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 whilst raising prices for pre-existing customers. Post-regulation, price incentives to new, likely inactive customers fell, and product proliferation and market segmentation increased in line with insurer incentives. The net effect keeps customer benefits of switching high and maintains price penalties for inaction. These findings illustrate the difficulty of regulating markets with inertial consumers in the face of endogenous supplier responses.

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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, a range of indirect remedies have been applied, often with limited success, including encouraging competition or "nudging" consumers through default options. Increasingly, a more muscular approach is being adopted, which is to directly regulate prices to protect customers. The goal of this paper is to investigate these issues—consumer inaction, firm behavior, and the impact of direct price regulatory interventions—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. As existing customers are not compelled to search for policies, they are potentially more likely to be inactive. This situation created the impetus for policy, leading to the UK regulation, which has a very similar design to 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). The regulation thus introduces a trade-off for firms: raising prices to profit from the back book reduces their ability to attract new customers. We study how the implementation of the regulation affected both customer and insurer behavior in response to this trade-off.

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 of consumers becomes inert following these initial choices. Firms face demand shocks in each period, capturing exogenous changes to their market shares, and set initial and renewal prices to maximise their profits, subject to prevailing regulation. We study Markov Perfect Equilibria of this model, and derive rich implications about firms' endogenous responses to both the announcement and implementation of price walking regulation. These responses include the reduction of "teaser" discounts on initial prices, prices that increase in the size of insurers' back books, and insurer market shares that oscillate through time. The model delivers a number of testable implications and highlights

[1] Appendix Table A.1 documents regulations of this type introduced in eight countries and 20 states of the U.S. over the past thirteen years.

the difficulty of improving welfare through regulatory intervention in markets with inertial consumers.

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 end up selecting.

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, we show that insurers shrink the teaser rates they offer to customers who are less likely to search (i.e., those more likely to be inactive going forward). We classify customers as likely versus unlikely to be inactive in various ways: customers who have not searched in previous years as opposed to those who have previously made the effort to do so; and customers who are forced to search at the point of first obtaining a driving license or purchasing a new car, rather than those who have voluntarily chosen to shop for insurance. In the run-up to the policy, across all these measures, likely inert customers' prices rise significantly relative to those who are more likely to search, both unconditionally and conditional on a tight set of controls.

Second, we show that firms respond to the policy by adjusting pricing as a function of their back books. More specifically, following the policy implementation, firms offer new customers less competitive prices for products that have large back books of similar customers. 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 quote for a given customer by over ten times the unconditional mean.

Third, we show that this pricing response causes market shares to oscillate through time after the policy's implementation, consistent with the model's prediction. We regress a product's market share for a given customer type on its market share one year before, and study how this autocorrelation varies through time. At the beginning of the sample, this autocorrelation is positive, but following policy implementation, the autocorrelation turns negative.

Fourth, we document substantial product proliferation driven by the firms most affected by the policy. The top third of firms ranked by the size of their customer back books increase the number of products they offer by 50%, with other firms leaving their product offerings largely unchanged. In aggregate, the number of insurance products the average insurer offers in the market increases by 25%.

Fifth, we show evidence that the regulation is ineffective at eradicating price increases for existing customers who do not switch their car insurance products. For customers who purchase insurance one year and shop again the next, we can directly estimate how much money they would lose by not switching their insurance policy. Post-regulation, customers who do not switch their insurance product pay 40% above the price of the cheapest available insurance product. The introduction of cheaper products through time and differences in non-price features across products account for approximately half of this differential, whereas the remainder can be attributed to the price of their chosen insurance product increasing relative to the available alternatives. We find that these costs of being inertial are higher at insurers that introduce a new product after a customer has shopped with them, suggesting that product proliferation is one of the mechanisms by which insurers exploit customer inertia post-regulation.

Finally, we study which types of consumers are likely to experience welfare losses after the policy; the model predicts that welfare losses will occur if customers are sufficiently inert. We proxy inertia by studying the likelihood that a customer who takes out insurance in our data searches again in following years. We find that inertia is greater for customers who insure cheaper cars, shop for less comprehensive insurance, are under twenty years of age, and are unemployed or out of work due to sickness or disability.

Taken together, our model and results show that the regulatory intent of banning direct price discrimination against inert customers does not ensure good outcomes. Prior to the policy, firms exploit customer inertia by price walking their back books, whilst leaving their front book prices untouched. After the policy, firms can (and do) still raise prices for the back book, but in so doing they become less competitive in the market for new customers—the additional regulation-induced cost means that inert customers are relatively less attractive than before the policy, so firms compete less aggressively for them, meaning that this behavior also causes market shares to oscillate through time after the policy. Additionally, firms adapt to the regulatory change by introducing new products to more finely segment the market. The net result of all of these supply-side responses is that inert customers still pay a penalty relative to those who shop, albeit in a different way. These results illustrate the difficulty of regulating household finance markets with inert customers when suppliers can endogenously respond to regulation.

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, Ramadorai, 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. Hence, 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). 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) may 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: regulatory responses to pricing constraints, similar to patterns in Medicare Part D (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)

Fifth, we contribute to the empirical literature on motor insurance markets. Earlier research has largely 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; and Honka (2014) and Honka and Chintagunta (2017) quantify substantial search and switching costs. 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 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.

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

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 an equivalent new customer. However, the policy included relatively little guidance on how to define or measure equivalence in this context. This ambiguity is important because it affects how insurers can segment their customer base and set prices for different customer types—issues we explore in our empirical analysis below.

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.[4] 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.

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

[4] https://icsr.co.uk/are-you-walking-into-a-price-problem-general-insurance-pricing-and-the-fca-remedies/

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, 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 (allowing negative prices when firms lock in consumers). Firms cannot distinguish new joiners from switchers.[5] 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 consumers are myopic, ignoring the possibility of becoming locked in through inertia.[6] 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 $\ell_t^* = \frac{1+\Delta_t}{2} - \frac{p_t^0 - p_t^1}{2c}$. Firm 0's market share among active consumers equals:

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

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.[7] Without regulation, firms set the maximum renewal price: $r_t^i = K$. Under price walking

[5] 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.

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

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

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

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

$$\Pi_0^t := \underbrace{s(\mathbf{p}_t, \Delta_t)p_t^0}_{\text{Period 1}} + \delta \left[\underbrace{\lambda s(\mathbf{p}_t, \Delta_t)K}_{\text{Period 2 passive}} + \underbrace{(1-\lambda)\, E_t\left[s(\mathbf{p}_{t+1}, \Delta_{t+1})\right] p_{t+1}^0}_{\text{Period 2 active}} \right]. \tag{4}$$

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 consumers who actively choose in period 2.

When setting period-t price, firm 0 faces 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, the fraction λ of these 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:[8]

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

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

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:[9]

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

We also assume K is large enough that equilibrium prices stay below the cap.[10]

Define firm 0's market share in period $t-1$ as $x_t := s(\mathbf{p}_{t-1}, \Delta_{t-1})$.[11] 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

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

[9] 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.

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

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

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 C contains all proofs).

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* $b \in (0, 1)$*.*

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:*

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

and symmetrically for firm 1, where $a \in (0, \frac{1}{2})$ is 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 two-period consumer lives to simplify exposition. The results extend naturally to $N \geq 2$ periods: the MPE remains unique and linear with $(N-1)$-dimensional states (market shares for each cohort). The regulation increases prices (with jumps increasing in λ) and generates stable, oscillating $AR(N-1)$ market-share dynamics.

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;[12] 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 back book—the stock of customers a firm attracted in the past. This back book 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 differential 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

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

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 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 six testable predictions that we evaluate in Section 5:

1. **Pre-regulation pricing 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 effects on pricing** (Proposition 1): Post-regulation, insurers price products with larger back books less competitively, as insurers 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.

6. **Welfare effects** (Propositions 4–6): Total surplus effects depend on consumer inertia and firm patience, with welfare potentially decreasing when inertia is high ($\lambda > 0.554$). We examine which customer groups are most likely to experience welfare losses in Section 5.6.

4 Data

Our primary dataset comes from *Compare the Market*, the largest price comparison website for UK motor insurance.[13] We obtain a random sample of 8 million motor insurance enquiries from January 2019 to December 2023. For each enquiry, we observe three types 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.[14]

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.

4.1 Summary Statistics

Table 1 summarizes customer characteristics and offered menus. The median customer is 29 years old, has held a license for 7 years, and insures a car worth £4,855. Insurance prices vary substantially with these characteristics—teenage 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

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

[14] Customers who purchase through other channels (e.g., phone) do not appear as sales in our data. Appendix Table A.3 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

Note: 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.

(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 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 times larger. 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. This variation stems from firms' differing cost assessments, product feature differences, and customer-insurer relationships.

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

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

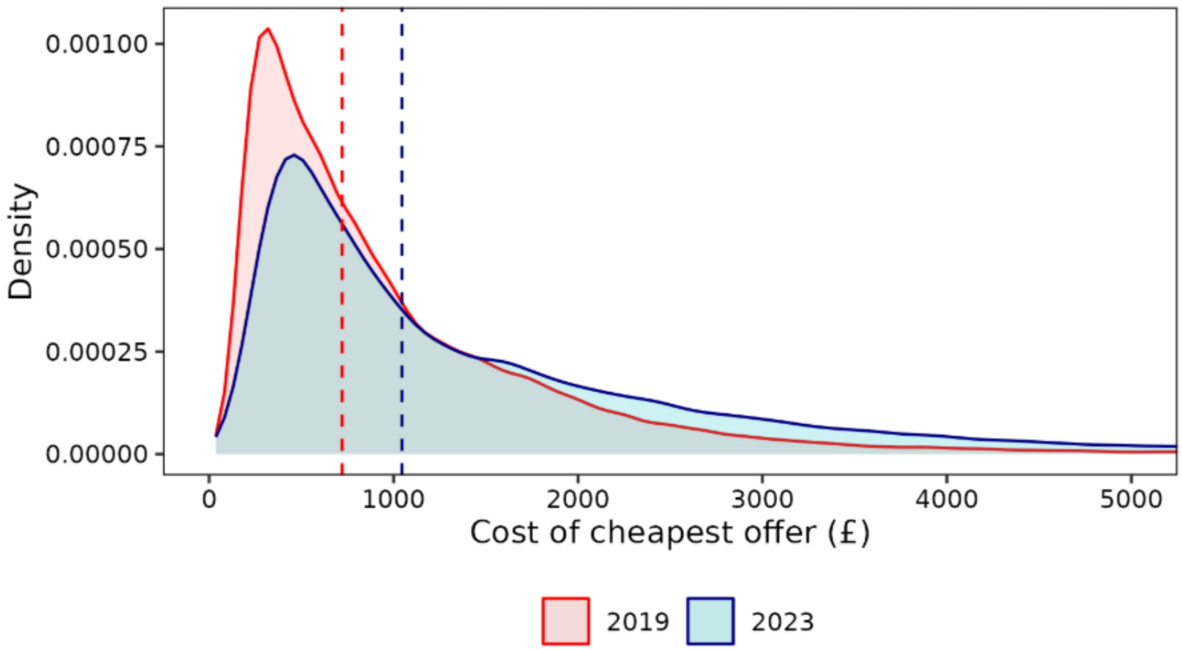
Table 2 summarizes choice and search patterns. 11% of enquiries result in purchases, which we aggregate through time to construct back book proxies (described below). Customers overwhelmingly choose cheap options: fewer than 20% select outside the five cheapest products. Lower-ranked choices reflect non-price product characteristics—e.g., 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 30% between these years, partly reflecting post-Covid inflation and supply-chain disruptions that increased insurers' costs.[15] Our identification strategy relies on granular cross-sectional variation rather than these aggregate time-series trends.

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

Figure 1: Price of Insurance, 2019 and 2023



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

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.

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 to prospective customers who are otherwise equivalent. As we recounted above, the regulations do not define this "equivalence" precisely. Based on our understanding of the policy implementation, we define customer types by (a) 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 bottom-quintile car whose policy expires on September 5, 2023. We compute the firm's back book for this product by counting customers of this type who purchased the same product in the 30 days around September 5, 2022 and September 5, 2021. Unless

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

Note: This table summarizes back book proxies defined in Section 4.2. Segment-specific back books cover the whole sample; aggregate back books are measured at December 2021.

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. Rows 1-2 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.

Rows 3-4 show aggregate firm back books. The average insurer attracted thousands of customers over our sample, but this distribution is highly skewed: small or new brands 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 four 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 Inert 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 as a result the regulation should cause greater price increases for customers more likely to be inert. 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 convergence once the rule comes into force.

Testing this hypothesis requires us to identify consumers who are likely to be inert and stay with the firm in the future. To do so, we leverage our data on customer search and customer characteristics, and identify three sets of consumers who are more likely to be inert.

Our first and second sets of likely inert consumers are based on the logic that an inert customer does not act unless forced to do so, whereas an active customer makes a discretionary choice to search. New drivers are forced to take out insurance when they obtain their license. Similarly, customers with a new car are forced to insure it. Hence, our first comparison is between the price of insurance through time for those customers who purchased a car within a month of shopping for insurance and the price of insurance for those who did not recently purchase their cars. The second comparison is between the price of insurance over time for those customers who obtained a license less than one year before shopping for car insurance and the price for those who did not. In each case, the proxy interprets the first group (forced searchers who are new drivers or have new collateral) as more inert, and the second as less inert.

Our third comparison uses data on repeat searchers. We divide our customer enquiries into two types: those in which we observed the same individual search for car insurance the previous year, and compare them to those who did not.[16] The former group we interpret as more-active searchers, and the latter as more-inert customers.

Naturally, our proxies of inertia are correlated with other characteristics beyond inertia. For example, drivers with a new license are more likely to be young, whilst customers who

[16]By construction, we can only compute this proxy of inertia from the second year of our sample onwards.

recently purchased a car are more likely to have an expensive car. As a result, we include a rich set of fixed effects—detailed below—to strip out the effects of these other variables. For example, we include fixed effects for the car being insured, defined as a combination of car brand, model, and year of registration. This means that our car-based definition of inertia compares individuals insuring the same car, one of whom bought the car that month and one of whom did not.

Figure 2 shows trends in the cheapest offer a customer receives in their menu by customer type through time. We normalise this price by its value in 2022, the first year after the policy's implementation, such that the vertical axis measures the percentage difference in a group's price relative to 2022. For each of our proxies of inertia, we show the unconditional trends in the price of insurance in the left-hand panel, and in the right-hand panel we show these trends after stripping out fixed effects for the model of car, the driver's age, the insurance firm, and the insurance product. Each row shows the results for each of the three sets of inert consumers and their "control" comparison groups of more-active consumers.[17]

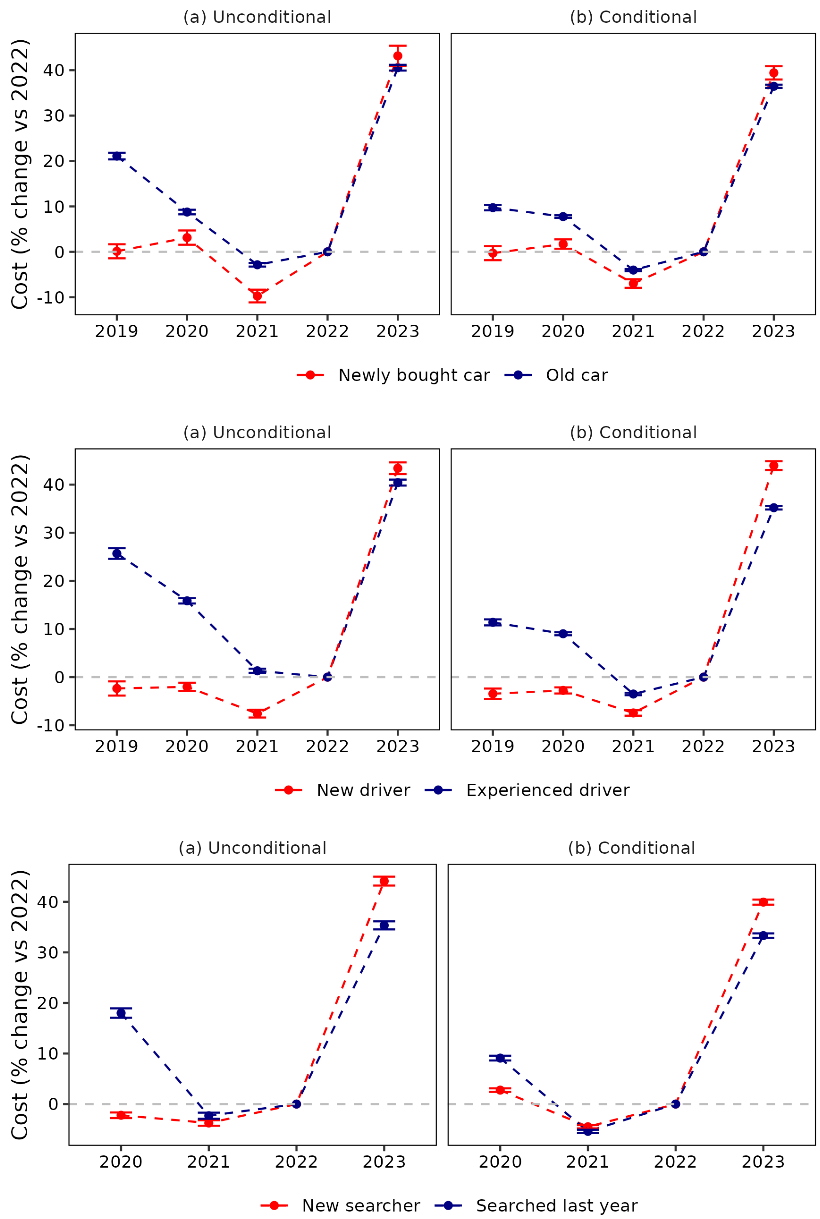
The top rows compare customers with newly-bought cars to those who bought their cars in the past. The price of insurance for those who recently bought a car (and hence, in some sense, were forced into shopping for insurance) was broadly flat in the years before the policy. By contrast, the price for those who had bought their car further in the past (and hence were not compelled to shop for insurance) fell by 20%. Put differently, before the policy implementation, there is a large relative increase in price for customers more likely to be inert relative to those more likely to search. After the policy implementation, despite the widespread disruption to car insurance markets post-Covid, the change in the price of insurance was essentially identical for the two groups.

This striking pattern—an increase in price for inert customers relative to those more likely to search—holds across all our sets of inert consumers in Figure 2. That is, it holds when we compare drivers who got their license this year to those who had a license for more than a year, as well as when we compare those that have new collateral relative to those who do not. It also holds when we compare prices for customers who searched the year before to those who did not. In each case, the pattern holds both unconditionally, as well as conditional on an expansive set of fixed effects.

These patterns in prices suggest that the effect of the regulation is to reduce the desir-

[17] We compute these statistics by regressing the log of the cheapest offer in a customer's menu on our inertia dummies, interacted with year fixed effects. Percentage changes are the exponential of the coefficients on the dummies minus 1, and confidence intervals are computed using the delta method.

Figure 2: Up-front Discounts to Inert Customers



Note: The panels in this figure show differential trends in the price of insurance for different customer groups. Our sets of inert customers are shown in red, and our proxies of searchers are shown in blue. The first row shows results where we compare drivers who acquired their car in the last month to those who did not. The second row shows results where we compare drivers who acquired their license in the last year to those who did not. The third row shows results where we compare drivers who did not search for car insurance in the previous year. Controls include indicator variables for the car being insured, the driver's age, and the product quoted. We also include the new-driver and new-car indicators as controls in specifications where these are not the regressors of interest.

ability of inactive customers. 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, inert 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, the benefit of attracting new inert customers shrinks, as there are fewer years in which they can be "costlessly" price walked. Post-policy, there is no further change to how desirable inert customers are relative to searchers. This explanation is consistent with the convergence of prices for inert customers and searchers in the run-up to the policy, with no further convergence following policy implementation.

5.2 Pricing and Segmentation

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.

Firms can adjust their quoting behaviour for a particular product (or a brand) and a particular customer in two ways: they can change the price at which they offer a product to a customer, or they can choose not to offer that particular customer the product at all. 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.[18]

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).

More precisely, we run different specifications of the following difference-in-difference

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

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 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.[19]

Table 4 reports the coefficient estimates of these difference-in-difference regressions. 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 brand-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 1st to the 99th percentile of the back book (Table 3) implies a decrease in the probability of a product giving the cheapest quote of 9%. 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 Column 3 in Table 4, 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

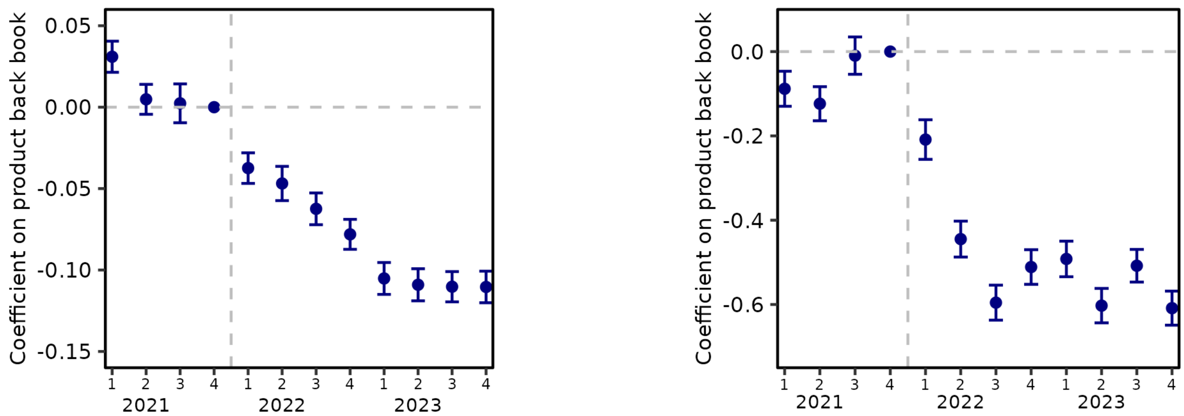
[19] Anecdotally, a minority of brands did not engage in price walking even before the policy.

Table 4: 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

Note: 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**

Note: 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 4. 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 4.

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 4 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 firm-level 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%. 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 4). 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 Oscillation

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—where types are 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:

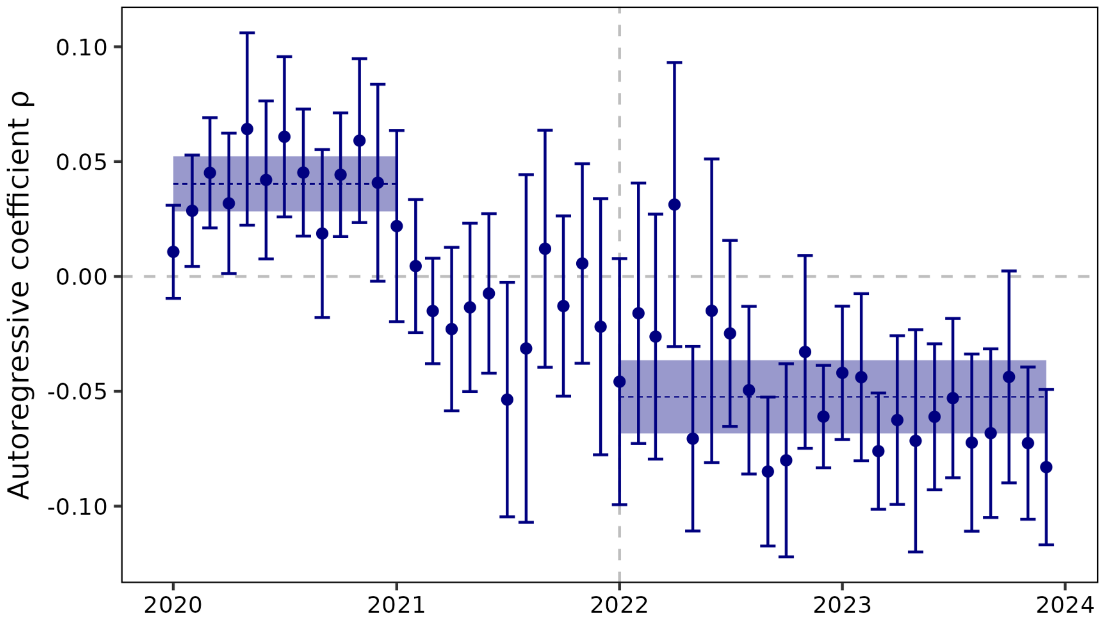
$$s_{j\theta t} = \rho_t s_{j\theta t-12} + \delta_{j\theta} + \epsilon_{j\theta t} \tag{13}$$

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.

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.

These results confirm the prediction of Proposition 2 regarding the impact of pricing

Figure 4: Oscillating Market Shares



Note: 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.

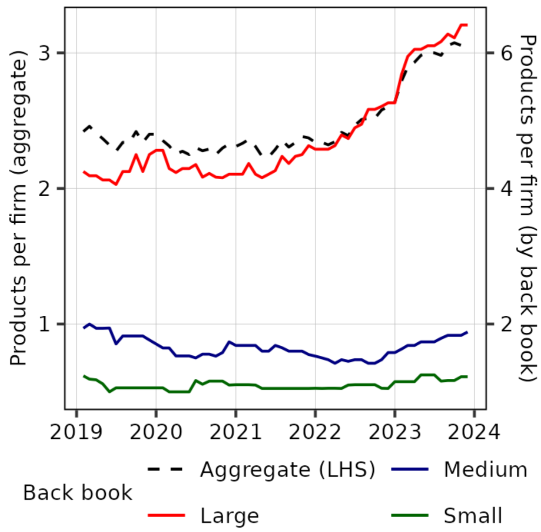
regulation on competition. As found in Section 5.2, after the policy the presence of a large back book inhibits a product's competitiveness. As shown in Figure 4, this pattern in pricing causes the market shares of products to oscillate through time after the policy.

5.4 Product Proliferation

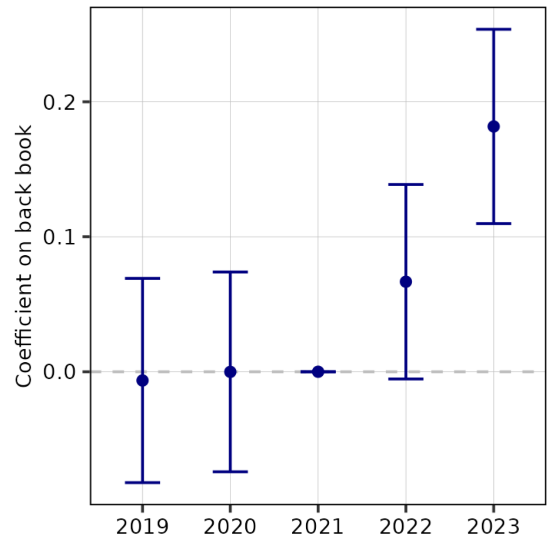
We now study the introduction of new products around the change in regulation. As explained in Section 3.5, the regulation introduces an incentive for firms to introduce new products, and this incentive is stronger for firms with large back books. We find support for this prediction in the data: following 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 brand 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

Note: These figures show the number of products offered by insurers through time and by the size of the firm's back book. Black dashed line in left panel shows the aggregate number of products offered each month by all insurance brands, divided by the total number of brands. Colored lines in the left panel show the average number of products per insurance brands according to the size of the brand's back book. Back books are defined as in Section 4.2 and are grouped into tertiles. 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 denote 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.[20] 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.[21]

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,

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

[21]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. 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.

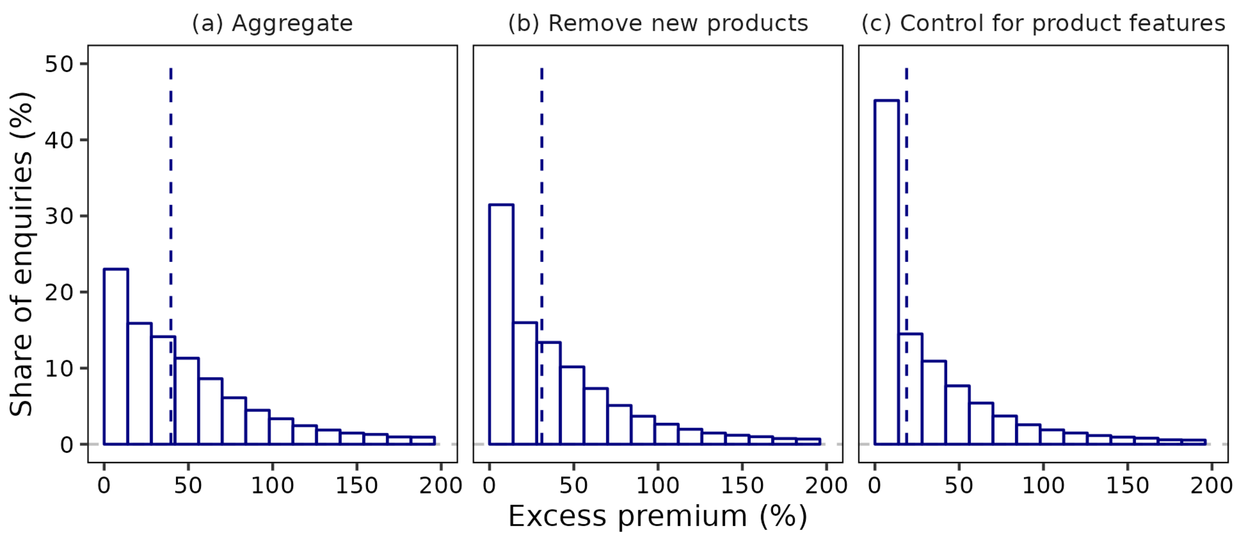
5.5 Gains to Search

The 2022 pricing regulations aimed to eliminate direct price discrimination between inert 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 of the paper 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 that 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 purchased a product in a given year and searched 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

Figure 6: Costs of Inertia: Decomposition



Note: 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 central panel computes the excess cost of the customer's product relative to the cheapest product in the menu that was also available the year previously. The third 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.

switched to the cheapest product in the menu rather than renewing the insurance policy they chose initially. This approach assumes that the quote a renewing customer receives (through any channel, including via physical mail or over the telephone) is the same as the quote they are offered for the same product and the same insurer if they search via a price comparison website, which is presumably the search route a new consumer would take in the first instance. In this draft of the paper, we perform this analysis for the period after the introduction of the policy, when prices for new customers could no longer be set below those for equivalent renewers, i.e., a period in which this "channel" assumption is likely to hold.

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 could cut the price of their insurance by around 40% by switching to the cheapest available online quote given their particular circumstances, as opposed to renewing their existing product.

The second and third panels in Figure 6 decompose these potential search-related savings. The second panel strips out the effects of new products appearing on the menu, by computing savings relative only to the set of products that were available when the customer first took out insurance; new products account for approximately a quarter of the gains from switching for the median customer.

The third panel in Figure 6 further controls for differences in the non-price features of different 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 and removing new products, 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 disaggregate these gains to search across insurers. As discussed in Section 5.4, product proliferation is a means by which insurers can ease the trade-offs imposed on them by the regulation: by introducing a new product, insurers can increase prices for their back book whilst still competing for new business with the new product. In Figure 7 we split the gains to search according to whether the insurer with which the customer initially shopped introduced a new product in the intervening year before the customer shops again.

As Figure 7 shows, the gains to search—alternatively, the penalty for inertia—are significantly larger when a customer's insurer has introduced a new product.[22] This highlights

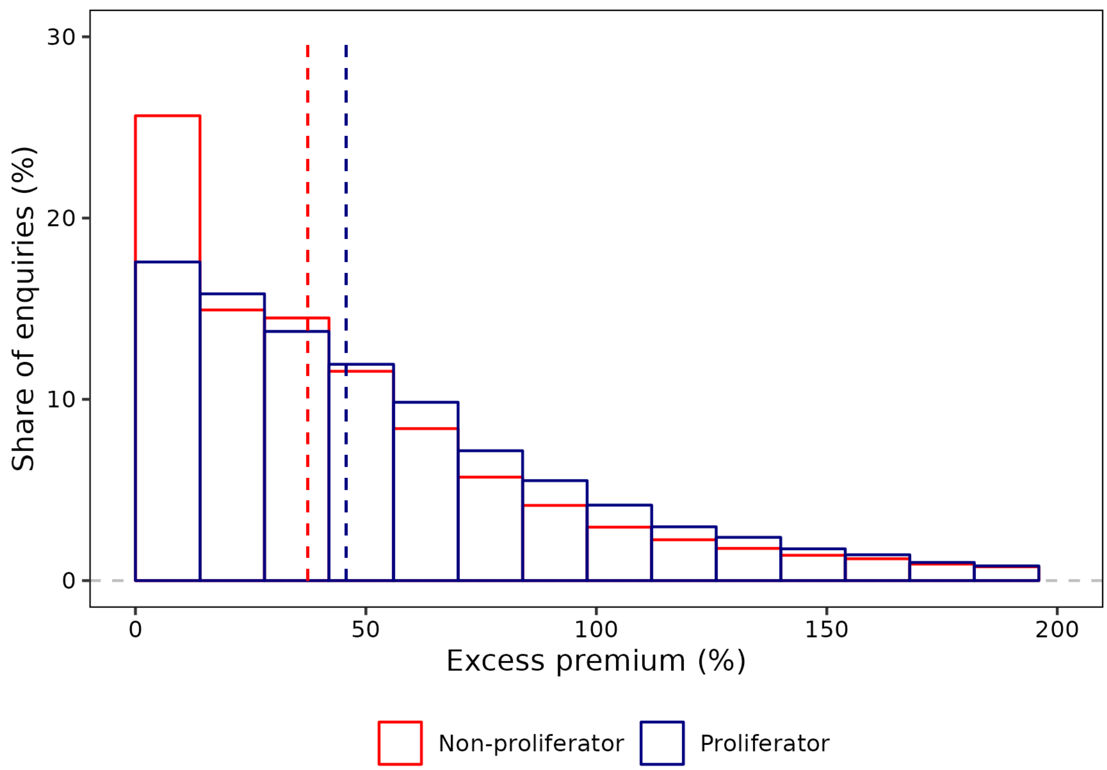
[22]Note that this explores a different mechanisms to the second panel of Figure 6. There, we show that part of the cost of inertia is failing to find and switch to a cheap new product. Here we show that introducing a new product enables an insurer to increase prices for their back book more sharply, such that the cost of inertia increases for its existing customers. These two forces interact: an insurer who introduces a cheap new product increases the gains to search for all customers, but particularly so for its own customers due to the prices rises that this proliferation enables.

Table 5: Inertia and Customer Characteristics

	Searched again
	(1)
Driver age	
Age under 20	-0.043***
	(0.002)
Age 20-29	-0.003
	(0.002)
Age 30-39	-0.018***
	(0.002)
Age 40-49	-0.016***
	(0.002)
Age 50-59	-0.019***
	(0.002)
Age 60-69	-0.008***
	(0.002)
Value of car	
Insuring cheap car	-0.078***
	(0.001)
Employment status	
Unemployed	-0.022***
	(0.004)
Disabled	-0.022***
	(0.005)
Level of cover	
Third-party, fire & theft cover	-0.060***
	(0.002)
Third-party cover	-0.099***
	(0.004)
N	885,523
Pseudo R^2	0.136
Mean of dependent variable	0.21

Note: This table summarises how the likelihood that a customer searches 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 in a subsequent year after taking out insurance. '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.

Figure 7: Costs of Inertia & Product Proliferation



Note: 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 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 blue bars shows 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 repeats the computation for those whose insurers did not ('non-proliferators'). Dashed vertical lines show medians. A Kolmogorov-Smirnov test rejects that the two distributions are the same at the 0.1% level.

the role of proliferation in the regulatory arbitrage at play here: insurers wish to continue to exploit inert customers, and proliferation is a means by which they do so.

5.6 Welfare Effects

Proposition 3 of our model finds that the policy reduces total surplus if customers are sufficiently inert. In this section we study how inertia varies across different groups of customers, to shed light on in which market segments surplus is likely to go up or down. To do so, 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 search for products again in subsequent years (i.e., behave as active rather than inert customers) and condition these estimates on observed customer characteristics.

Table 5 shows the marginal effects from these probit 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 unemployed or out of work due to sickness or disability, and are very young, i.e., under twenty years of age. Together, these results along with Proposition 3 suggest that welfare losses from the policy are more likely concentrated in segments serving poorer and more vulnerable customers.

6 Conclusion

We study the impacts of regulatory intervention in markets with inactive consumers and price-discriminating firms. We develop a simple theoretical framework to study this issue, and derive predictions about how suppliers endogenously respond to such regulatory intervention. The model is geared towards studying a unique episode in the UK motor insurance market, around the introduction of regulatory policy seeking to eliminate "price walking," in which insurers kept prices low for new customers, whilst simultaneously raising prices for existing customers. The ambition was to stop insurers profiting from customer inaction following their initial active choice of insurance product.

We test the predictions of the model by studying granular search and choice data in this market. Consistent with these predictions, we find that insurers endogenously responded to the policy by reducing the price discounts offered to likely inactive customers, especially those with large "back books" of customers. We find that this pricing response causes market shares to oscillate through time, such that products that successfully attracted customers in the past are priced in a less competitive manner in the future. We also find substantial product proliferation by insurers with large back books, in a seeming attempt to segment the market further. The endogenous responses of market participants to the regulatory policy resulted in a persistently high price penalty for inactive existing customers, contrary to the goals of the policy. Moreover, the benefits of searching remain substantial despite the intervention.

Prior research has revealed that encouraging competition and nudge-style interventions can have limited effects on improving outcomes in markets with inertial consumers. Our findings reveal that these difficulties extend to the use of muscular regulatory intervention when customers are inert and suppliers adapt their responses to regulation.

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Regulating Inaction: The Case of Price Walking
Online Appendix

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November 2025

A Additional Tables and Figures

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

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

Note: 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.

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

Table A.2: Major insurer's products

Note: 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.

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

Table A.3: Datasets: shares by age

Note: 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.

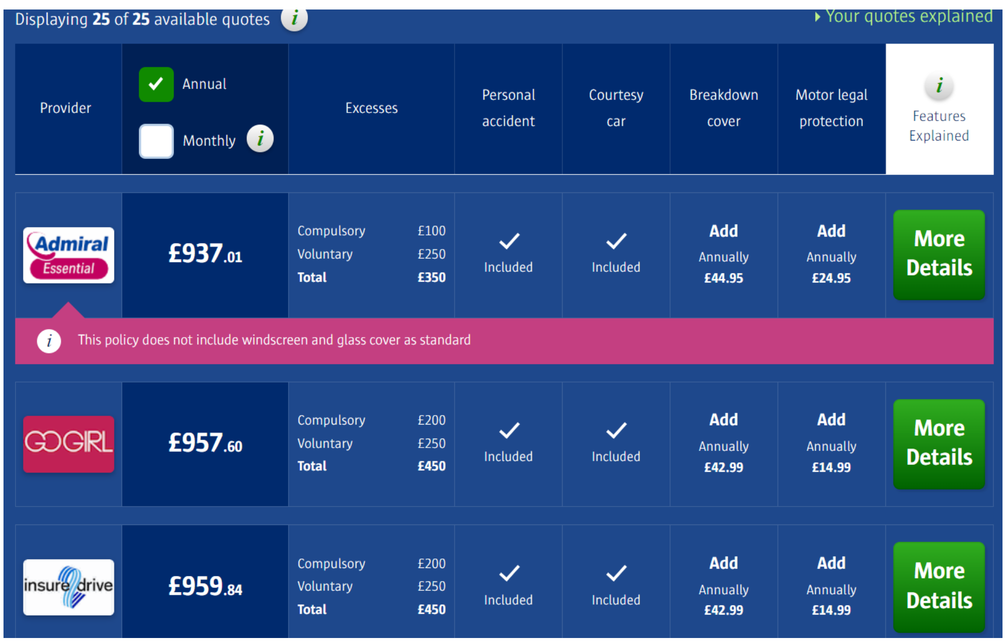
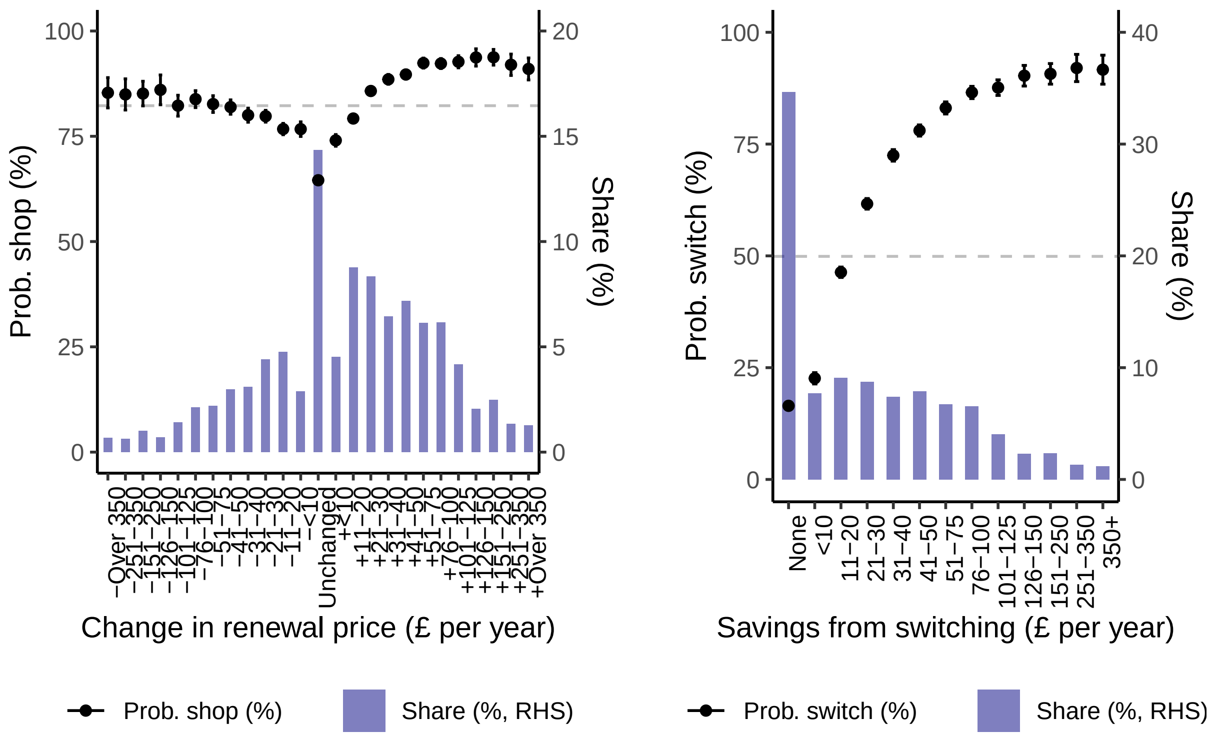


Figure A.1: Example of Price Comparison Website Menu

Note: Figure show the top of a menu of quotes for an insurance enquiry made via Compare the Market.

Figure A.2: 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 A.2 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 3 times as likely to switch as those facing savings under £5.

The *Consumer Intelligence* sample differs from our main *Compare the Market* data. Table A.3 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.

C 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:

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

Symmetrically, firm 1's Euler condition is:

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

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 or 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 (A.1) and (A.2):

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

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:

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

□

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 (A.1) and (A.2) and rearranging, gives

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

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*

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

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 (A.1) and (A.2). With (A.5),

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

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

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

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

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

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 (A.1) and (A.2) hold. This is equivalent to verifying that their sum and difference (A.3) and (A.4) conditions hold. Their sum (A.3) holds by the construction of M, as $p_0^t + p_1^t = 2M = S$. Their difference (A.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 (A.1)-(A.2), so equation (A.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

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

Subtracting one from the other, gives

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

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 (A.6), we have

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

Therefore,

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

Substituting (A.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 (A.9):

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

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:

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

We claim that $e\left(Z\right)=0$ for all Z is the unique solution of (A.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. $\square$

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:

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

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

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

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:

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

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 (A.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

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

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

Using the cutoff among active customers (A.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 (A.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:

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

We now use expression (A.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 (A.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:

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

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 (A.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 (A.14), gives the expected surplus loss:

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

Surplus Comparison

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

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

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 (A.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:

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

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^0_t, 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:

$$E[\Pi^R_{t,0}] = \frac{2c}{2-\lambda(1-\delta)} + c\sigma^2 \left\{ (2-\lambda)\, a \left(\frac{1}{2} - a\right) + \left[\lambda - (2-\lambda)\, b \right] \frac{b\left(\frac{1}{2}-a\right)^2}{1-b^2} \right\}, \tag{A.19}$$

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 (A.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 (A.18) and (A.19) are both continuous in δ, it suffices to consider the limit as $\delta \nearrow 1$. From (A.18), we immediately get:

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

We now turn to the limit of

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

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 (A.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

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

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

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

Use (A.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 (A.22) and (A.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 (A.21), we find:

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

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

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

By the definition of α,

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

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

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

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

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

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:

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

subject to

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

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:

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

and the symmetric condition for firm 1:

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

Adding the optimality conditions of both firms at T gives:

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

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

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

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

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

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

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

Equation (9) gives:

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

and

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

Therefore,

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

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 (A.30) in (A.29) and rearranging, gives:

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

Equations (A.28) and (A.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

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