1+\Delta_t}{2} + \frac{p_t^1 - p_t^0}{2c}\right) + \lambda x_t\right] - \frac{2-\lambda}{2c} p_t^0 - \frac{\delta\lambda}{2c} E_t\left[p_{t+1}^0\right] = 0. \tag{D.1}$$

Symmetrically, firm 1's Euler condition is:

$$\left[(2-\lambda)\left(\frac{1-\Delta_t}{2} - \frac{p_t^1 - p_t^0}{2c}\right) + \lambda(1-x_t)\right] - \frac{2-\lambda}{2c} p_t^1 - \frac{\delta\lambda}{2c} E_t\left[p_{t+1}^1\right] = 0. \tag{D.2}$$

Define the sum of prices as:

$$S(\Delta_t, x_t) := p^0(\Delta_t, x_t) + p^1(\Delta_t, x_t).$$

The following lemma establishes that in any MPE the sum of prices does not depend on the demand shock Δ_t and on the state x_t:

Lemma 1. *In any MPE, the sum of prices equals* $S(\Delta_t, x_t) = \frac{4c}{2-\lambda(1-\delta)}$.

Proof. Add the Euler conditions of both firms (D.1) and (D.2):

$$S_t = \frac{4c}{2-\lambda} - \frac{\delta\lambda}{2-\lambda} E_t\left[S_{t+1}\right]. \tag{D.3}$$

Define the operator $(Tf)(z) := \frac{4c}{2-\lambda} - \frac{\delta\lambda}{2-\lambda} E\left[f(Z')|Z=z\right]$ on the set of bounded functions f of $Z=(x,\Delta)$. The operator T is a contraction in the sup norm with modulus $\frac{\delta\lambda}{2-\lambda} < 1$. Hence, by the Banach fixed-point theorem, it has a unique solution. Substituting a constant verifies that the solution is:

$$S_t = \frac{4c}{2-\lambda\left(1-\delta\right)} \qquad \forall t.$$

□

To simplify notation, define the average price implied by Lemma 1 as $M := \frac{S}{2} = \frac{2c}{2-\lambda(1-\delta)}$. Fixing an MPE, define the price difference as $d_t := p_t^1 - p_t^0$. Subtracting the Euler conditions of both firms (D.1) and (D.2) and rearranging, gives

$$(2-\lambda)\left(\Delta_t + \frac{3}{2c} d_t\right) + \lambda\left(\Delta_{t-1} + \frac{d_{t-1}}{c}\right) + \frac{\delta\lambda}{2c} E_t\left[d_{t+1}\right] = 0. \tag{D.4}$$

As done in the text, redefine the state in terms of deviation from its mean:

$$y_{t+1} := x_{t+1} - \frac{1}{2} = \underbrace{\frac{1+\Delta_t}{2} + \frac{p_t^1 - p_t^0}{2c}}_{x_{t+1}} - \frac{1}{2} = \frac{\Delta_t}{2} + \frac{d_t}{2c}.$$

Lemma 2. *There exist constants A and B such that the linear strategies*

$$p^0(y,\Delta) = M + A\Delta + By, \qquad p^1(y,\Delta) = M - A\Delta - By \tag{D.5}$$

constitute an interior MPE.

Proof. The proof is constructive: we find the constants A and B under which the linear strategies above solve the Euler conditions (D.1) and (D.2). With (D.5),

$$d_t = -2\left(A\Delta_t + By_t\right), \tag{D.6}$$

so

$$y_{t+1} = \frac{\Delta_t}{2} + \frac{d_t}{2c} = \left(\frac{1}{2} - \frac{A}{c}\right)\Delta_t - \frac{B}{c} y_t.$$

Moving d_t one period forward and taking expectations, gives

$$E_t[d_{t+1}] = -2\left(A\overbrace{E_t[\Delta_{t+1}]}^{0} + BE_t[y_{t+1}]\right) = -2BE_t[y_{t+1}],$$

so by the previous condition

$$E_t[d_{t+1}] = -2B\left[\left(\frac{1}{2} - \frac{A}{c}\right)\Delta_t - \frac{B}{c}y_t\right] = -2B\left(\frac{1}{2} - \frac{A}{c}\right)\Delta_t + \frac{2B^2}{c}y_t. \tag{D.7}$$

Substitute (D.6) and (D.7) into (D.4):

$$0 = (2-\lambda)\left[\Delta_t - \frac{3}{c}\left(A\Delta_t + By_t\right)\right] + 2\lambda y_t + \frac{\delta\lambda}{c}\left[-B\left(\frac{1}{2} - \frac{A}{c}\right)\Delta_t + \frac{B^2}{c}y_t\right]$$

$$= \left[(2-\lambda)\left(1 - 3\frac{A}{c}\right) - \delta\lambda\frac{B}{c}\left(\frac{1}{2} - \frac{A}{c}\right)\right]\Delta_t + \left[2\lambda + \delta\lambda\left(\frac{B}{c}\right)^2 - 3\frac{B}{c}(2-\lambda)\right]y_t.$$

Since this condition must hold for all (Δ_t, y_t), the terms inside each bracket must be zero. Let $a := \frac{A}{c}$ and $b := \frac{B}{c}$. The condition on the term multiplying y_t becomes:

$$b^2 - 3\frac{2-\lambda}{\delta\lambda}b + \frac{2}{\delta} = 0.$$

This quadratic expression is positive at $b = 0$ and negative at $b = 1$. Therefore, it has two positive roots: the smallest lies between 0 and 1 and the largest is greater than 1. The relevant root is the smallest:

$$b^* = \frac{3(2-\lambda) - \sqrt{9(2-\lambda)^2 - 8\delta\lambda^2}}{2\delta\lambda} \in (0,1),$$

since a root greater than 1 would lead to an exploding path for p_t, violating the assumption that prices must be bounded.

The condition on the term multiplying Δ_t is:

$$(2-\lambda)(1-3a) - \delta\lambda b\left(\frac{1}{2} - a\right) = 0 \therefore a = \frac{2 - \lambda - \frac{\delta\lambda b}{2}}{3(2-\lambda) - \delta\lambda b}.$$

Substituting the expression for b gives:

$$a^* = \frac{2 - \lambda - \frac{\delta\lambda}{2}b^*}{3(2-\lambda) - \delta\lambda b^*}.$$

To conclude the proof, we need to verify that the Euler conditions of both firms (D.1) and (D.2) hold. This is equivalent to verifying that their sum and difference (D.3) and (D.4) conditions hold. Their sum (D.3) holds by the construction of M, as $p_0^t + p_1^t = 2M = S$. Their difference (D.4) holds by the choice of $A = a^*c$ and $B = b^*c$. □

We now show that the MPE is unique:

Lemma 3. *There exists at most one interior MPE.*

Proof. Let (p^0, p^1) be the interior MPE constructed above. Let $(\tilde{p}^0, \tilde{p}^1)$ also be an interior MPE. Define

$$\tilde{d}(\Delta, x) := \tilde{p}^1(\Delta, x) - \tilde{p}^0(\Delta, x), \qquad e(\Delta, x) := d(\Delta, x) - \tilde{d}(\Delta, x).$$

We claim that $e(\Delta, x) = 0$ for all (Δ, x).

Since $(\tilde{p}^0, \tilde{p}^1)$ is an interior MPE, it must also satisfy the Euler conditions (D.1)-(D.2), so equation (D.4) must hold for both d and $\tilde{d}$:

$$(2-\lambda)\left(\Delta_t + \frac{3}{2c} d_t\left(\Delta_t, x_t\right)\right) + \lambda x_t + \frac{\delta\lambda}{2c} E_t\left[d_{t+1}\left(\Delta_{t+1}, x_{t+1}\right)\right] = 0,$$

$$(2-\lambda)\left(\Delta_t + \frac{3}{2c} \tilde{d}_t\left(\Delta_t, x_t\right)\right) + \lambda x_t + \frac{\delta\lambda}{2c} E_t\left[\tilde{d}_{t+1}\left(\Delta_{t+1}, \tilde{x}_{t+1}\right)\right] = 0,$$

where

$$x_{t+1} = \frac{1+\Delta_t}{2} + \frac{d_t}{2c}, \qquad \tilde{x}_{t+1} = \frac{1+\Delta_t}{2} + \frac{\tilde{d}_t}{2c}. \tag{D.8}$$

Subtracting one from the other, gives

$$(2-\lambda)\frac{3}{2c}\underbrace{\left[d\left(\Delta_t, x_t\right) - \tilde{d}\left(\Delta_t, x_t\right)\right]}_{e(\Delta_t, x_t)} + \frac{\delta\lambda}{2c}\left\{\underbrace{E_t\left[d\left(\Delta_{t+1}, x_{t+1}\right)\right] - E_t\left[\tilde{d}\left(\Delta_{t+1}, \tilde{x}_{t+1}\right)\right]}_{*}\right\} = 0. \tag{D.9}$$

Consider the expression in *:

$$\begin{aligned} * &= E_t\left[d\left(\Delta_{t+1}, \tilde{x}_{t+1}\right) - \tilde{d}\left(\Delta_{t+1}, \tilde{x}_{t+1}\right)\right] + E_t\left[d\left(\Delta_{t+1}, x_{t+1}\right) - d\left(\Delta_{t+1}, \tilde{x}_{t+1}\right)\right] \\ &= E_t\left[e\left(\Delta_{t+1}, \tilde{x}_{t+1}\right)\right] + E_t\left[d\left(\Delta_{t+1}, x_{t+1}\right) - d\left(\Delta_{t+1}, \tilde{x}_{t+1}\right)\right] \end{aligned}$$

By equation (D.6), we have

$$d(x, \Delta) = -2\left[A\Delta + B\underbrace{\left(x - \frac{1}{2}\right)}_{y}\right].$$

Therefore,

$$* = E_t\left[e\left(\Delta_{t+1}, \tilde{x}_{t+1}\right)\right] + E_t\left\{-2\left[A\Delta_{t+1} + B\left(x_{t+1} - \frac{1}{2}\right)\right] + 2\left[A\Delta_{t+1} + B\left(\tilde{x}_{t+1} - \frac{1}{2}\right)\right]\right\}$$

$$= E_t\left[e\left(\Delta_{t+1}, \tilde{x}_{t+1}\right)\right] + 2BE_t\left(\tilde{x}_{t+1} - x_{t+1}\right)$$

Substituting (D.8) gives

$$* = E_t\left[e_{t+1}\left(\Delta_{t+1}, \tilde{x}_{t+1}\right)\right] - \underbrace{\frac{B}{c}}_{b} e(\Delta_t, x_t).$$

Plug back in (D.9):

$$\frac{3(2-\lambda)}{2c} e\left(\Delta_t, x_t\right) + \frac{\delta\lambda}{2c}\left\{E_t\left[e_{t+1}\left(\Delta_{t+1}, \tilde{x}_{t+1}\right)\right] - be(\Delta_t, x_t)\right\} = 0$$

$$\therefore \left[3(2-\lambda) - \delta\lambda b\right] e\left(\Delta_t, x_t\right) + \delta\lambda E_t\left[e_{t+1}\left(\Delta_{t+1}, \tilde{x}_{t+1}\right)\right] = 0$$

By the previous lemma, b^* solves the quadratic equation:

$$b^2 - 3\frac{2-\lambda}{\delta\lambda} b + \frac{2}{\delta} = 0 \therefore 3\left(2-\lambda\right) - b\delta\lambda = \frac{2\lambda}{b},$$

so the previous condition can be written as the functional equation:

$$e\left(\Delta_t, x_t\right) = -\frac{\delta b}{2} E_t\left[e_{t+1}\left(\Delta_{t+1}, \tilde{x}_{t+1}\right)\right]. \tag{D.10}$$

We claim that $e\left(Z\right) = 0$ for all Z is the unique solution of (D.10). By substitution, one verifies that it is a solution. To show uniqueness, define the operator $(\tilde{T}e)(z) := -\frac{\delta b}{2} E\left[e(Z')|Z = z\right]$ on the set of bounded functions e of $Z = (x, \Delta)$. Recall that $b^* \in (0, 1)$, so $0 < \frac{\delta b}{2} < 1$. Therefore, $\tilde{T}$ is a contraction in the sup norm, so it has a unique fixed point by the Banach fixed-point theorem. This establishes that the Euler conditions have a unique bounded solution, which is the unique interior MPE. □

Proof of Proposition 2.

Substitute the equilibrium prices (9) in the definition of state (8).

Proof of Proposition 3.

From equation (6), the average price of a new policy without regulation equals:

$$\frac{p_U^0(\Delta_t) + p_U^1(\Delta_t)}{2} = c - \frac{\delta\lambda}{2-\lambda} K.$$

From equations (9)-(10), the average price with price walking regulation equals:

$$\frac{p_R^0(y_t, \Delta_t) + p_R^1(y_t, \Delta_t)}{2} = \frac{2}{2 - \lambda\left(1-\delta\right)} c.$$

Comparing these two expressions, price walking regulation increases the average price of a new policy by:

$$(1-\delta)\cdot\frac{\lambda}{2-\lambda\,(1-\delta)}\cdot c+\delta\cdot\frac{\lambda}{2-\lambda}\cdot K>0. \tag{D.11}$$

Differentiating the previous expression, the price increase is increasing in the fraction of inert consumers λ.

Proof of Proposition 4.

Before presenting the proof, we obtain the expressions for the loss in total surplus with and without price walking regulation. As before, define the cutoff type as:

$$\ell^*=\frac{1+\Delta}{2}-\frac{p^0-p^1}{2c}=\frac{1+\Delta}{2}+\frac{d}{2c}, \tag{D.12}$$

where $d:=p^1-p^0$. Total transportation costs among shoppers equal:

$$c\left[\int_0^{\ell^*}|\ell-\varepsilon_0|\,d\ell+\int_{\ell^*}^1|\ell-(1-\varepsilon_1)|\,d\ell\right]=\frac{c}{2}\left[\varepsilon_0^2+\varepsilon_1^2+(\ell^*-\varepsilon_0)^2+(1-\varepsilon_1-\ell^*)^2\right].$$

The efficient ("first-best") allocation minimizes transportation costs by setting the cutoff exactly in between both firms:

$$\ell^{FB}=\frac{\varepsilon_0+1-\varepsilon_1}{2}=\frac{1+\Delta}{2}.$$

Substituting in equation (D.12), gives $d=0$. Therefore, total transportation cost among active customers is minimized by setting the same price for both firms.

Define the loss of surplus associated with cutoff ℓ as:

$$\frac{c}{2}\left[\varepsilon_0^2+\varepsilon_1^2+(\ell-\varepsilon_0)^2+(1-\varepsilon_1-\ell)^2\right]-\frac{c}{2}\left[\varepsilon_0^2+\varepsilon_1^2+(\ell^{FB}-\varepsilon_0)^2+(1-\varepsilon_1-\ell^{FB})^2\right],$$

which, using $\ell^{FB}=\frac{1+\Delta}{2}$, can be expressed as

$$c\cdot\left(\ell-\ell^{FB}\right)^2. \tag{D.13}$$

Note that the surplus loss only depends on the demand shock through the first-best threshold ℓ^{FB}.

Using the cutoff among active customers (D.12) and the fact that there is a mass $2-\lambda$ of such customers, we obtain the active cohort's loss of surplus relative to the first best:

$$(2-\lambda)c\left(\frac{1+\Delta_t}{2}+\frac{d_t}{2c}-\ell^{FB}\right)^2=(2-\lambda)c\left(\frac{1+\Delta_t}{2}+\frac{d_t}{2c}-\frac{1+\Delta_t}{2}\right)^2=\frac{2-\lambda}{4c}d_t^2.$$

Inertial consumers (mass λ) keep last period's assignment, so their cutoff at t remains at

$$\ell_{t-1} = \frac{1 + \Delta_{t-1}}{2} + \frac{d_{t-1}}{2c}.$$

Their deviation from the first best ℓ_t^{FB} equals:

$$\ell_{t-1} - \ell_t^{FB} = \frac{\Delta_{t-1} - \Delta_t}{2} + \frac{d_{t-1}}{2c}.$$

Substituting in equation (D.13) and using the fact that there is a mass λ of interial customers, we obtain their surplus loss period t:

$$\lambda c \left(\frac{\Delta_{t-1} - \Delta_t}{2} + \frac{d_{t-1}}{2c} \right)^2.$$

Combining the surplus loss among active and inertial customers, we obtain the surplus loss among all consumers in period t conditional on the demand shocks:

$$\frac{2 - \lambda}{4c} d_t^2 + \lambda c \left(\frac{\Delta_{t-1} - \Delta_t}{2} + \frac{d_{t-1}}{2c} \right)^2. \tag{D.14}$$

We now use expression (D.14) to evaluate the surplus loss in each case.

No Regulation

Recall that without regulation, in the unique MPE, active customers face prices:

$$p_t^0 = c - \frac{\delta\lambda}{2 - \lambda} K + \frac{c}{3}\Delta_t, \qquad p_t^1 = c - \frac{\delta\lambda}{2 - \lambda} K - \frac{c}{3}\Delta_t,$$

so the difference equals:

$$d_t = p_t^1 - p_t^0 = -\frac{2}{3} c\Delta_t \quad \forall t.$$

Substituting in (D.14), gives the surplus loss conditional on the shock realizations:

$$\frac{2 - \lambda}{9} c\Delta_t^2 + \lambda c \left(\frac{\Delta_{t-1}}{6} - \frac{\Delta_t}{2} \right)^2$$

Since net shocks are symmetric around zero, we have $E[\Delta_t] = 0$ for all t. Denote the variance of each period's taste shock by $\sigma^2 := Var(\Delta_t) = E[\Delta_t^2]$ and recall that $E[\Delta_t \Delta_{t-1}] = 0$ since shocks are i.i.d. with zero mean. Taking expectations, we obtain the expected surplus loss:

$$\frac{2 - \lambda}{9} c\sigma^2 + \lambda c\sigma^2 \left(\frac{1}{36} + \frac{1}{4} \right) = \frac{4 + 3\lambda}{18} c\sigma^2. \tag{D.15}$$

Note that K and δ affect average price levels but not the price difference, so they drop out of the misallocation cost.

Regulation

As calculated in equation (D.6), the MPE with price walking regulation has

$$d_t = -2\left(A\Delta_t + By_t\right),$$

where $A = ac$, $B = bc$, and

$$b = \frac{3(2-\lambda) - \sqrt{9(2-\lambda)^2 - 8\delta\lambda^2}}{2\delta\lambda}, \qquad a = \frac{2 - \lambda - \frac{\delta\lambda}{2}b}{3(2-\lambda) - \delta\lambda b}.$$

The state $y_t := x_t - \frac{1}{2}$ evolves according to

$$y_{t+1} = -by_t + \left(\frac{1}{2} - a\right)\Delta_t.$$

Note that $y_t \perp \Delta_t$ (since Δ_t is i.i.d.). Moreover, y_t has unconditional mean zero and unconditional variance

$$Var(y_t) = \frac{\left(\frac{1}{2} - a\right)^2}{1 - b^2}\sigma^2.$$

To calculate the loss per active customer, note that

$$E[d_t^2] = E\left[\left(-2\left(A\Delta_t + By_t\right)\right)^2\right] = 4c^2\sigma^2\left[a^2 + \frac{b^2}{1-b^2}\left(\frac{1}{2} - a\right)^2\right],$$

where we used the expression for the unconditional variance of y_t and $E[\Delta_t y_t] = 0$. Hence,

$$E\left[\frac{2-\lambda}{4c}d_t^2\right] = (2-\lambda)\,c\sigma^2\left[a^2 + \frac{b^2}{1-b^2}\left(\frac{1}{2} - a\right)^2\right].$$

For the loss of inertial customers, note that

$$\frac{\Delta_{t-1} - \Delta_t}{2} + \frac{d_{t-1}}{2c} = \left(\frac{1}{2} - a\right)\Delta_{t-1} - \frac{1}{2}\Delta_t - by_{t-1}.$$

Because $\Delta_t \perp (y_{t-1}, \Delta_{t-1})$ and $\Delta_{t-1} \perp y_{t-1}$, we have

$$E\left[\left(\frac{\Delta_{t-1} - \Delta_t}{2} + \frac{d_{t-1}}{2c}\right)^2\right] = \left[\frac{1}{4} + \frac{\left(\frac{1}{2} - a\right)^2}{1-b^2}\right]\sigma^2.$$

Substituting these expressions in (D.14), gives the expected surplus loss:

$$c\sigma^2\left\{(2-\lambda)\,a^2+\left[(2-\lambda)\,b^2+\lambda\right]\frac{\left(\frac{1}{2}-a\right)^2}{1-b^2}+\frac{\lambda}{4}\right\}. \tag{D.16}$$

Surplus Comparison

Comparing (D.15) and (D.16), we find that regulation has higher total surplus if and only if:

$$\frac{4+3\lambda}{18}\geq(2-\lambda)\,a^2+\left[(2-\lambda)\,b^2+\lambda\right]\frac{\left(\frac{1}{2}-a\right)^2}{1-b^2}+\frac{\lambda}{4}, \tag{D.17}$$

where $b:=\frac{3(2-\lambda)-\sqrt{9(2-\lambda)^2-8\delta\lambda^2}}{2\delta\lambda}$ and $a=\frac{2-\lambda-\frac{\delta\lambda}{2}b}{3(2-\lambda)-\delta\lambda b}$.

Define α as the unique root in $(0,1)$ of

$$\alpha^3-11\alpha^2+38\alpha-13=0,$$

and let $\bar{\lambda}:=\frac{2\alpha}{1+\alpha}\approx 0.554$. It can be shown that for any $\lambda<\bar{\lambda}$, there exists a cut-off $\delta^*_\lambda\in(\frac{1}{2},1)$ strictly increasing in λ such that condition (D.17) holds if and only if $\delta>\delta^*_\lambda$. For $\lambda>\bar{\lambda}$, the condition fails for all δ.

Proof of Propositions 5 and 6.

We start by calculating the expected profits without regulation. Firm 0's profits in period t equal:

$$\Pi^{NR}_{t,0}:=(2-\lambda)s_t p^0_U(\Delta_t)+\lambda s_{t-1}K.$$

Using the equilibrium prices from equation (6), market share among active choosers from (7), and the unconditional expectations: $E[\Delta_t]=0$, $E[\Delta_t^2]=\sigma^2$, and $E[s_{t-1}]=\frac{1}{2}$, we obtain:

$$E[s_t p^0_U(\Delta_t)]=\frac{c}{2}-\frac{\delta\lambda K}{2(2-\lambda)}+\frac{c}{18}\sigma^2.$$

Substituting in the previous equation, we obtain firm 0's expected per-period profit under no regulation:

$$E[\Pi^{NR}_{t,0}]=\frac{\lambda(1-\delta)}{2}K+\frac{2-\lambda}{2}\left(1+\frac{\sigma^2}{9}\right)c. \tag{D.18}$$

By symmetry, this expression is also firm 1's expected per-period profit.

Next, we calculate the expected profits with price walking regulation. Since firm 0 now sells to all customers at the same price $p^0_R(y_t,\Delta_t)$, its profits in period t are:

$$\Pi^R_{t,0}:=\left[(2-\lambda)\,s_t+\lambda x_t\right]\cdot p^0_R(y_t,\Delta_t).$$

Substituting the equilibrium objects s_t, p_t^0, and $x_t = y_t + 1/2$ using from Propositions 1 and 2, and using the fact that $E[\Delta_t] = E[y_t] = 0$, $\Delta_t \perp y_t$, and $Var(y_t) = \frac{(\frac{1}{2}-a)^2}{1-b^2}\sigma^2$, we obtain firm 0's expected per-period profit with price walking regulation:

$$E[\Pi_{t,0}^R] = \frac{2c}{2-\lambda(1-\delta)} + c\sigma^2 \left\{ (2-\lambda)\, a \left(\frac{1}{2} - a\right) + [\lambda - (2-\lambda)\, b] \frac{b\left(\frac{1}{2}-a\right)^2}{1-b^2} \right\}, \quad \text{(D.19)}$$

where a and b are as defined in Proposition 1. By symmetry, firm 1's expected profits are the same.

Proof of Proposition 5. Note that the expected profits without regulation—equation (D.18)—increase linearly in K, whereas expected profits with regulation are not affected by K. Therefore, for any $\delta < 1$ and any $\lambda > 0$, there exists K is large enough such that the expected profits without regulation exceed the ones with regulation. It can be shown that $E[\Pi_{t,0}^R] > \frac{2-\lambda}{2}\left(1 + \frac{\sigma^2}{9}\right) c$, so the cut-off $\bar{K}_{\delta,\lambda}$ is strictly positive. □

Proof of Proposition 6. Since the expressions in equations (D.18) and (D.19) are both continuous in δ, it suffices to consider the limit as $\delta \nearrow 1$. From (D.18), we immediately get:

$$\lim_{\delta \nearrow 1} E[\Pi_{t,0}^{NR}] = \frac{2-\lambda}{2}\left(1 + \frac{\sigma^2}{9}\right) c. \quad \text{(D.20)}$$

We now turn to the limit of

$$E[\Pi_{t,0}^R] = \frac{2c}{2-\lambda(1-\delta)} + c\sigma^2 \left\{ (2-\lambda)\, a_\delta \left(\frac{1}{2} - a_\delta\right) + [\lambda - (2-\lambda)\, b_\delta] \frac{b_\delta\left(\frac{1}{2}-a_\delta\right)^2}{1-b_\delta^2} \right\}, \quad \text{(D.21)}$$

as $\delta \nearrow 1$, where

$$a_\delta := \frac{1}{2} \cdot \frac{2-\lambda+\sqrt{9(2-\lambda)^2 - 8\delta\lambda^2}}{3\,(2-\lambda) + \sqrt{9(2-\lambda)^2 - 8\delta\lambda^2}}$$

and

$$b_\delta := \frac{3(2-\lambda) - \sqrt{9(2-\lambda)^2 - 8\delta\lambda^2}}{2\delta\lambda}.$$

The first term in (D.21) converges to c as $\delta \nearrow 1$.

To simplify the expression inside brackets, let $\alpha := 2-\lambda$ and $\beta := \sqrt{36\,(1-\lambda)+\lambda^2}$. Then, we have:

$$a_1 = \frac{1}{2} \cdot \frac{2-\lambda+\sqrt{36\,(1-\lambda)+\lambda^2}}{3\,(2-\lambda) + \sqrt{36\,(1-\lambda)+\lambda^2}} = \frac{\alpha+\beta}{2\,(3\alpha+\beta)},$$

$$b_1 = \frac{3(2-\lambda) - \sqrt{36\,(1-\lambda)+\lambda^2}}{2\lambda} = \frac{3\alpha-\beta}{2\lambda}.$$

Note that

$$\frac{1}{2} - a_1 = \frac{1}{2} - \frac{\alpha + \beta}{2(3\alpha + \beta)} = \frac{\alpha}{3\alpha + \beta}. \tag{D.22}$$

By construction (see proof of Proposition 1), b_1 solves:

$$b_1^2 - 3\frac{\alpha}{\lambda} b_1 + 2 = 0,$$

which can be rearranged as

$$\frac{\lambda - \alpha b_1}{1 - b_1^2} = \frac{\lambda}{3}. \tag{D.23}$$

Use (D.22) to obtain:

$$(2 - \lambda) a_\delta \left(\frac{1}{2} - a_\delta\right) \to \alpha a_1 \left(\frac{1}{2} - a_1\right) = \frac{\alpha^2 (\alpha + \beta)}{2(3\alpha + \beta)^2}.$$

Use (D.22) and (D.23) to obtain:

$$[\lambda - (2 - \lambda) b_\delta] \frac{b_\delta \left(\frac{1}{2} - a_\delta\right)^2}{1 - b_\delta^2} \to \frac{\lambda - \alpha b_1}{1 - b_1^2} \cdot b_1 \left(\frac{1}{2} - a_1\right)^2 = \frac{\lambda}{3} b_1 \left(\frac{\alpha}{3\alpha + \beta}\right)^2 = \frac{\alpha^2 (3\alpha - \beta)}{6(3\alpha + \beta)^2},$$

where the last equality substituted $b_1 = \frac{3\alpha - \beta}{2\lambda}$. Combining these expressions, gives:

$$(2 - \lambda) a_\delta \left(\frac{1}{2} - a_\delta\right) + [\lambda - (2 - \lambda) b_\delta] \frac{b_\delta \left(\frac{1}{2} - a_\delta\right)^2}{1 - b_\delta^2} \to \frac{\alpha^2 (\alpha + \beta)}{2(3\alpha + \beta)^2} + \frac{\alpha^2 (3\alpha - \beta)}{6(3\alpha + \beta)^2} = \frac{\alpha^2}{3(3\alpha + \beta)}.$$

Substituting back in (D.21), we find:

$$\lim_{\delta \nearrow 1} E[\Pi_{t,0}^R] = c + c\sigma^2 \frac{\alpha^2}{3(3\alpha + \beta)}. \tag{D.24}$$

Using equations (D.20) and (D.24), the difference in per-period profits becomes:

$$\lim_{\delta \nearrow 1} \left\{ E[\Pi_{t,0}^R] - \lim_{\delta \nearrow 1} E[\Pi_{t,0}^{NR}] \right\} = \left\{ 1 - \frac{\alpha}{2} + \sigma^2 \left[\frac{\alpha^2}{3(3\alpha + \beta)} - \frac{\alpha}{18} \right] \right\} c. \tag{D.25}$$

By the definition of α,

$$1 - \frac{\alpha}{2} = \frac{\lambda}{2} > 0. \tag{D.26}$$

With some algebraic manipulations, one obtains:

$$\frac{\alpha^2}{3(3\alpha + \beta)} - \frac{\alpha}{18} = \frac{\alpha}{18} \cdot \frac{9\alpha^2 - \beta^2}{(3\alpha + \beta)^2}.$$

Use the definitions of α and β to write:

$$9\alpha^2 - \beta^2 = 9(2-\lambda)^2 - \left[36\,(1-\lambda) + \lambda^2\right] = 8\lambda^2,$$

so that

$$\frac{\alpha^2}{3\,(3\alpha+\beta)} - \frac{\alpha}{18} = \frac{4\alpha\lambda^2}{9\,(3\alpha+\beta)^2} > 0. \tag{D.27}$$

Substituting (D.26) and (D.27) in (D.25), gives:

$$\lim_{\delta \nearrow 1} \left\{ E[\Pi^R_{t,0}] - \lim_{\delta \nearrow 1} E[\Pi^{NR}_{t,0}] \right\} = \left\{ \frac{\lambda}{2} + \sigma^2 \left[\frac{4\alpha\lambda^2}{9\,(3\alpha+\beta)^2} \right] \right\} c > 0.$$

Proof of Proposition 7.

The game starts at period T (announcement date). Let V_0 denote firm 0's Bellman equation with price walking regulation, as specified in the proof of Proposition 1. This coincides with firm 0's value function for periods $t > T$. Let W_0 denote firm 0's value function at T:

$$W_0(x_T, \Delta_T) = \max_{p^0_T} \left\{ (2-\lambda) s(\mathbf{p}_t, \Delta_t) p^0_T + \lambda x_T K + \delta E_T\left[V_0(x_{T+1}; \Delta_{T+1}) \right] \right\},$$

subject to

$$x_{t+1} = \frac{1+\Delta_t}{2} + \frac{p^1_t - p^0_t}{2c},$$

and analogously for firm 1.

Calculating the first-order condition and using the envelope condition applied to V_0, we obtain the optimality condition at T:

$$(2-\lambda)\, s(\mathbf{p}_T, \Delta_T) - \frac{2-\lambda}{2c}\, p^0_T - \frac{\delta\lambda}{2c} E_T[p^0_{T+1}] = 0,$$

and the symmetric condition for firm 1:

$$(2-\lambda)[1 - s(\mathbf{p}_T, \Delta_T)] - \frac{2-\lambda}{2c}\, p^1_T - \frac{\delta\lambda}{2c} E_T[p^1_{T+1}] = 0,$$

Adding the optimality conditions of both firms at T gives:

$$(2-\lambda) - \frac{2-\lambda}{2c}\left(p^0_T + p^1_T\right) - \frac{\delta\lambda}{2c}\left\{ E_T[p^0_{T+1}] + E_T[p^1_{T+1}] \right\} = 0.$$

As shown in Proposition 1, the sum of prices after regulation satisfies:

$$p^0_{T+1} + p^1_{T+1} = \frac{4c}{2 - \lambda(1-\delta)}$$

(independent of Δ_{T+1}). Substituting in the previous expression and rearranging, gives:

$$p_T^0 + p_T^1 = 2c - \frac{4c\delta\lambda}{(2-\lambda)\left[2-\lambda(1-\delta)\right]}. \tag{D.28}$$

Subtracting the two optimality conditions of both firms at T and using the expression for s, gives:

$$(2-\lambda)\left(\Delta_T + \frac{p_T^1 - p_T^0}{c}\right) + \frac{2-\lambda}{2c}\left(p_T^1 - p_T^0\right) - \frac{\delta\lambda}{2c}\left\{E_T[p_{T+1}^0] - E_T[p_{T+1}^1]\right\} = 0. \tag{D.29}$$

Equation (9) gives:

$$E_T[p_{T+1}^0] = c\left[\frac{2}{2-\lambda\left(1-\delta\right)} + a\underbrace{E_T[\Delta_{T+1}]}_{0} + by_{T+1}\right] = c\left[\frac{2}{2-\lambda\left(1-\delta\right)} + by_{T+1}\right]$$

and

$$E_T[p_{T+1}^1] = c\left[\frac{2}{2-\lambda\left(1-\delta\right)} - a\underbrace{E_T[\Delta_{T+1}]}_{0} - by_{T+1}\right] = c\left[\frac{2}{2-\lambda\left(1-\delta\right)} - by_{T+1}\right].$$

Therefore,

$$E_T[p_{T+1}^0] - E_T[p_{T+1}^1] = 2cby_{T+1} = bc\left(\Delta_T + \frac{p_T^1 - p_T^0}{c}\right), \tag{D.30}$$

where the last equality used the definition of the state y_t and the demand function s to write

$$y_{T+1} = \frac{\Delta_T}{2} + \frac{p_T^1 - p_T^0}{2c}.$$

Substituting equation (D.30) in (D.29) and rearranging, gives:

$$p_T^1 - p_T^0 = -c\frac{2\left(2-\lambda\right) - \delta\lambda b}{3(2-\lambda) - \lambda\delta b}\Delta_T = -2ac\Delta_T. \tag{D.31}$$

Equations (D.28) and (D.31) are a linear system of two equations and two unknowns, which have the unique solution:

$$p_T^0 = c\left[1 - \frac{2\delta\lambda}{(2-\lambda)\left[2-\lambda(1-\delta)\right]} + a\Delta_T\right],$$

and

$$p_T^1 = c\left[1 - \frac{2\delta\lambda}{(2-\lambda)\left[2-\lambda(1-\delta)\right]} - a\Delta_T\right].$$