Anticipated Regret and Product Innovation

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September 11, 2015

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Abstract

When a firm introduces a product with new features, some consumers may find it difficult to assess their valuations for these new attributes. Their purchase decisions made under such uncertainty may lead to post-purchase regret. It has been experimentally shown that consumers anticipate their potential post-purchase regret in the future and make their current choices to mitigate or minimize it. That is, a consumer’s anticipated regret can significantly impact his purchase decision. Given the trend among the firms in various markets to invoke regret to stimulate sales, this paper analytically explores whether and how anticipated regret affects competing firms’ profits and product innovation. We find that anticipated regret can have both positive and negative effect on innovation and firms’ profits. Our analyses reveal that the consumer’s anticipated regret has non-monotonic effects on the level of innovation and firms’ profits.

Key words: anticipated regret; product innovation; behavioral economics; competition
1 Introduction

In many markets firms introduce new, improved products that come with new features. Here are some new product introductions with new features in 2013. Apple launched the new iPad mini 2 with Retina display and A7 processor; Sony launched VAIO Flip PCs with displays that can twist, flip, and turn the laptop into a tablet; LG introduced a new HOM-BOT vacuum cleaner that can be remotely scheduled via smartphones to clean the house; Honda launched its new Odyssey Touring Elite minivan with a built-in vacuum cleaner housed in the rear cargo area. When a firm introduces a product with new features, even though consumers may know the quality of these new features (e.g., screen resolution, processor speed or power rating) through product descriptions or demos, expert product reviews, or in-store trials, some consumers may still find it difficult to assess their valuations for these new attributes. At the time of purchase, these consumers may remain unsure how much they will utilize the new product features in the future, e.g., they might use the built-in car vacuum very often but they might also hardly ever use it.

The extant literature provides abundant evidence of uncertain preferences leading consumers to make a wrong forecast regarding their future usage intensity of new products or which product best fits their need (Simonson, 1993; Gilbert and Wilson, 2000; Rabin, 2002; Lowenstein et al., 2003; Wilson and Gïbert, 2003; Gilbert, 2006; Patrick et al., 2007). A consumer’s purchase decision made under such uncertainty may have emotional consequences. More specifically, if the consumer buys a new product and ends up not utilizing its new features as much as he had expected, he may regret having wasted money and not bought a cheaper lower-quality product. Similarly, if the consumer decides to buy an old, lower-quality product and finds out later that he would have utilized the new product’s features much more than he had expected before, he may regret having bought the old product.

As consumers experience post-purchase regret in many past consumption situations, they gradually anticipate and become more aware of the potential regret in the future. For example, when making a decision about switching from iPhone to Android phone, one consumer asked in an internet post “Did you switch from iPhone to Android and prefer it or regret it?” 1 She was considering upgrading her phone but feared that she might later regret her switching. In

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1 http://boards.hellobee.com/topic/did-you-switch-from-an-iphone-to-android-and-prefer-it-or-regret-it
the online replies from other consumers, some described the same questions, some regretted switching while others loved it. Two facts emerge from many similar examples. First, consumers’ uncertainty about their valuations of the new products may not be about product quality per se. For example, consumers know the speed of a new phone’s processor or the resolution and size of its display (i.e., the objective quality attributes). Rather, their uncertainty comes from the fact that they are not sure about how much they will utilize such higher quality attributes. In this particular example, it is also clear from all discussions, whether a product best fits a particular consumer’s future needs is a personal question that cannot be fully resolved since consumers may be different (e.g., some consumers see an Android phone’s larger screen as a big plus, while others do not value that very highly). Naturally, unlike the uncertainty about product quality, firms cannot easily help consumers to fully resolve such uncertainty in their preferences. Second, clearly many consumers anticipate prior to purchase that they may experience post-purchase regret.

Anticipating the potential post-purchase regret that consumers may experience as a result of post-decisional feedback on the forgone alternatives, they may ex ante make their choices to minimize or alleviate it (Zeelenberg et al., 1996). Significant effects of anticipated regret on consumer decision making (e.g., regarding long-distance telephone services, purchase of PC, and the choice of apartment) have been experimentally shown (Zeelenberg, 1999). There is also other evidence that anticipated regret affects the consumer’s purchase decision under uncertainty (Bell, 1982; Loomes and Sugden, 1982, 1987; Simonson, 1992; Inmann et al., 1997; Zeelenberg and Beattie, 1997; Zeelenberg, 1999; Cooke et al., 2001; Lemon et al., 2002; Zeelenberg and Pieters, 2007). Furthermore we observe that in practice firms in various markets prominently invoke consumer regret in their marketing communications. For example, in its 2014 marketing campaign, Intel used its “rewind regret” commercial to invoke the potential regret consumers may experience if they do not buy the new laptop with Intel’s processor.² This suggests that firms also believe that anticipated regret is quite impactful on consumers’ purchasing decision and it can be manipulated (either invoked or mitigated) to improve sales or profitability.

Given the strong evidence that anticipated regret has significant impacts on consumer purchasing decisions and that firms sometimes invoke anticipated regret in their marketing communications, some questions naturally arise. When is it profitable for a firm to invoke consumer regret?

²https://www.youtube.com/watch?v=tkR5f5G4bZCc
regret about not buying its product? Is it always optimal for an incumbent to remind consumers that they might regret switching to a new entrant’s product? Is it always profitable for a new entrant to encourage consumers to adopt its new product by reminding them that they may regret later if they buy the old product? Does anticipated regret decrease or increase firms’ profits? How does the consumer’s anticipated regret affect the entrant’s innovation or quality decision?

To address these research questions, we develop an analytical framework to examine the impact of anticipated regret on firm profitability and product innovation. We study a market with an incumbent firm facing competition from an entrant that is introducing an improved product with a new feature that the incumbent’s product lacks. The entrant can choose the quality level of the new feature; the entrant’s marginal cost increases with the quality of the new feature. Consumers may have different levels of knowledge or familiarity with the entrant’s new feature. Before purchase, some consumers know their valuation for the new feature (i.e., how much they will utilize the new feature after purchase) whereas other consumers are uncertain about their valuations for the new feature. The consumers with valuation uncertainty are aware of the potential regret they may experience in the future. For example, if they buy the new product and end up not utilizing the new attribute very much (i.e., they turn out to have low valuation for the new feature), they will experience ex post regret for their purchase decision.

As suggested in the behavioral literature, we model two types of regret aversion: aversion to the regret from switching to the new product (switching regret) and aversion to the regret from repeat-purchasing the old product (repeat-purchase regret).

We find that anticipated regret can increase or decrease firms’ profits and foster or hinder product innovation, i.e., anticipated regret has a non-monotonic effect on firms’ profits and the entrant’s innovation level. The non-monotonic relationship exists whether consumers are more or less averse to switching regret than repeat-purchase regret, but under different conditions. Interestingly, we find that when consumers are more averse to switching regret (which biases consumer preferences against the entrant and favors the incumbent), anticipated regret can actually increase the entrant’s level of innovation and profit and can also reduce the incumbent’s profit. Similarly, when consumers are more averse to repeat-purchase regret (which favors the entrant), anticipated regret may actually increase the incumbent’s profit and may also reduce the entrant’s profit. This non-monotonic effect on profits suggests that a firm needs to be careful
when invoking anticipated regret through its communication strategies to discourage consumers to buy the competitor’s product. Our analysis reveals that anticipated regret may sometimes create a win-win or a lose-lose situation for both firms even though its direct effect favors one firm against the other. We also find that regardless of whether the impact of anticipated regret on firms’ profits is positive or negative, the size of that impact is higher for the incumbent, i.e., the incumbent will gain or lose from anticipated regret to a greater extent than the entrant will.

Finally, we extend our analysis to the case of the entrant’s new feature being a digital attribute which requires no additional variable cost, but a significant R&D cost that varies with the quality of the new feature. We show that anticipated regret has a similar effect on product innovation and firms’ profits to the case of the entrant’s new product feature being a physical attribute requiring marginal cost. However, if the new attribute is digital, the positive impact of anticipated regret on product innovation and firms’ profits is attenuated when consumers are more averse to repeat-purchase regret, and the negative impact of anticipated regret on product innovation and firms’ profits is attenuated when consumers are more averse to switching regret.

2 Literature Review

There is an active stream of literature on consumer regret that explores its implications on both consumers’ choices and firms’ decisions. Syam et al. (2008) investigate how anticipated regret affects consumers’ preferences for customized versus standardized products. They show that anticipated regret encourages consumers to buy standardized products. However, this effect of anticipated regret diminishes as the number of standardized products increases. We adopt a similar linear structure for anticipated regret to that in Syam et al. (2008); however, in contrast, we model two types of regret aversion—aversion to the regret from switching to a new product and aversion to the regret from repeat-purchasing an old product.

Nasiry and Popescu (2012) investigate the effect of anticipated regret on the consumer’s advance purchase decision and provide prescriptive insights on firms’ sales policies and profits. They use the same linear structure as ours to incorporate anticipated regret into the consumer’s utility function. They also model two types of regret aversion—consumer’s aversion to regret from paying above valuation or missing a subsequent markdown (called action regret) versus consumer’s aversion to regret from forgoing an affordable advance purchase discount or facing a
stockout (called inaction regret). Diecidue et al. (2012) also analyze the forward-purchase versus spot-purchase decisions of consumers with uncertain product valuations. They model both a buyer’s regret over the money paid in excess of his product valuation when buying forward and a hesitater’s regret for the lost opportunity of an increased surplus when not buying forward. They show that a consumer is more likely to buy forward when he is more averse to hesitater’s regret but more likely to delay the purchase when he is more averse to buyer’s regret.

Irons and Hepburn (2007) use anticipated regret to explain why having too many choices is bad. The authors demonstrate that if agents anticipate the regret from unsearched options that turn out to be better than their choice, too many choices can reduce welfare. Engelbrecht-Wiggans and Katok (2006) and Filiz-Ozbay and Ozbay (2007) have used anticipated regret to explain overbidding behavior in sealed-bid first-price auctions of a single object. Both papers differentiate between the winner’s regret (i.e., a function of the difference between the winner’s bid and the minimum amount that would preserve her winning position after she learned others’ bids) and loser’s regret (i.e., a function of the difference between the loser’s valuation and the winning bid if the winning bid is affordable) and Filiz-Ozbay and Ozbay (2007) also experimentally test their theory. In their follow-up work, Engelbrecht-Wiggans and Katok (2008) experimentally show that being sensitive to winning and paying too much (i.e., higher aversion to winner’s regret) should result in lower average bids and being sensitive to missing opportunities to win at a favorable price (i.e., higher aversion to loser’s regret) should result in higher bids. Furthermore, Braun and Muermann (2004) use anticipated regret as a factor in explaining consumers’ demand for different types of insurance. However, none of these papers examine the effect of anticipated regret on the incentives of a firm to innovate and on the resulting price competition and profits.

Shih and Schau (2011) study the effect of perceived rate of innovation (PRI) on consumers’ timing of upgrade purchases. They show that a high PRI in a product category will increase anticipated regret about purchasing of the current best technology, which in turn leads to upgrade delays. However, the effect of PRI on anticipated regret is moderated by the presence of decision justifications. Sarangee et al. (2013) study anticipated regret of decision makers who must make continuation/termination decisions for new-product-development projects. The authors show that anticipated regret from stopping the project does not diminish as a failing project progresses whereas the anticipated ‘keep’ regret from continuing the project increases as more
negative information is received over the course of the project.3

Our paper contributes to both the regret literature and the growing literature that adopts the behavioral economic paradigm to provide insights on marketing phenomena and firms’ strategies (Feinberg et al., 2002; Amaldoss and Jain, 2005a,b; Cui et al., 2007; Lim and Ho, 2007; Ofek et al., 2007; Amaldoss and Jain, 2008a,b; Ho and Zhang, 2008; Syam et al., 2008; Jain, 2009; Orhun, 2009; Chen et al., 2010; Kuksov and Villas-Boas, 2010; Chen and Cui, 2013; Chen and Turut, 2013; Narasimhan and Turut, 2013). Note that regret aversion differs from the traditional risk aversion in that a consumer’s risk aversion is merely based on the amount of the consumer’s payoff uncertainty. In contrast, the consumer’s regret aversion, as shown in the extant behavioral literature, depends not only on the level of uncertainty in his or her ex post payoff but also on whether the consumer has switched to the new product or has bought the old product. We contribute to these streams of literature in two ways. First, given the abundance evidence for the effect of anticipated regret on consumers’ purchasing decision for new innovative products, we outline the optimal innovation and pricing strategies for firms in markets where anticipated regret is prevalent. Second, we provide guidelines to the innovating entrant and the incumbent on how to profitably manage consumers’ anticipated regret, i.e., when to invoke regret and when to mitigate it to increase profitability.

3 Model Setup

Consider a market with an incumbent firm offering a product having a non-price attribute, denoted by \( a_1 \). Without loss of generality, the incumbent’s marginal cost of production is normalized to zero. An entrant enters the market with a new improved product that has, in addition to the same baseline attribute \( a_1 \) as the incumbent’s product, a new non-price attribute, denoted by \( a_2 \). The entrant’s product has a quality level of \( q \) for the new attribute \( a_2 \). This quality level \( q \) represents the level of product innovation. The entrant’s fixed cost for entry is sunk, but it incurs a marginal cost of \( c^2 \).

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3Our paper is also related to Chen and Turut (2013) paper which studies the effect of another well-known behavioral phenomenon on product innovation. The authors investigate how context-dependent preferences affect the follower firm’s decision of whether to improve a disruptive innovation on the key performance dimension shared with the old technology or on the new performance dimension introduced by the disruptive innovation. They find that when consumers exhibit context-dependent preferences, the follower is more inclined to improve the new technology on the new performance dimension.
There is a unit mass of consumers that has past usage experience with the incumbent’s product and these consumers are in the market again in this category. A consumer has a valuation of $v$ for the incumbent’s product (i.e., for attribute $a_1$) and a valuation of $v + \theta q$ for the entrant’s product, where $\theta$ is the consumer’s willingness to pay for quality of the new attribute $a_2$ and is distributed uniformly over $[0, \bar{\theta}]$. Each consumer maximizes his surplus and buys at most one of the two products; the outside option of not buying has a utility of zero. Consumers may have different levels of familiarity with the new attribute. $\alpha$ proportion of consumers are familiar with the new attribute and know, at the time of purchase, how much they will benefit from the new attribute, i.e., they know their own $\theta$. We call these consumers the “informed” consumers. $(1 - \alpha)$ proportion of consumers are less familiar with the new attribute, but these “uninformed” consumers receive a signal $\theta_j$ regarding their valuation of the new attribute. For simplicity, we assume that $\theta_j \sim U[0, \bar{\theta}]$, i.e., the signal is distributed on the same interval as the distribution of the informed consumers’ valuations. Ex post, these uninformed consumers’ true valuation can be equal to their signal or much lower than it. For simplicity, we assume that uninformed consumers’ beliefs about their true valuation of the new attribute is $\theta_j$ (i.e., $\theta = \theta_j$) with probability $x$ and is zero with probability $(1 - x)$ (i.e., we normalize the low state of realized valuation to zero). This means that an uninformed consumer who receives a positive signal of his valuation for the new attribute knows that he could later discover that the new attribute does not have much value for him (i.e., his true valuation of the new attribute may turn out to be zero). Thus, $1 - x$ represents the probability of the new attribute having a low value for an uninformed consumer. Prior to purchase, the signal an uninformed consumer receives regarding how much he will value the new attribute may depend on, for example, the expert product reviews, the demo in stores, or other information from advertising. The uninformed consumers will ex post learn their future needs and their true valuation for the new attribute from their own post-purchase experience with the new product or (online or offline) word-of-mouth from other consumers with similar needs and preferences. Note that the uninformed consumer’s uncertainty is not about the quality of the new attribute, but rather about his own future usage value or needs of that attribute, e.g.,

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4 One might alternatively model consumers to have heterogeneous willingness to pay for the baseline attribute $a_1$. Note that that both the incumbent’s product and the entrant’s new product have the same baseline attribute $a_1$. Thus, as long as the minimum willingness to pay for $a_1$ is high enough that the market is fully covered in equilibrium, it will not have any material effect on $q$ or firms’ prices, and our results will stay qualitatively the same.

5 Naturally, as $x \to 1$ the realized distribution of heterogeneity of the uninformed consumers approaches to that of the informed consumers.
the consumer may be unsure how often he will utilize the new feature or how well/fast he can learn the new attribute to meet his anticipated future needs. We will discuss in Section 7 the implications of alternative models of uncertainty.

For the rest of the paper we refer to the incumbent’s product as the old product and denote it by subscript \(O\) and the entrant’s product as the new product and denote it by subscript \(N\).

We model the interactions among the market participants with the following 3-stage game. At stage 1, the entrant decides the quality level \(q\) of its new feature. At stage 2, firms simultaneously set their prices (i.e., \(p_N\) and \(p_O\)). Lastly, at stage 3, consumers make purchase decisions, and firms receive their payoffs.

### 4 Benchmark: No Anticipated Regret

We first analyze a benchmark case in which consumers do not anticipate any post-purchase regret. In this case, the consumers’ ex ante utility functions are as follows.

For the informed consumers:

\[
U_{iN} = v + \theta q - p_N \\
U_{iO} = v - p_O
\]

For the uninformed consumers:

\[
U_{uN} = v + x\theta j q - p_N \\
U_{uO} = v - p_O
\]

We identify two types of pure-strategy equilibria depending on whether in equilibrium the entrant will serve any uninformed consumers. The following lemma characterizes the entrant’s equilibrium quality and the two firms’ profits under these types of pure-strategy equilibria.\(^6\) All the proofs are presented in the Appendix.

**Lemma 1** There exist \(x_1, x_2, \) and \(x^*\), corresponding to the probability the signal indicates a positive willingness to pay to an uninformed consumer, such that

\(^6\)We assume that \(v\) (which is exogenous) is high enough so that in equilibrium the market is covered and corner solutions do not exist.
i if $\alpha \geq 0.58$ and $x_1 < x < x_2$ then in equilibrium the entrant serves only the informed segment and the incumbent serves both segments, and the entrant sets $q = \frac{2\theta(1+\alpha)}{3\alpha c}$. \(^7\) Firms’ equilibrium profits are $\pi_N = \frac{6\theta^2(1+\alpha)^3}{243\alpha^2 c}$ and $\pi_O = \frac{2\theta^2(1+\alpha)(7-2\alpha)^2}{243\alpha^2 c}$.

ii if $x > x^*$ then in equilibrium both firms serve both segments and the entrant sets $q = \frac{4\theta}{3(\alpha+y(1-\alpha))c}$. \(^8\) Firms’ equilibrium profits are $\pi_N = \frac{64\theta^2}{243(\alpha+y(1-\alpha))^2}$ and $\pi_O = \frac{100\theta^2}{243(\alpha+y(1-\alpha))^2}$.

This lemma shows that only when the fraction of informed consumers is high (i.e., $\alpha \geq 0.58$) and the probability of the new attribute having a low value for uninformed consumers is not very small (i.e., $x > x^*$ or $x < x_2$) the entrant finds it profitable not to serve the uninformed segment. When the probability of the new attribute having a low value for uninformed consumers is very large (i.e., $x < x_1$), the entrant loses its competitive advantage in this segment, which encourages the incumbent to charge a high price. In this case, the entrant prefers to cut its price to target uninformed consumers with high $j$. Thus, the probability of the new attribute having a low value for uninformed consumers should not be very large (i.e., $x$ must be higher than $x_1$) so that in equilibrium the entrant prefers not to serve the uninformed segment (i.e., the equilibrium described in point (i)).\(^9\) Obviously, when the probability of the new attribute having a low value for uninformed consumers is very small (i.e., $x > x^*$) the entrant chooses to serve the uninformed segment, hence in equilibrium both firms serve both segments (i.e., the equilibrium described in point (ii)).

5 Analysis with Anticipated Regret

In this section we examine the market outcomes when consumers anticipate potential post-purchase regret. Note that the informed consumers will have no ex-post regret since their ex-ante purchase decisions are based on their true valuations. In contrast, the uninformed consumers are, at the time of purchase, uncertain of the value they will derive from the entrant’s new feature. These consumers know that after purchase they will learn their valuations for the new feature either through direct usage experience or through word-of-mouth from their friends or other consumers who bought it, and if ex post they realize that their choice results in a lower utility

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\(^7\)Note that $x_1 = 0$ for $\alpha \geq 0.8$.

\(^8\)Note that $x^* > x_2$ for $\alpha \geq 0.58$.

\(^9\)Note that if $\alpha$ is too high (i.e., $\alpha \geq 0.8$) then the entrant does not have an incentive to cut its price and steal the uninformed consumers. For that reason, $x_1 = 0$ for $\alpha \geq 0.8$. 

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than the forgone alternative, they will experience regret. For example, if an uninformed consumer buys the new product but later realizes a low valuation for the entrant’s new product feature, she will regret for not having repeat-purchased the old product, which would have given her a higher ex-post utility. Thus, at the time of purchase, the uninformed consumers’ decision will be based on their expected utility which includes anticipated potential post-purchase regret. Note that these consumers may experience such regret ex post even though their purchase decisions are ex ante optimal.

To model such anticipated regret, we introduce a linear regret term in the consumer utility similar to what Syam et al. (2008) use. A consumer will experience some disutility or regret when ex post her forgone alternative would have given her a higher net utility than her actual choice; the amount of that disutility is proportional to the difference in the net utility between theforgone alternative and the chosen alternative (Inmann et al., 1997). Thus, the consumer’s anticipated regret is equal to:

\[ -\gamma_j \operatorname{Prob}(U_f > U_c) \cdot (U_f - U_c), \]

where

- \( U_f \): utility from the forgone alternative
- \( U_c \): utility from the chosen alternative
- \( \gamma_j \): regret aversion sensitivity

The extant literature (Inmann and Zeelenberg, 2002) argues that consumers feel different levels of regret depending on whether the regret is a result of repeat-purchasing an old product versus switching to a new product. Consumers feel more regret from their switching decision than their repeat-purchase decision if they have had extensive positive experience with the old product before. Similarly, consumers will feel less regret from their switching decision than repeat-purchase decision if they had mediocre experience with the old product or if they have a good reason for switching to the new product (e.g., friends’ suggestions). We call these two types of regret “switching regret” and “repeat-purchase regret” respectively. Thus, in the consumer utility functions we use \( \gamma_s \) to represent consumer’s aversion to switching regret and \( \gamma_r \) consumer’s aversion to repeat-purchase regret.\(^\text{10}\)

\(^\text{10}\)Sarangee et al. (2013), similar to our model, use two types of anticipated regret. When decision makers
Let $\theta^*$ denote the willingness to pay of the informed consumer who is indifferent between buying the new product and the old product, i.e., $v + q\theta^* - p_N = v - p_O$. Uninformed consumers with $\theta_j < \theta^*$ will buy the old product (as long as $p_O < v$) and these consumers will have no regret ex post because buying the new product could not have given them higher utility. Thus, only those uninformed consumers with $\theta_j > \theta^*$ may experience ex post regret and take into consideration such regret when making their purchasing decision. Therefore, for those consumers with $\theta_j > \theta^*$ the utilities from the new product and the old product are as follows.

Utility from buying the new product: $U^u_N = v + x\theta_jq - p_N - \gamma_s(1 - x)(p_N - p_O)$ (2)

Utility from buying the old product: $U^u_O = v - p_O - \gamma_r x(\theta_jq - p_N + p_O)$.

To clearly untangle the effects of repeat-purchase regret and switching regret, we investigate two qualitatively different cases: (a) $\gamma_s > \gamma_r = 0$ and (b) $\gamma_r > \gamma_s = 0$.

5.1 Case of $\gamma_s > \gamma_r = 0$

This case corresponds to the situation in which consumers have had extensive positive experience with the old product before and hence, they are more averse to switching regret. Lemma 2 characterizes two types of pure-strategy equilibria depending on whether in equilibrium the entrant serves any uninformed consumers.$^{11}$

Lemma 2 There exist $\gamma_1$, $\gamma_2$, and $\gamma^*$ such that

i if $\alpha \geq 0.58$, $x_1 < x$, and $\gamma_1 < \gamma_s < \gamma_2$ then in equilibrium the entrant serves only the informed segment and the incumbent serves both segments, and the entrant sets $q = \frac{2\theta(1+\alpha)}{3\alpha c}$. Firms’ equilibrium profits are $\pi_N = \frac{8\theta^2(1+\alpha)^3}{243\alpha^2 c}$, and $\pi_O = \frac{2\theta^2(1+\alpha)(7-2\alpha)^2}{243\alpha^2 c}$.

ii if $x > x^*$ and $\gamma_s < \gamma^*$, where $x$, then in equilibrium both firms serve both segments and the entrant sets $q = \frac{4\theta}{3(\alpha + (1-\alpha)(y + \gamma_s(y-1)))c}$. Firms’ equilibrium profits are $\pi_N = \frac{64\theta^2}{243c(\alpha + (1-\alpha)(y + \gamma_s(y-1)))^2}$.

decide to continue a new-product-development project, they might regret their decision (called ‘keep’ regret) if later they receive disconfirming information. When they stop the project, they might also regret that decision later if they subsequently conclude that it was an error to do so (called ‘drop’ regret). The authors show that anticipated keep and drop regrets exert pressures that differ in direction and magnitude.

$^{11}$In equilibrium the market is fully covered.

$^{12}$Note that $\gamma_1 = 0$ for $x < x_2$ and $\gamma_2 \to \infty$ for $\alpha \geq 0.8$. 
and \( \pi_O = \frac{100\theta^2}{243c(\alpha+(1-\alpha)(y+\gamma_s(y-1)))y} \), where \( y = \frac{1}{x}. \)

As in the benchmark case, if the segment of informed consumers is large enough (i.e., \( \alpha \geq 0.58 \)) the entrant will in equilibrium target only the informed segment provided that aversion to switching regret is relatively strong (i.e., \( \gamma_1 < \gamma_s < \gamma_2 \)) and the probability of the new attribute having a low value for uninformed consumers is small enough (i.e., \( x_1 < x \)). When \( x_1 < x < x_2 \), the entrant prefers to serve only the informed segment as long as aversion to switching regret is not very high (i.e., \( \gamma_s < \gamma_2 \)). Note that the uninformed consumer’s price sensitivity increases with their regret aversion (\( \gamma_s \)). If \( \gamma_s > \gamma_2 \), then the two segments of consumers are very different (i.e., the uninformed segment is much more price sensitive than the informed one). In this case, the entrant has less incentive to serve the uniformed segment, which in turn encourages the incumbent to charge a high price. This, however, tempts the entrant to cut its price to poach uninformed consumers with high \( \theta_j \). We know from Lemma 1 that in the absence of anticipated regret if the probability of the new attribute having a low value for uninformed consumers is very small (i.e., \( x > x_2 \)) the entrant will prefer to serve the uninformed segment. Hence, when \( x > x_2 \), if the consumer’s regret aversion is very weak (\( \gamma_s < \gamma_1 \)), then the difference between the informed and uninformed consumers becomes smaller and the entrant will target some uninformed consumers (those with high \( \theta_j \)). This means that when \( x > x_2 \), the consumer’s regret aversion should be high enough (\( \gamma_s > \gamma_1 \)) for the entrant not to serve the uninformed segment. We show that in equilibrium the entrant will not serve the uninformed segment (i.e., the equilibrium described in point (i)) if the probability of the new attribute having a low value for uninformed consumers is small enough (i.e., \( x_1 < x \)) and the regret aversion is in the medium range (i.e., \( \gamma_1 < \gamma_s < \gamma_2 \)). Obviously, if the probability of the new attribute having a low value for uninformed consumers is small enough (i.e., \( x > x^* \)) and regret aversion is weak enough (i.e., \( \gamma_s < \gamma^* \)), the two segments will be very similar and the entrant will serve the uninformed segment; hence in equilibrium both firms serve both segments (i.e., the equilibrium described in point (ii)).

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\(^{13}\)Note that \( \gamma^* < \gamma_1 \) for \( \alpha \geq 0.58 \) and \( x^* < x \). For the rest of the paper \( x_1, x_2, \) and \( x^* \) are the same as given in Lemma 1 (i.e., the benchmark case).

\(^{14}\)Note that if \( \alpha \) is high enough (i.e., \( \alpha \geq 0.8 \)) the entrant does not have an incentive to steal the uninformed consumers. Hence, \( \gamma_2 \rightarrow \infty \) for \( \alpha \geq 0.8 \).

\(^{15}\)The proof of Lemma 2 is provided in the Technical Appendix.
As we can see from Lemma 2, when $\alpha \geq 0.58$, $x_1 < x$, and $\gamma_1 < \gamma_s < \gamma_2$, in the equilibrium the entrant serves only the informed segment and regret aversion does not affect the entrant’s optimal quality or the firms’ profits. However, when $x > x^*$ and $\gamma_s < \gamma^*$, in the equilibrium the entrant serves both segments and regret aversion affects both the entrant’s quality choice and the firms’ profits. Proposition 1 investigates the effects of regret aversion on the entrant’s quality decision and the firms’ profits.

**Proposition 1** If $x > x^*$ and $\gamma_s < \gamma^*$, stronger regret aversion ($\gamma_s$) reduces both firms’ profits and the entrant’s quality. Furthermore, $\left| \frac{\partial \pi_O}{\partial \gamma_s} \right| > \left| \frac{\partial \pi_N}{\partial \gamma_s} \right|$. 

According to Proposition 1, as the consumers’ regret aversion ($\gamma_s$) increases, the incumbent suffers more than the entrant. One might expect the incumbent to gain as consumers become more averse to switching regret since such regret makes consumers more likely to buy the incumbent’s product. Interestingly, our analysis shows that the incumbent may actually suffer more than the entrant. Why does this happen? When the probability of the new attribute having a low value for uninformed consumers is small (i.e., $x > x^*$) the informed and uninformed segments are less differentiated, giving both firms incentive to serve both segments. Furthermore, anticipated regret tends to increase the uninformed consumers’ price sensitivity for both firms’ products by $\gamma_s(1 - x)$. Therefore, as $\gamma_s$ increases both firms tend to lower their prices, which reduces the entrant’s incentive to invest in quality. Naturally, as the entrant’s quality decreases, firms become less differentiated, which forces the incumbent (who offers lower quality) to reduce its price even more. That is why, as $\gamma_s$ increases the incumbent may suffer more than the entrant.

Having characterized the equilibrium outcomes for both cases with and without anticipated regret, we can now determine the effects of anticipated regret on product innovation (i.e., the entrant’s quality) and firms’ profits by comparing these two cases.

**Proposition 2** If $\alpha \geq 0.58$, $x > x^*$, and $\gamma_1 < \gamma_s < \gamma_2$, anticipated regret increases the entrant’s quality and firms’ profits. If $x > x^*$ and $\gamma_s < \gamma^*$, anticipated regret decreases the entrant’s quality and firms’ profits. Finally, if $\alpha \geq 0.58$, $x_1 < x < x_2$, and $\gamma_1 < \gamma_s < \gamma_2$, anticipated regret has no effect on the entrant’s quality or firms’ profits.

According to Proposition 2, consumers’ anticipated switching regret may not adversely affect the equilibrium level of innovation or the entrant’s profitability. On the contrary, when consumers have extensive positive experience with the old product (i.e., when they are more averse
to switching regret), invoking regret may increase product innovation and the innovator’s profit if the informed segment is large enough, the probability of the new attribute having a low value for uninformed consumers is small enough, and consumers’ regret aversion is not too extreme. However, interestingly if regret aversion is weak, anticipated regret reduces innovation and the innovator’s profit. Therefore, there is a non-monotonic relationship between anticipated switching regret and the innovation level or profits. The intuition for this outcome is as follows. As we know from Lemma 1, in the absence of anticipated regret if the probability of the new attribute having a low value for uninformed consumers is small enough (i.e., $x > x^*$), in equilibrium the entrant will serve both segments. However, for $x > x^*$, as we know from Proposition 1, in the presence of anticipated regret, if uninformed consumers’ regret aversion is relatively strong (i.e., $\gamma_1 < \gamma_s < \gamma_2$) the entrant will not serve the uninformed consumers anymore. That is, for $\alpha \geq 0.58$, $x > x^*$, and $\gamma_1 < \gamma_s < \gamma_2$, invoking anticipated regret will induce the entrant to target only the informed segment. This alleviates the price competition, which encourages the entrant to invest in innovation. The increase in price offsets the entrant’s loss in market share and therefore, firms’ profits increase as well.

However, when $x > x^*$ (i.e., the probability of the new attribute having a low value for uninformed consumers is small), weak regret aversion (i.e., $\gamma_s < \gamma^*$) will not convince the entrant to give up the uninformed segment. We know that due to anticipated regret uninformed consumers’ price sensitivity will increase, leading to more intensified price competition, which reduces the entrant’s incentive to invest in quality. As a result, firms’ profits will decrease.

This result also implies that invoking regret (e.g., by reminding consumers about post-purchase regret in their advertisements) is a win-win situation for both firms if: 1. the informed segment is large enough, 2. the probability of the new attribute having a low value for uninformed consumers is small enough, and 3. regret aversion is in middle range. In contrast, invoking regret is a lose-lose situation for both firms (e.g., they should mitigate regret such as by offering generous money back guarantees in case consumers do not like the product) if: 1. the probability of the new attribute having a low value for uninformed consumers is small enough and 2. regret aversion is weak.

\[\text{In fact, invoking regret through advertising is fairly common in practice. The classic example is the then entrant FedEx playing up this anxiety by pointing out to customers the dire consequences of choosing the post office (USPS). The State Farm insurance company’s current campaign about its service and why consumers should value it highly is another example that firms are paying attention to consumers’ regret behaviors when positioning or repositioning their products. One Percent Realty and Comcast Xfinity are also among the firms using advertising messages to remind consumers of their potential future regret if they do not use the firms’ services.}\]
aversion is weak.

Finally, from Lemmas 1 and 2 we know that if \( \alpha \geq 0.58, x_1 < x < x_2, \) and \( \gamma_1 < \gamma_s < \gamma_2, \) both in the absence of anticipated regret and in the presence of anticipated regret, in equilibrium the entrant serves only the informed segment, in which case both the entrant’s quality and the firms’ profits do not depend on regret aversion.

5.2 Case of \( \gamma_r > \gamma_s = 0 \)

This case corresponds to the situation in which consumers had mediocre or poor experience with the old product or if they have some good reason for switching to the new product and thus, they are more averse to repeat-purchase regret. Lemma 3 characterizes two types of pure-strategy equilibria depending on whether in equilibrium the entrant serves any uninformed consumers.\(^{17}\)

**Lemma 3** There exist \( \hat{\gamma}_1, \hat{\gamma}_2, \hat{\gamma}^*, \) and \( \tilde{x} \) such that

i if \( \alpha \geq 0.58, x < \tilde{x}, \) and \( \hat{\gamma}_1 < \gamma_r < \hat{\gamma}_2, \) then in equilibrium the entrant serves only the informed segment and the incumbent serves both segments, and the entrant sets \( q = \frac{2\theta(1+\alpha)}{3\alpha c}. \)^{18} Firms’ equilibrium profits are \( \pi_N = \frac{8\theta^2(1+\alpha)^3}{243\alpha^2c} \) and \( \pi_O = \frac{2\theta^2(1+\alpha)(7-2\alpha)^2}{243\alpha^2c}. \)

ii if \( \gamma_r > \hat{\gamma}^*, \) then in equilibrium both firms serve both segments and the entrant sets \( q = \frac{4\theta}{3c(\alpha+\frac{1}{1+\gamma_r})}. \)^{19} Firms’ equilibrium profits are \( \pi_N = \frac{64\theta^2}{243c(\alpha+\frac{1-\gamma_s}{1+\gamma_s})^2} \) and \( \pi_O = \frac{100\theta^2}{243c(\alpha+\frac{1-\gamma_s}{1+\gamma_s})^2}, \)
where \( y = \frac{1}{x}. \)

As in Lemmas 1 and 2, with a large enough informed segment (i.e., \( \alpha \geq 0.58 \)) the entrant will in equilibrium target only the informed segment if repeat-purchase regret aversion (i.e., \( \hat{\gamma}_1 < \gamma_r < \hat{\gamma}_2 \)) is relatively strong and probability of the new attribute having a low value for uninformed consumers (i.e., \( x < \tilde{x} \)) is large enough. Note that as the regret aversion (\( \gamma_r \)) increases so does the disutility of the old product for the uninformed consumers (\( -\gamma_r x(\theta_j g - p_N + p_O) \)). The entrant’s competitive advantage in the uninformed segment increases as the probability of the new attribute having a low value for uninformed consumers decreases or as aversion to repeat-purchase regret increases. Thus, for low \( x \) values, if the uninformed consumers’ regret aversion is also weak (\( \gamma_r < \hat{\gamma}_1 \)), then the entrant does not have a significant competitive advantage over the

\(^{17}\)In any equilibrium the market is fully covered.

\(^{18}\)Note that \( \hat{\gamma}_1 = 0 \) for \( \alpha \geq 0.8. \)

\(^{19}\)Note that \( \hat{\gamma}^* = 0 \) for \( x > x^* \) and \( \hat{\gamma}^* > \hat{\gamma}_2 \) for \( \alpha \geq 0.58 \) and \( x < \tilde{x}. \)
incumbent, which encourages the incumbent to charge a high price. This however tempts the entrant to cut its price to poach uninformed consumers with high $\theta_j$.\footnote{Note that if $\alpha$ is high enough (i.e., $\alpha \geq 0.8$) the entrant does not have an incentive to steal the uninformed consumers. Hence, $\hat{\gamma}_1 = 0$ for $\alpha \geq 0.8$.} On the other hand, for low $x$ values, very strong regret aversion ($\gamma_r > \hat{\gamma}_2$) can compensate and still provides a significant competitive advantage to the entrant, which encourages the entrant to serve this segment. In equilibrium the entrant will not serve the uninformed segment (i.e., the equilibrium described in point (i)) if the probability of the new attribute having a low value for uninformed consumers is large enough (i.e., $x < \bar{x}$) and the aversion to repeat-purchase regret should be in medium range (i.e., $\hat{\gamma}_1 < \gamma_r < \hat{\gamma}_2$). Obviously, if regret aversion is very strong (i.e., $\gamma_r > \hat{\gamma}^*$), in equilibrium the entrant will serve both segments (i.e., the equilibrium described in point (ii)).\footnote{The proof of Lemma 3 is provided in the Technical Appendix.}

As we can see from Lemma 3, when the entrant serves only the informed segment (i.e., when $\alpha \geq 0.58$, $x < \bar{x}$, and $\hat{\gamma}_1 < \gamma_r < \hat{\gamma}_2$), regret aversion does not affect the entrant’s optimal quality or the firms’ profits. However, in the equilibrium where the entrant serves both segments (i.e., when $\gamma_r > \hat{\gamma}^*$), regret aversion affects both the entrant’s quality choice and the firms’ profits. Proposition 3 investigates the effects of regret aversion on the entrant’s choice of quality and the firms’ profits.

**Proposition 3** If $\gamma_r > \hat{\gamma}^*$, as the aversion regret ($\gamma_r$) increases both firms’ profits and the entrant’s quality will increase. Furthermore, $\frac{\partial \pi_D}{\partial \gamma_r} > \frac{\partial \pi_N}{\partial \gamma_r}$.

One may intuit that the incumbent will suffer as the aversion to repeat-purchase regret ($\gamma_r$) increases because such regret makes consumers more likely to buy the entrant’s product. Interestingly, as Proposition 3 shows, stronger regret aversion may benefit the incumbent and further the incumbent actually gains more than the entrant. While stronger regret aversion makes the uninformed consumers more price sensitive for both firms’ products, it also increases their effective willingness to pay for the new attribute. Due to the latter effect, the entrant becomes more inclined to invest in innovation, which increases the differentiation between the products. Thus, firms charge higher price and hence, their profits increase. Since unlike the entrant the incumbent does not incur any marginal cost (which increases as $q$ increases) it enjoys a higher increase in its profits.
Comparing the equilibrium outcomes for the cases with and without anticipated regret, we can determine the effects of anticipated regret on product innovation and firms’ profits.

**Proposition 4** If \( x > x^* \) and \( \gamma_r > \hat{\gamma}^* \), anticipated regret increases the entrant’s quality and firms’ profits. If \( \alpha \geq 0.58 \), \( x_1 < x < x_2 \), and \( \gamma_r > \hat{\gamma}^* \), anticipated regret decreases the entrant’s quality and firms’ profits. Finally, if \( \alpha \geq 0.58 \), \( x_1 < x < \hat{x} \), and \( \hat{\gamma}_1 < \gamma_r < \hat{\gamma}_2 \), anticipated regret has no effect on the entrant’s quality or firms’ profits.

Proposition 4 has several interesting implications. First, consumers’ anticipated regret from repeat purchase may not positively affect the equilibrium level of innovation and the innovator’s profitability. On the contrary, high enough regret aversion can lower the entrant’s incentive to invest in innovation and reduce its profitability if the informed segment is large enough and the probability of the new attribute having a low value for uninformed consumers is not extreme. Second, when consumers have mediocre or poor experience with the old product, or good reasons to switch to the new product (i.e., when consumers are more averse to repeat-purchase regret), anticipated regret may actually increase the incumbent’s profit (i.e., the firm with the old product) and this surprisingly happens when regret aversion is strong. Third, anticipated regret from repeat purchase has a non-monotonic effect on the innovation level and profits. The intuition for this outcome is as follows. First, as we know from Lemma 1, in the absence of anticipated regret if the probability of the new attribute having a low value for uninformed consumers is small (i.e., \( x > x^* \)), in equilibrium the entrant prefers to serve both segments. Further, from Lemma 3 we know that strong regret aversion (i.e., \( \gamma_r > \hat{\gamma}^* \)) will induce the entrant to serve both segments in equilibrium. We also know from Proposition 3 that in this equilibrium as \( \gamma_r \) increases, both the innovation level and firms’ profits increase. So if \( x > x^* \) and \( \gamma_r > \hat{\gamma}^* \), regardless of the presence of anticipated regret, in equilibrium the entrant serves both segments and anticipated regret from repeat purchase increases the entrant’s quality and firms’ profits. As we know from Lemma 1, in the absence of anticipated regret if \( \alpha \geq 0.58 \) and \( x_1 < x < x_2 \), then in equilibrium the entrant serves only the informed segment. However, for \( \alpha \geq 0.58 \) and \( x_1 < x < x_2 \), anticipated regret with \( \gamma_r > \hat{\gamma}^* \) makes the entrant serve both segments in equilibrium. In other words, if regret aversion is strong enough, anticipated regret leads the entrant to change its equilibrium strategy and serve both segments. As a result, price competition intensifies and firms will lower their prices, which reduces the entrant’s incentive to invest in innovation. Since the drop in
the entrant’s price dominates the increase in its market share, anticipated regret will reduce the firms’ profits.

In the light of our findings in Propositions 2 and 4, Table 1 summarizes when it is optimal for firms to invoke regret and when it is optimal to mitigate it.

Table 1: When to Invoke Regret vs. When to Mitigate Regret

<table>
<thead>
<tr>
<th>Condition</th>
<th>Invoke</th>
<th>Mitigate</th>
<th>Invoke</th>
<th>Mitigate</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \gamma_s &gt; \gamma_r = 0 )</td>
<td>large</td>
<td>-</td>
<td>-</td>
<td>large</td>
</tr>
<tr>
<td>( \gamma_r &gt; \gamma_s = 0 )</td>
<td>low</td>
<td>low</td>
<td>low</td>
<td>medium</td>
</tr>
</tbody>
</table>

So far we know that regardless of whether consumers are more averse to switching regret or to repeat-purchase regret, anticipated regret can have both positive and negative effect on firms’ profits. The next corollary investigates which firm, the innovator (i.e., the entrant) or the incumbent, is more affected by anticipated regret and hence has more incentive to invoke or mitigate regret.

**Corollary 1** In both cases of \( \gamma_s > \gamma_r = 0 \) and \( \gamma_r > \gamma_s = 0 \) anticipated regret has a greater (both positive and negative) impact on the incumbent’s profit than on the entrant’s profit.

Corollary 1 implies that the incumbent has a higher incentive to invoke or mitigate anticipated regret than the entrant. Recall that in the case of \( \gamma_s > \gamma_r = 0 \), anticipated regret has a positive effect on firms’ profits under the conditions such that the entrant serves only the informed segment in the presence of anticipated regret and serves both segments in the absence of it. In this case, the incumbent gains both in price and market share whereas the entrant gains in price but loses in market share. Therefore, anticipated regret has a greater impact on the incumbent’s profit than on the entrant’s profit. In contrast, anticipated regret has a negative effect on firms’ profits under the conditions such that the entrant prefers to serve both segments regardless of the presence of anticipated regret. As we know from Proposition 1, in this equilibrium, as \( \gamma_s \) increases, both firms’ profits decrease, but the incumbent’s profit decreases even more. In the case of \( \gamma_r > \gamma_s = 0 \), anticipated regret has a positive effect on firms’ profits under the conditions such that the entrant prefers to serve both segments regardless of the presence of anticipated regret. As we know from Proposition 3, in this equilibrium, as \( \gamma_r \) increases, both firms’ profits
increase, but the incumbent’s profit increases more. Note that anticipated regret has a negative effect on firms’ profits under the conditions such that the entrant serves both segments in the presence of anticipated regret and serves only the informed segment in the absence of it. Hence, anticipated regret leads to lower prices due to more intense price competition. In this case, the entrant loses in price but gains in market share, whereas the incumbent loses both in price and market share. Therefore, anticipated regret has a greater impact on the incumbent’s profit than on the entrant’s profit.

6 Digital Attributes with R&D Cost

Our analysis so far has assumed that the entrant’s new product feature is a physical attribute (e.g., a front-end camera for a smartphone) requiring some marginal cost of production commensurate with its quality level. In this section, we examine how our results would change if the entrant’s new attribute is digital (e.g., software-enabled panorama photo taking or built-in video-editing capability for a new smartphone), requiring significant R&D costs but negligible marginal costs of production. Since the entrant’s marginal cost for its new feature is negligible, the new and the old products have the same marginal costs, which we normalize to zero. The entrant chooses the quality $q$ for its new feature and its corresponding R&D cost is $kq^2$.

To investigate the impact of anticipated regret on product innovation ($q$) and firms’ profits, we characterize and compare the market outcomes under two cases: (1) Consumers do not anticipate the potential post-purchase regret, and (2) consumers anticipate such regret. The analyses and results are qualitatively similar to those presented in Sections 4 and 5. Thus, for the sake of saving space, we relegate analyses to the Technical Appendix.

Proposition 5 shows that depending on whether $\gamma_s > \gamma_r = 0$ or $\gamma_r > \gamma_s = 0$ anticipated regret may benefit or hurt the firms to a greater extent in the case of a digital attribute than in the case of a physical attribute.\(^{22}\)

**Proposition 5** When $\gamma_s > \gamma_r = 0$, anticipated regret more (less) likely decreases (increases) product innovation and firms’ profits in the case of the entrant’s new feature being a digital attribute than in the case of it being a physical attribute. When $\gamma_r > \gamma_s = 0$, anticipated regret

\(^{22}\)We would like note that that the equilibrium conditions do not depend on $c$ in the case of a physical attribute or on $k$ in the case of digital attribute.
more (less) likely increases (decreases) product innovation and firms’ profits in the case of the entrant’s new feature being a digital attribute than in the case of it being a physical attribute.

Proposition 5 implies that anticipated regret may have opposite effects on product innovation and firms’ profits in the case of digital new attribute and in case of physical new attribute; while in the former case the effect is negative, in the latter one the effect may be positive and vice versa depending on whether consumers are more averse to switching regret or repeat-purchase regret. The intuition for Proposition 5 is as follows. First, note that regardless of the existence of any anticipated regret, the entrant has more incentive to serve both segments in the case of a new digital attribute than in the case of a new physical attribute. This is because in the case of a new digital attribute the entrant incurs no additional cost when it increases its market share. Recall that when $\gamma_s > \gamma_r = 0$, anticipated regret has a positive effect on product innovation ($q$) and firms’ profits when the entrant serves only the informed consumers in the presence of anticipated regret and both segments in the absence of anticipated regret and has a negative effect when the entrant serves both segments regardless of the presence of anticipated regret. Hence, as the parameter region in which the entrant serves only the informed consumers shrinks, the parameter region in which anticipated regret has a positive (negative) effect on $q$ and firms’ profits shrinks (expands) accordingly. For this reason, when $\gamma_s > \gamma_r = 0$, the parameter region in which anticipated regret has a positive (negative) effect on $q$ and firms’ profits is smaller (larger) in the case of a new digital attribute than in the case of a new physical attribute. In contrast, when $\gamma_r > \gamma_s = 0$, anticipated regret has a positive effect on $q$ and firms’ profits when the entrant serves both segments regardless of the existence of anticipated regret and has a negative effect when the entrant serves only the informed segment in the absence of anticipated regret and both segments in the presence of anticipated regret. Thus, as the parameter region in which the entrant serves only the informed consumers shrinks, the parameter region in which anticipated regret has a positive (negative) effect on $q$ and firms’ profits expands (shrinks) accordingly. For this reason, when $\gamma_r > \gamma_s = 0$, the parameter region in which anticipated regret has a positive (negative) effect on $q$ and firms’ profits is larger (smaller) in the case of a new digital attribute than in the case of a new physical attribute.\textsuperscript{23}

\textsuperscript{23}The proof of Proposition 5 is provided in the Technical Appendix.
7 Discussion and Conclusion

When a firm introduces a product with a new feature, some consumers may find it difficult to assess their valuations for this feature. If a consumer buys a product with a new feature and ends up not utilizing it, he may regret having wasted money and not having bought the existing product. Similarly, if a consumer decides not to buy the new product and later finds out that he would have utilized the new feature much more than he had thought prior to purchase, he may regret not having switched to the new product. Anticipating this potential post-purchase regret, consumers may make their purchase decisions to alleviate or minimize it. This paper examines how consumers’ anticipated regret affects product innovation and firms’ profits using a game-theoretic model in which an entrant introduces an improved product with a new feature about which some consumers have uncertain valuations. Our results provide firms with guidelines about the optimal quality or innovation and pricing decisions in markets where consumers anticipate the potential regret from their product choices made under valuation uncertainty and about how to most profitably manage the consumer’s anticipated regret (i.e., when to invoke regret and when to mitigate it).

We modeled two types of regret aversion as suggested in the behavioral literature: aversion to regret from repeat-purchasing an existing product versus aversion to regret from switching to a new (higher-priced) product with a new, unfamiliar attribute. Our analyses show that consumers’ anticipated regret from repeat-purchasing and switching decisions has important implications on the firms’ profits and the level of innovation in the market. We find that anticipated regret can sometimes intensify price competition and sometimes mitigate it, which then can increase or decrease firms’ profits and foster or hinder product innovation. Anticipated regret is shown to have a non-monotonic effect on the innovation level and firms’ profits. The non-monotonic relationship exists regardless of whether consumers are more averse to switching regret or more averse to repeat-purchase regret, but under different conditions. Thus, firms should take into consideration the non-monotonic effect of anticipated regret on profits when deciding to invoke anticipated regret through their communication strategies to encourage consumers to buy their own brand. We also find that the incumbent has more to gain or lose by invoking or mitigating regret than the entrant innovator and hence should be more cautious about invoking or mitigating regret.
One might also wonder whether ex-post regret will remain an important force in the consumer’s purchase decision in the presence of money-back guarantees. In most cases in practice, firms’ refunds or guarantees are very restrictive. For example, in high-tech or home electronics (such as smartphones, tablet or laptop computers, home electronics/appliances, etc.), once the customers have used the products, they will be charged a standard 15% restocking fee for return (Apple, Samsung, Verizon Wireless and other major carriers, Fry’s Electronics, Best Buy, etc.). And that is only part of the transaction cost that a consumer has to incur when returning a product to the retailer/manufacturer. There can also be a significant cost of hassle, e.g., packing the product back into the original box, driving back to the store with the original receipt (or shipping it back), waiting in line at the customer service counter, etc. In our model setting, the uninformed consumers will learn their usage of the new feature or how well it fits their needs only after significant use of the product. In that case, most stores will no longer accept returns unless the product has defects (and even in most of those cases the products will be repaired rather than refunded). Hence, in practice money back guarantees may alleviate the consumer’s anticipated regret to some extent but will not eliminate it. In an extended model that incorporates money back guarantees, our main results would remain qualitatively the same as long as the uninformed consumers’ transaction costs for product return is above some threshold.

We also note that post-purchase regret can be a result of consumers’ uncertainty about either the product’s objective attributes (e.g., quality) or the consumer’s own preference for the known product attributes. We have modeled the latter type of uncertainty as in Syam et al. (2008) for two reasons. First, in reality, consumers can easily share information among themselves and learn about new products from expert reviews or by trying the demo product in stores. Thus, uncertainty in quality ($q$) very often can be resolved before purchase. However, the consumer’s future usage intensity/benefit of the new features of the products may still be uncertain even after he/she learns the objective quality of the product/feature. Second, from a conceptual and theoretical point of view, modeling quality uncertainty in our setting will lead to a different and more complex level of analysis. This is because either the entrant’s price or both firms’ prices (in the case in which the incumbent knows the entrant’s quality) may signal to the uninformed consumers some information about quality. We leave it to future marketing and economics research to deal with the challenge of signaling theory in such a competitive context. Furthermore, under an alternative model with quality uncertainty, if consumers do not make such sophisticated
signaling inferences about quality, then our main results and intuition will be qualitatively the same.

In this paper, we have modeled a single interaction between the firms and consumers. In particular, we have modeled the incumbent as responding to the new entry by adjusting only its price. While this is a reasonable representation in the short run, the incumbent might also on a longer time horizon invest in quality changes. Explicitly modeling dynamic interactions between the firms and consumers over multiple periods may bring forth new insights about anticipated regret though such models undoubtedly increase the analytical complexity and may preclude analytical closed-form solutions. We leave that to future research.

References


**Appendix**

**Proof of Lemma 1:** Let $C = \frac{c q^2}{2}$. There are two types of pure-strategy equilibria.

Equilibrium 1: The entrant does not serve to uninformed segment.

The entrant’s profit is equal to $(p_N - C)\alpha \frac{\beta q - p_N + p_O}{\beta q}$ and the incumbent’s profit is equal to $p_O(1 - \alpha + \alpha \frac{p_N - p_O}{\beta q})$. When one solves for profit maximization problem for both firms, for a given $q$ firms’ optimal prices and profits are $p_N = \frac{\beta q (1+\alpha)}{3a}, p_O = \frac{\beta q (2-\alpha)+ac}{3a}, \pi_N = \frac{(\beta q (1+\alpha)-ac)^2}{9a\beta q}$, and $\pi_O = \frac{(\beta q (2-\alpha)+ac)^2}{9a\beta q}$. In this case, given that marginal cost is equal to $\frac{c q^2}{2}$, the entrant sets $q = \frac{\beta q (1+\alpha)}{3ac}$. Thus, $\pi_N = \frac{8\beta q^2 (1+\alpha)^3}{243a^2 c}$ and $\pi_O = \frac{2\beta q^2 (1+\alpha)(7-2a)^2}{243a^2 c}$.

This equilibrium can exist if $x < \frac{5}{6}$ and $\alpha > \frac{2}{7-9x}$ (these two conditions are required for $p_N$ to be high enough so that the entrant does not sell to uninformed segment- i.e., $\beta q x - p_N < -p_O$).
For \( p_O = \frac{\theta q (2 - \alpha) + \alpha c}{3a} \) and \( q = \frac{2\theta (1 + \alpha)}{3ac} \), the entrant may want to deviate to \( p_N' \) and sell to the uninformed segment. For such deviation to happen \( p_N' \) should be low enough for the entrant to serve the uninformed segment. If \( 18\alpha^2 x^2 + 13\alpha x - 23\alpha^2 x + 4 - 9\alpha + 5\alpha^2 < 0 \) then \( p_N' > \theta qx + p_O \). Thus, such deviation cannot happen.

If \( 18\alpha^2 x^2 + 13\alpha x - 23\alpha^2 x + 4 - 9\alpha + 5\alpha^2 > 0 \) then \( p_N' < \theta qx + p_O \). Then, for this deviation not to be profitable we need \( 4\phi(1 + \alpha) - \phi^2(4 - 5\alpha) - 9\alpha^2 > 0 \), where \( \phi = \sqrt{\alpha(\alpha + y(1 - \alpha))} \) and \( y = \frac{1}{x} \).

As a result, the conditions necessary and sufficient for this equilibrium to exist are: \( x < \frac{5}{6} \), \( \alpha > \frac{2}{7 - 2x} \), and either \( 18\alpha^2 x^2 + 13\alpha x - 23\alpha^2 x + 4 - 9\alpha + 5\alpha^2 < 0 \) or \( 18\alpha^2 x^2 + 13\alpha x - 23\alpha^2 x + 4 - 9\alpha + 5\alpha^2 > 0 \) and \( 4\phi(1 + \alpha) - \phi^2(4 - 5\alpha) - 9\alpha^2 > 0 \), where \( \phi = \sqrt{\alpha(\alpha + y(1 - \alpha))} \) and \( y = \frac{1}{x} \).

Note that \( 4\phi(1 + \alpha) - \phi^2(4 - 5\alpha) - 9\alpha^2 < 0 \) if \( \alpha < 0.58 \). Furthermore, \( 18\alpha^2 x^2 + 13\alpha x - 23\alpha^2 x + 4 - 9\alpha + 5\alpha^2 > 0 \) for \( \alpha < 0.58 \). Thus, this equilibrium cannot exist for \( \alpha < 0.58 \).

We would like to note that potentially there can be another pure-strategy equilibrium in which the entrant sets \( q = \frac{2\theta (1 + \alpha)}{3ac} \). We would like to note that potentially there can be another pure-strategy equilibrium in which the entrant serves only the informed segment and \( p_O = p_N - \theta qx \). However, one can show that this equilibrium cannot exist.

Equilibrium 2: Both firms serve to both segments.

The entrant’s profit is equal to \((p_N - C)(\alpha \frac{\theta q - p_N + p_O}{\theta q} + (1 - \alpha) \frac{\theta q - y(p_N - p_O)}{\theta q})\) and the incumbent’s profit is equal to \(p_O(\alpha \frac{\theta q - p_N - p_O}{\theta q} + (1 - \alpha) \frac{\theta q - y(p_N - p_O)}{\theta q})\), where \( y = \frac{1}{x} \). When one solves for profit maximization problem for both firms, for a given \( q \) firms’ optimal prices and profits are

\[ p_N = \frac{2(\theta q + C(\alpha + y(1 - \alpha)))}{3(\alpha + y(1 - \alpha))} \quad \text{and} \quad p_O = \frac{\theta q + C(\alpha + y(1 - \alpha))}{3(\alpha + y(1 - \alpha))} \].

In this case, the entrant sets \( q = \frac{4\theta}{3(\alpha + y(1 - \alpha))} \). Thus, \( \pi_N = \frac{64\theta^2}{243c(\alpha + y(1 - \alpha))} \) and \( \pi_O = \frac{4\theta^2}{243c(\alpha + y(1 - \alpha))} \).

This equilibrium can exist if \( x > \frac{9\alpha - 4}{9a} \) (this condition is required for \( \theta qx - p_N > -p_O \)).

For \( p_O = \frac{\theta q + C(\alpha + y(1 - \alpha))}{3(\alpha + y(1 - \alpha))} \) and \( q = \frac{4\theta}{3(\alpha + y(1 - \alpha))} \), the entrant may want to deviate to \( p_N' \) and just serve to the informed segment. If \( \frac{\theta q + p_O + C}{2} < \theta qx + p_O \) then \( p_N' = \theta qx + p_O \). Note that \( \frac{\theta q + p_O + C}{2} < \theta qx + p_O \) if \( 9(1 - \alpha) + 9\alpha x(3 - 2x) - 17x < 0 \). In this case, one can show that \( \pi_N < \pi_N' \) and hence, the entrant does not deviate.
However, if \(9(1-\alpha) + 9\alpha(3-2x) - 17x > 0\) then \(p'_N = \frac{\delta q + \rho c}{2}\). In this case, \(p'_N < p_N\) if 
\[8\phi - 9\phi^2 + \alpha > 0,\]
where \(\phi = \sqrt{\alpha(y + (1-\alpha))}\) and \(y = \frac{1}{x}\).

As a result, the conditions necessary and sufficient for this equilibrium to exist are: \(x > \frac{9\alpha - 4}{9\alpha}\), and either \(9(1-\alpha) + 9\alpha(3-2x) - 17x < 0\) or \(9(1-\alpha) + 9\alpha(3-2x) - 17x > 0\) and \(8\phi - 9\phi^2 + \alpha > 0\), where \(\phi = \sqrt{\alpha(y + (1-\alpha))}\) and \(y = \frac{1}{x}\).

Note that there exists \(a\) such that \(9(1-\alpha) + 9\alpha(3-2x) - 17x < 0\) if \(x > a\). Furthermore, there exists \(b\) such that \(8\phi - 9\phi^2 + \alpha > 0\) if \(x > b\). Note that \(a > b > \frac{9\alpha - 4}{9\alpha}\). Therefore, this equilibrium can exist if \(x > x^*\), where \(x^* = b\).

Note that \(x^* > x_2\) for \(\alpha \geq 0.58\). For a given \(q\), Equilibria 1 and 2 cannot coexist.

**Proof:**

Let \(p_{O,2}\) denote the incumbent’s price in Equilibrium 2. Given \(p_{O,2}\) for the entrant not to deviate from Equilibrium 2 we need:
\[
\frac{(\delta q + (p_{O,2} - C)(\alpha + y(1-\alpha)))^2}{4(\alpha + y(1-\alpha))}\alpha > 0.
\]

Let \(p_{O,1}\) denote the incumbent’s price in Equilibrium 1. Given \(p_{O,1}\) for the entrant not to deviate from Equilibrium 1 we need:
\[
\frac{(\delta q + (p_{O,1} - C)(\alpha + y(1-\alpha)))^2}{4\delta y} - \frac{(\delta q + (p_{O,2} - C)(\alpha + y(1-\alpha)))^2}{4\delta y} > 0.
\]

Note that \(\frac{\partial}{\partial p_{O,1}} < 0\).

For a given \(q\), since \(p_{O,1} > p_{O,2}\) if \(\frac{(\delta q + (p_{O,1} - C)(\alpha + y(1-\alpha)))^2}{4\delta y} - \frac{(\delta q + (p_{O,2} - C)(\alpha + y(1-\alpha)))^2}{4\delta y} > 0\) then we cannot have \(\frac{(\delta q + (p_{O,2} - C)(\alpha + y(1-\alpha)))^2}{4\delta y} - \frac{(\delta q + (p_{O,2} - C)(\alpha + y(1-\alpha)))^2}{4\delta y} > 0\).

Since the entrant’s profit under Equilibrium 1 is higher than its profit under Equilibrium 2 the entrant would not play mixed strategy when setting \(q\). □

**Proof of Proposition 1:** As we know from Lemma 2, \(\pi_N = \frac{64\delta^2}{243c(\alpha + (1-\alpha)(y + \gamma_s(y-1)))^2}\) and \(\pi_O = \frac{100\delta^2}{243c(\alpha + (1-\alpha)(y+\gamma_s(y-1)))^2}\). It is obvious that \(\frac{\partial \pi_N}{\partial \gamma_s} = \frac{-128\delta^2(1-\alpha)(y-1)}{243c(\alpha + (1-\alpha)(y + \gamma_s(y-1)))^2} < 0\) and \(\frac{\partial \pi_O}{\partial \gamma_s} = \frac{-200\delta^2(1-\alpha)(y-1)}{243c(\alpha + (1-\alpha)(y + \gamma_s(y-1)))^2} < 0\). One can see that \(\left|\frac{\partial \pi_N}{\partial \gamma_s}\right| > \left|\frac{\partial \pi_O}{\partial \gamma_s}\right|\). □

**Proof of Proposition 2:** Since \(x^* > x_1\), for \(\alpha \geq 0.58\), \(x > x^*\), and \(\gamma_1 < \gamma_2\) Equilibrium 1 exists in the presence of anticipated regret (AR) and Equilibrium 2 exists in the absence of anticipated regret. Thus, in the presence of AR \(q_{AR} = \frac{2\delta(1+\alpha)}{3ac}\), \(\pi_{N,AR} = \frac{8\delta^2(1+\alpha)^3}{243a^2c^2}\), and \(\pi_{O,AR} = \frac{2\delta^2(1+\alpha)(7-2\alpha)^2}{243a^2c^2}\), and in the benchmark case \(q_B = \frac{4\theta}{3(\alpha+y(1-\alpha))c}\), \(\pi_{N,B} = \frac{64\delta^2}{243c(\alpha + (1-\alpha)(y + \gamma_s(y-1)))^2}\), and \(\pi_{O,B} = \frac{8\delta^2(1+\alpha)^3}{243a^2c^2}\). One can show that \(\frac{2\delta^2(1+\alpha)(7-2\alpha)^2}{243a^2c^2} > \frac{100\delta^2}{243c(\alpha + y(1-\alpha)(y-1)))^2}\).
If $x > x^*$ and $\gamma_s < \gamma^*$ then Equilibrium 2 exists both in the presence of AR and in the benchmark case. In the presence of AR $q_{AR} = \frac{4\theta}{3(\alpha+1)(y+\gamma_s(y-1))c}$, $\pi_{N,AR} = \frac{64\theta^2}{243c(\alpha+1)(y+\gamma_s(y-1))^2}$, and $\pi_{O,AR} = \frac{100\theta^2}{243c(\alpha+1)(y+\gamma_s(y-1))^2}$, where $y = \frac{1}{x}$. One can show that $\frac{4\theta}{3(\alpha+1)(y+\gamma_s(y-1))c} > \frac{4\theta}{3(\alpha+1)(y+\gamma_s(y-1))c}$.

In the former case, $\frac{\partial \pi_{N}}{\partial \gamma_r} > 0$, $\frac{\partial \pi_{O}}{\partial \gamma_r} > 0$, and $\frac{\partial q}{\partial \gamma_r} > 0$. Note that

$$\frac{\partial \pi_{O}}{\partial \gamma_r} = \frac{-200\theta^2}{243c(\alpha+1)(y+\gamma_r+y_s(y-1))^2} \frac{(y-1)(1-\alpha)}{(1+\gamma_r)^2} > \frac{\partial \pi_{N}}{\partial \gamma_r} = \frac{128\theta^2}{243c(\alpha+1)(y+\gamma_r+y_s(y-1))^2} \frac{(y-1)(1-\alpha)}{(1+\gamma_r)^2},$$

Proof of Proposition 3: If $\gamma_r > \gamma^*$ then Equilibrium 2 exists. As we know from the proof of Lemma 3 in this equilibrium $\pi_N = \frac{64\theta^2}{243c(\alpha+1)(y+\gamma_r+y_s(y-1))^2}$, $\pi_O = \frac{100\theta^2}{243c(\alpha+1)(y+\gamma_r+y_s(y-1))^2}$, and $q = \frac{4\theta}{3(\alpha+1)(y+\gamma_r+y_s(y-1))c}$. It is obvious that $\frac{\partial \pi_N}{\partial \gamma_r} > 0$, $\frac{\partial \pi_O}{\partial \gamma_r} > 0$, and $\frac{\partial q}{\partial \gamma_r} > 0$. Note that $\frac{\partial \pi_O}{\partial \gamma_r} = \frac{100\theta^2}{243c(\alpha+1)(y+\gamma_r+y_s(y-1))^2} \frac{(y-1)(1-\alpha)}{(1+\gamma_r)^2}$.

Proof of Proposition 4: If $x > x^*$ and $\gamma_r > \gamma^*$ then both in the benchmark case and in the presence of AR Equilibrium 2 exists. Thus, in the presence of AR $q_{AR} = \frac{2\theta(1-\alpha)}{3\alpha c}$, $\pi_{N,AR} = \frac{64\theta^2}{243c(\alpha+1)(y+\gamma_s(y-1))^2}$, and $\pi_{O,AR} = \frac{100\theta^2}{243c(\alpha+1)(y+\gamma_s(y-1))^2}$, and in the benchmark case $q_B = \frac{2\theta(1-\alpha)}{3\alpha c}$, $\pi_{N,B} = \frac{8\theta^2(1-\alpha)^3}{243c^2}$, and $\pi_{O,B} = \frac{2\theta(1-\alpha)(7-2\alpha)}{243c^2}$, where $y = \frac{1}{x}$. One can show that $q_{AR} > q_B$, $\pi_{N,AR} > \pi_{N,B}$, and $\pi_{O,AR} > \pi_{O,B}$.

If $\alpha \geq 0.58$, $x_1 < x < x_2$, and $\gamma_r > \gamma^*$ then Equilibrium 1 exists in the benchmark case and Equilibrium 2 exists in the presence of AR. Thus, in the benchmark case $q_B = \frac{2\theta(1-\alpha)}{3\alpha c}$, $\pi_{N,B} = \frac{8\theta^2(1-\alpha)^3}{243c^2}$, and $\pi_{O,B} = \frac{2\theta(1-\alpha)(7-2\alpha)^2}{243c^2}$. One can show that $q_B > q_{AR}$, $\pi_{N,B} > \pi_{N,AR}$, and $\pi_{O,B} > \pi_{O,AR}$.

If $\alpha \geq 0.58$, $x_1 < x < x_2$, and $\gamma_r > \gamma^*$ then Equilibrium 1 exists both in the presence of AR and in the benchmark case. In that case $q_{AR} = q_B = \frac{2\theta(1-\alpha)}{3\alpha c}$, $\pi_{N,AR} = \pi_{N,B} = \frac{8\theta^2(1-\alpha)^3}{243c^2}$, and $\pi_{O,AR} = \pi_{O,B} = \frac{2\theta(1-\alpha)(7-2\alpha)^2}{243c^2}$.

Proof of Corollary 1: In case of $\gamma_s > \gamma_r = 0$, as we know from the proof of Proposition 2, AR has positive effect on the firms’ profits when Equilibrium 1 exists in the presence of anticipated regret (AR) and Equilibrium 2 exists in the benchmark case and AR has negative effect on the firms’ profits when Equilibrium 2 exists both in the presence of AR and in the benchmark case. In the former case, $\pi_{O,AR} = \frac{2\theta(1-\alpha)(7-2\alpha)^2}{243c^2} > \pi_{O,B} = \frac{100\theta^2}{243c(\alpha+1)(y+\gamma_s(y-1))^2} \pi_{N,AR} = \frac{8\theta^2(1-\alpha)^3}{243c^2} - \pi_{N,B} = \frac{64\theta^2}{243c(\alpha+1)(y+\gamma_s(y-1))^2}$.

In the latter case, $\pi_{O,B} = \frac{100\theta^2}{243c(\alpha+1)(y+\gamma_s(y-1))^2} - \pi_{O,AR} = \frac{100\theta^2}{243c(\alpha+1)(y+\gamma_s(y-1))^2} > \pi_{N,B} = \frac{64\theta^2}{243c(\alpha+1)(y+\gamma_s(y-1))^2} - \pi_{N,AR} = \frac{64\theta^2}{243c(\alpha+1)(y+\gamma_s(y-1))^2}$.
In case of $\gamma_r > \gamma_s = 0$, as we know from the proof of Proposition 4, AR has positive effect on the firms’ profits when Equilibrium 2 exists both in the presence of AR and in the benchmark case, and AR has negative effect on the firms’ profits when Equilibrium 2 exists in the presence of anticipated regret (AR) and Equilibrium 1 exists in the benchmark case. In the former case, $\pi_{O,AR} = \frac{100\theta^2}{243c(\alpha + \frac{(1-\alpha)(y+\gamma_r)}{(1+\gamma_r)^2})^2} - \pi_{O,B} = \frac{64\theta^2}{243c(\alpha+y(1-\alpha))^2} > \pi_{N,AR} = \frac{100\theta^2}{243c(\alpha+\frac{(1-\alpha)(y+\gamma_r)}{(1+\gamma_r)^2})^2} - \pi_{N,B} = \frac{8\theta^2(1+\alpha)^3}{243\alpha^2c} - \pi_{N,AR} = \frac{64\theta^2}{243c(\alpha + \frac{(1-\alpha)(y+\gamma_r)}{(1+\gamma_r)^2})^2}$. In the latter case, $\pi_{O,B} = \frac{2\theta^2(1+\alpha)(7-2\alpha)^2}{243\alpha^2c} - \pi_{O,AR} = \frac{100\theta^2}{243c(\alpha+\frac{(1-\alpha)(y+\gamma_r)}{(1+\gamma_r)^2})^2} > \pi_{N,B} = \frac{8\theta^2(1+\alpha)^3}{243\alpha^2c} - \pi_{N,AR} = \frac{64\theta^2}{243c(\alpha + \frac{(1-\alpha)(y+\gamma_r)}{(1+\gamma_r)^2})^2}$. □

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