The Timing of Choice-Enhancing Policies

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Abstract

Recent studies investigate policies motivating consumers to make an active choice as a way to protect unsophisticated consumers. We analyze the optimal timing of such choice-enhancing policies when a firm can strategically react to them. In our model, a firm provides a contract with automatic renewal. We show that a policy intending to enhance consumers' choices when they choose a contract can be detrimental to welfare. By contrast, a choice-enhancing policy at the time of contract renewal increases welfare more robustly. Our results highlight that policies should be targeted in timing to the actual choice inefficiency.

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1 Introduction

Automatic-renewal contracts are prevalent in many services such as mobile-phone plans, mortgage contracts, and Internet-connection subscriptions. With mounting evidence that some consumers exhibit systematic behavioral biases, there are concerns that firms may use automatic renewals to exploit unsophisticated consumers. To protect such consumers, policies that motivate consumers to make an active choice have been discussed and employed.[1] However, two issues associated with such policies have been under-investigated. First, what are the welfare effects of such policies when firms can respond to these policies? Second, when should a policymaker motivate consumers to make an active choice?

This paper analyzes the welfare consequences of choice-enhancing policies when a firm can change its pricing strategy in response to the policies. Section 2.1 introduces our basic model, in which a firm automatically renews its service contract (e.g., a mobile plan) for consumers who bought its initial package (e.g., a smartphone with a teaser-rate mobile plan). Some consumers are naive present-biased à la O'Donoghue and Rabin (1999a), whereas all others are time-consistent and rational. Each consumer incurs a positive switching cost (e.g., an effort cost to search for a different firm or to cancel the contract) when she either forms a contract with some other (non-default) firm or opts out of the service before the automatic renewal. Section 2.2 describes how our model can be mapped to markets with automatic renewals, such as mobile-phone plans, mortgage contracts, and Internet-connection subscriptions.

Section 3 analyzes the model and presents our main results. The firm faces a trade-off between selling both its initial package and recurring service to all consumers at moderate prices and exploiting naive consumers' present bias by selling its initial package and recurring service to only those consumers at high prices. If the firm chooses the exploitative pricing strategy, rational consumers will choose a contract with a different firm and incur a socially inefficient switching cost. In this case, the firm serves fewer customers but earns a higher profit per customer.

We first analyze the effect of a policy that makes it easier (or more attractive) for consumers

[1] For example, Florida House Bill 751 in 2010 states that "[t]he burden [of contracts with automatic renewal provisions] is generally placed on the consumer, who may not always notice the provisions, to terminate the contract. Therefore, consumers may ultimately contract for a period longer than anticipated." The bill requires sellers to "clearly and conspicuously disclose automatic renewal provisions to consumers" and "provide written or electronic notification to consumers no more than sixty and no less than thirty days prior to the cancellation deadline." In Section 5, we extensively discuss other real-world policies which have been employed (or could be employed) in each industry mentioned above.

to switch to a competitor when choosing a contract. As long as the firm does not change its type of pricing strategy (or if the firm's pricing strategy is exogenously given), then such a policy always increases each consumer's utility and social welfare. By contrast, we show that if the firm changes its type of pricing strategy in response, then this policy can strictly decrease consumer and social welfare. Intuitively, because naive consumers may procrastinate on their switching decision, rational consumers are more responsive to the policy (i.e., more likely to switch to a competitor in response to the policy) than naive present-biased consumers are. Because the policy makes rational consumers less profitable for the firm, exploiting naive consumers (who are less price elastic and less responsive to a policy than rational consumers are) becomes relatively more attractive. As an optimal response to the policy, the firm may increase its prices to exploit naive consumers. Hence, the policy can reduce naive consumers' long-run utility, and thus the effect of decreasing the switching cost at the time of choosing an initial contract on the equilibrium prices is non-monotonic. This is a perverse result because such policies typically aim to protect naive consumers. In this case, social welfare also decreases because rational consumers switch and thus incur a (socially wasteful) switching cost.

As an alternative policy, we then investigate a policy that makes it easier for consumers to switch to a competitor right before the contract renews automatically. As a practical example of such an alternative policy, a firm could be required to inform consumers prominently about how to cancel its service right before the contract renewal. We show that—in contrast to the policy above, which is effective right before the contract is signed—this alternative policy always (weakly) increases consumer and social welfare. Intuitively, under the alternative policy, both rational and naive consumers are more likely to consider switching right before the automatic renewal. When both types of consumers plan to switch at the same time, the policy will not give the firm an additional incentive to increase its prices. Consequently, the alternative policy does not have the perverse effect of inducing the firm to increase its prices. This logic and our policy implications apply whenever naive consumers are less responsive to a policy than rational consumers are. Thus, to avoid the perverse welfare effect, it is important to target choice-enhancing policies *in timing* to the actual choice inefficiency.

In Section 4, we investigate extensions and modifications of the model. We show that our main message remains unchanged when we allow consumers to be inattentive to the price after the automatic renewal rather than being present-biased, analyze the case where the firm can charge fees for its recurring service multiple times, endogenize competition among firms, give the firm the option to offer menu contracts, or consider partially naive and sophisticated present-biased consumers. Section 5 describes concrete choice-enhancing policies that have been (or could be) employed and discusses them with respect to the welfare predictions of our model: (i) information provision policies such as saliently explaining the contract terms or sending notifications at a time of an automatic renewal; (ii) taxes, subsidies, and price regulations to encourage switching to alternatives; and (iii) opt-in, opt-out, and active-choice policies. Section 6 concludes. Proofs are provided in the Appendix.

Related Literature. This paper contributes to the literature on behavioral public policy.[2] As the most closely related studies, Carroll, Choi, Laibson, Madrian and Metrick (2009), Keller, Harlam, Loewenstein and Volpp (2011), and Chetty, Friedman, Leth-Petersen, Nielsen and Olsen (2014) investigate the policy effects on active choice. These studies focus on cases where a policymaker either decreases consumers' switching costs to zero or forces consumers to make an explicit choice. In contrast to these studies, we investigate the case where a policymaker can reduce consumers' switching costs, but the lower switching cost is still positive and consumers themselves decide whether to switch. We extensively discuss the real-world applications and interpretations of such a policy in Section 5.

This paper is also related to two theoretical literatures: pricing for unsophisticated present-biased consumers and the equilibrium effects of policies. First, the literature on behavioral industrial organization studies how firms can exploit consumers' time inconsistency and naivete.[3] Building upon this stream of the literature, we focus on the policy implications of enhancing active choice and analyze how the timing of policies can affect consumer and social welfare.

Second, recent theoretical and empirical studies analyze the equilibrium effects of policies when consumers are inattentive.[4] These studies find that policies that intend to help consumers, such as

[2] O'Donoghue and Rabin (2003, 2006) investigate the welfare effect of tax/subsidy policies under present bias and naivete. Baicker, Mullainathan and Schwartzstein (2015) analyze the design of health insurance under behavioral biases. For surveys of behavioral public policy, see, for example, Mullainathan, Nöth and Schoar (2012) and Chetty (2015).

[3] See, for example, DellaVigna and Malmendier (2004), Kőszegi (2005), Gottlieb (2008), Heidhues and Kőszegi (2010), and Heidhues and Kőszegi (2017).

[4] For the theoretical literature, see Armstrong, Vickers and Zhou (2009), Armstrong and Chen (2009), Piccione and Spiegler (2012), de Clippel, Eliaz and Rozen (2014), Grubb (2015), Spiegler (2015), and Ericson (2016). For the

price caps or increasing naive consumers' attention, may reduce consumer welfare in equilibrium. Although we are not aware of any study that investigates the perverse welfare effect of reducing switching costs under consumer naivete, our theoretical mechanism of the perverse welfare effect is related to the existing studies. As probably the closest one, based on Gabaix and Laibson's (2006) shrouded add-on model, Kosfeld and Schüwer (2017) investigate an intervention of increasing the proportion of sophisticated consumers in the market. They show that the intervention can decrease social welfare because it may increase the proportion of consumers who (socially inefficiently) substitute away from an add-on consumption.[5] To the best of our knowledge, however, the timing of policies and the differences in the resulting welfare effect have not been investigated.[6] Complementing but beyond the previous studies, we highlight the perverse welfare effect of a conventional policy, analyze how the timing of policies can lead to different welfare effects, and derive implications on the optimal timing to employ a policy.

2 Model

This section introduces our model. Section 2.1 sets up the model. Section 2.2 illustrates how our framework can be applied to study markets with renewable contracts such as mobile phones, mortgages, and Internet connections.

2.1 Setup

A risk-neutral firm provides a (recurring) service with automatic renewals—e.g., a mobile plan—to a measure one of risk-neutral consumers. The firm also provides an initial package—e.g., a

empirical literature, see Duarte and Hastings (2012), Handel (2013), Grubb and Osborne (2015), and Damgaard and Gravert (2016).

[5] Precisely, Kosfeld and Schüwer (2017) show that the intervention can decrease social welfare when firms keep employing the same type of pricing strategy, whereas the intervention may lead them to switch to a different and less exploitative type of pricing strategy. However, the source of welfare losses differs because the perverse welfare effect in our model occur when a firm switches to a different and more exploitative type of pricing strategy. This difference stems from investigating different types of biases and policies. More importantly, our results highlight that employing a policy with a different timing can improve welfare more robustly. Specifically, if policymakers could employ Kosfeld and Schüwer's (2017) intervention after consumers can substitute away (e.g., they cannot buy a GPS at an airport to avoid renting it), but before consumers' initial contracting (e.g., renting a car at the airport), then the intervention (e.g., disclosing GPS rental prices at the airport) would not decrease social welfare.

[6] A recent paper by Johnen (2017) analyzes a screening problem with automatic-renewal contracts where a fraction of consumers have limited memory. He shows that competition between firms may exacerbate consumer exploitation in equilibrium and hence can decrease social welfare compared to a monopoly. Although he investigates a different framework, along with our main message, sending reminders in his model is more beneficial right before a contract renewal than right before an initial contracting.

smartphone with a teaser-rate mobile plan—to the consumers.[7] The firm's cost of providing the initial package and the service are $c^{\tilde{v}} \geq 0$ and $c^v \geq 0$, respectively. Each consumer values the initial package at $\tilde{v} > c^{\tilde{v}}$ and the service at $v > c^v$. A competitive fringe also provides an initial package and a (recurring) service with the same value, and for simplicity, it charges a price of $c^{\tilde{v}}$ for the initial package and a price of c^v for the service.[8] However, if consumers want to purchase the initial package from the competitive fringe rather than from the (default) firm, they incur a switching cost of $k_0 > 0$ (i.e., a cost to switch from a default firm or a cost to find alternatives). Similarly, they incur a switching cost of $k_1 > 0$ if they switch to a different recurring service (i.e., a cost to cancel a contract or a cost to sign a new contract). For simplicity, we assume that consumers prefer to buy from the competitive fringe with incurring a switching cost rather than not buying at all (i.e., $\tilde{v} + v > c^{\tilde{v}} + c^v + k_0$).

At the beginning of the game, a policymaker decides whether to enact a choice-enhancing policy that reduces the switching cost for each period $t = 0, 1$. Formally, let $k_t = \overline{k}_t > 0$ denote the switching cost in period t without such a policy. If a policymaker enacts the policy in period t, then the switching cost of that period reduces to $k_t = \underline{k}_t \in (0, \overline{k}_t)$.[9]

The timing of the game is as follows. There are three periods: $t = 0, 1, 2$. In $t = 0$, the policymaker decides whether to enact a choice-enhancing policy for each period $t = 0, 1$. Then, the firm sets and commits to its prices: a price for the initial package $p^{\tilde{v}} \in \mathbb{R}$, which it charges in $t = 1$, and a price for the service $p^v \in \mathbb{R}$, which it charges in $t = 2$. Afterward, consumers decide whether they want to purchase the initial package from the firm or from the competitive fringe. If they purchase the initial package from the firm, they pay $p^{\tilde{v}}$ in $t = 1$. If they purchase the initial package from the competitive fringe, they incur a cost of k_0 in $t = 0$ and pay $c^{\tilde{v}}$ in $t = 1$. In $t = 1$, consumers consume the initial package $\tilde{v}$ and those who purchased the firm's initial package decide whether or not to switch to the service of the competitive fringe at a cost of k_1.[10] In $t = 2$, consumers consume the service. Consumers who buy the service from the firm pay p^v and those

[7] Our setting encompasses the case where a firm provides a consumer's default option with a grace period or a firm automatically enrolls consumers in its optional service. Note also that the initial package can be identical to the recurring service. For example, a credit card can function the same during a teaser-rate period and thereafter.

[8] In Section 4.3, we analyze the case where multiple (non-fringe) firms compete to attract consumers.

[9] If the firm chooses k_t endogenously, then the firm would set it to the maximum amount. Without loss of generality, we can think of $\overline{k}_t$ as that amount. Note also that our analysis in Section 3 covers the case where a policy reduces switching costs in both $t = 0$ and $t = 1$.

[10] As formally shown in Section 3, consumers who purchased the initial package from the competitive fringe do not have an incentive to switch to the firm's service in $t = 1$.

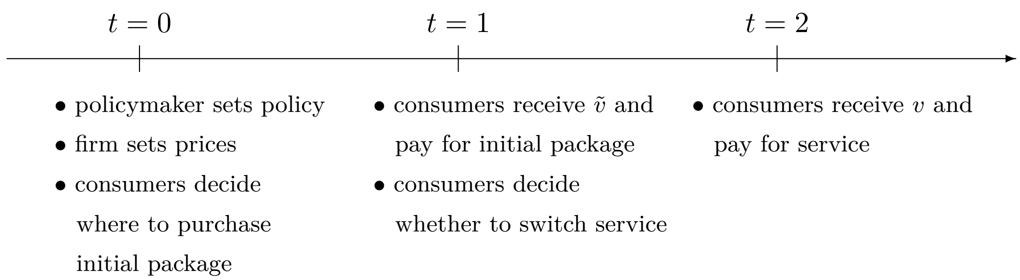

Figure 1: Timeline of the model.

who switched to the competitive fringe pay c^v. Figure 1 illustrates the timeline of the model.

Recent empirical and experimental studies show that people often procrastinate their decisions.[11] Following O'Donoghue and Rabin (1999a, 2001), we assume that a proportion $\alpha \in (0, 1)$ of consumers are present-biased and naive, whereas the remaining proportion of consumers are time-consistent and rational. To explain this, suppose that u_t is a consumer's period-t utility. In period $t = 0, 1$, time-consistent consumers choose their action based on $u_t + \sum_{s=t+1}^{2} \delta^{s-t} u_s$, and correctly expect their future behavior. By contrast, present-biased consumers choose their action based on $u_t + \beta \sum_{s=t+1}^{2} \delta^{s-t} u_s$, where $\beta \in (0, 1)$ represents the present bias. These present-biased consumers are (fully) naive about their future self-control problem: in $t = 1$, they think that they will behave as if they were time-consistent.[12] In the following, we set $\delta = 1$ without loss of generality. We investigate the perception-perfect equilibria of the game: each player maximizes her perceived utility in each subgame (O'Donoghue and Rabin 2001). Let $U^i = \sum_{t=0}^{2} u_t$ denote the long-run utility of consumer with type $i \in \{R, N\}$, where R represents a rational time-consistent consumer and N represents a naive present-biased consumer. We evaluate consumer welfare based on the sum of the consumers' long-run utility, i.e., $CW = (1 - \alpha)U^R + \alpha U^N$. Social welfare is defined by the sum of consumer welfare and the firm's profits (denoted by Π), i.e., $SW = CW + \Pi$.

Although we believe that naive present bias is a major source of consumer bias in our industry

[11] Following O'Donoghue and Rabin (2001) and DellaVigna (2009), we say that a consumer "procrastinates" if she plans to switch in some period ex ante but does not actually switch in that period. For evidence of procrastination, see, for example, Ariely and Wertenbroch (2002), DellaVigna and Malmendier (2006), and Skiba and Tobacman (2008).

[12] Note that consumers incur the switching cost now but make the payment later. Due to this discrepancy in timing, naive present-biased consumers may procrastinate on their switching decisions. In Section 4.5, we analyze the case where present-biased consumers are partially aware of their bias in the sense of O'Donoghue and Rabin (2001) and that where a fraction of perfectly sophisticated present-biased consumers exist in the model.

examples, we here emphasize that other behavioral biases—such as inattention to future prices or future switching costs—are also plausible. In Section 4.1, we extensively discuss how our results and policy implications are robust to inattention instead of present bias.

2.2 Applications

This subsection describes how to apply our model to markets for mobile phones, mortgages, and Internet connections. For each market, Section 5 discusses (potential or actually implemented) choice-enhancing policies extensively.

Mobile Phones. In many countries, mobile phone companies offer a two-year contract with a discount for a smartphone and a teaser-rate mobile plan. After two years, the contract on the mobile plan is automatically renewed. Although firms typically recoup their losses from offering a discount for a smartphone through the monthly mobile-plan fees for the initial two years, they often continue to charge the same monthly fees after the initial two years. Indeed, there is a concern that firms may use such automatic renewals to exploit unsophisticated consumers.[13] In this case, we can regard k_0 as the cost to understand the contract terms and find an alternative (i.e., an unlocked or SIM-free mobile phone, finding a cheap mobile plan, and forming a mobile-plan contract), whereas k_1 is the cost to cancel the automatic renewal, find a cheap mobile plan, and form a new mobile-plan contract.

Mortgages. In most developed countries, there are two types of mortgage loans: fixed-rate mortgages and adjustable-rate mortgages. While interest rates are fixed over time in fixed-rate mortgages, adjustable-rate mortgages offer lower introductory interest rates and then charge higher post-introductory interest rates. In the US, there is a concern that some consumers do not fully anticipate the level of post-introductory interest rates or the cost for switching a mortgage contract when they form a contract.[14] Further, before the financial crisis, mortgage lenders in the US often

[13] In Japan, for example, the scheme of mobile phone companies was to attract customers with a cheap mobile phone and "then get them to sign contracts with high monthly fees and options through the use of confusing terms that change from one carrier to another" (Phone Users in Japan Still Paying for Plenty of Stuff They Don't Need, The Japan Times, May 23, 2015).

[14] Lacko and Pappalardo (2007) find in a survey that most consumers in the US could not correctly identify the cost for switching a mortgage contract (called prepayment penalties), and two-thirds of consumers did not even recognize the presence of the prepayment penalties.

tried to sell adjustable-rate mortgages.[15] In this case, we can regard k_0 as the cost for finding and forming an alternative mortgage contract (i.e., a fixed-rate mortgage), whereas k_1 is the cost for switching a mortgage contract (including the penalty fees for switching).

Internet Connections. Internet-connection providers automatically enroll (and automatically renew) customers in their software options with some grace period. As a specific example, Kabel Deutschland, one of the largest Internet-connection providers in Germany, automatically enrolled all new customers in a three-month free trial for the option of an antivirus software, a firewall, and a parental control software. After the first three months, the option was automatically renewed at €3.98 per month.[16] Customers have to take (arguably complicated) steps to cancel the option. According to one of the most popular newspapers in Germany, many customers—who did not opt out of this option and paid its fees—did not even activate the option.[17] In this case, the switching cost in $t = 0$ is a cost to cancel the option immediately after the initial contracting, and the switching cost in $t = 1$ is a cost to cancel the option when the free trial ends.[18]

3 Analysis

This section analyzes the model and discusses welfare and policy implications. Section 3.1 characterizes consumer behavior and explains how firms can exploit naive consumers. Section 3.2 derives the firm's pricing strategy given consumer behavior. Section 3.3, the main part of the analysis, investigates the effects of policies on equilibrium prices and welfare.

[15] Gurun, Matvos and Seru (2016) report that consumers are less sensitive to the post-introductory interest rates than to the initial interest rates of adjustable-rate mortgages and that mortgage lenders often push to sell expensive adjustable-rate mortgages. See also the Federal Trade Commission's article on deceptive mortgage advertisements, `http://www.consumer.ftc.gov/articles/0087-deceptive-mortgage-ads` (accessed October 1, 2017). Relatedly, retail banks often promote credit cards with very low interest rates for an initial teaser period, after which the interest rate rises (Ausubel 1991, DellaVigna and Malmendier 2004).

[16] For the detailed description of the contract, see `http://www.kabel-internet-telefon.de/news/7214-kabel-deutschland-mit-neuem-sicherheitscenter-kabelsicherheit-de` (in German, accessed October 1, 2017).

[17] `http://www.bild.de/digital/internet/darauf-muessen-sie-achten-12199746.bild.html` (in German, accessed October 1, 2017).

[18] The illustrative model in our old working paper (Murooka and Schwarz 2016) describes such a market with an automatic enrollment to an option.

3.1 Consumer Behavior

This subsection characterizes each consumer's behavior given prices and switching costs. Note that consumers do not take any action in $t = 2$. Note also that in the context of our model, consumers do not have an incentive to switch back from the competitive fringe to the firm, because the firm does not have an incentive to charge such an overly low p^v (as we will show in Lemma 1).

We first analyze rational consumers' behavior by backward induction. If rational consumers use the firm's service at the beginning of period 1, they switch to the competitive fringe if and only if $-k_1 + v - c^v > v - p^v$, or equivalently, $p^v - c^v > k_1$. That is, rational consumers switch in $t = 1$ if and only if the surcharge for the service exceeds the switching cost, as in the classical switching-cost literature (Farrell and Klemperer 2007). Given this, we can divide rational consumers' switching behavior in period 0 into the following two cases. First, if $p^v - c^v \leq k_1$, they switch in period 0 if and only if $-k_0 + \tilde{v} - c^{\tilde{v}} + v - c^v > \tilde{v} - p^{\tilde{v}} + v - p^v$, or equivalently, $p^{\tilde{v}} + p^v - c^{\tilde{v}} - c^v > k_0$. Second, if $p^v - c^v > k_1$, rational consumers switch in period 0 if and only if $-k_0 + \tilde{v} - c^{\tilde{v}} + v - c^v > \tilde{v} - p^{\tilde{v}} - k_1 + v - c^v$, or equivalently, $k_1 + p^{\tilde{v}} - c^{\tilde{v}} > k_0$. Intuitively, when the switching cost in $t = 1$ is sufficiently high, rational consumers switch in $t = 0$ if the firm's total surcharge exceeds the switching cost in $t = 0$; otherwise, they switch in $t = 0$ if the switching cost in period 0 is lower than that in $t = 1$ and the surcharge for the initial package.

We next analyze naive consumers' behavior by backward induction. If naive consumers use the firm's service at the beginning of $t = 1$, they switch to the competitive fringe if and only if $-k_1 + \beta[v - c^v] > \beta[v - p^v]$, or equivalently, $p^v - c^v > \frac{k_1}{\beta}$. In contrast to rational consumers, naive consumers may not switch, even if the surcharge for the firm' service exceeds the switching cost. Intuitively, because the benefit from switching comes later, but they incur the cost of switching immediately, these present-biased consumers are less likely to switch the service than rational consumers are. In period 0, naive consumers are overconfident about their future self-control and think that they will switch in the next period if and only if $p^v - c^v > k_1$. Given this (incorrect) belief, we can divide naive consumers' switching behavior in period 0 into the following two cases. First, if $p^v - c^v \leq k_1$, naive consumers think they will keep using the firm's service in period 1. Hence, they switch in period 0 if and only if $-k_0 + \beta[\tilde{v} - c^{\tilde{v}} + v - c^v] > \beta[\tilde{v} - p^{\tilde{v}} + v - p^v]$, or equivalently, $p^{\tilde{v}} + p^v - c^{\tilde{v}} - c^v > \frac{k_0}{\beta}$. Second, and most important for the following results, if $p^v - c^v > k_1$, these consumers think they will switch in period 1. Hence, they switch in period 0 if and only if

	$p^v \leq c^v + k_1$	$p^v \in (c^v + k_1, c^v + \frac{1}{\beta}k_1]$	$p^v > c^v + \frac{1}{\beta}k_1$
Rational consumer	Not switch	Switch	Switch
Naive consumer	Not switch	Anticipated to switch, but not switch	Switch

Table 1: Summary of consumer behavior in $t = 1$.

$-k_0 + \beta[\tilde{v} - c^{\tilde{v}} + v - c^v] > \beta[\tilde{v} - p^{\tilde{v}} - k_1 + v - c^v]$, or equivalently, $k_1 + p^{\tilde{v}} - c^{\tilde{v}} > \frac{k_0}{\beta}$. Intuitively, naive present-biased consumers tend to procrastinate switching in period 0 because they underestimate their future impatience, which generates the source of exploitation by the firm. Table 1 summarizes each type of consumer's behavior of switching from the firm in $t = 1$ depending on the parameters.

3.2 Firm Behavior

This subsection analyzes the firm's optimal pricing. Intuitively, the firm faces a trade-off between (i) serving its recurring service to all consumers at a moderate price after the automatic renewal ($p^v \leq c^v + k_1$) and a moderate total price ($p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + k_0$) and (ii) serving only naive consumers at a high price after the automatic renewal ($p^v = c^v + \frac{1}{\beta}k_1$) and a high total price ($p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + \frac{1}{\beta}k_0 + \frac{1-\beta}{\beta}k_1$). Lemma 1 describes the firm's optimal pricing:

Lemma 1. *(i) If $k_1 \leq \frac{\beta-\alpha}{\alpha(1-\beta)}k_0$, the firm sets its total price equal to $p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + k_0$ with $p^{\tilde{v}} \in [c^{\tilde{v}} + k_0 - k_1, c^{\tilde{v}} + k_0 + k_1]$ and $p^v \in [c^v - k_1, c^v + k_1]$. No consumer switches from the firm. The firm's profits are $\Pi = k_0$. For both types of consumers, the long-run utility is $U^R = U^N = \tilde{v} + v - c^{\tilde{v}} - c^v - k_0$.*

(ii) If $k_1 > \frac{\beta-\alpha}{\alpha(1-\beta)}k_0$, the firm sets its total price equal to $p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + \frac{1}{\beta}k_0 + \frac{1-\beta}{\beta}k_1$ with $p^{\tilde{v}} = c^{\tilde{v}} + \frac{1}{\beta}k_0 - k_1$ and $p^v = c^v + \frac{1}{\beta}k_1$. Naive consumers do not switch from the firm, whereas rational consumers switch from the firm in $t = 0$. The firm's profits are $\Pi = \frac{\alpha}{\beta}k_0 + \frac{\alpha(1-\beta)}{\beta}k_1$. Naive consumers' long-run utility is $U^N = \tilde{v} + v - c^{\tilde{v}} - c^v - \frac{1}{\beta}k_0 - \frac{1-\beta}{\beta}k_1$, whereas rational consumers' long-run utility is $U^R = \tilde{v} + v - c^{\tilde{v}} - c^v - k_0$.

The intuition for Lemma 1 is as follows. First, when the firm sells the service to both rational and naive consumers, the firm can make profits up to its market power at the initial purchase (i.e., k_0). This is in line with the result in the classical switching-cost literature. Second, when the firm sells the service only to naive consumers, the firm can make higher profits per sale by setting a high price after the automatic renewal and a high total price (although the firm has a smaller market share). Intuitively, akin to the result in the literature on behavioral industrial organization, such as DellaVigna and Malmendier (2004) or Heidhues and Kőszegi (2010), naive consumers are less price sensitive than rational consumers are due to the bias. Consequently, the firm faces a trade-off between having a larger market share and exploiting naive consumers by setting high prices.[19] Importantly, because k_0 limits the profits from selling to all consumers, the firm prefers to serve all consumers only if k_0 is at a relatively high level.[20] Note also that a decrease in k_1 increases naive consumers' long-run utility in Lemma 1 (ii) while rational consumers' long-run utility is always independent of k_1, which is a key factor for the following policy results.

The cut-off value for the optimal pricing, $\frac{\beta-\alpha}{\alpha(1-\beta)}k_0$, is decreasing in α and increasing in β. That is, the firm is more likely to exploit naive consumers if there are more naive consumers (larger α) or if naive consumers suffer from a more severe present bias (smaller β). This is because the firm's profits from exploiting naive consumers are increasing in α and decreasing in β. For example, if $\beta \leq \alpha$, the firm always chooses to exploit naive consumers.

3.3 Effects of Choice-Enhancing Policies

We now analyze the effects of choice-enhancing policies. Holding k_1 fixed, we first investigate the effect of a choice-enhancing policy in $t = 0$ that reduces the switching cost from $\overline{k}_0$ to $\underline{k}_0$. Proposition 1 illustrates a potential perverse effect of such a policy:

Proposition 1. *If $k_1 \in \left(\frac{\beta-\alpha}{\alpha(1-\beta)}\underline{k}_0, \frac{\beta-\alpha}{\alpha(1-\beta)}\overline{k}_0\right)$, then employing a choice-enhancing policy in $t = 0$ strictly increases the price after the automatic renewal p^v and strictly decreases social welfare. If, in addition, $k_1 > \frac{1}{1-\beta}(\beta\overline{k}_0 - \underline{k}_0)$, the policy also strictly increases the total price $p^{\tilde{v}} + p^v$ and strictly decreases naive consumers' long-run utility. If, in addition, $k_1 > \frac{1}{\alpha(1-\beta)}[\beta\overline{k}_0 - \underline{k}_0 + (1-\beta)(1-\alpha)\underline{k}_0]$, then the policy also strictly decreases consumer welfare.*

[19] Note that there are multiple optimal pricing pairs in the former case of Lemma 1. This is because as long as all consumers pay both $p^{\tilde{v}}$ and p^v on the equilibrium path, only the total price $p^{\tilde{v}} + p^v$ matters. Any such pricing pair, however, sets strictly lower p^v and $p^{\tilde{v}} + p^v$ than the latter case of Lemma 1. In this sense, the comparison of equilibrium pricing strategies is clear: in the latter case, the firm exploits naive consumers by charging a higher price after the automatic renewal and a higher total price.

[20] One may wonder whether there is any optimal pricing in which the firm sells its initial package to all consumers but sells its service after the automatic renewal only to naive consumers. In the basic model, there is no such equilibrium; intuitively, because naive consumers underestimate both $p^{\tilde{v}}$ and p^v in $t = 0$, whenever the firm prefers to exploit naive consumers by charging high p^v, the firm also prefers to exploit them by charging high $p^{\tilde{v}}$. In other specifications of behavioral biases, however, such a pricing strategy can be optimal. In Section 4.1, we provide a formal analysis based on inattention to the price after the automatic renewal and extensively discuss the robustness of our results.

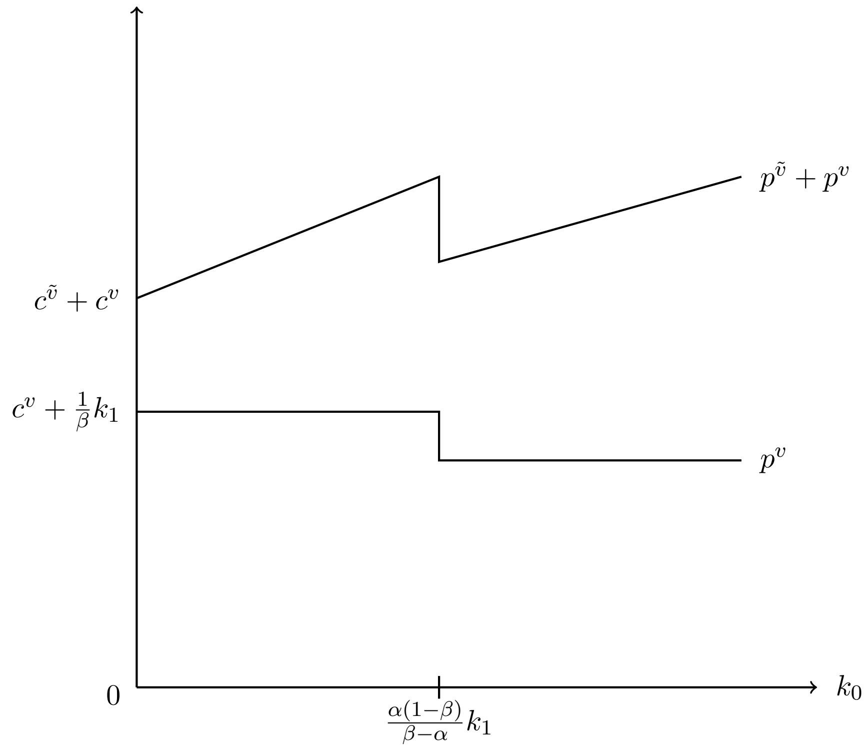

Figure 2: Equilibrium prices for $c^{\tilde{v}} = 2, c^v = 1, \beta = 0.7, \alpha = 0.5, k_1 = 1$.

Proposition 1 highlights the adverse effect of the policy of reducing k_0. Intuitively, because naive consumers are less willing to pay switching costs, the firm has an incentive to increase its price if rational consumers switch in $t = 0$ while naive consumers plan to switch later but do not. By backward induction, reducing k_0 will make rational consumers more likely to switch in $t = 0$, and hence, give the firm an additional incentive to increase p^v.

Note that in equilibrium the firm faces a trade-off between exploiting naive consumers at high prices and selling to all consumers at moderate prices. Because reducing k_0 lowers the firm's initial market power, the policy decreases the total price $p^{\tilde{v}} + p^v$ and increases consumer and social welfare *if* the firm keeps using the same type of pricing strategy. However, the policy reducing k_0 makes exploiting naive consumers relatively more attractive for the firm. When $k_1 \in \left(\frac{\beta-\alpha}{\alpha(1-\beta)}\underline{k}_0, \frac{\beta-\alpha}{\alpha(1-\beta)}\overline{k}_0\right)$, the policy leads the firm to switch to the exploitative pricing strategy. This change always leads to a higher price after the automatic renewal p^v and lower social surplus (because rational consumers incur the switching cost). If the effect of the change outweighs the direct effect of reducing k_0 on the total price, i.e., if $k_1 > \frac{1}{1-\beta}(\beta\overline{k}_0 - \underline{k}_0)$, the policy also leads to a higher total price and hence lowers naive consumers' long-run utility. If $k_1 > \frac{1}{\alpha(1-\beta)}[\beta\overline{k}_0 - \underline{k}_0 + (1-\beta)(1-\alpha)\underline{k}_0]$, which is a stronger condition than that in the last sentence because it accounts for the effect on rational consumers, the policy also lowers consumer welfare.

Figure 2 shows how the policy of decreasing k_0 affects the firm's equilibrium pricing strategy. Because decreasing k_0 lowers the firm's initial market power, it decreases the total price $p^{\tilde{v}} + p^v$ if it does not lead the firm to change the type of its pricing strategy. At $k_0 = \frac{\alpha(1-\beta)}{\beta-\alpha}k_1$, however, the firm changes the type of its pricing strategy and increases both $p^{\tilde{v}} + p^v$ and p^v.[21] Hence, reducing k_0 can perversely affect consumer and social welfare if it leads to a change in the firm's behavior.

Perhaps surprisingly, even when the policymaker can make the switching cost at the initial enrollment arbitrarily small (i.e., even when $\underline{k}_0$ is close to 0), the policy may decrease social welfare and naive consumers' long-run utility. To see this in a simple numerical example, take a sufficiently small $\epsilon > 0$ and suppose that $\underline{k}_0 = \epsilon$ and $\beta = \frac{1}{2}$. Then, the policy decreases social welfare and naive consumers' long-run utility if $k_1 \in \left(\overline{k}_0 - 2\epsilon, \frac{1-2\alpha}{\alpha}\overline{k}_0\right)$, and such k_1 exists if $\alpha \leq \frac{1}{3}$.[22] Intuitively, when $\underline{k}_0$ is close to 0, the only way for the firm to make positive profits is to exploit naive consumers by charging a higher price after the automatic renewal, which can cause the perverse welfare effect.

As an alternative policy, we next investigate the effect of a choice-enhancing policy in $t = 1$, which reduces the switching cost from $\overline{k}_1$ to $\underline{k}_1$ (holding k_0 fixed). Proposition 2 summarizes the result of such a policy:

Proposition 2. *Employing a choice-enhancing policy in $t = 1$ always strictly decreases the maximum price after the automatic renewal p^v, weakly decreases the total price $p^{\tilde{v}} + p^v$, and weakly increases consumer and social welfare. The policy strictly decreases the total price and strictly increases consumer welfare if $\overline{k}_1 > \frac{\beta-\alpha}{\alpha(1-\beta)}k_0$. If, in addition, $\underline{k}_1 \leq \frac{\beta-\alpha}{\alpha(1-\beta)}k_0$, the policy also strictly increases social welfare.*

Proposition 2 implies that a policy that decreases the switching cost at the automatic renewal does not have the perverse effect as described in Proposition 1. Such a policy always strictly decreases the maximum price after the automatic renewal p^v and weakly decreases the total price

[21] To make the comparison clear, for the domain of $k_0 > \frac{\alpha(1-\beta)}{\beta-\alpha}k_1$, we depict the highest price after the automatic renewal p^v among the firm's equilibrium pricing pairs. The contrast of p^v between $k_0 < \frac{\alpha(1-\beta)}{\beta-\alpha}k_1$ and $k_0 > \frac{\alpha(1-\beta)}{\beta-\alpha}k_1$ becomes even starker if we choose other possible p^v. As Lemma 1 shows, none of them affects the equilibrium total price, consumer welfare, or social welfare.

[22] Note that when $\underline{k}_0$ approaches 0, the decrease in social welfare by employing the choice-enhancing policy in $t = 0$ also approaches 0. Additionally, when $\underline{k}_0$ approaches 0, employing the policy always increases consumer welfare.

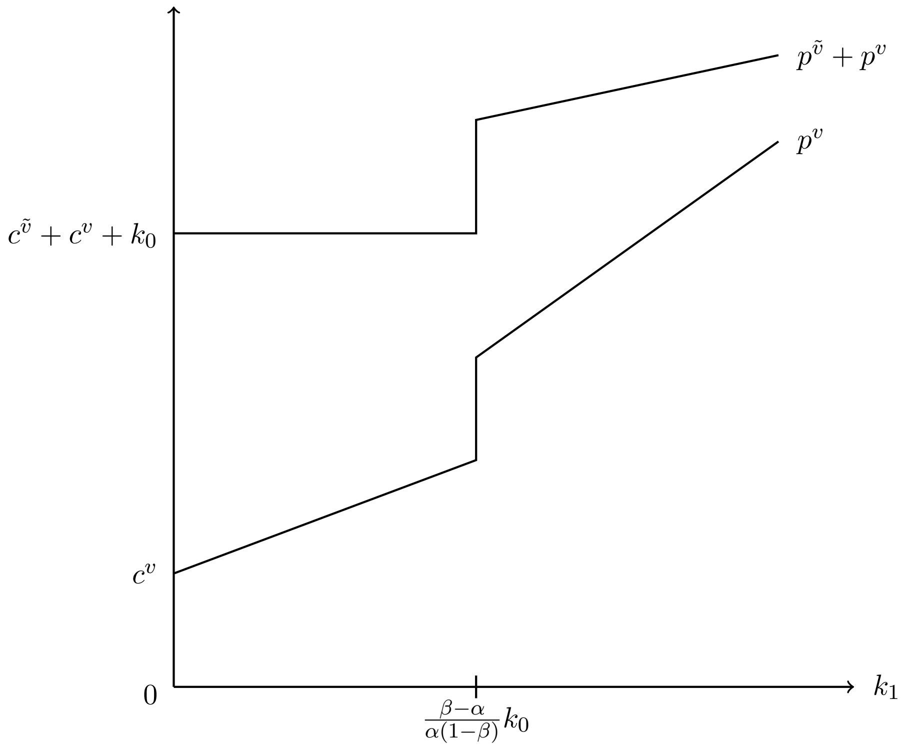

Figure 3: Equilibrium prices for $c^{\tilde{v}} = 2, c^v = 1, \beta = 0.7, \alpha = 0.5, k_0 = 1$.

$p^{\tilde{v}} + p^v$.[23] Thus, the choice-enhancing policy in $t = 1$ always weakly increases consumer and social welfare compared to the absence of this policy. Intuitively, when k_1 is lower, both rational and naive consumers are more likely to consider switching at the same time (i.e., in $t = 1$). By backward induction, reducing k_1 will not give the firm an additional incentive to increase p^v. Further, because the maximum markup the firm can charge for the service after the automatic renewal is directly linked to k_1, reducing k_1 leads to a decrease in p^v.

As Lemma 1 shows, a decrease in k_1 does not affect rational consumers' long-run utility, while it increases naive consumers' long-run utility under the exploitative pricing strategy. Hence, under the exploitative pricing strategy, the policy strictly increases consumer welfare. Furthermore, when the firm stops using the exploitative pricing strategy in response to the policy, social welfare increases compared to the case without the policy.

Figure 3 shows how the policy of decreasing k_1 affects the firm's equilibrium pricing strategy.

[23] Unlike in Proposition 1, our statement here is about the "maximum price" after the automatic renewal. This is because if the firm serves all consumers, there are multiple optimal pricing pairs $(p^{\tilde{v}}, p^v)$ as Lemma 1 (i) shows. Hence, we focus on the maximum p^v among such optimal pricing pairs.

Because lowering k_1 does not have the perverse effect, it always strictly decreases the price after the automatic renewal p^v and weakly decreases the total price $p^{\tilde{v}} + p^v$. Moreover, at $k_1 = \frac{\beta-\alpha}{\alpha(1-\beta)} k_0$, the firm switches to the non-exploitative pricing strategy, thus reducing k_1 drops both $p^{\tilde{v}} + p^v$ and p^v.[24]

The following corollary summarizes the findings in Propositions 1 and 2:

Corollary 1. *Employing a choice-enhancing policy in* $t = 0$ *may strictly decrease consumer and social welfare, whereas employing a choice-enhancing policy in* $t = 1$ *never strictly decreases consumer or social welfare.*

Corollary 1 highlights that the timing of enacting the policy matters for both consumer and social welfare. If a policymaker enacts a choice-enhancing policy when consumers are initially enrolled, then a firm may change its pricing strategy in response to the policy, and hence the perverse welfare effect can occur. By contrast, a choice-enhancing policy at automatic renewal does not have this adverse effect and hence is welfare-improving. Therefore, policymakers should target a choice-enhancing policy *in timing* to the actual choice inefficiency because trying to do so at a different point in time can backfire.

So far, we compared policies that reduce the switching cost either in $t = 0$ or in $t = 1$. Another natural candidate policy is to reduce the switching cost in both periods. Proposition 3 highlights that even a policy that reduces the switching cost in both periods can have the perverse welfare effect:

Proposition 3. *Employing a choice-enhancing policy that reduces the switching costs in* $t = 0$ *and* $t = 1$ *by the same amount can strictly decrease consumer and social welfare.*

Intuitively, even when a policymaker reduces the switching cost in both periods, the firm may change its pricing strategy in response to such a policy, such that the firm exploits naive consumers, and rational consumers incur the switching cost. Proposition 3 implies that the policymaker should always be careful about employing a choice-enhancing policy in $t = 0$ because it may increase equilibrium prices, whereas a choice-enhancing policy in $t = 1$ does not have such a perverse equilibrium effect.

[24] To make the comparison clear, for the domain of $k_1 < \frac{\beta-\alpha}{\alpha(1-\beta)} k_0$, we depict the highest price after the automatic renewal p^v among the firm's equilibrium pricing pairs. The contrast of p^v between $k_1 < \frac{\beta-\alpha}{\alpha(1-\beta)} k_0$ and $k_1 > \frac{\beta-\alpha}{\alpha(1-\beta)} k_0$ becomes even starker if we choose other possible p^v. As Lemma 1 shows, none affect the equilibrium total price, consumer welfare, or social welfare.

We conclude this section by emphasizing that the choice-enhancing policy in $t = 1$ does not decrease the long-run utility of any type of consumer, whereas the choice-enhancing policy in $t = 0$ may decrease naive consumers' long-run utility in equilibrium. In this sense, a choice-enhancing policy in $t = 1$ is in line with "asymmetric paternalism," which benefits consumers who make errors, while it imposes no (or relatively little) harm on rational consumers (Camerer, Issacharoff, Loewenstein, O'Donoghue and Rabin 2003).

4 Extensions

This section investigates extensions and modifications of our basic model. Section 4.1 analyzes a model where a fraction of consumers are inattentive rather than naive present-biased. Section 4.2 incorporates the possibility of multiple payments by assuming that the firm offers an initial package in $t = 0$ and provides a recurring service in multiple periods. Section 4.3 investigates endogenous competition among firms. Section 4.4 discusses menu contracts. Section 4.5 studies models incorporating partially naive and sophisticated present-biased consumers.

4.1 Inattention as a Source of Bias

While we believe that naive present bias is important in our industry examples, it is plausible that other behavioral biases, especially inattention to non-salient recurring prices, can be a source of consumer bias. This subsection shows that our results are qualitatively robust when, instead of being naive present-biased, a fraction $\alpha \in (0, 1)$ of consumers are inattentive to the price after the automatic renewal.[25]

Specifically, we assume that if inattentive consumers use the firm's service at the beginning of $t = 1$, they switch to the competitive fringe if and only if $-k_1 + v - \theta c^v > v - \theta p^v$, or equivalently, $p^v - c^v > \frac{k_1}{\theta}$, where $\theta \in (0, 1)$ is their degree of attention to the price after the automatic renewal. In contrast to naive present-biased consumers, however, these inattentive consumers think in period 0 that they will switch in the next period if and only if $p^v - c^v > \frac{k_1}{\theta}$ (i.e., if consumers are inattentive to p^v in some period, they are also inattentive to p^v in the previous period). Given this, we can divide inattentive consumers' switching behavior in period 0 into the following two cases. First,

[25] In our Online Appendix, we also analyze cases where (i) a fraction of consumers are inattentive to any future price (but are attentive to any switching cost) and (ii) a fraction of consumers are inattentive to any future cost (i.e., they are inattentive to future prices and future switching costs). The results are qualitatively the same.

if $p^v - c^v \le \frac{k_1}{\theta}$, inattentive consumers switch in period 0 if and only if $-k_0 + \tilde{v} - c^{\tilde{v}} + v - \theta c^v > \tilde{v} - p^{\tilde{v}} + v - \theta p^v$, or equivalently, $p^{\tilde{v}} - c^{\tilde{v}} + \theta(p^v - c^v) > k_0$. Second, if $p^v - c^v > \frac{k_1}{\theta}$, inattentive consumers switch in period 0 if and only if $-k_0 + \tilde{v} - c^{\tilde{v}} + v - \theta c^v > \tilde{v} - p^{\tilde{v}} - k_1 + v - \theta c^v$, or equivalently, $p^{\tilde{v}} - c^{\tilde{v}} > k_0 - k_1$. Rational consumers' behavior is exactly the same as in Section 3.1.

We next analyze firm behavior. Akin to Lemma 1, the firm faces a trade-off between serving its recurring service to all consumers at a moderate p^v and serving it only to inattentive consumers at a high p^v. In this case, however, the firm also faces a trade-off between serving its initial package to all consumers and serving it only to inattentive consumers (the firm prefers the former if $k_0 \ge k_1$). Lemma 2 describes the optimal pricing in this case:

Lemma 2. *Suppose that a fraction $\alpha \in (0,1)$ of consumers are inattentive to the price after the automatic renewal.*

(i) If $k_1 \le \frac{\theta(1-\alpha)}{\alpha(1-\theta)} k_0$ and $\alpha \le \theta$, the firm sets its total price equal to $p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + k_0$ with $p^{\tilde{v}} \in [c^{\tilde{v}} + k_0 - k_1, c^{\tilde{v}} + k_0 + k_1]$ and $p^v \in [c^v - k_1, c^v + k_1]$. No consumer switches from the firm. The firm's profits are $\Pi = k_0$. For both types of consumers, the long-run utility is $\tilde{v} + v - c^{\tilde{v}} - c^v - k_0$.

(ii) If $k_1 > \frac{\theta(1-\alpha)}{\alpha(1-\theta)} k_0$ and $k_1 \ge k_0$, the firm sets its total price equal to $p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + k_0 + \frac{1-\theta}{\theta} k_1$ with $p^{\tilde{v}} = c^{\tilde{v}} + k_0 - k_1$ and $p^v = c^v + \frac{1}{\theta} k_1$. Inattentive consumers do not switch from the firm, whereas rational consumers switch from the firm in $t = 0$. The firm's profits are $\Pi = \alpha k_0 + \frac{\alpha(1-\theta)}{\theta} k_1$. Inattentive consumers' long-run utility is $\tilde{v} + v - c^{\tilde{v}} - c^v - k_0 - \frac{1-\theta}{\theta} k_1$, whereas rational consumers' long-run utility is $\tilde{v} + v - c^{\tilde{v}} - c^v - k_0$.

(iii) If $\alpha > \theta$ and $k_1 < k_0$, the firm sets its total price equal to $p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + k_0 + \frac{1-\theta}{\theta} k_1$ with $p^{\tilde{v}} = c^{\tilde{v}} + k_0 - k_1$ and $p^v = c^v + \frac{1}{\theta} k_1$. Inattentive consumers do not switch from the firm, whereas rational consumers switch from the firm in $t = 1$. The firm's profits are $\Pi = k_0 + \frac{\alpha-\theta}{\theta} k_1$. Inattentive consumers' long-run utility is $\tilde{v} + v - c^{\tilde{v}} - c^v - k_0 - \frac{1-\theta}{\theta} k_1$, whereas rational consumers' long-run utility is $\tilde{v} + v - c^{\tilde{v}} - c^v - k_0$.

Although Lemma 2 contains three cases, each consumer's long-run utility is the same in cases (ii) and (iii), and hence we can easily see the potential perverse effect of decreasing k_0.[26] Note also

[26] Note that prices in cases (ii) and (iii) in Lemma 2 are the same, whereas rational consumers have different behavior because they are indifferent as to whether or not to purchase the firm's initial package. Precisely, in case (iii), the firm can lead all consumers to buy the initial package by setting $p^{\tilde{v}} = c^{\tilde{v}} + k_0 - k_1 - \epsilon$ for a sufficiently small $\epsilon > 0$. Similarly, in case (ii), the firm can lead only inattentive consumers to buy the initial package by setting $p^{\tilde{v}} = c^{\tilde{v}} + k_0 - k_1 + \epsilon$ and $p^v = c^v + \frac{1}{\theta} k_1 - \frac{2}{\theta}\epsilon$ for a sufficiently small $\epsilon > 0$.

that the three cases in Lemma 2 cover all parameters; for example, if $k_1 \leq \frac{\theta(1-\alpha)}{\alpha(1-\theta)} k_0$ and $\alpha > \theta$, then $k_1 < k_0$, and hence, the optimal pricing is case (iii).

Proposition 4 summarizes that our main result, highlighted as Corollary 1, does not change even when such inattention is the source of consumer bias:

Proposition 4. *Suppose that a fraction $\alpha \in (0, 1)$ of consumers are inattentive to the price after the automatic renewal. Then, employing a choice-enhancing policy in $t = 0$ may strictly decrease consumer and social welfare, whereas employing a choice-enhancing policy in $t = 1$ never strictly decreases consumer or social welfare.*

Intuitively, whenever some consumers misperceive future costs, they can be exploited by firms, and are thus potentially more profitable for firms than rational consumers. A policy that makes rational consumers relatively more likely to switch than naive consumers makes rational consumers even less profitable; hence, the firm may switch to a more exploitative pricing strategy. As Corollary 1 highlights, a choice-enhancing policy should be targeted *in timing* to the actual choice inefficiency.

We conclude this subsection by discussing another potential intervention for inattention—educating inattentive consumers. It relates particularly to accountability on terms and conditions as we discuss in Section 5. If such a policy intervention can uniformly increase attention (i.e., increase each inattentive consumer's θ by the same amount), it decreases the price after the automatic renewal and the total price, and hence is welfare-improving. If the effect of the intervention is heterogeneous among inattentive consumers, which is more likely in the industries we describe, its welfare effect is non-monotonic. For example, if the intervention leads a fraction of inattentive consumers to become rationally attentive (i.e., decreases α), then as Kosfeld and Schüwer (2017) show, employing it can decrease social welfare. This is because such an intervention may increase the number of consumers who (socially inefficiently) incur the switching cost if the firm keeps using an exploitative pricing strategy.

4.2 Multiple Payments

So far, we have assumed that the consumers pay for a service after the automatic renewal only once. This subsection extends the model such that consumers may use and pay for the service at multiple times, which allows us to derive additional comparative statics.

Suppose $T+1$ periods: $t = 0, 1, 2, \cdots, T$ where $T \geq 2$. The firm provides an initial package at a price $p^{\tilde{v}}$ in $t = 1$ and a recurring service with automatic renewals at prices p_t^v in periods $t = 2, \cdots, T$. Consumers can switch to the competitive fringe, which charges $c^{\tilde{v}}$ for the initial package and c^v for each period the consumer uses the service in each $t = 0, \cdots, T-1$. We denote the switching cost in period t by $k_t > 0$. The policymaker can enact a choice-enhancing policy for each period $t = 0, 1, \cdots, T-1$. Without any such policy, $k_t = \overline{k}_t > 0$ for all $t = 0, 1, \cdots, T-1$. If a policymaker enacts the policy in period t, then the switching cost of that period is reduced to $k_t = \underline{k}_t \in (0, \overline{k}_t)$. The game ends at the end of period T. We assume that $\overline{k}_t = \overline{k}_{t-1}$ and $\underline{k}_t = \underline{k}_{t-1}$ for $t = 2, \cdots, T-1$: the effect of employing the policy for the recurring service is the same across periods.

Proposition 5 summarizes the results:

Proposition 5. *Suppose that consumers may use and pay for the service after automatic renewals at $T-1$ times.*

(i) As T increases, the firm is more likely to set the prices after automatic renewals at which only naive consumers use and pay for the service.

(ii) Employing a choice-enhancing policy in $t = 0$ may strictly decrease consumer and social welfare, whereas employing a choice-enhancing policy in $t = 1, 2 \cdots, T-1$ never strictly decreases consumer or social welfare.

Proposition 5 (i) states that exploiting naive consumers becomes a more attractive option for the firm as the number of payment periods increases because it can exploit naive consumers in more periods. Still, as Proposition 5 (ii) shows, the firm's main trade-off and our main result are essentially the same as in Section 3.

4.3 Competition for Attracting Consumers

In Section 3, we assumed that only one firm endogenously chooses its pricing strategy in $t = 0$. In this subsection, we analyze the case where $N \geq 2$ symmetric firms compete to attract consumers. Consumers do not incur k_0 if they take up a contract from one of the firms in $t = 0$.[27] We investigate

[27] Another possible situation is that each consumer has one default firm and has to pay k_0 if the consumer switches from the default firm to other firms or to the competitive fringe in $t = 0$. In this situation, even under competition, each firm still has some market power and earns positive profits. Akin to the trade-off highlighted in Lemma 1, a choice-enhancing policy in $t = 0$ may lead firms to change their pricing strategies from non-exploitative to exploitative; hence, it can decrease both consumer and social welfare.

a symmetric pure-strategy equilibrium in which all firms offer the same contract in $t = 0$ and equally split each type of consumer when tie-breaking is necessary. Proposition 6 summarizes the result:

Proposition 6. *Suppose that there are $N \geq 2$ firms. Then, all firms earn zero profits in any equilibrium. Both consumer and social welfare are weakly higher when enacting the choice-enhancing policy in $t = 1$ than when enacting it in $t = 0$. Consumer and social welfare are strictly higher if $\alpha > \beta$.*

The result comes from a simple logic: because there are multiple symmetric firms competing to attract consumers, they will compete down initial prices as in the standard Bertrand-type price competition, and both types of consumers purchase some firm's initial package. Hence, the equilibrium outcomes are independent of k_0. When $\alpha > \beta$, however, each firm prefers to exploit naive consumers by setting a high price after the automatic renewal rather than to sell it to both types of consumers, so reducing k_1 can be welfare-improving.

Proposition 6 highlights that although profits are passed on to consumers and all firms earn zero profits in equilibrium, the timing of the policies still matters. In addition, because the presence of naive consumers decreases the equilibrium initial price, a cross-subsidization from naive consumers to rational consumers may occur under competition (Gabaix and Laibson 2006).

4.4 Menu Contract

In Section 3, the firm can offer only a single pair of $p^{\tilde{v}}$ and p^v. Proposition 7 shows that the results are the same, even when the firm can offer a menu of contracts, i.e., multiple pairs of $(p^{\tilde{v}}, p^v)$:

Proposition 7. *Suppose that a firm can offer a menu of contracts $\{(p^{\tilde{v}}, p^v)\}$ in $t = 0$. All equilibrium outcomes in Section 3 remain the same.*

A key step of our result is that whenever rational consumers strictly prefer to take up some contract, naive consumers also strictly prefer to take up the same contract. Intuitively, naive consumers (wrongly) think in $t = 0$ that they will behave time-consistently in $t = 1$, and given that they will take up a contract from the firm, they will choose a contract that maximizes $\beta[u_1 + u_2]$, which is the contract rational consumers will also choose.[28]

[28] One caveat is that, if the firm can charge an additional payment when consumers purchase the initial package, i.e., charge p_0 in $t = 0$ in addition to $(p^{\tilde{v}}, p^v)$, then the firm can screen between rational and naive consumers by offering different levels of p_0. In a different framework with limited memory, Johnen (2017) analyzes the welfare

Similarly, a menu contract that specifies prices (i.e., $p^{\tilde{v}}$ and p^v) and pre-selected cancellation periods do not change our results. Intuitively, because naive consumers (wrongly) believe that they will behave as rational consumers do, the firm cannot use the option of pre-selected cancellation as a screening device.

4.5 Partial Naivete and Sophistication

So far, we assumed that present-biased consumers are fully naive about their self-control problems. In this subsection, we discuss models where naive consumers are partially aware of their self-control problems and some present-biased consumers are fully aware of their self-control problems.

First, following O'Donoghue and Rabin (2001), consider the case where a fraction α of consumers are partially naive: in $t = 0$, they think that their present bias in $t = 1$ will be equal to $\hat{\beta} \in (\beta, 1)$. The remaining fraction of consumers are time-consistent and rational. Proposition 8 shows that our results remain the same *no matter how small* the degree of naivete (i.e., $\hat{\beta} - \beta$) is:

Proposition 8. *Suppose that a fraction α of consumers are partially naive, whereas the remaining fraction of consumers are rational. Then, for any $\hat{\beta} \in (\beta, 1]$, all equilibrium outcomes in Section 3 remain the same.*

To see the intuition, suppose that the firm sets $p^v = c^v + \frac{k_1}{\beta}$. Note first that consumer behavior in $t = 1$ does not depend on $\hat{\beta}$. In $t = 0$, partially naive consumers think that they will switch in $t = 1$ if and only if $p_v > c^v + \frac{k_1}{\hat{\beta}}$. Since $\frac{k_1}{\beta} > \frac{k_1}{\hat{\beta}}$ for any $\hat{\beta} > \beta$, consumers think they will switch in $t = 1$. Given this, they do not switch in $t = 0$ if and only if $-k_0 + \beta[\tilde{v} - c^{\tilde{v}} + v - c^v] > \beta[\tilde{v} - p^{\tilde{v}} - k_1 + v - c^v]$, or equivalently, $k_1 + p^{\tilde{v}} - c^{\tilde{v}} > \frac{k_0}{\beta}$. Hence, consumer behavior in both $t = 0$ and $t = 1$ does not depend on $\hat{\beta}$ if the firm sets $p^v = c^v + \frac{k_1}{\beta}$. Note also that the firm sets $p^v = c^v + \frac{k_1}{\beta}$ when naive consumers procrastinate. Hence, akin to Heidhues and Kőszegi (2010), the firm can make partially naive consumers procrastinate and can exploit them by setting the same price for the service.[29] Consequently, all equilibrium outcomes are the same for any $\hat{\beta} \in (\beta, 1]$.

effects of such screening problems. There are two remarks, however. First, to employ such a screening strategy, firms must charge consumers the payment at the time of the initial contracting. If the initial payment is not immediate (e.g., the firm charges the first bill at the end of the first month or consumers use a credit card), it would be plausible to assume that consumers incur the initial payment after the switching cost in the initial period. Second and perhaps more importantly, this type of screening is not possible under some other biases. For example, if consumers are inattentive to prices after automatic renewals as in Section 4.1, then screening using p_0 is also not possible, and the optimal menu includes only a single contract.

[29] Specifically, Heidhues and Kőszegi (2010) show that in a general contracting setting, for any $\hat{\beta} > \beta$, the ex-ante incentive compatibility constraint (in our model, the condition that partially naive consumers procrastinate switching

We next analyze the model where some present-biased consumers are fully aware of their self-control problems. Assume that a proportion $\alpha^s > 0$ of consumers are present-biased but are perfectly sophisticated about their own present bias: $\hat{\beta} = \beta < 1$. A proportion $\alpha^n > 0$ of consumers are naive present-biased and the remaining proportion $1 - \alpha^s - \alpha^n$ are time-consistent. When sophisticated present-biased consumers are also in the market, the conditions in which the firm chooses to exploit naive consumers and in which it chooses to sell both the initial package and the service to all consumers become different because sophisticated consumers cannot be exploited as much as naive consumers and would rather switch in $t = 0$ if both prices are high.[30] In addition, the firm has a third option that may be optimal: if there are many sophisticated consumers, it might charge a price of $\frac{1}{\beta}k_0 - k_1 + c^{\tilde{v}}$ for the initial package and a price of $k_1 + c^v$ for the service. At those prices, sophisticated consumers buy both the service and the initial package from the firm and are exploited, though not to the same extent that the firm could exploit naive consumers. Rational consumers switch in $t = 0$. Nonetheless, our main result is robust:

Proposition 9. *Suppose that a fraction $\alpha^n \in (0, 1)$ of consumers are naive present-biased and a fraction $\alpha^s \in (0, 1)$ of consumers are present-biased and fully aware of that. Then, employing a choice-enhancing policy in $t = 0$ may strictly decrease consumer and social welfare, whereas employing a choice-enhancing policy in $t = 1$ never strictly decreases consumer or social welfare.*

5 Discussion of Policies

In this section, we discuss the effects and potential limitations of policies that can encourage consumers to make a decision in turn.

Information Provision. Providing information, either at the time of the initial contracting or right before the automatic renewal, can encourage consumer action. We explain such policies by illustrating the regulations in the Japanese mobile-phone industry.

As we described in Section 2.2, there is a concern that firms may use a teaser-rate mobile plan and automatic renewals to exploit customers. In response to such a concern, from the early age of

in $t = 0$) does not bind as long as the ex-post incentive compatibility constraint (in our model, the condition that partially naive consumers do not switch in $t = 1$) binds.

[30] Nocke and Peitz (2003) analyze the durable-goods market in the presence of sophisticated present-biased consumers.

the mobile phone industry, the Japanese government imposed regulations effective at the time of the initial contracting. One of them is on accountability for terms and conditions: before forming a contract, each mobile-phone company has to saliently explain its automatic-renewal system and the type of contract a consumer chose.[31] Corresponding to our model, this regulation may help consumers understand the difference between contracts, which can decrease consumers' search costs. Hence, the regulation is likely to discourage consumers from choosing a high-fee mobile plan in $t = 0$.[32] There were no regulations or notifications at the time of automatic renewals, however.

Despite this regulation, the post-renewal mobile phone plan monthly fees remained high in Japan.[33] In May 2016, the Japanese government imposed an additional regulation effective at the time of automatic renewal: mobile-phone companies must notify consumers during the cancellation window (i.e., just before the automatic renewal). Specifically, these companies have to notify consumers that the contract for the service will be automatically renewed and to provide a clear explanation of how consumers can cancel the automatic renewal.[34] While there is no solid empirical evidence yet, our model predicts that the new policy in Japan will decrease the post-renewal mobile phone plan monthly fees.[35]

Tax, Subsidy, and Price Regulation. As we described in Section 2.2, there is a concern that consumers might be exploited by adjustable-rate mortgages with high post-introductory interest rates. One way to encourage consumers to take up alternatives (i.e., fixed-rate mortgages) is to give subsidies or tax benefits to the alternatives. Indeed, Japan and the US have subsidized fixed-rate mortgages.[36] Although these subsidies are intended to promote fixed-rate mortgages, our result in Proposition 1 suggests that such subsidies can lead firms to further increase the post-introductory

[31] Telecommunications Business Law, Ministry of Internal Affairs and Communications, Government of Japan, modified in November 2006.

[32] As we discussed in Section 4.1, the regulation may also make some consumers attentive to future costs and hence increase the consumers' attention to future prices.

[33] See, for example, the article "Phone Users in Japan Still Paying for Plenty of Stuff They Don't Need" (The Japan Times, May 23, 2015).

[34] Guidelines for Consumer Protection Rules in Telecommunications Business Law, Ministry of Internal Affairs and Communications, Government of Japan, March 2016.

[35] Note that if consumers also have other biases such as forgetting or inattention to their switching opportunities, the policy issued in March 2016 would also work as a reminder, which helps consumers with such behavioral biases. Relatedly, the notification at the automatic renewal imposed by Florida House Bill 751 in 2010 is likely to help such consumers.

[36] See Kobayashi (2016) and Lea and Sanders (2011).

interest rates of adjustable-rate mortgages and hence can be detrimental to welfare.[37]

By contrast, when firms directly charge fees to switch a service at the automatic renewal, a policymaker can directly regulate such fees. In the mortgage industry, consumers pay penalty fees to switch a mortgage contract, called prepayment penalties. Prepayment penalties are charged when consumers refinance or repay their mortgage payments earlier, which directly increase k_1 in our model. In the US, the maximum prepayment penalty amount has been severely regulated since 2013.[38] In the mobile phone industry, firms have an incentive to charge a fee for porting a mobile phone number. In the EU, for example, such a fee is regulated.[39] Our model predicts that these regulations encourage consumers to make a decision without adversely affecting prices after the automatic renewal.[40]

Opt-in, Opt-out, and Active-Choice Policy. In some industries, a policymaker may be able to impose an automatic termination of service subscriptions (effective at the time of a renewal), or equivalently, to employ an opt-in policy. For example, some Internet-connection providers automatically enroll their customers into software options with some grace period, as we described in Section 2.2. Note that under automatic enrollment, consumers must actively opt out from a recurring service. In this situation, a policymaker can impose an opt-in policy, or alternatively, an active-choice policy (i.e., at the end of an initial period, a consumer needs to actively choose which contract to take up in the next period). Note that either policy decreases the cost to switch to an alternative. Building upon but beyond the literature on active-choice policies, our analysis highlights that the timing of such a policy can be an important issue: policies that encourage consumers' active choice are better to be targeted at the instant of automatic renewals compared

[37] Precisely speaking, such subsidies decrease the cost (and hence the price) of the competitive fringe in our model. By the same logic as reducing k_0, it decreases the firm's profits from serving rational consumers and the firm may change its type of pricing strategy.

[38] Precisely, the 2013 Home Ownership and Equity Protection Act Rule by the Consumer Financial Protection Bureau prohibits charging prepayment penalties more than 36 months after consummation or in an amount of more than 2 percent of the amount prepaid.

[39] Specifically, Article 30(2) of the Directive 2002/22/EC of the European Parliament and of the Council of 7 March 2002 on universal service and users' rights relating to electronic communications networks and services (Universal Service Directive) states that, "[n]ational regulatory authorities shall ensure that pricing for interconnection related to the provision of number portability is cost oriented and that direct charges to subscribers, if any, do not act as a disincentive for the use of these facilities." In Germany, for example, the fee to transfer mobile phone number is capped at €25.82 before tax (the Bundesnetzagentur, `https://www.bundesnetzagentur.de/cln_1931/SharedDocs/Pressemitteilungen/DE/2004/041201Rufnummermobil.html`, in German, accessed October 1, 2017).

[40] One caveat, however, is that it may be difficult for the policymaker to estimate a firm's cost. Hence, while imposing mild price regulation would prevent firms' exploitation and increase welfare, imposing a stringent price regulation would be difficult and questionable.

	Encourages switching	
	in $t = 0$	in $t = 1$
Accountability for terms and conditions in $t = 0$	Likely	Unlikely
Providing a simple cancellation format in $t = 1$	No	Yes
Subsidy for other products in $t = 0$	Yes	No
Regulating switching fees in $t = 1$	No	Yes
Opt-in or active-choice policy in $t = 0$	Yes	No
Opt-in or active-choice policy in $t = 1$	No	Yes

Table 2: Summary of when policies encourage switching.

to the instant of the initial enrollment.[41]

Beyond automatic enrollments, our main logic and results can apply to situations in which consumers find it easier to register with one firm compared to others. As an example, for customers of a retail bank, signing up for a credit card associated with that bank is often easier than doing so at other firms because the bank can use the customer information that it already holds. In such a case, a policymaker could reduce the switching cost either at the initial enrollment or at the automatic renewal, and our results highlight that just reducing the initial advantage of the default bank may work perversely.

Table 2 summarizes the real-world policies we discussed in this section. Note that this is not an exhaustive list: we can regard policies that discourage consumers to take up a contract at initial enrollment as a choice-enhancing policy in $t = 0$, whereas we can regard policies that encourage consumers to switch a recurring service right before automatic renewal as a choice-enhancing policy in $t = 1$.

6 Concluding Remarks

We investigate the welfare consequences of policies that reduce consumers' switching costs when a firm can change its strategy in response to a policy. We show that a conventional policy—

[41] The opt-in policy has one caveat. Since the policy requires consumers who want to keep using the current firm's service to sign another contract, it may generate unnecessary re-registration costs. In addition, if a recurring service is automatically terminated, then present-biased consumers (or consumers who may forget to re-subscribe to the service) may fail to sign up again, which can harm consumer and social welfare.

reducing the switching cost when consumers are enrolled in a service—can decrease consumer and social welfare. We also show that an alternative policy—reducing the switching cost when a firm automatically renews its service—always (weakly) increases consumer and social welfare. Our analysis sheds light on the optimal design of choice-enhancing policies. The logic of our model and its policy implications seem to apply when rational consumers are more responsive to a change in the economic environment than consumers who have behavioral biases.

We conclude by discussing two important issues. First, how to detect consumer naivete and adverse policy effects from market data is both theoretically and practically important. One difficulty, as we briefly discussed in Section 5, is that an automatic enrollment or renewal itself may not be harmful to consumer and social welfare. For example, naive present-biased consumers may procrastinate on taking up a valuable additional service if there are registration costs and no automatic enrollment. In this case, the automatic enrollment itself is valuable, although it may allow the firm to exploit consumers as analyzed in this paper. As a potential future direction, investigating usage as well as purchase data could help identify consumer naivete and exploitation.

Second, although our policy implications seem to apply whenever rational consumers are more responsive to a policy than naive consumers are, it is important to identify the type of consumer bias empirically. Further, designing an optimal policy depends on the types of consumer biases in general.[42] Identifying the type of consumer biases from market data and investigating an optimal policy in a model with multiple sources of consumer biases are left for future research.

[42] For example, a policymaker may be able to impose a strict deadline for consumers' switching decisions. Indeed, in line with O'Donoghue and Rabin (1999b) and Herweg and Müller (2011), if consumers may incur multiple payments as investigated in Section 4.2, then imposing such a deadline can increase welfare. Unlike a policy that decreases switching costs, however, policymakers should be cautious about imposing such a deadline in practice because it may be harmful if the values of the service or switching costs change over time. In addition, if consumers are inattentive to or forget about their switching opportunities, then imposing such a deadline would decrease consumer and social welfare.

Appendix: Proofs

Proof of Lemma 1.

We first discuss the different candidates for the optimal price after the automatic renewal p^v and then derive the optimal pricing pairs. For $p^v > c^v + \frac{1}{\beta}k_1$, no consumer would pay p^v, thus this cannot be optimal. For $p^v \in (c^v + k_1, c^v + \frac{1}{\beta}k_1]$ only naive consumers pay p^v. Because naive consumers plan to switch in $t = 1$ (but fail to do so), $p^v \in (c^v + k_1, c^v + \frac{1}{\beta}k_1)$ cannot be optimal as $p^v = c^v + \frac{1}{\beta}k_1$ would result in a higher profit. For $p^v \leq c^v + k_1$, all consumers who bought the firm's initial package buy the firm's service. If $p^v \geq c^v - k_1$, rational consumers who did not buy from the firm in $t = 0$ do not switch to the firm in $t = 1$. If $p^v < c^v - k_1$, rational consumers who did not buy from the firm in $t = 0$ switch to the firm in $t = 1$, and the firm would suffer losses from them because $p^v < c^v$. There are two possible cases under $p^v < c^v - k_1$. First, if the firm sells its initial package to naive consumers only, then the firm can charge at most $p^{\tilde{v}} = c^{\tilde{v}} + c^v + \frac{k_0}{\beta} - p^v$, and it can profitably deviate by setting $p^{\tilde{v}} = c^{\tilde{v}} + \frac{1}{\beta}k_0 - k_1$ and $p^v = c^v + \frac{1}{\beta}k_1$. Second, if the firm sells its initial package to all consumers, the firm can charge at most $p^{\tilde{v}} = c^{\tilde{v}} + k_0 + k_1$. This is because rational consumers will buy the initial package from the competitive fringe and then buy the recurring service from the firm if $p^{\tilde{v}} > c^{\tilde{v}} + k_0 + k_1$. But then, the firm can profitably deviate by setting $p^{\tilde{v}} = c^{\tilde{v}} + k_0$ and $p^v = c^v$. Hence, $p^v < c^v - k_1$ cannot be optimal pricing.

Thus, we are left with $p^v = c^v + \frac{1}{\beta}k_1$ and $p^v \in [c^v - k_1, c^v + k_1]$ as candidates. If $p^v = c^v + \frac{1}{\beta}k_1$, $p^{\tilde{v}} = c^{\tilde{v}} + \frac{1}{\beta}k_0 - k_1$ is the maximum price for the initial package naive consumers are willing to pay and $p^{\tilde{v}} = c^{\tilde{v}} + k_0 - k_1$ is the maximum price for the initial package rational consumers are willing to pay. If $p^v \in [c^v - k_1, c^v + k_1]$, then the optimal initial price is $p^{\tilde{v}} \in [c^{\tilde{v}} + k_0 - k_1, c^{\tilde{v}} + k_0 + k_1]$ such that $p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + k_0$ and all consumers buy and do not switch from the firm. This is because the firm cannot make more profits from rational consumers than from naive ones, and if the firm wanted to sell only to naive consumers, it could also choose $p^v = c^v + \frac{1}{\beta}k_1$ and make higher profits.

Hence, we are left with three cases: First, suppose that the firm sells its initial package and its service to both naive and rational consumers. In this case, the firm sets $p^{\tilde{v}} \in [c^{\tilde{v}} + k_0 - k_1, c^{\tilde{v}} + k_0 + k_1]$ and $p^v \in [c^v - k_1, c^v + k_1]$ such that $p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + k_0$. Then, the firm's profits are $\Pi = k_0$.

Second, suppose that the firm sells both its initial package and its service only to naive consumers. In this case, the firm sets $p^{\tilde{v}} = c^{\tilde{v}} + \frac{1}{\beta}k_0 - k_1$ and $p^v = c^v + \frac{1}{\beta}k_1$. Then, the firm's profits are $\Pi = \frac{\alpha}{\beta}[k_0 + (1 - \beta)k_1]$.

Third, suppose that the firm sells its initial package to all consumers but its service to naive consumers only. In this case, the firm sets $p^{\tilde{v}} = c^{\tilde{v}} + k_0 - k_1$ and $p^v = c^v + \frac{1}{\beta}k_1$. Then, the firm's profits are $\Pi = k_0 + \frac{\alpha-\beta}{\beta}k_1$. However, this third case turns out to be never optimal, as the profits in the third case are lower than the profits in the first case when $\alpha < \beta$, and the profits in the third case are lower than the profits in the second case when $\alpha \geq \beta$.

By comparing the profits in the first two cases, we obtain the results. □

Proof of Proposition 1.

This follows from Lemma 1. If $k_1 \in \left(\frac{\beta-\alpha}{\alpha(1-\beta)}\underline{k}_0, \frac{\beta-\alpha}{\alpha(1-\beta)}\overline{k}_0\right)$, then employing a choice-enhancing policy in $t = 0$ lets the firm switch from case (i) of Lemma 1 to case (ii), thus strictly increasing the price after the automatic renewal p^v and strictly decreasing social welfare. If in addition the reduction of k_0 is not enough, i.e., $k_1 > \frac{1}{1-\beta}(\beta\overline{k}_0 - \underline{k}_0)$, the total price and naive consumers' long-run utility strictly decrease. Similarly, if $k_1 > \frac{1}{\alpha(1-\beta)}[\beta\overline{k}_0 - \underline{k}_0 + (1-\beta)(1-\alpha)\underline{k}_0]$, the policy also strictly decreases consumer welfare. □

Proof of Proposition 2.

This follows from Lemma 1. The policy strictly decreases the price after the automatic renewal in both cases of Lemma 1. As long as $\overline{k}_1 > \frac{\beta-\alpha}{\alpha(1-\beta)}k_0$, the policy strictly decreases the total price and strictly increases naive consumers' long-run utility while it leaves rational consumers' long-run utility unchanged. Changing from case (ii) to case (i) has the same effect, and in addition, this strictly increases social welfare. If $\overline{k}_1 \leq \frac{\beta-\alpha}{\alpha(1-\beta)}k_0$, employing the policy has no effect on total prices, consumer welfare, and social welfare. □

Proof of Corollary 1.

This follows immediately from Propositions 1 and 2. □

Proof of Proposition 3.

This follows from Lemma 1. If $\alpha \leq \beta$, $\overline{k}_0$ is just above $\frac{\alpha(1-\beta)}{\beta-\alpha}\overline{k}_1$ without the policy, and $\underline{k}_0$ is just below $\frac{\alpha(1-\beta)}{\beta-\alpha}\underline{k}_1$ with the policy (which also requires $\frac{\alpha(1-\beta)}{\beta-\alpha} < 1$), then the total price becomes higher by employing the policy. Thus, naive consumers' long-run utility is reduced. Furthermore, the firm does not sell any product to rational consumers. They switch, which decreases social welfare. Because rational consumers' long-run utility is unchanged, and the policy also decreases consumer welfare. □

Proof of Lemma 2.

The candidates for equilibrium prices are derived in the same manner as in Lemma 1, except that inattentive consumers do not falsely expect to switch in $t = 1$.

For $p^v > c^v + \frac{1}{\theta}k_1$, no consumer would buy from the firm, hence this cannot be optimal. For $p^v \in (c^v + k_1, c^v + \frac{1}{\theta}k_1]$ only inattentive consumers buy from the firm. Because inattentive consumers only partially take into account the price for the service, $p^v \in (c^v + k_1, c^v + \frac{1}{\theta}k_1)$ cannot be optimal as $p^v = c^v + \frac{1}{\theta}k_1$ would result in a higher profit. For $p^v < c^v - k_1$, rational consumers who did not buy from the firm in $t = 0$ would switch to the firm in $t = 1$ and the firm would suffer losses from them. These prices after the automatic renewal are never optimal by the same logic as in Lemma 1.

Thus, we are left with $p^v = c^v + \frac{1}{\theta}k_1$ and $p^v \in [c^v - k_1, c^v + k_1]$ as candidates. If $p^v = c^v + \frac{1}{\theta}k_1$, $p^{\tilde{v}} = c^{\tilde{v}} + k_0 - k_1$ is the maximum price for the initial package rational and inattentive consumers are willing to pay. If $p^v \in [c^v - k_1, c^v + k_1]$, only $p^{\tilde{v}} \in [c^{\tilde{v}} + k_0 - k_1, c^{\tilde{v}} + k_0 + k_1]$, such that $p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + k_0$ and all consumers buy and do not switch from the firm, can be optimal because the firm cannot make more profits from rational consumers than from inattentive ones, and if the firm wanted to sell only to inattentive consumers, it could also choose $p^v = c^v + \frac{1}{\theta}k_1$ and make higher profits.

Hence, we are left with three cases: First, suppose that the firm sells its initial package and its service to both inattentive and rational consumers. In this case, the firm sets $p^{\tilde{v}} \in [c^{\tilde{v}} + k_0 - k_1, c^{\tilde{v}} + k_0 + k_1]$ and $p^v \in [c^v - k_1, c^v + k_1]$ such that $p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + k_0$. Then, the firm's profits are $\Pi = k_0$.

Second, suppose that the firm sells both its initial package and its service only to inattentive consumers. In this case, the firm sets $p^{\tilde{v}} = c^{\tilde{v}} + k_0 - k_1$ and $p^v = c^v + \frac{1}{\theta}k_1$. Then, the firm's profits are $\Pi = \alpha \left[k_0 + \frac{1-\theta}{\theta}k_1\right]$.[43]

Third, suppose that the firm sells its initial package to all consumers but its service to inattentive consumers only. In this case, the firm sets $p^{\tilde{v}} = c^{\tilde{v}} + k_0 - k_1$ and $p^v = c^v + \frac{1}{\theta}k_1$. Then, the firm's profits are $\Pi = k_0 - k_1 + \frac{\alpha}{\theta}k_1$.

Analogous to Lemma 1, Lemma 2 follows by comparing profits of the different cases. □

Proof of Proposition 4.

[43] Given these prices, rational consumers are indifferent between buying and not buying the initial package. However, the firm can make only inattentive consumers buy the initial package by slightly increasing $p^{\tilde{v}}$ and slightly decreasing p^v. See footnote 26 for the detail.

This follows from Lemma 2. We first show that there exist parameter values α, k_0, k_1 such that a choice-enhancing policy in $t = 0$ strictly decreases consumer and social welfare. Assume $\alpha < \theta$ and let $k_1 < \frac{\theta(1-\alpha)}{\alpha(1-\theta)} k_0$ without the policy. The firm sells all products to all consumers. If the policy reverses the second inequality, however, the firm sells both the initial package and the service to inattentive consumers only. This reduces both consumer and social welfare. Because $\frac{\theta(1-\alpha)}{\alpha(1-\theta)} > 0$ if $\alpha < \theta$, such parameters exist.

We next show that a choice-enhancing policy in $t = 1$ never strictly decreases consumer or social welfare. To prove that, we check three cases of Lemma 2 in turn. First, if case (i) is the firm's optimal pricing without the policy, then employing the policy will not change the type of the firm's pricing strategy, and neither consumer or social welfare are affected. Second, if case (iii) is the firm's optimal pricing without the policy, then employing the policy will not change the type of the firm's pricing strategy and will increase both consumer and social welfare.

Finally, suppose that case (ii) is the firm's optimal pricing without the policy. If employing the policy will not change the type of the firm's pricing strategy, then it will increase consumer welfare and will not change social welfare. If employing the policy will lead to case (i), then it will increase both consumer and social welfare. If employing the policy will lead to case (iii), then it implies that $\underline{k}_1 < k_0 < \overline{k}_1$. In this case, consumer welfare obviously increases, and social welfare also increases because rational consumers pay a lower switching cost when the policy is employed. □

Proof of Proposition 5.

Before the proof, we characterize the consumer switching behavior. For notational simplicity, let β^i be consumer i's degree of present bias, where time-consistent consumers have $\beta^R = 1$ and naive consumers have $\beta^N = \beta < 1$.

Note that consumers do not take any action in $t = T$. We first analyze the switching decision in $t = T - 1$. Suppose that consumers bought the firm's initial package and kept using the firm's service. Then, consumers do not switch to the competitive fringe if and only if $-k_{T-1} + \beta^i(v - c^v) \leq \beta^i(v - p^v_T)$, or equivalently, $p^v_T - c^v \leq \frac{k_{T-1}}{\beta^i}$. We next analyze consumer behavior in period $1 \leq \tau < T - 1$. Consumers think that they will not switch in any future period if and only if $\sum_{i=t+1}^{T}(p^v_i - c^v) \leq k_t$ for all $t > \tau$. Given this belief, consumers' switching behavior in period τ can be divided into the following two cases. First, if $\sum_{i=t+1}^{T}(p^v_i - c^v) \leq k_t$ for all $t > \tau$, consumers do not switch in period τ if and only if $\beta^i \sum_{i=t+1}^{T}(p^v_i - c^v) \leq k_\tau$ because they think that they will never switch in any future period $t > \tau$. Second, if there exists a period $t > \tau$ such that $\sum_{i=t+1}^{T}(p_i^v - c^v) > k_t$, by backward induction consumers form a belief about whether they will switch or not in each future period, and as a result, they think they will switch in some future period. Let $\hat{t} > \tau$ denote such a period. Given $\hat{t}$, they do not switch in period τ if and only if $k_\tau > \beta^i \left(k_{\hat{t}} + \sum_{i=\tau+1}^{\hat{t}}(p_i^v - c^v)\right)$.

Given these beliefs, each consumer buys the firm's initial package in $t = 0$ if and only if her perceived utility is equal to or greater than buying it from the competitive fringe. We here explicitly describe the consumer behavior on the purchase of the initial package in $t = 0$. Given the switching decisions regarding the service, each consumer takes up the firm's initial package in $t = 0$ if and only if one (or both) of the following two conditions is satisfied; (i) the total perceived utility of buying the firm's initial package and service is greater than or equal to buying the initial package and the service from the competitive fringe: $-\beta^i(p^{\tilde{v}} + \sum_{t=2}^{T} p^v) \geq -k_0 - \beta^i(c^{\tilde{v}} + \sum_{t=2}^{T} c^v)$, or equivalently, $\beta^i(p^{\tilde{v}} - c^{\tilde{v}}) \leq k_0 - \beta^i[\sum_{t=2}^{T}(p_t^v - c^v)]$, (ii) the total perceived utility of buying the firm's initial package and switching in period $\hat{t}$ is greater than or equal to buying the initial package and the service from the competitive fringe for some $\hat{t} \in \{1, \cdots, T-1\}$: $-\beta^i(p^{\tilde{v}} + \sum_{t=2}^{\hat{t}} p_t^v + k_{\hat{t}} + \sum_{t=\hat{t}+1}^{T} c^v) \geq -k_0 - \beta^i(c^{\tilde{v}} + \sum_{t=2}^{T} c^v)$, or equivalently, $\beta^i(p^{\tilde{v}} - c^{\tilde{v}}) \leq k_0 - \beta^i[k_{\hat{t}} + \sum_{t=2}^{\hat{t}}(p_t^v - c^v)]$.

It is easy to show that the firm sells its service to some consumers in every period: $p_t^v \leq \frac{k_t}{\beta^i}$. It is also easy to show that if rational consumers pay p_t^v, then naive consumers also pay p_t^v.

Firm behavior. We now analyze the firm's optimal pricing. Again, the firm faces a trade-off between selling its service to all consumers at a moderate price (at most $\sum_{i=2}^{T}(p_i^v - c^v) = k_1$) and exploiting naive consumers at a high price ($p_t^v = c^v - k_t + \frac{1}{\beta}k_{t-1}$ for $t = 2, \cdots, T-1$ and $p_T^v = c^v + \frac{1}{\beta}k_{T-1}$). Similarly, the firm faces a trade-off between selling its initial package to all consumers at a moderate price or selling it only to naive consumers at a high price. Obviously, the firm will only consider charging a moderate price for the service if it also charges a moderate price for the initial package as otherwise rational consumers would have switched in $t = 0$ anyway.

Lemma 3 describes the firm's optimal pricing:

Lemma 3. *(i) If* $\sum_{i=1}^{T-1} k_i \leq \frac{\beta-\alpha}{\alpha(1-\beta)}k_0$*, the firm sets its total price equal to* $p^{\tilde{v}} + \sum_{i=2}^{T} p_i^v = c^{\tilde{v}} + (T-1)c^v + k_0$ *with* $p^{\tilde{v}} \in [c^{\tilde{v}} + k_0 - k_1, c^{\tilde{v}} + k_0 + k_1]$ *and* $\sum_{i=2}^{T} p^v \in [c^v - k_1, c^v + k_1]$*. No consumer switches from the firm. The firm's profits are* $\Pi = k_0$*. For both types of consumers, the long-run* *utility is* $U^R = U^N = \tilde{v} - c^{\tilde{v}} + (T-2)(v - c^v) - k_0$*.*

(ii) If $\sum_{i=1}^{T-1} k_i > \frac{\beta-\alpha}{\alpha(1-\beta)} k_0$*, the firm sets its total price equal to* $p^{\tilde{v}} + \sum_{i=2}^{T} p_i^v = c^{\tilde{v}} + (T-1)c^v + \frac{\alpha}{\beta}\left(k_0 + (1-\beta)\sum_{i=1}^{T-1} k_i\right)$ *with* $p^{\tilde{v}} = c^{\tilde{v}} + \frac{1}{\beta}k_0 - k_1$*,* $p_t^v = c^v - k_t + \frac{1}{\beta}k_{t-1}$ *for* $t = 2, \cdots, T-1$*, and* $p_T^v = c^v + \frac{1}{\beta}k_{T-1}$*. Naive consumers do not switch from the firm, whereas rational consumers switch from the firm in* $t = 0$*. The firm's profits are* $\Pi = \frac{\alpha}{\beta}\left(k_0 + (1-\beta)\sum_{i=1}^{T-1} k_i\right)$*. Naive consumers' long-run utility is* $U^N = \tilde{v} - c^{\tilde{v}} + (T-2)(v - c^v) - \frac{1}{\beta}\left(k_0 + (1-\beta)\sum_{i=1}^{T-1} k_i\right)$*, whereas that of rational consumers is* $U^R = \tilde{v} - c^{\tilde{v}} + (T-2)(v - c^v) - k_0$*.*

Proof. The candidates for equilibrium prices are chosen by the same arguments as those for Lemma 1; naive consumers can be exploited several times because they can make false plans several times. The maximum service prices for exploiting naive consumers are $p_t^v = c^v - k_t + \frac{1}{\beta}k_{t-1}$ for $t = 2, \cdots, T-1$, and $p_T^v = c^v + \frac{1}{\beta}k_{T-1}$. Analogous to Lemma 1, Lemma 3 follows by comparing profits of the different cases. □

The proof of part (ii) of Proposition 5 is completely analogous to the proof of Corollary 1. Part (i) follows immediately from Lemma 3. □

Proof of Proposition 6.

Suppose that a symmetric pure-strategy equilibrium exists in which firms earn positive profits. Then, each firm can profitably deviate by offering the same service price and a slightly lower price for the initial package, because the deviating firm can attract all consumers and each consumer's behavior regarding the service purchase does not change—a contradiction.

As firms make zero profits in equilibrium, the price for the initial package equals the production cost minus the total profits from the service. Similar to Lemma 1, the outcomes are summarized as follows:

If $\alpha > \beta$, there exists an equilibrium in which $p^{\tilde{v}} = c^{\tilde{v}} - \frac{\alpha}{\beta}k_1$ and $p^v = c^v + \frac{1}{\beta}k_1$. Rational consumers switch in $t = 1$ (which causes a welfare loss of k_1), whereas naive consumers do not switch. Rational consumers' long-run utility is $U^R = \tilde{v} + v - c^{\tilde{v}} - c^v + \frac{\alpha-\beta}{\beta}k_1$. Naive consumers' long-run utility is $U^N = \tilde{v} + v - c^{\tilde{v}} - c^v - \frac{1-\alpha}{\beta}k_1$.

If $\alpha \leq \beta$, there exists an equilibrium in which $p^{\tilde{v}} = c^{\tilde{v}} - k_1$ and $p^v = c^v + k_1$. No consumer switches. For both types of consumers, the long-run utility is $U^R = U^N = \tilde{v} + v - c^{\tilde{v}} - c^v$.

Note that in each case, neither consumer or social welfare depend on k_0, and both depend negatively on k_1 if $\alpha > \beta$. □

Proof of Proposition 7.

We first show that whenever rational consumers prefer to choose some menu of the firm, naive consumers always prefer to choose the same menu. Suppose that rational consumers prefer to choose a contract $(\hat{p}^{\tilde{v}}, \hat{p}^{v})$. It implies that (i) choosing $(\hat{p}^{\tilde{v}}, \hat{p}^{v})$ is better for rational consumers than choosing the competitive fringe in $t = 0$, i.e., $\hat{p}^{\tilde{v}} + \hat{p}^{v} \leq \tilde{c} + c + k_0$, and that (ii) choosing $(\hat{p}^{\tilde{v}}, \hat{p}^{v})$ maximizes rational consumers' long-run utility among the menus of the firm, i.e., $(\hat{p}^{\tilde{v}}, \hat{p}^{v}) \in \operatorname{argmax}_{\{(p^{\tilde{v}}, p^{v})\}} \ \tilde{v} + v - p^{\tilde{v}} - \min\{p^{v}, c^{v} + k_1\}$. Now think about the incentives for naive consumers. Note that the above (i) implies that naive consumers also prefer to choose a contract $(\hat{p}^{\tilde{v}}, \hat{p}^{v})$ rather than to choose the competitive fringe in $t = 0$. Also, given that naive consumers take up the firm's initial package, in $t = 0$ they choose a menu which maximizes $\beta[\tilde{v} + v - p^{\tilde{v}} - \min\{p^{v}, c^{v} + k_1\}]$. Hence, whenever rational consumers prefer to choose some menu, naive consumers always prefer to choose the same menu.

The above result implies that, even when the firm can offer menus of contracts, there are only three cases in the equilibrium : (1) rational and naive consumers take up the same menu in $t = 0$ and no one switches in $t = 1$, (2) rational and naive consumers take up the same menu in $t = 0$ and only rational consumers switch in $t = 1$, (3) only naive consumers take up the firm's menu in $t = 0$. By the same logic in Lemma 1, case (2) never becomes an optimal pricing. The rest of the derivations is exactly same as in Lemma 1. $\square$

Proof of Proposition 8.

Note that actual consumer behavior in $t = 1$ does not change because $\hat{\beta}$ is not relevant to a consumer's actual decision in $t = 1$. In $t = 0$, partially naive consumers think that they will not switch in $t = 1$ if and only if $p^{v} \leq c^{v} + k_1/\hat{\beta}$. Conditional on this belief, by backward induction, consumers' switching behavior in $t = 0$ can be divided into the following two cases. First, if $p^{v} \leq c^{v} + k_1/\hat{\beta}$, consumers think they will not switch in $t = 1$. Given this, they switch in period 0 if and only if $-k_0 + \beta[\tilde{v} - c^{\tilde{v}} + v - c^{v}] > \beta[\tilde{v} - p^{\tilde{v}} + v - p^{v}]$, or equivalently, $p^{\tilde{v}} + p^{v} - c^{\tilde{v}} - c^{v} > \frac{k_0}{\beta}$. Second, if $p^{v} > c^{v} + k_1/\hat{\beta}$, consumers think they will switch in $t = 1$. Given this, they switch in period 0 if and only if $-k_0 + \beta[\tilde{v} - c^{\tilde{v}} + v - c^{v}] > \beta[\tilde{v} - p^{\tilde{v}} - k_1 + v - c^{v}]$, or equivalently, $k_1 + p^{\tilde{v}} - c^{\tilde{v}} > \frac{k_0}{\beta}$. Note that $k_1/\hat{\beta} < k_1/\beta$ for any $\hat{\beta} \in (\beta, 1]$ and that the firm always sets $p^{v} = c^{v} + k_1/\beta$ whenever naive consumers procrastinate as in Lemma 1. Hence, akin to Heidhues and Kőszegi (2010), the firm can make partially naive consumers procrastinate and can exploit them by setting the same

p^v as in Section 3 irrespective of $\hat{\beta} \in (\beta, 1]$. □

Proof of Proposition 9.

Let U^S denote the long-run utility of sophisticated consumers. We first briefly discuss how sophisticated consumers behave, then establish Lemma 4 on firm behavior, and finally discuss the welfare effects of choice-enhancing policies.

Sophisticated consumers (who have not switched in $t = 0$) switch in $t = 1$ if and only if $p^v > c^v + \frac{1}{\beta}k_1$. Given this behavior and correct beliefs about it, they switch in $t = 0$ if $p^{\tilde{v}} > c^{\tilde{v}} + c^v - p^v + \frac{1}{\beta}k_0$ if they plan to stay in $t = 1$ and they switch in $t = 0$ if $p^{\tilde{v}} > c^{\tilde{v}} + k_1 + \frac{1}{\beta}k_0$ if they plan to switch in $t = 1$. Thus, the firm may optimally charge $p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + \frac{1}{\beta}k_0$ to maximally exploit sophisticated consumers.

Lemma 4. *Suppose that a fraction $\alpha \in (0, 1)$ of consumers are inattentive to the price after the automatic renewal.*

(i) If $k_1 \leq \frac{\beta-\alpha^n}{\alpha^n(1-\beta)}k_0$ and $\beta \geq \alpha^n + \alpha^s$, the firm sets its total price equal to $p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + k_0$ with $p^{\tilde{v}} \in [c^{\tilde{v}} + k_0 - k_1, c^{\tilde{v}} + k_0 + k_1]$ and $p^v \in [c^v - k_1, c^v + k_1]$. No consumer switches from the firm. The firm's profits are $\Pi = k_0$. For all types of consumers, the long-run utility is $U^R = U^N = U^S = \tilde{v} + v - c^{\tilde{v}} - c^v - k_0$.

(ii) If $k_1 > \frac{\beta-\alpha^n}{\alpha^n(1-\beta)}k_0$ and $k_1 > \frac{\alpha^s}{\alpha^n(1-\beta)}k_0$, the firm sets its total price equal to $p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + \frac{1}{\beta}k_0 + \frac{1-\beta}{\beta}k_1$ with $p^{\tilde{v}} = c^{\tilde{v}} + \frac{1}{\beta}k_0 - k_1$ and $p^v = c^v + \frac{1}{\beta}k_1$. Naive consumers do not switch from the firm, whereas rational and sophisticated consumers switch from the firm in $t = 0$. The firm's profits are $\Pi = \frac{\alpha^n}{\beta}[k_0 + (1-\beta)k_1]$. Naive consumers' long-run utility is $U^N = \tilde{v} + v - c^{\tilde{v}} - c^v - \frac{1}{\beta}k_0 - \frac{1-\beta}{\beta}k_1$, whereas that of rational and sophisticated consumers is $U^R = U^S = \tilde{v} + v - c^{\tilde{v}} - c^v - k_0$.

(iii) If $\beta < \alpha^n + \alpha^s$ and $k_1 \leq \frac{\alpha^s}{\alpha^n(1-\beta)}k_0$, the firm sets its total price equal to $p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + \frac{1}{\beta}k_0$ with $p^{\tilde{v}} \in [c^{\tilde{v}} + \frac{1}{\beta}k_0 - k_1 - \frac{1-\beta}{\beta}\min\{k_0, k_1\}, c^{\tilde{v}} + \frac{1}{\beta}k_0 + k_1]$ and $p^v \in [c^v - k_1, c^v + k_1 + \frac{1-\beta}{\beta}\min\{k_0, k_1\}]$. Naive and sophisticated consumers do not switch from the firm, whereas rational consumers switch from the firm in $t = 0$. The firm's profits are $\Pi = \frac{\alpha^n+\alpha^s}{\beta}k_0$. Naive and sophisticated consumers' long-run utility is $U^N = U^S = \tilde{v} + v - c^{\tilde{v}} - c^v - \frac{1}{\beta}k_0$, whereas that of rational consumers is $U^R = \tilde{v} + v - c^{\tilde{v}} - c^v - k_0$.

Proof.

The candidates for equilibrium prices are chosen by the same arguments as those for Lemma 1, except that sophisticated consumers are aware of their present bias. Then, $p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + \frac{1}{\beta}k_0$

is an additional equilibrium candidate that will not attract rational consumers while exploiting sophisticated consumers maximally (which is less than naive consumers could be exploited, because sophisticated consumers have correct expectations). If $k_1 < k_0$, rational consumers will not purchase the firm's initial package for any $p^{\tilde{v}} \in [c^{\tilde{v}} + \frac{1}{\beta}k_0 - \frac{1}{\beta}k_1, c^{\tilde{v}} + \frac{1}{\beta}k_0 + k_1]$ and present-biased consumers are willing to pay at most $p^v = c^v + \frac{1}{\beta}k_1$ for the service. If $k_1 \geq k_0$, the firm wants to prevent rational consumers from purchasing the its initial package because it would make losses from them. In this case, the minimum price for the initial package is $p^{\tilde{v}} = c^{\tilde{v}} + k_0 - k_1$. Analogous to Lemma 1, Lemma 4 follows by comparing profits of the different cases. □

The effects of choice-enhancing policies on social welfare follow immediately from Lemma 4. Likewise, it is immediate that consumer welfare in case (i) is higher than in in cases (ii) and (iii). Thus, it is left to show that a reduction of k_1 that leads to a change from case (ii) to case (iii) does not decrease consumer welfare. To see it, note that consumer welfare in case (iii) is higher than or equal to that in case (ii) if $(\alpha^n + \alpha^s)\left(\tilde{v} + v - c^{\tilde{v}} - c^v - \frac{1}{\beta}k_0\right) + (1 - \alpha^n - \alpha^s)\left(\tilde{v} + v - c^{\tilde{v}} - c^v - k_0\right) \geq (1 - \alpha^n)\left(\tilde{v} + v - c^{\tilde{v}} - c^v - k_0\right) + \alpha^n\left(\tilde{v} + v - c^{\tilde{v}} - c^v - \frac{1}{\beta}k_0 - \frac{1-\beta}{\beta}k_1\right) \Leftrightarrow k_1 \geq \frac{\alpha^s}{\alpha^n}k_0$. Because the change from case (ii) to case (iii) occurs only when $\overline{k}_1 \geq \frac{\alpha^s}{\alpha^n(1-\beta)}k_0 \left(> \frac{\alpha^s}{\alpha^n}k_0\right)$, it never decreases consumer welfare. □

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Supplementary Material for "The Timing of Choice-Enhancing Policies" by Takeshi Murooka and Marco A. Schwarz (not intended for publication)

In this supplementary material, we show that our results are qualitatively robust when a fraction α of agents, whom we call naive, are inattentive to future prices (and less inattentive to future switching costs) or inattentive to just a recurring price after the automatic renewal (and potentially inattentive to future switching costs).

To describe the decision utility of naive consumers in this case, suppose that u_t is a naive consumer's period-t gross utility (i.e., the utility excluding payments). We introduce the indicator function $\mathbf{1}_t$ (which represents a consumer's decision) where $\mathbf{1}_t = 1$ if consumers are enrolled at the firm at the end of period t and $\mathbf{1}_t = 0$ otherwise. Naive consumers decide whether to switch based on $u_0 - \theta_{p^{\tilde{v}}} \left((p^{\tilde{v}} - c^{\tilde{v}})\mathbf{1}_0 + c^{\tilde{v}}\right) + \theta_K u_1 + \theta_K u_2 - \theta_{p^v} \left((p^v - c^v)\mathbf{1}_1 + c^v\right)$ in $t = 0$, where $\theta_{p^v} \in (0,1)$ represents the degree of their attention to the recurring price, $\theta_{p^{\tilde{v}}} \in [\max\{\theta_{p^v}, \theta_K\}, 1]$ represents the degree of their attention to the price for the initial package, and $\theta_K \in [0,1)$ represents the degree of their attention to other costs and benefits.[44] In $t = 1$, naive consumers decide whether to switch to the competitive fringe based on $u_1 + \theta_K u_2 - \theta_{p^v}((p^v - c^v)\mathbf{1}_1 + c^v)$. If $\theta_K = 1$, consumers are inattentive to future payments only; if, in addition, $\theta_{p^{\tilde{v}}} = 1$, consumers are inattentive to the future recurring price only. That is, the case investigated in Section 4.1 is $\theta_{p^{\tilde{v}}} = \theta_K = 1$ and $\theta_{p^v} = \theta$.

Consumer behavior. We first characterize naive consumer's behavior given prices and switching costs. Rational consumers behave as in our basic model. If naive consumers still use the firm's service at the beginning of $t = 1$, they switch to the competitive fringe if and only if $p^v - c^v > \frac{1}{\theta_{p^v}} k_1$. In period 0 they think they will switch in the next period if and only if $p^v - c^v > \frac{\theta_K}{\theta_{p^v}} k_1$. Given this belief, period 0's switching behavior can be divided into the following two cases. First, if $p^v - c^v \leq \frac{\theta_K}{\theta_{p^v}} k_1$, naive consumers think they will keep using the firm's service in period 1. Hence, they switch in period 0 if and only if $\theta_{p^{\tilde{v}}}(p^{\tilde{v}} - c^{\tilde{v}}) + \theta_{p^v}(p^v - c^v) > k_0$. Second, if $p^v - c^v > \frac{\theta_K}{\theta_{p^v}} k_1$, these consumers think they will switch in period 1. Hence, they switch in period 0 if and only if

[44] We could allow $\theta_K = 1$ if $\theta_{p^{\tilde{v}}} \neq \theta_{p^v}$.

$\theta_{p^{\tilde{v}}}(p^{\tilde{v}} - c^{\tilde{v}}) + \theta_K k_1 > k_0$. Note that the "attention weight" attached to k_0 is always equal to one because once a consumer chooses to switch in period 0 it is incurred in that period.

Firm behavior. We now analyze the firm's optimal pricing. Intuitively, the firm faces a trade-off between selling its service to all consumers at a moderate price ($p^v = c^v + k_1$) and exploiting naive consumers at a high price ($p^v = c^v + \frac{1}{\theta_{p^v}} k_1$). Similarly, the firm faces a trade-off between selling its initial package to all consumers at a moderate price ($p^{\tilde{v}} = c^{\tilde{v}} + k_0 - k_1$) or selling it only to naive consumers at a high price ($p^{\tilde{v}} = c^{\tilde{v}} + \frac{1}{\theta_{p^{\tilde{v}}}} k_0 - \frac{\theta_K}{\theta_{p^{\tilde{v}}}} k_1$). Obviously, the firm will only consider charging a moderate price for the service if it also charges a moderate price for the initial package as otherwise rational consumers would have switched in $t = 0$ anyway.

Lemma 5 describes the firm's optimal pricing:

Lemma 5. *(i) If $\alpha \left(\frac{\theta_{p^{\tilde{v}}}}{\theta_{p^v}} - \theta_K \right) k_1 \leq (\theta_{p^{\tilde{v}}} - \alpha) k_0$ and $\alpha \leq \theta_{p^v}$, the firm sets its total price equal to $p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + k_0$ with $p^{\tilde{v}} \in [c^{\tilde{v}} + k_0 - k_1, c^{\tilde{v}} + k_0 + k_1]$ and $p^v \in [c^v - k_1, c^v + k_1]$. No consumer switches from the firm. The firm's profits are $\Pi = k_0$. For both types of consumers, the long-run utility is $U^R = U^N = \tilde{v} + v - c^{\tilde{v}} - c^v - k_0$.*

(ii) If $(\theta_{p^{\tilde{v}}} - \alpha\theta_K) k_1 > (\theta_{p^{\tilde{v}}} - \alpha) k_0$ and $\alpha \left(\frac{\theta_{p^{\tilde{v}}}}{\theta_{p^v}} - \theta_K \right) k_1 > (\theta_{p^{\tilde{v}}} - \alpha) k_0$, the firm sets its total price equal to $p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + \frac{1}{\theta_{p^{\tilde{v}}}} k_0 + \left(\frac{1}{\theta_{p^v}} - \frac{\theta_K}{\theta_{p^{\tilde{v}}}} \right) k_1$ with $p^{\tilde{v}} = c^{\tilde{v}} + \frac{1}{\theta_{p^{\tilde{v}}}} k_0 - \frac{\theta_K}{\theta_{p^{\tilde{v}}}} k_1$ and $p^v = c^v + \frac{1}{\theta_{p^v}} k_1$. Naive consumers do not switch, whereas rational consumers switch in period 0. The firm's profits are $\pi = \alpha \left[\frac{1}{\theta_{p^{\tilde{v}}}} k_0 + \left(\frac{1}{\theta_{p^v}} - \frac{\theta_K}{\theta_{p^{\tilde{v}}}} \right) k_1 \right]$. Naive consumers' long-run utility is $U^N = \tilde{v} + v - c^{\tilde{v}} - c^v - \frac{1}{\theta_{p^{\tilde{v}}}} k_0 - \left(\frac{1}{\theta_{p^v}} - \frac{\theta_K}{\theta_{p^{\tilde{v}}}} \right) k_1$, whereas that of rational consumers is $U^R = \tilde{v} + v - c^{\tilde{v}} - c^v - k_0$.

(iii) If $(\theta_{p^{\tilde{v}}} - \alpha\theta_K) k_1 \leq (\theta_{p^{\tilde{v}}} - \alpha) k_0$ and $\alpha > \theta_{p^v}$, the firm sets its total price equal to $p^{\tilde{v}} + p^v = c^{\tilde{v}} + c^v + k_0 + \left(\frac{1 - \theta_{p^v}}{\theta_{p^v}} \right) k_1$ with $p^{\tilde{v}} = c^{\tilde{v}} + k_0 - k_1$ and $p^v = c^v + \frac{1}{\theta_{p^v}} k_1$. Naive consumers do not switch, whereas rational consumers switch in period 1. The firm's profits are $\pi = k_0 + \left(\frac{\alpha - \theta_{p^v}}{\theta_{p^v}} \right) k_1$. Naive consumers' long-run utility is $U^N = \tilde{v} + v - c^{\tilde{v}} - c^v - k_0 - \frac{1 - \theta_{p^v}}{\theta_{p^v}} k_1$, whereas that of rational consumers is $U^R = \tilde{v} + v - c^{\tilde{v}} - c^v - k_0$.

Proof.

The candidates for equilibrium prices are chosen by the same arguments as those for Lemma 1. Analogous to Lemma 1, the result follows by comparing profits of the different cases. □

The next proposition shows that our main finding is unchanged:

Proposition 10. *For all $\theta_{p^v}, \theta_{p^{\tilde{v}}}, \theta_K$, there exist α, k_0, k_1 such that employing a choice-enhancing policy in $t = 0$ strictly decreases consumer and social welfare. For all $\theta_{p^v}, \theta_{p^{\tilde{v}}}, \theta_K$, employing a choice-enhancing policy in $t = 1$ never strictly decreases consumer or social welfare.*

Proof.

We first show that there exist parameter values α, k_0, k_1 such that a choice-enhancing policy in $t = 0$ may strictly decrease consumer and social welfare. Assume $\alpha < \theta_{p^v} (\leq \theta_{p^{\tilde{v}}})$ and let k_1 be slightly below $\frac{(\theta_{p^{\tilde{v}}} - \alpha)}{\alpha\left(\frac{\theta_{p^{\tilde{v}}}}{\theta_{p^v}} - \theta_K\right)} k_0$. The firm sells both the initial package and the service to all consumers. However, a reduction of k_0 that reverses the inequality lets the firm sell both the initial package and the service to naive consumers only. This reduces both consumer and social welfare. The according k_0, k_1 can always be chosen because $\frac{(\theta_{p^{\tilde{v}}} - \alpha)}{\alpha\left(\frac{\theta_{p^{\tilde{v}}}}{\theta_{p^v}} - \theta_K\right)} > 0$.

We next show that a choice-enhancing policy in $t = 1$ can never strictly decrease consumer or social welfare. First, note that the firm's choice between case (i) and case (iii) does not depend on the switching costs. Hence, a choice-enhancing policy can never backfire if the firm only had the choice between those two pricing strategies. Second, because $\left(\frac{1}{\theta_{p^v}} - \frac{\theta_K}{\theta_{p^{\tilde{v}}}}\right) > 0$, the profits when selling nothing to rational consumers positively depend on k_1, whereas the profits of selling both services to all consumers are independent of k_1. Consequently, a reduction of k_1 can never let the firm change from selling everything to all consumers to selling nothing to rational consumers, and thus never decrease consumer or social welfare.

Hence, the only remaining case is the choice between selling just the initial package to rational consumers and selling nothing to rational consumers. As the former strategy is only optimal if $\alpha > \theta_{p^v}$, consider these parameters. Let $k_1 (> 0)$ be slightly above $\max\left\{0, \frac{\theta_{p^v} - \alpha}{\theta_{p^v} - \alpha\theta_K} k_0\right\}$ and reduce it such that it is slightly below if possible (if it is not possible, then we are done). Because $\frac{\theta_{p^v} - \alpha}{\theta_{p^v} - \alpha\theta_K} \leq 1$, $k_1 < k_0$ after the reduction, and thus social welfare does not decrease. Comparing consumer welfare in the two cases, $\tilde{v} + v - c^{\tilde{v}} - c^v - \alpha k_0 - \frac{\alpha(1-\theta_{p^v})}{\theta_{p^v}} k_1 - (1-\alpha)k_0 \geq \tilde{v} + v - c^{\tilde{v}} - c^v - (1-\alpha)k_0 - \frac{\alpha}{\theta_{p^{\tilde{v}}}} k_0 - \alpha\left(\frac{1}{\theta_{p^v}} - \frac{\theta_K}{\theta_{p^{\tilde{v}}}}\right) k_1$, shows that the reduction does not decrease consumer welfare, either: for $k_0 = k_1$, the comparison reduces to $0 \leq \theta_{p^v}(1 - \theta_K)$ and, by comparing the factors in front of k_0, this implies that this is also true for $k_0 > k_1$ (and $k_0 < k_1$ cannot happen as we established when analyzing social welfare). $\square$