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Screening Procrastinators with Automatic-Renewal Contracts*

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Abstract

Automatic contract renewals are a common feature in consumer markets and a frequent concern among policy makers. They can be used to exploit consumer inertia when consumers forgo benefits from switching to better alternatives. I consider two sources for this inertia—limited attention and present bias—which can both lead to procrastination. In both cases, I study how firms can use contract renewal to price discriminate between consumers with different inclinations to procrastinate. Monopolists optimally distort automatic-renewal contracts to exploit procrastination of consumers. However, the more a monopolist designs contracts to exploit procrastinators, the higher are the benefits to more sophisticated consumers who take advantage of these offers by not procrastinating. This adverse-selection problem forces monopolists to focus less on exploiting procrastinating consumers, leading to fewer consumer mistakes. Adverse selection can induce monopolists to offer more efficient contracts. I show that adverse selection does not occur with competition, and that competitive firms focus more on exploitation. Competitive firms frequently offer less efficient contracts. Indeed, with limited attention, competition leads to larger renewal prices and more back-loaded pricing. I discuss implications for teaser rates and evaluate recent policies on automatic-renewal contracts in the USA and the UK, such as reminders and increased salience of automatic-renewal features.

JEL classification: D03, D18, D41, D42, D82

Keywords: Limited Attention, Automatic Contract Renewal, Price Discrimination, Present Bias, Naiveté.

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1 Introduction

Contracts with automatic renewal or open-ended subscription are widely used in consumer markets. We observe these contracts in areas as diverse as telephone services, utilities, gym memberships, retail banking, credit-card services and newspaper subscriptions. The defining feature of automatic renewal is that contracts are valid until consumers cancel, which they usually need to do within a predefined time period. If not canceled, the contract renews automatically.

A common concern among policymakers is that automatic-renewal features exploit consumer inertia and induce consumers to forgo benefits of switching. As a response, many US states and the UK recently introduced regulation on automatic contract renewal. The existing literature also presents reasons to be concerned. For example DellaVigna and Malmendier (2004) show how firms can design contract renewal conditions to exploit overconfidence of present-biased consumers who procrastinate contract cancellation.[1] Yet existing work does not study how firms design offers for heterogeneous consumers, in particular when more sophisticated consumers are also present in the market. This article explores how firms use automatic-renewal contracts to price-discrimination between consumers who differ in their propensity to procrastinate.

Existing papers on automatic contract renewal focus on present-biased consumers.[2] Yet recent empirical studies[3] suggest that limited attention plays a crucial role in explaining low switching rates. Imperfectly attentive consumers procrastinate switching because they may forget to cancel their existing contract. For empirical evidence, see Ericson (2011, 2017) or Tasoff and Letzler (2014). In line with this evidence, I allow consumers to naively overestimate their future attention. In the main text I focus on limited attention as a reason for why consumers procrastinate switching. In the Web Appendix, I establish that the results are robust to price discrimination between diversely present-biased consumers.[4]

Allowing for consumer heterogeneity in attention, my main finding is that competition induces

[1] See also O'Donoghue and Rabin (1999a), O'Donoghue and Rabin (1999b) and O'Donoghue and Rabin (2001).

[2] See for example DellaVigna and Malmendier (2004), or Murooka and Schwarz (2016).

[3] Handel (2013) andMarzilli Ericson (2014) stud inertia in health insurance. Heiss et al. (2016) study plan choice after the introduction of Medicare Part D, and Kiss (2016) looks at car-insurance choice in Hungary.

[4] Present-biased consumers do not forget to cancel. They overweight the current costs of canceling a contract relative to future benefits of switching, causing them to procrastinate the cancellation.

firms to intensify exploitation of inattentive consumers. Monopolists would like to distort offers to exploit inattentive consumers. However, these exploitative offers adversely attract more attentive and therefore less profitable consumers. This adverse selection of attentive consumers reduces the extent to which monopolists exploit inattentive consumers. Competition shifts rents to consumers, thereby limiting adverse selection of attentive consumers. This is why competitive firms intensify the exploitation of inattentive consumers, leading to more back-loaded pricing in competitive markets. For a wide range of parameters, monopolists distort switching decisions less and offer more efficient contracts.

Section 2 introduces a model with automatic-renewal contracts and limited attention. Consumers purchase a product or service from a firm. Firms make a take-it-or-leave-it offer at the contracting period 0. After paying a setup price for consuming the good in period 1, consumers learn their value of consuming again in period 2. If they want to consume again in the second period, they have to do nothing at the end of period 1. But for consumption in period 2 consumers will pay a renewal price. If they want to switch to an outside option, consumers have to make an active decision to cancel their contract such as making a phone call or writing a letter. This setting includes the crucial feature of automatic-renewal contracts: without active consumer intervention, contracts extend automatically.

Consumers differ in their degree of limited attention. I consider perfectly attentive consumers who always make a decision about contract renewal, and (potentially naively or overconfidently) inattentive consumers who forget to make a decision with positive probability. Section 3 characterizes the switching behavior and contract choice of these consumers.

Section 4.1 studies a benchmark case where a monopolist can distinguish attentive and inattentive consumers, and targets offers accordingly. Monopolists offer efficient renewal prices to attentive consumers. But they design offers to exploit mistakes of naively inattentive consumers. At the contracting stage, naively inattentive consumers believe they will act and switch more often than they actually do. To exploit this switching error of inattentive consumers, monopolists increase their renewal price, and reduce their setup price to ensure participation. By increasing renewal prices, monopolists exploit and further increase the switching error of inattentive consumers, and earn an exploitation rent. Even when the monopolist is perfectly informed about consumer inattention, it distorts offers to inattentive consumers.

Section 4.2 explores monopolistic price discrimination. When a monopolist cannot distinguish between attentive and inattentive consumers, it faces an adverse-selection problem. Attentive consumers take actions about contract renewal with a higher probability and therefore benefit more from any given contract. They could choose the offer intended for inattentive consumers, enjoy the lower setup price and then switch more often at the larger renewal price. In this way, attentive consumers can take advantage of the exploitative offer and become less profitable.

Adverse selection limits the ability of monopolists to exploit inattentive consumers. The lower setup- and larger renewal prices intended to exploit inattentive consumers adversely attract attentive consumers who can take advantage of these exploitative offers. To soften the impact of adverse selection, monopolists make these offers less exploitative. Adverse selection induces monopolists to offer less exploitative contracts with less back-loaded pricing, i.e. smaller renewal prices, and can increase total welfare.

Section 5 studies implications of these results for competitive markets. Compared to monopolists, competitive firms intensify exploitation of inattentive consumers. Competition shifts surplus from firms to consumers and relaxes incentive constraints. This induces attentive consumers to self select into their designated offers, and softens the impact of adverse selection. But mitigated adverse selection allows competitive firms to intensify exploitation of inattentive consumers. Whenever competitive equilibria exist, they induce self selection, and lead to larger renewal prices, i.e. more back-loaded pricing, than monopolistic contracts. However, for similar reasons as in Rothschild and Stiglitz (1976), pure-strategy competitive equilibria may not always exist. As a robustness check, I discuss Wilson equilibria who always exist in this context, and show that the main results hold.

Section 6 investigates implications for back-loaded pricing such as teaser rates. Teaser rates are offers with lower introductory prices and larger post-introductory prices. They are regularly used in phone contracts, credit cards and many more. In line with existing research on present-biased consumers (DellaVigna and Malmendier, 2004; Heidhues and Kőszegi, 2010, 2016), I find that firms want to target inattentive consumers with teaser rates. But existing work is silent on how firms adjust teaser rates and back-loaded pricing when market power changes. I show that competing firms offer initial discounts with larger renewal prices, and inattentive consumers choose these contracts. But monopolists offer lower or no initial teaser discounts to prevent adverse selection, and charge lower prices after the teaser period. My results predict that competing firms are more likely offer teaser rates, and they offer products with larger post-introductory prices, i.e. more back-loaded prices.

My findings are consistent with empirical evidence. In the US credit-card industry Ru and Schoar (2016) find that companies target less-educated consumers with offers containing lower teaser rates and larger post-teaser prices.[5] Agarwal et al. (2017) use mitigation of interstate banking restrictions in the USA since 1994 as an exogenous shock to competition. Consistent with my findings, increased competition leads to more back-loaded pricing. Banks to reduce initial rates offered on adjustable-rate mortgages but, increased interest rates after the rates reset. Hence, "*competition may not eliminate firms' exploitation of naïve consumers but even intensify such exploitation under certain conditions.*" (Agarwal et al. (2017), Abstract.). Di Maggio et al. (2015) study banks' supply of loans to households after a deregulation that only affected some firms. To study effects of competition, the authors look at competing firms not directly affected by the deregulation and find they offered more back-loaded pricing.

Section 7 discusses policy implications. Policymakers are concerned with low switching rates in many consumer markets. Especially in the USA and the UK this led them to introduce regulation to encourage switching despite automatic-renewal contracts. They introduced compulsory *reminders* before contracts renew automatically, or tried to make automatic renewal more salient to consumers at the point a contract is signed (henceforth *salience policies*). Having a model with limited attention allows me to study the impact of these policies. As one might expect, both policies can reduce overconfidence and thereby reduce exploitation rents. But somewhat more surprisingly they can backfire. When these policies affect initial beliefs, they mitigate adverse selection and can actually induce larger renewal prices. Yet reminders, employed just before the switching decision, seem less likely to affect initial beliefs. This suggests that reminders are superior to salience policies in reducing exploitation of consumer inertia.

Section 8 compares results to the related literature. No previous paper has studies the tradeoff

[5] The authors use education as a proxy for sophistication of consumers. In the context of the present model, more educated consumers would be less likely to be naive about their inattention.

between exploiting naive procrastinators and adverse selection of more sophisticated ones, and the resulting implication of more back-loaded pricing in competitive markets and implications for policies. My formal model is most closely related to DellaVigna and Malmendier (2004). I extend this model in two ways. First, I introduce ex-ante heterogeneous consumers to study adverse selection. Second, I study limited attention in automatic-renewal contracts. This simplifies the analysis and makes the model comparable with the empirical evidence on limited attention and low switching rates discussed above.[6]

In contrast to existing papers on back-loaded pricing (DellaVigna and Malmendier, 2004; Heidhues and Kőszegi, 2010, 2016), I study how back-loaded pricing changes with market power, leading to the novel prediction that competition induces more back-loaded pricing. Compared to other papers on distorting competition (Carlin, 2009; Chen and Riordan, 2008; Gabaix et al., 2016), firms do not mitigate rent-shifting to consumers. But competing firms cater more to consumer mistakes, leading to more back-loaded pricing and more consumer mistakes.

Section 9 concludes. All proofs are in the Appendix. In Appendix 8, I briefly discuss how the main results are robust in a model with present-biased consumers; I discuss this case in more detail in the the Web Appendix.

2 A Model with Limited Attention and Automatic-Renewal Contracts

This section introduces a model with automatic-renewal contracts and heterogeneously attentive consumers. It also captures contracts with open-ended subscription that we observe in many different settings such as bank or credit-card accounts, insurances, gym- and other club memberships, electricity- or gas-supply contracts for consumers and many more. A monopolist offers a set of contracts that specify terms of consumption of a product over two periods. After consuming once,

[6]Additionally, having a model with inattentive consumers allows me to study the impact of recently implemented policies. In particular reminders or increasing salience of automatic renewal. These policies target consumers' awareness and limited memory and seem rather ineffective with present-biased consumers. Present-biased consumers do not forget to make a decision and they are aware of contract terms they face. When they are naive, they might mis-predict implications of contract terms, but they are aware of their existence.

heterogeneously attentive consumers *can* decide to stay and consume again or switch to their outside option. Switching, however, requires an active decision such as writing a cancellation letter or making a phone call. Perfectly attentive consumers are unaffected by automatic renewal. But inattentive consumers might forget to make a decision which triggers automatic renewal.

Consumers have the following basic characteristics. They are risk neutral and can consume a product in each of two periods. For simplicity, consumers have the long-run discount factor $\delta = 1$. Before consumption takes place, firms make take-it-or-leave-it offers at the contracting stage, denoted period 0. Consumers have unit demand in each period. The value of consumption in period 1 is w and is non-random for simplicity.[7] At the end of period 1, consumers learn their second-period utility v which is drawn from the cumulative distribution function G.[8] G has a continuous probability density function g that is strictly positive everywhere on the support $[\underline{v}, \overline{v}]$, and zero otherwise. The derivative of g is continuous as well.

I model automatic renewal in the following way. Consumers have an outside option $\bar{u}$ in each period, normalized to zero. Consumers have to actively opt-out of automatic renewal to consume the outside good in period 2. This Cancellation requires costless effort from consumers.[9]

As in Ericson (2011, 2017) or Tasoff and Letzler (2014), consumers have limited memory. Limited memory causes consumers to pay less attention to the switching decision because they might forget to make a decision. I model this (in)attention in the following way.[10] At the contracting stage, there are two types of consumers $i \in \{A, I\}$. The share $1 - \lambda$ are attentive consumers A.

[7] Random valuation in period 1 can be included in the model but adds complexity and does not change results qualitatively. I abstract from correlated values over time to focus on the effects of heterogeneity with respect to inattention or present-biases. With correlated values, similar to the logic applied in Eső and Szentes (2007), firms would have to screen for the part of the information that is new in period 2.

[8] $G(\cdot)$ captures that future valuations can depend on uncertain states of the world, or learning about future valuation after experiencing consumption in period 1. This assumption makes the screening more problem tractable by making beliefs about future switching probabilities continuous in renewal prices. Whenever consumers face a renewal price p on the support of G, they expect to switch and to stay with some positive probability respectively. When p changes, these beliefs change continuously. With fixed continuation values, a marginal increase in p can change beliefs from staying with probability one to switching with probability one.

[9] In many cases, a positive switching effort is the more realistic assumption. It can be incorporated into the analysis but adds complexity without changing results qualitatively.

[10] I follow Ericson (2017) and Levy and Loftus (1984) in modeling limited memory.

In period 1 these consumers make a switching decision with probability one, and in period 0 they correctly expect this probability. The remaining share λ are inattentive consumers I. In period 1 inattentive consumers act with probability α and forget to act otherwise. Conditional on acting they are identical to attentive consumers. When not acting, inattentive consumers stick to the default option and their contract renews automatically. Consistent with empirical evidence inattentive consumers can be overconfident about their future level of attention.[11] In period 0 inattentive consumers believe they will make an active decision in period 1 with probability $a \geqslant \alpha$, and $a < 1$. When $a > \alpha$, they are overconfident and I call them naively inattentive consumers. I sometimes use the notation a_i, and α_i, where $a_I = a$,$\alpha_I = \alpha$ and $a_A = \alpha_A = 1$.

I make the following additional assumption on consumer attention. All consumers switch with probability one at prices for which they would never want to continue, that is if a price p for second-period consumption is such that $p > \overline{v}$. If the stakes are high enough consumers will pay attention and switch.[12] This assumption ensures that the firms' problem always has a solution. It rules out the economically uninteresting case where firms want to set renewal prices towards infinity because consumers do not switch with a probability bounded away from zero for arbitrarily large prices.

Firms have the following basic characteristics. They maximize profits and have marginal production costs c. Firms have the same long-run discount factor as consumers $\delta = 1$. They know the distribution of attention λ and of future valuations G but cannot distinguish either of these types at the contracting stage. When firms learn a consumer's belief a_i, they can deduce the corresponding future attention α_i. This captures the feature that firms are aware of their consumers' overconfidence.

Firms use the following contract structure. They can commit to a two-period menu of offers $M = \{f_i, p_i\}_{i \in \{A,I\}}$. These offers determine for each type $i \in \{A, I\}$ a first-period or setup price f_i, and a second-period or renewal price p_i that consumers pay if and only if they stay in period 2. That is if they either decide to stay, or if they forget to make a decision and stay due to automatic

[11] For evidence, see Ericson (2011) or Tasoff and Letzler (2014).

[12] This assumption is a simple way of imposing that consumer attention depends on prices. The following alternative assumptions lead to equivalent results. First, consumers do not sign contracts with renewal prices $p > \overline{v}$. Second, $\alpha_i = a_i$ if $p > \overline{v}$. Additionally, regulators and policy makers would likely become suspicious of a firm who offers a renewal price at which no perceivable consumer would want to continue, inducing firms not to raise prices too much.

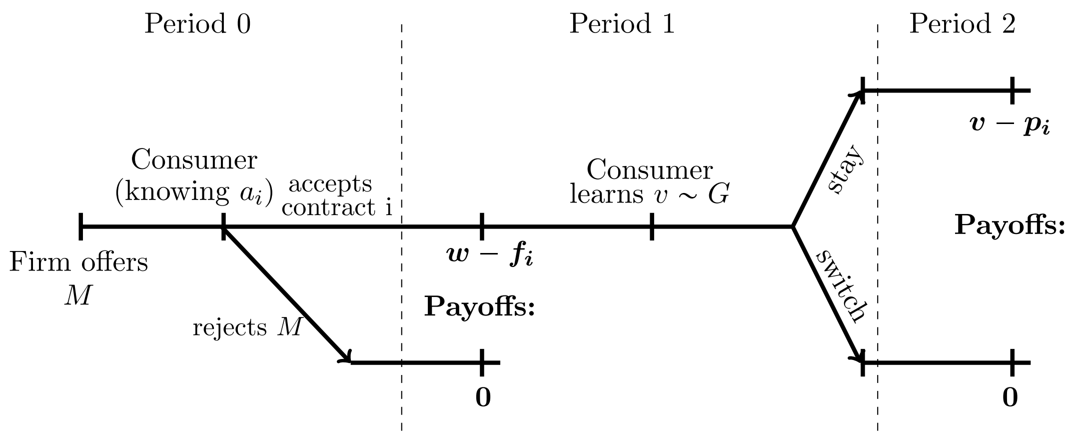

Figure 1: Timing of the model

renewal. Throughout, I focus on deterministic decisions where consumers either switch or stay with probability one. Consumers learn and reveal their private information over time by their choices, making this a sequential screening problem with biased beliefs.

This contract structure implies that firms cannot condition contracts on the consumers' inattentive state. In particular, firms cannot distinguish in period 1 whether a consumer is inattentive or has a very high valuation $\overline{v}$ for consumption in period 2.

Figure 1 summarizes the timing of this model. In the contracting period (t=0), the firm offers the menu of contracts M. Consumers have private information about their beliefs a_i on their limited attention. Consumers can accept one of these contracts or reject both and enjoy their outside option. In period 1, consumption takes place and payment of the setup price. Afterwards, each consumer learns her value v for consumption in period 2. In an attentive state consumers *decide* whether to switch to their outside option or to stay to enjoy v at the renewal price p_i in period 2. If consumers are in an inattentive state, they stay with probability one.

I maintain the following assumptions throughout. The first assumption guarantees interior solutions of the firms' problems.

Assumption 1. $(a - \alpha)/\alpha < (\overline{v} - c)g(\overline{v})$.

The main results hold at corner solutions as well, but this assumption simplifies the exposition. It is clearly satisfied for small-enough levels of overconfidence, i.e. if a is sufficiently close to α.

In addition, to make the problem interesting, I assume that switching is efficient at the lowest valuations, i.e. $\underline{v} < c$, and inefficient at the highest one, i.e. $\overline{v} > c$.

Remark: I show in Appendix B.2 that these cut-off type offers that consist of a setup- and a renewal price are without loss of generality when allowing for more general direct-revelation mechanism. These direct-revelation mechanisms allow for payments after staying, but also for cancellation fees after consumers switch. We observe cancellation fees in real-life contracts, but in this setting it is without loss of generality to set them to zero. Thus, firms cannot use cancellation fees to increase profits. This has important implications for regulation. In particular, cancellation fees do not help firms to exploit inattentive consumers. Regulation of such fess is therefore unlikely to mitigate issues related to procrastination in automatic-renewal contracts.[13]

3 Consumer Behavior

In this section I characterize consumer behavior for a given menu of contracts M. This includes the switching decision at the end of period 1 and the contract choice in period 0.

We start with the switching decision in period 1. Conditional on making a decision, each consumer type i stays in contract j if and only if $v \geqslant p_j$. If they pay attention, all types have the same cut-off in any given contract. When not acting, inattentive consumers stay with probability one.

We can now approach the contract choice of consumers in period 0 by specifying type i's expected utility from contract j:

$$U_i(j) = w - f_j + \underbrace{(1 - a_i)\left(v^e - p_j\right) + a_i\left[\int_{p_j}^{\infty}(v - p_j)g(v)dv\right]}_{\equiv V(p_j;a_i)}. \tag{1}$$

Here v^e denotes the expected value of v, and $V(p_j; a_i)$ is the expected second-period utility of consumer type i in contract j. When not paying attention, consumers stay due to automatic renewal and get $v^e - p_j$. When they pay attention, they only switch if $v \geqslant p_j$. Since this is the

[13]Regulating cancellation fees has been considered, for example, in OFT (2013). Even a price cap on cancellation fees would shift prices from the second to the first period. Only a joint regulation of both prices can have an effect.

second-period utility that consumers expect at the contracting stage, it only depends on the belief a_i and the renewal price p_j. The following Lemma summarizes properties of $V(p_j; a_i)$.

Lemma 1. *Properties of $V(p; a)$.*

1. $\frac{\partial V(p;a)}{\partial a} = -(v^e - p) + \left[\int_p^\infty (v-p) g(v) dv\right] \geqslant 0.$
2. $\frac{\partial V(p;a)}{\partial p} = -(1-a) - a(1 - G(p)) \leqslant 0.$
3. $\frac{\partial^2 V(p;a)}{\partial a \partial p} = G(p) \geqslant 0.$

All inequalities are strict for $p \in (\underline{v}, \overline{v})$.

The first property says that consumers who believe to act more often anticipate a higher second-period utility. This property implies that more attentive consumers get a larger utility from any given contract, implying that more attentive consumers need to get an information rent.

The second property states that demand decreases in prices. Whether attentive or not, consumers benefit from lower prices.

The third property shows that a single-crossing property holds. The second-period utility of more attentive consumers decreases slower in the renewal price. Because they are more likely to make a decision, more attentive consumers respond more often to a price increase, and are therefore less affected by it.

We can now characterize incentive-compatibility constraints for the contract choice in period 0. Inattentive consumers report their beliefs about their inattention truthfully if and only if

$$U_I(I) \geqslant U_A(A) + V(p_A; a) - V(p_A; 1). \qquad (IC_I)$$

Similarly, the incentive-compatibility constraint for attentive types is

$$U_A(A) \geqslant U_I(I) + V(p_I; 1) - V(p_I; a). \qquad (IC_A)$$

By Lemma 1, $V(p_I; 1) - V(p_I; a) \geqslant 0$, with equality if and only if $a = 1$. Thus, as long as $a < 1$ attentive types A need to earn an information rent to choose their designated contract. In the same way, (IC_I) shows that inattentive types expect a lower utility than attentive types from choosing contract A. In this sense, types A are the 'high types' who needs to get at least $V(p_I; 1) - V(p_I; a)$ more than types I to reveal their private information about their attention truthfully.

The individual-rationality constraints ensure that consumers want to participate in period zero given their beliefs.

$$U_i(i) \geqslant 0, \;\; \forall i\{I, A\}. \qquad (IR_i)$$

Remark on (IC_I)**:** In contrast to classic screening problems, the single-crossing condition does not imply that if one incentive constraint is binding, the other will be slack. The reason is that optimal contracts *can* involve smaller renewal prices for attentive consumers (i.e. 'high' types). In this case $V(p_I; 1) - V(p_I; a) > V(p_A; 1) - V(p_A; a)$ such that (IC_I) and (IC_A) cannot be both satisfied. For more details on this see Appendix B.3.

Nonetheless, firms ensure that (IC_I) is slack even when $p_A < p_I$, so we ignore it from now on. To ensure that (IC_I) is slack, optimal contracts of attentive consumers *can* involve discounts or bonus payments that reward attentiveness and make these offers more expensive for inattentive consumers.

Intuitively, these benefits can ensure that (IC_I) is slack for the following reason. Firms increase the setup price for attentive consumers but offer a discount of the same magnitude for an action that the consumer has to remember to do, e.g. for bringing the loyalty card, a voucher, or for using the loyalty program in the right way. Attentive consumers will remember and their setup price is unaffected. Inattentive consumers, partially aware of their inattention, anticipate that they will forget the right conditions or to use vouchers, and shy away from contracts that involve them. Punishing inattention in this way makes contracts designed for attentive consumers more expensive for inattentive ones, while expected setup prices for attentive consumers are unaffected. Also renewal prices remain unchanged. For more details see Appendix B.3.[14]

Many such discounts or benefits are frequently used in retailing settings. Discounts can take the form of vouchers or loyalty cards that consumers have to remember to bring along, or conditions that consumers have to remember to satisfy to get a discount or bonus. For example, they have to remember for which airlines they get bonus miles with which credit card, or for which card they get the most beneficial cash benefits.

[14]If such discounts or benefits were not available for some exogenous reason, firms would offer a pooling contract instead of prices $p_A < p_I$. This would leave the trade of between exploitation and reducing information rents unaffected.

4 Monopoly

4.1 Benchmark: Public Information about Inattention

We now characterize offers in a benchmark case with public information on inattention. A monopolist who knows the degree of inattention of consumers solves the following problem:

$$\begin{aligned}\max_{(f_i,p_i)} \ & f_i - c + \alpha_i(1-G(p_i))(p_i-c) + (1-\alpha_i)(p_i-c), \\ s.t. \ & (IR_i).\end{aligned} \tag{2}$$

Consumers in an attentive state have a standard downward-sloping demand. But in an inattentive state they always buy due to automatic renewal, making consumers less responsive to renewal prices. Firms are aware of their consumers' overconfidence about their inattention, and take the true α_i into account when evaluating the consumer's renewal decision.

We can simplify the problem by substituting f_i from the binding (IR_i) into the profit and by denoting total welfare with correct beliefs by $W_i(p_i;\alpha_i) \equiv w-c+(1-\alpha_i)(v^e-c)+\alpha_i \int_{p_i}^{\infty}(v-c)dG(v)$.[15] The lower boundary of the integral in $W_i(p_i)$ is determined by the switching decision. The simplified problem becomes

$$\max_{p_i} \ W_i(p_i;\alpha_i) + V(p_i;a_i) - V(p_i;\alpha_i). \tag{3}$$

The simplified problem reveals that an informed monopolist distorts welfare to exploit overconfidence in attention. The monopolist maximizes total welfare of a sophisticated (in)attentive consumer plus a term $V(p_i;a_i) - V(p_i;\alpha_i)$. This term captures the firm's exploitation rent. This rent results from consumers misperceiving their future behavior due to overconfidence about their attention. By Lemma 1 the exploitation rent is zero for attentive types who correctly predict their future behavior ($a_A = \alpha_A$). These consumers get welfare-maximizing contracts. But for inattentive types I, we know from Lemma 1 that the exploitation rent is positive when these consumers are overconfident about their degree of inattention ($a > \alpha$). This exploitation rent induces monopolists to distort renewal prices to exploit naively inattentive consumers.

The following Proposition summarizes the solution to (3),

[15] The welfare with correct beliefs $a_i = \alpha_i$ describes the welfare of a consumer who is fully aware of his inattention. As we will see below, renewal prices equal marginal cost when consumers are sophisticated about their degree of inattention.

Proposition 1. (Monopoly, Public Information about Inattention)

A profit-maximizing contract $(f_i^*, p_i^*)_{i \in \{A,I\}}$ *exists. The renewal price* p_i^* *satisfies*

$$p_i^* - c = \frac{a_i - \alpha_i}{\alpha_i} \frac{G(p_i^*)}{g(p_i^*)}. \tag{4}$$

For attentive types A, $p_A^* = c$*. For inattentive types I,* $p_I^* - c > 0$ *for all* $a_i > \alpha_i$*. The binding individual-rationality constraint of type* $i \in \{A, I\}$ *determines* f_i^**.*

The monopolist distorts switching and target naively inattentive consumers with more back-loaded pricing. The monopolist exploits naively inattentive consumers even when she can distinguish consumers by attention. These consumers pay strictly positive margins on renewal prices, and these margins increase in the degree of overconfidence $a - \alpha$. (4) reduces to marginal-cost pricing for attentive types and sophisticated inattentive consumers ($a = \alpha$). They get undistorted contracts from an ex-ante point-of-view. Thus, since the right-hand side of (4) is strictly positive only for naively inattentive consumers ($a > \alpha$), it is a welfare distortion due to overconfidence, and we can interpret it as an *exploitation distortion.*

The exploitation rent induces monopolists to cater to consumers' mistakes. We see from Lemma 1 that all consumers prefer lower prices, also the inattentive ones. But when they mispredict their probability to switch, i.e. if $(a - \alpha)G(p_I) > 0$, the monopolist can increase p_I above marginal cost, and offer a discount on the setup price f_I (relative to f_A). Overconfident inattentive consumers pay p_I more often than they expect and wrongly perceive the initial discount on f_I as a good deal. Thus, this distorted contract maximizes perceived utility. The monopolist distort the switching decision to cater to consumers' mistakes. Note that by distorting renewal prices upwards, firms increase the switching error even further. In this way firms disproportionately distort switching of naive consumers.

Example: This example illustrates Proposition 1 for the spacial case where $G(\cdot)$ is uniformly distributed on the interval $[0, 1]$. Assuming that $\underline{v} < c < \overline{v}$, Assumption 1 simplifies to $2\alpha - a > 2c \geqslant 0$. Thus, the optimal price condition given by equation (4) simplifies to

$$p_I^* - c = \frac{a - \alpha}{2\alpha - a} c,$$

which is strictly positive for naively inattentive consumers.

The full-information results suggest that attentive consumers have an incentive to choose the offer intended for inattentive consumers. Using the expressions for f_I^* and p_I^* to compute $U_A(I)$ reveals that attentive consumers can get a rent of $V(p_I^*;1) - V(p_I^*;a) > 0$ from choosing the inattentives' contract. Intuitively, they benefit from the lower setup price of inattentive consumers and pay the larger renewal price less often.

4.2 Price Discrimination with Inattention

I now turn to the case where the monopolist cannot distinguish consumers' degree of attention. The monopolist solves

$$\begin{aligned} \max_{(f_i,p_i)_{i\in\{A,I\}}} \quad & \lambda\left[f_I - c + \alpha(1-G(p_I))(p_I - c) + (1-\alpha)(p_I - c)\right] \\ & (1-\lambda)\left[f_A - c + (1-G(p_A))(p_A - c)\right], \\ & s.t.\ (IC_A), (IC_I), (IR_i), i \in \{A, I\}. \end{aligned} \tag{MP}$$

The first term is the profit from inattentive consumers, and the second term the profit from attentive ones. Due to private information about their degree of attentiveness, consumers might misreport their beliefs about their attention. The monopolist prevents this by taking (IC_A) and (IC_I) into account.

The following three steps simplify this problem. First, by Lemma 1 $V(p_I;1) - V(p_I;a) > 0$, such that (IR_I) and (IC_A) jointly imply (IR_A). Second, in any optimal contract, (IR_I) and (IC_A) must be binding. Otherwise, firms could increase profits by increasing either f_I or f_A. Third, as discussed previously and in more detail in Appendix B.3, firms can ensure that (IC_I) is slack. These steps lead to the following reduced-form problem.

$$\begin{aligned} \max_{\{p_A,p_I\}} \quad & \left[\lambda W_I(p_I;\alpha) + (1-\lambda)W_A(p_A;1)\right] \\ & +\lambda\left[V(p_I;a) - V(p_I;\alpha)\right] - (1-\lambda)\left[V(p_I;1) - V(p_I;a)\right]. \end{aligned} \tag{M-R}$$

The first term in squared brackets is expected welfare. The first term in the second line ($\lambda\left[V(p_I;a) - V(p_I;\alpha)\right]$) is the exploitation rent that we know already from Section 4.1.

The last term ($-(1-\lambda)\left[V(p_I;1) - V(p_I;a)\right]$) is new and reflects the monopolist's adverse-selection problem. This term represents the information rent that monopolists have to leave to attentive consumers. This rent ensures that attentive consumers choose the contract intended for them. Since (IR_I) is binding, inattentive consumers get a utility equal to their outside option. But we know from Lemma 1 that attentive types enjoy a larger perceived utility from each contract. This implies that attentive consumers earn strictly more than their outside option from choosing the contract intended for inattentive consumers. Thus, to choose their designated contract, attentive consumers have to earn an information rent. This rent prevents adverse selection but reduces the monopolists' profits. Since the information rent of attentive consumers results from the benefits that these consumers enjoy from the inattentive consumers' contract, it depends on the renewal price of inattentive consumers p_I.

Problem (M-R) shows that the monopolist has two reasons distort total welfare. She wants to (i) exploit the overconfidence of inattentive consumers about their future attention and (ii) reduce the information rent they leave to attentive consumers. But the only tool available to influence both goals is p_I—the renewal price of inattentive consumers.

The monopolist faces a tradeoff between exploitation- and information rents. The exploitation rent and the information rent affect profits in different directions. Due to the single-crossing property in Lemma 1, reducing information rents calls for a downward distortion of p_I while increasing exploitation rents requires an upward distortion. Consequently, the monopolist faces a tradeoff between reducing information rents and increasing exploitation rents.

Stated more intuitively, attentive consumers can take advantage of the exploitative offers, which discourages exploitation. We saw in Proposition 1 that to exploit naively inattentive consumers, monopolists want to increase the renewal price p_I above marginal cost and reduce the setup price f_I. But attentive consumers can take advantage of these exploitative offers: they benefit from a lower setup price but switch more often and pay p_I less frequently. In this way attentive consumers can adversely select the offers of inattentive consumers. To reduce these losses from adverse selection, the monopolist increases setup- and reduces renewal prices p_I, and makes contracts for inattentive consumers less exploitative.

We can see this in more detail the first-order condition (8b) in the Proof of Proposition 2. This condition shows that the inattentive consumers' false belief to switch $(a - \alpha)G(p_I)$ induces the monopolist to increase p_I. By exploiting overconfidence, the monopolist increases the switching error further. Yet a larger p_I also increases the additional switching probability $(1-a)G(p_I)$ of attentive consumers.

Proposition 2 summarizes these results and the solution to (M-R), and is the main result of the article, namely that adverse selection of attentive consumers induces monopolists to focus less on exploiting naively inattentive consumers. Relative to the full-information benchmark, adverse selection induces monopolists to offer *smaller* renewal prices and use less back-loaded pricing.

Proposition 2. (Monopoly, Private Information about Inattention)

A profit-maximizing contract $(f_i^M, p_i^M)_{i\in\{A,I\}}$ *exists. The renewal price for type A is* $p_A^M = c$. *For inattentive types, the renewal price satisfies*

$$p_I^M - c = \frac{a-\alpha}{\alpha}\frac{G(p_I^M)}{g(p_I^M)} - \frac{1-\lambda}{\lambda}\frac{1-a}{\alpha}\frac{G(p_I^M)}{g(p_I^M)}. \tag{5}$$

The binding (IR_I) *and* (IC_A) *constraints pin down* f_I^M *and* f_A^M *respectively.*

An interior solution to (M-R) always exists. Equation (5) might have multiple solutions, but by Assumption 1, there is an interior solution that satisfies (5). For the sake of exposition, I assume that the solution is unique.[16]

We look first at attentive consumers. Equation (5) shows that these consumers pay renewal prices equal to marginal costs. This resembles the no-distortion-at-the-top result from classic screening problems.

We now look at renewal prices for inattentive consumers. The first term in (5) captures the *exploitation distortion* that we already know from Proposition 1. The second term represents the *information-rent distortion*. It reflects the monopolist's goal to reduce the information rent of attentive consumers. This information-rent distortion $-\frac{1-\lambda}{\lambda}\frac{1-a}{\alpha}\frac{G(p_I^M)}{g(p_I^M)}$ is always negative. Thus, renewal prices under adverse selection are indeed smaller than with a fully informed monopolists. This also implies that adverse selection reduces the switching error $(a-\alpha)G(p_I^M)$.

[16]DellaVigna and Malmendier (2004) make the same assumption in the context of present-biased consumers. A standard continuity argument shows that solutions must be unique when α is sufficiently close to a. As $a \to \alpha$, the problem converges to a classic monopoly problem, and we know from Bagnoli and Bergstrom (2005) that this has a unique solution under log-concavity of $1-G(\cdot)$.

Why is adverse selection always an issue for monopolists? Monopolists extract all rents but information rents, so they always want to distort contracts to reduce information rents and extract more surplus. Consequently adverse selection is always an issue.

The results have important implications for welfare. Adverse selection might reduce welfare if renewal prices are much lower than marginal cost and induce consumers to switch inefficiently often. But for a wide range of parameters this tradeoff between exploitation and information rents *reduces* the switching distortion and *increases* total welfare. This is the case if adverse selection induces renewal prices closer to marginal costs. This occurs if the share of inattentive consumers λ is not too small or beliefs of consumers are similar, i.e. a is 'close' to 1.[17]

Adverse selection has a strong impact already for small degrees of overconfidence. The results in Proposition 2 exhibit a discontinuity in renewal prices. When $a = \alpha$, all consumers are sophisticated and firms clearly offer renewal prices at marginal costs. Yet as $a \to \alpha$, the margin due to overconfidence vanishes, but the margin due to the information rent does not. The reason is that for small levels of overconfidence, the switching error $(a - \alpha)G(p)$ vanishes, but the additional switching probability $(1 - a)G(p)$ does not. Inattentive consumers almost correctly predict their switching behavior, but the adverse-selection problem is already large because attentive consumers switch much more often. This suggests that adverse selection is relevant already for small degrees of overconfidence.

Example continued: When $G(\cdot)$ is uniformly distributed on $[0, 1]$, (5) simplifies to

$$p_I^M - c = \frac{\lambda(a - \alpha) - (1 - \lambda)(1 - a)}{\lambda(2\alpha - a) + (1 - \lambda)(1 - a)} c.$$

This margin is strictly increasing in λ and therefore smaller than the margin with private information.

Remark: The main result that adverse selection reduces renewal prices also holds when Assumption 1 is violated. In this case, the optimal solution with full information on attention in Proposition

[17] A sufficient, but not necessary, condition is that (5) is positive. This is the case if $\lambda \geqslant (1 - a)/(1 - \alpha)$. Adverse selection might reduce welfare when inattentive consumers switch inefficiently often.

1 is the corner solution $p_I^* = \overline{v}$. But since for any renewal price, marginal profits are larger under full information, we know that $p_I^M \leqslant p_I^*$ also when considering corner solutions.[18]

5 Competitive Price Discrimination and Inattention

This Section studies competition. To start I define competitive equilibria and introduce a maximization problem that captures these equilibria. I then derive some general properties of competitive equilibria. Afterwards, I characterize competitive equilibria and find that whenever they exist, competition induces firms to intensify exploitation of inattentive consumers. As a consequence competition can reduce welfare. As a robustness check, I also compute Wilson equilibria that always exist in this context. They lead to the same result.

I define a competitive equilibrium as follows. Suppose there is a finite number of identical firms in the market. A competitive equilibrium satisfies the following conditions:

1. Firms maximize profits given consumer behavior.
2. Consumers choose perceived-optimal contracts in period 0, and switch according to their true degree of attention in period 1.
3. Firms earn zero profits for any menu of contracts they offer.

The first two conditions are standard. Firms maximize profits and consumers make perceived-optimal choices.

The second condition stipulates that consumers switch to their outside option $\bar{u} = 0$ in period 2. I do not model competition in period 2 explicitly, but since in period 0 firms can commit to future prices, also monopolists do not distort participation in period 2 due to market power. Thus, endogenous outside options in period 2 that depend on competition would add complexity without changing results qualitatively.

The third condition reflects competition and states that firms earn zero profits from the menu of contracts. This allows for cross subsidization between contracts as long as this is profit maximizing.

[18] More precisely, the marginal profits w.r.t. p_I under full information, that is (7) in the proof of Proposition 1, is weakly larger than the marginal profits with private information on attention, i.e. (8b) in the proof of Proposition 2.

This condition is weaker than demanding zero profits from any contract, and allows for cross subsidization between contracts; but only if this is part of a profit-maximizing menu. Firms might optimally want to continue unprofitable contracts if discontinuing these contracts would lead to larger losses. When firms stop to offer an unprofitable contract, these consumers can still choose one of the remaining contracts. Within this alternative contract, their behavior might make them even more unprofitable. This is why firms may have a strict incentive to continue the initial unprofitable contract.[19]

Since these strategic concerns might be important for firms, the definition allows for cross-subsidization between contracts. But as we will see in Lemma 2, competition will imply that firms earn zero profits *from each contract*.

I argue next that the solution to the following problem characterizes competitive equilibria as defined above.

Let $M^C = \{(f_A^C, p_A^C), (f_I^C, p_I^C)\}$ be a menu of contracts that satisfies the following two conditions:

$$\begin{aligned} M^C = \underset{\{f_A, p_A, f_I, p_I\}}{\operatorname{argmax}} \quad & \lambda \left[f_I - c + \alpha(1 - G(p_I))(p_I - c) + (1-\alpha)(p_I - c)\right] \\ & (1-\lambda)\left[f_A - c + (1 - G(p_A))(p_A - c)\right], \\ & s.t.\ w - f_i + V(p_i; a_i) \geqslant \hat{u}_i, \text{ for } i \in \{A, I\}, \\ & (IC_A), (IC_I) \end{aligned} \tag{C}$$

and

$$\begin{aligned} & \lambda \left[f_I^C - c + \alpha(1 - G(p_I^C))(p_I^C - c) + (1-\alpha)(p_I^C - c)\right] \\ & \quad + (1-\lambda)\left[f_A^C - c + (1 - G(p_A^C))(p_A^C - c)\right] = 0. \end{aligned} \tag{zero profits}$$

[19] To give some more guidance why this is relevant, recall that a binding (IC_A) implies that attentive consumers are indifferent between contracts designated for them and the contracts for inattentive consumers. If a firm would discontinue the contracts of attentive consumers, these consumers could chose the contracts of inattentive consumers. These contracts typically involve smaller setup- and larger renewal prices. Attentive consumers would enjoy the lower setup price and pay the renewal price less often. Attentive consumers choosing the contract of inattentive ones are, therefore, typically unprofitable and firms might want to reduce these losses by offering an alternative efficient contract that gives attentive consumers the same utility but generates fewer losses. Thus, it might be profitable for a firm to continue the initial offer to attentive consumers. Even when it is unprofitable itself, it might be part of a profit-maximizing menu. Condition 3 allows for this kind of behavior of firms.

The first condition (C) is a profit-maximization problem subject to two kinds of constraints. The first constraints $w - f_i + V(p_i; a_i) \geqslant \hat{u}_i$, for $i \in \{A, I\}$ are consumers' participation constraints. They ensure that consumers only participate if they are better off than with their outside option $\hat{u}_i$. The other constraints are incentive-compatibility constraints that guarantee that each consumer chooses the contract designed for her in period 0. The outside options of the participation constraints $\hat{u}_i$ can be any constant. This problem maximizes profits and pins down setup prices for any given $\hat{u}_i$. Among these solutions, condition (zero profits) selects those with the outside options that are consistent with perfect competition. In this way, condition (zero profits) pins down the outside options $\hat{u}_i$ that leaves zero profits to firms and shifts all generated surplus to consumers. The zero-profit condition endogenously determines the outside option as the best alternative offer, i.e. the equilibrium contracts.[20]

Solutions to (C) that satisfy the zero-profit constraint are competitive equilibria as defined above. Concerning condition 2 of competitive equilibria, the participation constraints and the incentive-compatibility constraints ensure that consumers choose perceived-optimal contracts in period 0. The consumers' true attention parameters determines the firms' profits, implying that consumers switch according to their true attention parameter. Thus, condition 2 of the definition of a competitive equilibrium is satisfied. Given this consumer behavior firms maximize profits, satisfying condition 1 of the definition of a competitive equilibrium. The zero-profit condition guarantees that condition 3 of the definition of a competitive equilibrium is satisfied. Looking at (C) without considering the zero-profit condition, outside options $\hat{u}_i$ could be such that M^C generates positive profits. This would not characterize a competitive equilibrium since a competitor could marginally undercut the setup prices and attract consumers profitably. Condition (zero profits) chooses among the solutions of (C) those with the outside options $\hat{u}_i$ that induce zero profits to firms. In this way, the outside options are endogenous and determined by competition via the zero-profit condition. Thus, solutions to (C) that satisfy the zero-profit constraint are competitive equilibria as defined above.

The following Lemma characterizes properties of competitive equilibrium contracts that will be

[20] The zero profit condition shifts all generated surplus to consumers. This is why consumers will always get more than $\bar{u} = 0$ as well.

helpful later.

Lemma 2. *In any competitive-equilibrium contract, firms offer screening contracts, and firms earn zero profits from each customer group.*

The Lemma implies that competitive equilibria might not exist due to creme skimming. We know since Rothschild and Stiglitz (1976) that competitive equilibria with price discrimination might not exist. The same arguments as in Rothschild and Stiglitz (1976) apply in this context. Essentially, whenever there is cross-subsidization in a competitive equilibrium, a competitor could make a profitable counteroffer that only the profitable consumers choose. Because of this creme skimming, pooling equilibria as well as screening ones with cross-subsidization are ruled out.

5.1 Optimal Competitive Screening Contracts

In this section I characterize competitive equilibria. I proceed in three steps. First, I solve the firms' problem (C) as if they knew consumers' types, that is ignoring incentive-compatibility constraints. Without these constraints, firms maximize profits per customer type subject to competition. This induces firms to maximize perceived utility for each consumer type. Second, I check whether the resulting contracts are incentive compatible and therefore constitute a competitive equilibrium with privately informed consumers.

Without adverse selection, we can use the participation constraint to simplify (C) to

$$\max_{p_i} \; W_i(p_i;\alpha_i) + [V(p_i;a_i) - V(p_i;\alpha_i)] - \hat{u}_i, \;\text{ for } i \in \{A, I\}. \tag{C-R}$$

This problem is the same as in the benchmark case when firms know consumers' types except for the outside option $\hat{u}_i$. Since the constant outside option leaves optimal renewal prices unaffected, this problem leads to the same renewal prices as (4) in Proposition 1, i.e. the benchmark case with perfect information on consumer attention. The only difference is that setup prices depend on the endogenous outside option $\hat{u}_i$. The zero-profit condition pins down these outside options and thereby setup prices and outcomes.

The solution to this problem leads to the following candidate prices for optimal contracts. For attentive consumers, $f_A^C = p_A^C = c$, and for inattentive consumers $p_I^C = p_I^*$, and $f_I^C = c - (1 - \alpha)(p_I^C - c) - \alpha(1 - G(p_I^C))(p_I^C - c)$. The renewal prices are the same as in Proposition 1, and setup prices are such that consumers get the profits that firms earn from them in the second period. These setup prices are strictly smaller than the ones in Proposition 1 and consumer utility is also larger than $\bar{u}$.

In this candidate equilibrium, firms earn zero profits from each customer type, making it consistent with the properties of Lemma 2. Inattentive consumers get a distorted renewal price above marginal costs. These consumers induce a profit in the second period. In a competitive equilibrium, firms hand back these profits to inattentive consumers by reducing the setup price f_I^C.

Finally, we need to check whether these offers are incentive compatible. They are incentive compatible for inattentive consumers. Note that attentive consumers pay prices equal to marginal cost in every period. They earn zero profits to firms irrespective of consumer behavior, making them feasible offers to any consumer type. This implies that inattentive types cannot be better off by choosing the contracts of attentive types: if inattentive consumers choose these prices, firms still earn zero profits. But these prices do not solve (C-R) for inattentive consumers and therefore do not maximize their perceived welfare. This is why inattentive consumers never choose the contracts designed for attentive ones.

These candidate offers might not be incentive compatible for attentive consumers. When attentive consumers choose the contract of inattentive consumers these contracts do not break even. Firms price below marginal cost in the first period and above marginal cost with the renewal price. Firms recover the initial discount from inattentive consumers in the second period. But attentive types act more often. If they choose the inattentives' contract they would earn the upfront discount, but suffer less from the distorted renewal price. Thus, they get a larger benefit from these contracts than inattentive consumers. On the other hand, the larger renewal price reduces their consumption utility in period 2 relative to their designated contract. Plugging the candidate prices into (IC_A) formalizes this tradeoff of attentive consumers and leads to the following condition

$$V(c;1) - V(p_I^C;1) \geqslant (1-\alpha)(p_I^C - c) + \alpha(1 - G(p_I^C))(p_I^C - c). \tag{6}$$

That is, attentive consumers self select if the additional consumption utility they earn from their designated contract is larger than the discount on setup prices of inattentive consumers. We know from Lemma 1 that the left-hand side is always positive since $p_I^C \geqslant c$. We also know that the discount equals the second-period profits from inattentive consumers.

Competitive equilibria with self selection indeed exist. Condition (6) is always satisfied when a and α are sufficiently close. If $G(\cdot)$ is uniformly distributed as in the example discussed above, the condition always holds when c is sufficiently small.[21]

If condition (6) is violated, candidate equilibria include adverse selection. This induces a distortion that leads to cross-subsidization, which is why these candidate equilibria contradict Lemma 2 and do not exist. I discuss this in more detail in the Proof of Proposition 3.

Proposition 3 is the second main insight and summarizes the previous discussion.

Proposition 3. (Competition, Private Information about Attention, Screening)

If (6) *holds, a competitive equilibrium in pure strategies exists. This equilibrium is a pair of competitive contracts* $(f_i^C, p_i^C)_{i\in\{A,I\}}$ *that screens consumers, and is characterized as follows: Continuation prices are as in Proposition 1 and setup prices are* $f_A^C = c$ *and* $f_I^C = c - (1-\alpha)(p_I^C - c) - \alpha(1 - G(p_I^C))(p_I^C - c)$.

If (6) *does not hold, a pure-strategy competitive equilibrium does not exist.*

Why does competition induce self selection and mitigate adverse selection? Recall that monopolists extract all rents from consumers, but they have to leave information rents to attentive consumers. As a result, monopolists would always distort contracts to reduce information rents and extract even more surplus. But competition shifts surplus to consumers, and induces firms to maximize perceived consumer surplus. But since competition shifts rents to consumers, information constraints might no longer be binding. Indeed, condition (6) shows that there exist perceived-optimal contracts where consumers self select into their designated contracts. As a result, competitive firms do not distort offers to reduce information rents. Instead, they focus on maximizing perceived optimal contracts.

The Proposition shows that competing firms intensify exploitation of inattentive consumers. They offer larger renewal prices with more back-loaded pricing than monopolistic firms. When consumers self select, competitive firms offer perceived-optimal contracts to consumers. That is,

[21] Using integration by parts, one can show that the condition simplifies to $\alpha G(p_I^C) \geqslant \int_c^{p_I^C} G(v)dv$. As α approaches a, the left hand side stays positive but the right-hand side goes to zero, and the condition is always satisfied. When $G(\cdot)$ is uniform on $[0,1]$, the condition simplifies to $2\alpha(2\alpha - a) \geqslant (a-\alpha)(3\alpha - a)c$. For interior solutions, we know that $2\alpha > a$, and this condition is always satisfied when c is sufficiently small.

unhindered by adverse selection, they cater entirely to consumer mistakes. Monopolists, as we saw in Proposition 2, were induced by adverse selection to focus less on exploitation of inattentive consumers. As a result, competing firms intensify exploitation of inattentive consumers. Renewal prices are always larger with competition.

By increasing the focus on exploitation, competition leads to larger consumer mistakes. To see this, recall that for any renewal price p, the switching error of inattentive consumers is $(a-\alpha)G(p)$. Since renewal prices are larger in competitive equilibria, competition leads to larger switching errors.

Because of adverse selection, monopolistic markets can be more efficient. For a wide range of parameters, i.e. when the share of inattentive consumers λ is sufficiently large, monopolists offer more efficient contracts. On the other hand, if λ is very small, the focus on reducing information rents can offset benefits from reduced exploitation. In these cases, monopolists offer inefficiently low renewal price for inattentive consumers with a very negative margin, and consumers switch inefficiently often. But a sufficient condition for monopolists to be more efficient is that they offer positive margins.

Remark on existence of equilibria: Competitive equilibria might not exist because of cream-skimming. A shortcoming of these results is that competitive equilibria might not exist. An extensive literature has followed the non-existence problem of competitive equilibria identified in Rothschild and Stiglitz (1976). For an overview see Mimra and Wambach (2014). In the present context, the reason why competitive equilibria might not exist is the following. When firms cross-subsidize the contracts of attentive consumers with the profits from inattentive ones, competitors can cream-skim the profitable inattentive consumers.

A way around is to add more structure to the firms' interaction. Wilson (1977) assumes that firms can withdraw contracts that become unprofitable when a competitor attracts some consumer types.[22] In this way, cream-skimming of profitable consumers can become unprofitable when the original contract is withdrawn. The constraints derived in Lemma 2 no longer apply.

Wilson equilibria always exist in this context. Clearly, the equilibrium identified in Proposition

[22]For another application of Wilson eqiuilibria, see Schumacher (2016).

3 does not involve cross-subsidization, and if (6) holds, it exists as a Wilson equilibrium. But if (6) is violated, a Wilson equilibrium exists as well and it involves adverse selection. In this Wilson equilibrium (IC_A) is binding, renewal prices are the same as in Proposition 2, and welfare is shifted to consumers in the form of lower setup prices.[23] In this equilibrium, contracts of inattentive consumers cross-subsidize those of attentive ones, but this is still a profit-maximizing menu in the sense of condition 3 of the definition on competitive equilibria. Thus, two types of Wilson equilibria exist. Some involve self selection, others adverse selection of attentive consumers.

Allowing for Wilson equilibria reinforces the main point of this paper that competition increases renewal prices. When (6) is violated, a Wilson equilibrium exists that induces the same distortions as the monopolistic contract in Proposition 2. But when (6) holds, competitive equilibrium contracts induce lower renewal prices. Overall, when allowing for Wilson equilibria competition *always* leads to weakly larger renewal prices and more back-loaded pricing.

6 Back-Loaded Pricing and Teaser Rates

The benchmark results in Section 4.1 state that firms want to offer larger renewal- and lower setup prices to exploit inattentive ones. This is consistent with the widely observed practice in many consumer markets of using back-loaded pricing such as teaser rates. Teaser rates are discounts for an initial period of time, regularly used in phone contract, credit cards and many more. My model predicts that firms want to offer teaser rates (i.e. lower setup prices) to inattentive consumers with larger post-teaser prices (i.e. renewal prices). DellaVigna and Malmendier (2004) find that firms want to target present-biased consumers with teaser rates, and Heidhues and Kőszegi (2010) and Heidhues and Kőszegi (2016) predict that firms use back-loaded pricing schemes with present-biased consumers. I confirm these findings with inattentive consumers. But these previous papers are silent on how back-loaded pricing interacts with competition.

I show that with heterogeneously attentive consumers, competition leads to more back-loaded pricing and competitive firms make more extensive use of teaser rates. Section 4.2 shows that adverse selection of attentive consumers reduces the profitability of teaser rates for monopolists and induces them to reduce post-teaser prices. And we saw in Section 5 that competitive firms are

[23] I derive this in more detail in the proof of Proposition 3.

less restricted by adverse selection. They focus more on exploiting inattention, leading competitive firms to offer more back-loaded pricing. Competitive firms will make more use of teaser rates, and offer larger post-teaser prices.

My findings in Section 4 are consistent with empirical evidence that firms want to target overconfident consumers with back-loaded pricing. In the US credit-card industry Ru and Schoar (2016) find that companies target less-educated consumers with offers containing lower teaser rates and larger post-teaser prices. My results predict that if firms had to make the same offers to all consumers, adverse selection of sophisticated consumers would lead to less back-loaded pricing.

My predictions that competition can induce more back-loaded pricing is consistent with Agarwal et al. (2017). They use a deregulation of interstate banking restrictions in the USA since 1994 as an exogenous shock to competition. Consistent with my results, increased competition leads banks to reduce initial rates offered on adjustable-rate mortgages but, most importantly, increased interest rates after the rates reset. Similarly, Di Maggio et al. (2015) study the supply of loans to households after a deregulation that only affected some firms. Also firms that were not directly affected by deregulation offered more back-loaded loans and mortgages as a response to increased competitive pressure.[24] My results offer an explanation for these findings, according to which competition induce firms to intensify exploitation of naive consumers and leads to more back-loaded pricing.

7 Policy

Policies that affect attention can backfire by mitigating adverse selection. My main results show how adverse selection of more attentive consumers can mitigate exploitation and improve performance of markets. But if adverse selection is beneficial, policies that educate consumers and increase their sophistication could reduce adverse selection and backfire, leading to larger prices. I discuss this possibility in this section.

Over the last years policymakers in many countries worried about low switching rates in consumer contracts. Especially automatic-renewal contracts have received significant attention of policymakers in the U.S. and the U.K., which lead to many new laws and regulations on these

[24]More precisely, banks offer more adjustable-rate mortgages and mortgages with negative amortization that involve early repayments below interests.

and related contract features. Especially *reminders* and disclosure requirements that aim to make automatic renewal more salient (henceforth '*salience policies*') directly target limited attention of consumers towards automatic-renewal features. Having a model with limited attention allows me to discuss implications of these policies in the context of this model.[25]

I now demonstrates that reminders and salience policies can backfire. They can soften the beneficial effects of adverse selection and lead to larger renewal prices. Yet salience policies seem more likely to do so.

First consider reminders. Policymakers oblige firms to remind consumers before contracts renew automatically. According to Florida's House Bill 751 (2010), firms have to give notice 30 - 60 days before self renewal, and the New York General Obligations Law 5-903 (2014) requires firms to give notice by certified mail.[26]

Reminders are targeted at consumers *closely* before automatic renewal to induce consumers to act. In the context of the model in Section 2, they aim to increase the probability that consumers act (α). To the extent that consumers anticipate future reminders, they might also increase the belief to act in the future a. I denote the change in the actual probability to act by $\Delta\alpha$, and the change in beliefs Δa.

We see in Proposition 1 that without adverse selection, reminders could reduce overconfidence ($a-\alpha$), and therefore renewal prices. This benefit occurs if $\Delta a < \Delta\alpha$, which means that a reminder decreases overconfidence.

With adverse selection as in Proposition 2 reminders might no longer be beneficial, and could actually backfire. Again, the reminder reduces overconfidence. But by increasing a, the reminder also reduces information rents for attentive consumers. Since these information rents reduce the renewal price, the reminder might end up *increasing renewal prices.*

To illustrate this, consider two extreme scenarios.

Case 1: Unanticipated reminders. When reminders do not affect beliefs ($\Delta a = 0$), for example when consumers are unaware of a new law, reminders always lower renewal prices, i.e. whether

[25] Concerning the effectiveness of reminders, Calzolari and Nardotto (2016) show that weekly reminders increase gym attendance. For another example, see Haushofer (2014).

[26] Another example is Illinois 815 ILCS 201/1 (2000), or the U.K., where Ofgem (2014) introduced a standardized automatic-renewal process with a 30-day termination notice for micro-business consumers

the market is competitive or monopolistic. Reminders only reduce overconfidence without affecting information rents. Renewal prices decrease.

Case 2: Fully anticipated reminder. Suppose all consumers are aware of the policy. The belief and the actual probability to act increase by the same amount ($\Delta\alpha = \Delta a$). In this case, reminders do not change overconfidence and the exploitation distortion is unaffected. But since $\Delta a > 0$, information rents decrease, leading to larger renewal prices. Reminders have negative effects in monopolistic markets, and have no effect in competitive ones.

These examples illustrate that unanticipated reminders are more effective in reducing renewal prices than anticipated reminders. The reason is that anticipated reminders can mitigate adverse selection and thereby induce the firms *increase* renewal prices. This finding complement the arguments in Ericson (2017) in favor of unanticipated reminders. He argues that when consumers are both present biased and inattentive, they might procrastinate setting up a reminder. But if a reminder is unanticipated and not set by consumers themselves, it can be an effective tool.

Salience policies seem more likely than reminders to backfire and increase renewal prices. In contrast to reminders, salience policies increase awareness of automatic-renewal features *when consumers sign a contract*. These salience policies directly target the belief to act a, and influence α only to the extend that consumers correctly anticipate their future actions. For example, salience affects consumers who were previously unaware of automatic-renewal clauses, and it affects these consumers at the contracting stage. Reminders on the other hand reach these previously unaware consumers only just before automatic renewal. This suggests that reminders target the actual probability to act α. On the other hand, salience policies have a stronger impact on a, suggesting that their effects are closer to those of fully anticipated reminders. In this way, salience policies are more likely to mitigate the beneficial effects of adverse selection. This suggests that reminders are superior to salience policies in the context of this model.

8 Related Literature

In this Section I discuss the relationship with previous theoretical research. While I point out other differences below, no previous paper has studies the tradeoff between exploiting naive procrastinators and adverse selection of more sophisticated ones, and the resulting implication of more back-loaded pricing in competitive markets and implications for policies. Accordingly, the main insights of the subsequently discussed papers are largely distant.

The paper contributes to the literature on behavioral economics and **back-loaded pricing** by making novel predictions on how back-loaded pricing changes with market power. It is most closely related to DellaVigna and Malmendier (2004). They study automatic-renewal contracts, but with homogeneous- and present-biased consumers. The most closely related papers with heterogeneous consumers, but also looking at present-biased consumers, are Heidhues and Kőszegi (2010), and Heidhues and Kőszegi (2016). These papers study how firms can exploit naivete about present bias in credit-card or mortgage markets. All three papers predict back-loaded pricing for naively present-biased consumers. I confirm their findings on back-loaded pricing when consumers have limited attention. But all three papers look only at competitive settings. Thus, they are silent on how back-loaded pricing interacts with market power and different degrees of competition. I show that consumer heterogeneity and adverse selection affect monopolists and competitive firms differently. This leads to the novel prediction that competition induces more back-loaded pricing.[27]

This paper also contributes to work on **distorting competition**. Many papers in behavioral industrial organization study the role of consumer mistakes in competitive markets,[28] but few study how exploitation of consumer mistakes interacts with different levels of competition. One paper in that direction is Carlin (2009). In the context of a Varian-type search model Carlin (2009) shows that firms respond to more intense competition by increasing product complexity. This complexity renders product comparison more difficult, and mitigates competitive pressure on prices. Similar to my model, they highlight how competition can induce firms to focus more on exploiting consumer biases. The bias and the mechanism are very different in my model.[29] But more importantly, in Carlin (2009), firms increase complexity to prevent rent-shifting to consumers. Also non-behavioral papers study how rent-shifting can be distorted as markets become more competitive. Chen and

[27]Also Gabaix and Laibson (2006) predict that naive consumers pay more hidden- or shrouded add-on fees. In this sense, they also predict back-loaded pricing. But they do not model contracts explicitly, and they do not study how the exploitation motive changes with different levels of competition. Also, naive and sophisticated consumers only observe transparent fees such that firms cannot use add-on prices to price-discriminate between consumers.

[28]For an overview see Grubb (2015), or Eliaz and Spiegler (2015)

[29]In my model exploitation works leads to a more exploitative pricing structure, rather than the way in which prices are presented.

Riordan (2008) study a discrete choice model of product differentiation. Adding a second firm with a differentiated product to the market can increase prices. Similarly, Gabaix et al. (2016) show in a homogeneous-product market with a random-utility model that firms can sustain large markups even with a large number of competitors. In both models, demand curvature can mitigate pricing pressure of competitors and prevent rent-shifting to consumers.

In contrast to these papers (Carlin, 2009; Chen and Riordan, 2008; Gabaix et al., 2016) in my model firms in competitive markets do not impede rent-shifting to consumers. But competition leads to a more exploitative contract design that increases consumer mistakes. By shifting surplus to consumers, competition mitigates adverse selection and induces firms to cater products more to consumer mistakes. This leads to a more exploitative pricing structures with more back-loaded pricing. Competition increases consumer mistakes and can lead to less efficient contracts. Additionally, by modeling specific biases, I can analyze the impact of consumer-protection measures such as reminders and salience policies on competition and pricing.

Present Bias and Automatic Renewal: Existing models on automatic-renewal contracts such as the aforementioned DellaVigna and Malmendier (2004) i) focus on present-biased consumers and ii) studies homogeneous consumers. Yet recent empirical evidence (Handel, 2013; Marzilli Ericson, 2014; Heiss et al., 2016; Kiss, 2016) supports the key role of consumer inertia and limited attention to explain low switching rates. I relax both assumptions and introduce a model with limited attention as a cause for procrastination in automatic-renewal contracts, and I study implications of heterogeneously biased consumers.

Murooka and Schwarz (2016) also study automatic-renewal contracts with present-biased consumers. They study a different set of policies that do not target limited attention but reduce switching costs in automatic-renewal contracts with free trial periods. Yet similar to my results on reminders, they find that reducing switching costs is most beneficial to consumers when applied just before contracts renew.

Heterogeneously Biased Consumers: Besides the aforementioned Heidhues and Kőszegi (2010), and Heidhues and Kőszegi (2016), other papers (Galperti, 2015; Eliaz and Spiegler, 2006) consider screening of heterogeneously biased consumers. Both papers do not study a tradeoff between exploiting consumer naivete and reducing information rents. Galperti (2015) only considers sophisticated present-biased consumers. In contrast, Eliaz and Spiegler (2006) study consumers who differ in their beliefs about future preferences but are ex-post identical.[30]

This paper contributes to the literature on **limited attention**. Many papers on rational inattention (Sims, 2003; Sims et al., 2010; Maćkowiak and Wiederholt, 2009; Matejka and McKay, 2014) study how consumers allocate attention between exogenous sources of uncertainty. The present paper focuses on understanding firm pricing given consumers are inattentive. Ericson (2014) uses an overlapping generations model with inattentive consumers and switching costs to study when firms want to use which default rule, choosing between automatic renewal, automatic switching, or no purchase. In contrast to my paper, consumers are ex-ante identically (in)attentive and there is no scope for price discrimination along these dimensions.

Models of transaction costs, i.e. **switching costs** also study switching behavior of consumers. My approach differs from switching-cost models for three main reason. First, as pointed out by Farrell and Klemperer (2007) in their overview article, switching costs are irrelevant when firms can commit to future prices. I analyze a setting where firms have this commitment power. Especially when thinking about teaser rates, which firms typically commit to in a contract, this kind of commitment power seems reasonable in many applications. Second, empirical work (Heiss et al., 2016; Kiss, 2016) identifies limited attention separately from switching costs and finds that limited attention is crucial to explain low switching rates of consumers. Third, the policies I discuss in Section 7, i.e. reminders or salience policies, directly target limited memory and inattention towards automatic-renewal features. To understand these policies, it is therefore important to model limited attention explicitly.

[30] See Heidhues and Kőszegi (2010) for a detailed discussion on the differences of the model in Eliaz and Spiegler (2006) to one with present-biased consumers. While the authors do not consider implications of competition, a simple variant of this model with competition is studied in Spiegler (2011). But since consumers are ex-post identical, competition only affects how many consumers choose an exploitative betting-type contract over a commitment device, but not how firms distort decisions within these contracts. Yet in my model competition influences also the design, i.e. the pricing structure, of exploitative contracts.

9 Conclusion

In many classic environments, competition induces firms to maximize perceived consumer welfare. But when consumers are not perfectly sophisticated, their perceived welfare can be different from their actual welfare. In these cases, competition fails to maximize consumer welfare, and firms might cater to consumer mistakes. In classic monopoly settings, information rents distort the incentives of a monopolist to maximize the perceived welfare of consumers. This article provides an example of how this information-rent distortion can be systematically beneficial for welfare by inducing firms to focus less on exploiting consumer naivete, i.e. to cater less to consumers' mistakes. Somewhat paradoxically, market power induces less exploitation and lower renewal prices for naive consumers, and can thereby increase total welfare.

My model predicts that competitive firms rely more frequently on back-loaded pricing such as teaser rates and offer larger teaser discounts. In practice, firms might also use teaser rates to increase their market shares. My results suggest that this strategy is successful because teaser discounts disproportionately attracts consumers who are overconfident about their future probability to cancel after the teaser period. These consumers switch less often and induce firms to increase prices after the teaser period.

I study price discrimination in this paper, but the same tradeoff between exploitation- and information rents is present if for some exogenous reason firms have to offer the same contracts to several consumer groups. Similarly, results easily extent to a case where attentive consumers are not perfectly sophisticated but only more attentive than the others.

Also with heterogeneously present-biased consumers, competitive firms are less restricted by adverse selection and intensify exploitation of naively present-biased consumers. Present bias complicates the analysis because consumer naivete can induce and upward- or downward distortion of the efficient renewal price. But under arguably weak conditions on the demand function for consumption in period 2, adverse selection induces a distortion in the opposite direction. Thus, the tradeoff driving the main results of this article is robust to present-biased consumers. But in contrast to consumers with limited attention, present bias and competition *might* lead to less back-loaded pricing, which is nonetheless more exploitative. Appendix B.1 discusses this briefly and the Wep Appendix in more detail.

If competition softens the beneficial effects of adverse selection, policymakers might want to encourage adverse selection in competitive markets. For example, in line with Ru and Schoar (2016), firms might target subgroups of consumers with specific offers. This makes it harder for consumers to be aware of all the offers in the market, potentially weakening adverse selection effects. Increasing consumer awareness of other offers could then have beneficial effects by encouraging adverse selection.

Policymakers in many countries worry about low switching rates of consumers and implemented policies that increase awareness of automatic-renewal features to encourage switching. My results suggests that these policies can backfire when they mitigate adverse selection. But my model also suggests that reminders—implemented just before automatic renewal—are less likely to backfire in that way than policies that make automatic-renewal features more salient at the contracting stage.

A more drastic policy would be to turn automatic renewal into automatic cancellation, or regulation of contract length.[31] In the context of this model, such policies take away the opportunity of firms to exploit naive procrastinators and increase welfare when markets are competitive. In reality, however, such policies require consumers to search and sign new contracts which is costly for them. Consented renewal seems like a promising alternative policy in competitive markets since firms need to push consumers into making a decision. Studying these policies in detail is left for future research.

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A Proofs

Proof of Proposition 1. The derivative of (3) w.r.t. p_i for $p_i \in [\underline{v}, \overline{v}]$ simplifies to

$$-\alpha_i g(p_i)(p_i - c) + (a_i - \alpha_i)G(p_i). \tag{7}$$

Prices $p_i < c$ are clearly not optimal. Prices $p_i > \overline{v}$ cannot be optimal as well since consumers switch with probability one and firms earn zero profits from renewal. By Assumption 1, the expression is becomes negative as p_i approaches $\overline{v}$. Thus, we can infer that (3) has an interior solution with $p_i \in (\underline{v}, \overline{v})$. Furthermore, this solution satisfies (4). [32] □

Proof of Proposition 2. The derivatives of (M-R) w.r.t. p_A and p_I are

$$-(1-\lambda)(p_A - c)g(p_A) \qquad \text{and} \tag{8a}$$

$$-\alpha g(p_I)(p_I - c) + (a - \alpha)G(p_I) - \frac{(1-\lambda)}{\lambda}(1-a)G(p_I). \tag{8b}$$

respectively. All cross-derivatives are zero. Thus, (8a) implies the existence of an interior solution for p_A since it is positive when p_A approaches $\underline{v}$ and negative when it approaches $\overline{v}$. For (8b) note that it is weakly smaller than (7) from the benchmark. Since it is still positive for $p_I = \underline{v}$, we can infer the existence of an interior solution.

Any solution therefore requires that (8a) and (8b) are equal to zero. For the former, this pins down marginal cost pricing and for the latter it leads to (5). □

Proof of Lemma 2. I show first that firms earn zero profits from each customer group. Suppose otherwise, i.e. some firm B earns positive profits from one type of consumers and make losses from the other. Suppose the profitable types get a contract (f_i, p_i) of firm B. In any candidate equilibrium, the other types $j \neq i$ must weakly prefer their own offer. Note that this includes the case that both types choose the same contract. But we know from Lemma 1 that a single-crossing property holds. I.e. that the marginal second-period utility w.r.t. renewal prices depends on consumer beliefs. Since $a_i \neq a_j$, a marginal change in renewal prices affects both types differently. This implies that a competitor of firm B can profitably attract only the profitable types i of firm B. To do so, she changes p_i marginally in the direction that is less harmful to the profitable types i, implying that the profitable types enjoy a larger second-period utility from this offer than the unprofitable types j. But then, this competing firm can adjusts f_i to make sure that only types i prefer this offer. Since types i were profitable at the initial offer of firm B, this is always possible and profitable. I conclude that there is no cross-subsidy between types in competitive equilibrium contracts.

This also rules out pooling contracts that include cross-subsidization between types. The only pooling contract that induces zero profits and does not induce cross-subsidization is the one where firms offer $(f, p) = (c, c)$. This can not be an equilibrium contract though, Since firms could increase profits by exploiting overconfidence: Due to overconfidence, increasing p increases second-period profits from inattentive types by more than these types anticipate. Some of these unanticipated profits can be used to make consumers indifferent to the increased renewal price, while firms keep the rest as profits. I conclude that there are no pooling contracts in any competitive equilibrium. □

[32] Note that (3) might have multiple solutions. I assume the solution is unique.

Proof of Proposition 3. I show in the text why the equilibrium exists when (6) holds. It remains to show that it does not exist when this condition is violated.

If (6) is violated, there is an adverse-selection problem also with competition. Firms can make sure that attentive consumers choose their designated contract by ensuring that (IC_A) is binding. Again, we know from Lemma 1 that attentive consumers enjoy a larger utility from any given contract, implying that $w - f_I + V(p_I; a) = \hat{u}_I$. This leads to the following reduced-form problem.

$$\max_{\{p_A, p_I\}} \lambda W_I(p_I; \alpha) + (1-\lambda) W_A(p_A; 1) - \hat{u}_I \\ + \lambda \left[V(p_I; a) - V(p_I; \alpha)\right] - (1-\lambda)\left[V(p_I; 1) - V(p_I; a)\right]. \tag{C-R'}$$

The only difference to the monopoly's problem (M-R) is the constant $\hat{u}_I$. This leads to the same renewal prices as the monopolistic ones in Proposition (2). Intuitively, the incentive-compatibility constrain (IC_A) is binding in both cases and some kind of participation constraint for inattentive consumers. The difference is the outside option $\hat{u}_I$. The solution to this problem is conditional on this outside option, which is pinned down by the zero-profit condition. As in the previous section, this reflects competition between firms.

This candidate equilibrium does not constitute a competitive equilibrium since it contains cross-subsidization from inattentive to attentive consumers and contradicts the Properties of Lemma 2. To see this, note first that the binding (IC_A) is equivalent to $f_A - f_I = V(p_A; 1) - V(p_I; 1)$, and zero profits imply that $f_A = c + \lambda \left[V(p_A; 1) - V(p_I; 1)\right] - \lambda\pi(p_I; \alpha) - (1-\lambda)\pi(p_A; 1)$, where $\pi(p_i, \alpha_i) = \alpha_i(1 - G(p_i))(p_i - c) + (1-\alpha)(p_i - c)$ denote the expected second-period profits of customer i. In the candidate equilibrium, $p_A = c$, implying that $\pi(p_A; 1) = 0$, simplifying $f_{A1} = c + \lambda \left[V(p_A; 1) - V(p_I; 1)\right] - \lambda\pi(p_I; \alpha)$. Thus, first period prices of attentive consumers depend on the second-period profits of inattentive ones, contradicting the no-cross-subsidization result from Lemma 2. I conclude that no pure-strategy equilibrium exists when (6) is violated.

But as outlined in the main text, Wilson equilibria with cross-subsidization do exist. Thus, the candidate equilibrium is a Wilson equilibrium. □

B Supplementary Material

B.1 Robustness with Present-Biased Consumers

I discuss briefly in this Subsection how the key result—the tradeoff between exploiting overconfidence and reducing information rents—translates to the case with present biased consumers. I present these results in more detail in the Web Appendix.

The analysis follows the same general structure as before. I show that it is again without loss of generality to focus on cut-off contracts with a single renewal price and no cancellation fee. I establish benchmark results with full information on consumers' time preferences and show that firms distort contracts to exploit overconfidence. I then explore the implications of private information about time preferences for a monopolistic seller, where I derive arguably mild conditions under which monopolists face the same aforementioned tradeoff. Afterwards, I establish that competitive equilibrium contracts, whenever they exist, involve self-selection, and focus more on exploitation than monopolistic ones.

	Limited Attention	Present Bias
Switching error of procrastinators	$(a-\alpha)G(p)$	$G(p-\frac{s}{b})-G(p-\frac{s}{\beta})$
Additional switching of non-procrastinators	$(1-a)G(p)$	$G(p-s)-G(p-\frac{s}{b})$

Table 1: Switching error of overconfident consumers and additional switching probability from the perspective of period 0 with limited attention and present bias.

In terms of modeling, I introduce a switching effort $s>0$ in the analysis of present-biased consumers. Consumers need to invest these costs in period 1 to cancel the contract and enjoy their outside option in period 2. While the qualitative features of the model with inattentive consumers do not depend on switching effort, this effort is important with present-biased consumers. Present-biased consumers, when facing the switching decision in period 1, put a larger weight on the switching effort relative to future gains from switching. This induces them to procrastinate.

Even though results are similar, there are some crucial differences to the case with inattention that require the detailed analysis. We saw earlier that with limited attention, all consumers in an attentive state switch according to the same decision rule. This is different with present bias. Consumers have to decide in period 1 whether to switch or consume again in period 2, and invest the switching effort s immediately. This is why the switching decision now depends on present bias. A consumer with present-bias parameter β who faces a renewal price p will switch if and only if $v\leqslant p-\frac{s}{\beta}$. Such a consumer's true utility in period 1 is maximized with an efficient commitment device priced at $c+\frac{1-\beta}{\beta}s$. If in period 0 such a consumer overconfidently beliefs that his future present-bias is characterized by $b\geqslant\beta$, he will falsely expect to switch if and only if $v\leqslant p-\frac{s}{b}$. Time consistent consumers on the other hand, have the same decision rule as attentive consumers, adjusted for switching effort. That is $v\leqslant p-s$.

The switching error, i.e. the probability with which present-biased consumers falsely believe to switch, is therefore $G(p-\frac{s}{b})-G(p-\frac{s}{\beta})\geqslant 0$. Similarly, time-consistent consumers believe to switch more often than present-biased ones with probability $G(p-s)-G(p-\frac{s}{b})\geqslant 0$. This is summarized and compared to the case with limited attention in Table 1.

The comparison of switching error and additional switching probability reveals a crucial difference between the two cases. With limited attention a single-crossing property holds. Since $G(\cdot)$ is an increasing function, increasing the switching error requires increasing the renewal price, and reducing the additional switching probability requires reducing it. These are exactly the directions of the distortions to exploit overconfidence and to reduce information rents respectively. But with present bias, the direction of the distortion to increase the switching error and to reduce additional switching depends on the curvature of $G(\cdot)$. Thus, also a single-crossing property holds under conditions on $G(\cdot)$.

This observation is the reason why with present bias, the tradeoff between exploiting overconfidence and reducing information rents depends on the curvature of $G(\cdot)$. Indeed, as we can guess from Table 1, local concavity or convexity of the demand $G(\cdot)$ are sufficient conditions for the tradeoff to exist also with present-biased consumers. The precise conditions are summarized in Corollary 1 in the Web Appendix.[33]

[33]Under the conditions of Corollary 1 in the Web Appendix, a similar single-crossing property as in Lemma 1 holds

While efficiency calls for marginal-cost pricing with limited attention, present biased consumers efficiently purchase a commitment device at a renewal price $c + \frac{1-\beta}{\beta}s$. Since the direction of the distortions depends on the curvature of $G(\cdot)$, both distortions can induce an inefficiently high or low renewal price. This has two important implications.

First, under the conditions of Corollary 1 in the Web Appendix, the distortions go in opposite directions. Under these conditions a monopolist faces a tradeoff between exploitation and information-rent reduction also with present bias, limiting the extent to which monopolists exploit consumer mistakes.

Second, with present-biased consumers the effect of competition on renewal prices is more ambiguous. Improving competition *can* reduce renewal prices and lead to less back-loaded pricing. This reduction can be inefficient though when prices move away from the efficient commitment device. But with inattention, competition *always* increases renewal prices. Conversely, observing a lower renewal price in a more competitive setting is only consistent with present bias.

B.2 Cutoff Contracts

In this section I show that it is without loss of generality that firms use cutoff contracts as specified in Section 2.

I model the interaction between firms and consumers using tools from mechanism design. In this reformulation of the model, consumers do not directly decide to switch. Instead they can a report (true or false) valuation $\tilde{v}$ for continued consumption. This report determines whether or not to terminate the relationship. I use these tools to show that, even when consumers are naively inattentive, cut-off-type contracts are without loss of generality. This implies that firms cannot benefit from using cancellation fees in this setting. Since firms apply these fees in many real-life settings, it is important to understand if and how firms can beneficially use them in this setting.

Firms can commit to a two-period menu of contracts to maximize total profits. In general, contract terms could depend on complex communication and messages between consumers and firms; but by the revelation principle it is without loss of generality to focus on direct mechanisms. In such mechanisms, consumers only report[34] their private information *at each stage of the game* and reports are assigned a contract.[35] Thus, optimal menus of contracts are of the form $M = \{f_i, y_i(v), p_i(v)\}_{i\in\{A,I\}}$. At each stage of the game, contracts are conditioned on the private information of a consumer and her history of private information. Consumers first learn their beliefs about their future attention before learning the valuation for consumption in period 2. This is why the consumers' first-period transfers f_i are a function of the consumers' report about their attention. The second-period transfer $p_i(v)$ and the renewal probability $y_i(v)$ are functions of the

also with present-biased consumers.

[34]In the end, consumers "reporting" information will be the same as choosing one contract or contract option over the other.

[35]The logic follows the standard revelation-principle argument as in Myerson (1986). In general messages from consumers to firms could come from very large message spaces. Any equilibrium message is perceived optimal and depends on the consumers' type, i.e. her private information. But then it is without loss of generality to ask consumers to report their private information directly and make the potentially complex communication an implicit part of the mechanism. Revelation principles have already been used in the context of quasi-Bayesian models. For examples, see Eliaz and Spiegler (2006) or Eliaz and Spiegler (2008).

earlier reported attention type i and consumers' valuation for renewal v. This specification allows for payments after both staying and switching.[36] I study non-random contracts, i.e. $y_i(v) \in \{0,1\}$ which equals one if the consumer stays and zero if she switches.

Firms cannot condition contracts on the consumers' inattentive state. In particular, firms cannot distinguish in period 1 whether a consumer is inattentive or has a very high valuation $\overline{v}$ for consumption in period 2. For the direct revelation mechanism, this means that inattentive consumers who forget to act 'automatically' report a valuation $\widetilde{v} = \overline{v}$. This ensures that inattentive consumers who do not act stay with probability 1 as long as transfers are below $\overline{v}$.

This specification allows for payments after both staying and switching. Firms offer a menu of contracts at the contracting stage (period 0) that maximizes their objective function.

I assume in the main text that all consumers switch with probability one at prices for which they would never want to continue, that is if a price p for second-period consumption is such that $p > \overline{v}$. In the context of a direct revelation mechanism, this means that consumers automatically report $\widetilde{v} = \overline{v}$ if they are in an inattentive state.[37]

Switching Behavior: At the end of period 1 a consumer with value v reports a valuation $\widetilde{v}$ that determines her renewal decision $y_i(\widetilde{v})$ and transfers $p_i(\widetilde{v})$. In an inattentive state, consumers 'automatically' report $\widetilde{v} = \overline{v}$. To guarantee truthful reports ($\widetilde{v} = v$) of consumers in an attentive state on the equilibrium path—i.e. that consumers switch when they are supposed to—the following incentive-compatibility constraints have to be satisfied conditional on acting:

$$\begin{aligned} u_i(v) \equiv& \bar{u}(1 - y_i(v)) + v y_i(v) - p_i(v) \geqslant \\ & \bar{u}(1 - y_i(\widetilde{v})) + v y_i(\widetilde{v}) - p_i(\widetilde{v}) \equiv u_i(\widetilde{v}), \ \ \forall v, \widetilde{v}, \ i \in \{A, I\}. \end{aligned} \tag{IC_2}$$

Consumers stay with probability $y_i(v)$ and enjoy the renewal value v, or switch with probability $(1 - y_i(v))$ and enjoy their outside option $\bar{u} = 0$.

The following Lemma states that we can use cut-off contracts to simplify the analysis. These contracts have the following structure:

$$y_i(v) = \begin{cases} 1 & \text{if } v \geqslant \hat{v}_i \\ 0 & \text{else} \end{cases}, \ \ \forall i \in \{C, I\},$$

with prices $p_i(v) = \hat{p}_i$ if $y_i(v) = 1$, and otherwise $p_i(v) = q_i$.

I refer to $\hat{p}_i$ as a renewal price, and to q_i as a cancellation fee that consumers have to pay to be allowed to leave the contract. These cancellation fees are common in many real-life settings.

The key argument applies standard techniques. I establish first the monotonicity of $y_i(\cdot)$ and $u_i(\cdot)$. Since $y_i(\cdot)$ is monotone and only takes values in $\{0,1\}$, there exists a single cutoff.

Lemma 3. *(IC_2) hold if and only if firms use cut-off strategies in period 2.*

[36] Results are unchanged when firms cannot write the renewal decision $y_i(v)$ into the contract but instead give a recommendation which consumers follow in equilibrium.

[37] Alternative assumptions that lead to the same result are the following. First, consumers do not sign contracts with renewal prices $p > \overline{v}$. Second, $\alpha_i = a_i$ if $p > \overline{v}$. Additionally, regulators and policy makers would likely become suspicious of a firm's who offer a renewal price at which no perceivable consumer would want to continue, inducing firms not to raise prices too much.

Proof of Lemma 3. I now show that $(IC_2) \Rightarrow$ cut-off strategies.

If $v > \widetilde{v}$, then $y_i(\widetilde{v}) \leqslant \frac{u_i(v)-u_i(\widetilde{v})}{v-\widetilde{v}} \leqslant y_i(v)$. The proof is standard. Assume $v > \widetilde{v}$. Then (IC_2) can be rewritten as $u_i(v) \geqslant u_i(\widetilde{v}) + y_i(\widetilde{v})(v - \widetilde{v})$. Similarly, using (IC_2) for type $\widetilde{v}$'s deviation to v pins down the upper bound for $\frac{u_i(v)-u_i(\widetilde{v})}{v-\widetilde{v}}$.

Since $y(\cdot) \geqslant 0$, this implies that $u_i(v)$ and $y_i(v)$ are non-decreasing. Finally, since $y_i(\cdot)$ is monotone and only takes values in $\{0, 1\}$, there exists a single cutoff.

I show next that cut-off contracts of the form above imply (IC_2). The type $\hat{v}$ who is indifferent between switching and staying is given by $p_i(\hat{v}) = \hat{v}$, with a utility of zero. Clearly no customer can benefit from misreports that have no impact on the allocation. Every $v > \hat{v}$ gets strictly more than zero by saying the truth and every $v < \hat{v}$ would get strictly less than zero by a false report that gets him assigned to stay. Therefore, cut-off contracts are incentive compatible. □

The constraints (IC_2) only ensure truthful reports on the equilibrium path and conditional on acting. They neither characterize off-equilibrium reports, i.e. when type i reported $j \neq i$ for $i, j \in \{A, I\}$ earlier in the game, nor the anticipated switching behavior in period 0 given overconfidence $a_i > \alpha_i$.

Lemma 3 states that it is w.l.o.g. to assume that firms induce cut-off strategies. Intuitively, firms use cut-off contracts because they implement truthful reports of consumers conditional acting.

The result that it is without loss of generality to use cut-off contracts is familiar from the sequential screening literature, e.g. Courty and Li (2000). However, I make the argument here to show that firms do not benefit from using cancellation fees. These fees are a common feature in consumer markets and might appear a useful tool to influence switching decisions of procrastinating consumers. But Lemma 3 shows that they are an unnecessary instrument in the context of automatic contract renewal to exploit procrastinating consumers.

A first important observation is that cancellation fees do not affect incentives. Intuitively, any cut-off contract with $q_i \neq 0$ can be redefined as an incentive-equivalent contract with a cancellation fee equal to zero and a renewal price equal to $\hat{p}_i - q_i$. Both formulations lead to the same incentive-compatibility constraints when plugged into (IC_2). This is why it is without loss of generality to set $q_i = 0$, which I do throughout this article. The menu of contracts offered by firms therefore simplifies to $M = \{f_i, p_i\}_{i \in \{A,I\}}$. In what follows the correct interpretation of the renewal price is the extra margin consumers pay for staying in addition to a price for switching.

This observation has important implications for regulation. It implies that regulating cancellation fees has no impact on issues related to procrastination and automatic contract renewal. Even a price cap on these fees would only shift prices from the second to the first period. Only a joint regulation of both prices can have an effect.

We can now easily characterize the switching decision. Conditional on making a decision, each consumer type i stays in contract j if and only if $p_i \leqslant v$. All types have the identical cut-off in any contract given they pay attention and make a decision. When not acting, inattentive consumers stay with probability one.

B.3 How Firms ensure (IC_I) is slack: Discounts and Conditional Benefits

The reason why (IC_I) might be slack absent discounts, note that this condition together with (IC_A) can be rewritten as

$$V(p_A, 1) - V(p_A, a) \geqslant U_A(A) - U_I(I) \geqslant V(p_I, 1) - V(p_I, a).$$

Part 1 of Lemma 1 together with (IC_A) imply that $U_A(A) - U_I(I) \geqslant 0$. We know from the third property of Lemma 1 that $V(p, 1) - V(p, a)$ increases in p. Consequently, absent discounts, the condition is violated if $p_A < p_I$. This is why, despite a single-crossing condition, (IC_I) might not be satisfied and might not to be binding.

But firms can ensure that (IC_I) is slack by using payments that condition on consumers being attentive, such as vouchers or loyalty cards. These conditional benefits have in common that consumers have to remember to bring them along. Another group of examples are benefits that, in order to get them, require the consumer to satisfy certain conditions that consumers have to remember. Examples are bonus miles or cash benefits from credit cards, where consumers have to remember which card to use for which airline to get the right bonus miles, or loyalty cards for which consumers have to remember the proper usage conditions.

To see this in more detail, suppose (IC_I) is binding. Then the firm can make it slack in the following way by using that inattentive consumers are partially aware of their inattention ($a < 1$). Firms can increase the setup prices of attentive consumers by Δ and give a discount of Δ whenever consumers remember to bring a voucher, loyalty card or remember to satisfy some condition. Attentive consumers bring the voucher with probability one and their setup price is unaffected. But inattentive consumers expect to bring the voucher only with probability $a < 1$, effectively increasing their expected first-period price in contract A by $(1 - a)\Delta$. In this way, an arbitrarily small voucher makes the (IC_I) slack. With vouchers, we can rewrite (IC_I) as

$$U_I(I) \geqslant U_A(A) + V(p_A; a) - V(p_A; 1) - (1 - a)\Delta.$$

This shows that vouchers can ensure that (IC_I) is slack.

Note that as long as attentive consumers are around, vouchers are not useful to extract rents from inattentive consumers. To keep perceived setup prices unchanged for inattentive consumers, the extra price Δ has to be smaller than the expected discount $a \cdot X$, where X is the total amount payed out in case the consumers remembers the voucher. Thus, due to awareness of inattention ($a < 1$) the price increase Δ has to be significantly smaller than the effective discount X. This creates an arbitrage opportunity for more attentive consumers. They could buy the product and get the voucher with probability one, inducing a loss to firms. It might even attract consumers without any interest in the actual product.

It follows that firms are not restricted by (IC_I). If such discounts were not feasible or if the arbitrage opportunity for attentive consumers was restricted for some exogenous reason, monopolists might offer pooling contracts. These pooling contracts feature the same tradeoff between exploitation and information rents as the screening contracts. Thus, even if pooling contracts would exist for some parameter values, the results that compare monopolistic and competitive screening contracts hold.