Product Preannouncement Under Consumer Loss Aversion

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Abstract

When a firm preannounces its new product, this affects both competitors and consumers. Preannouncement may motivate consumers to postpone their purchase in favor of an improved new product. If the postponement results in sufficiently higher profit margins and offsets the delayed realization of profits the firm prefers to preannounce. In this paper, we study the consequences of a fim's new product preannouncement by focusing on its effect on consumers who have context-dependent preferences. Context-dependent preferences cause consumers' current utility to be affected by the knowledge of a future choice alternative even if that alternative is currently not available. Specifically, we investigate how the existence of context-dependent preferences affect firms' decision to preannounce their new products. We find that the context-dependent preferences reduce the willingness of a firm to preannounce if the firm is a monopolist and under competition if its current product quality is lower than its rival's. On the other hand, the context-dependent preferences encourage the firm to preannounce its new product if its current product quality is higher than its rival's. We then extend our analysis and integrate the effect of the incumbent firm's new product preannouncement on a rival entrant's entry decision. Interestingly, we find that context-dependent preferences make it more profitable for a rival to enter following a preannouncement than if there were no preannouncement.

(Context-Dependent Preferences, New Product Preannouncement, Competition)

1 Introduction

Preannouncing a new product is a strategy that must reckon with its effect on both competitors and consumers. As a strategy it might get competitors to either postpone or altogether forego entry especially with a product that is inferior to the one preannounced (Rabino and Moore, 1989; Eliashberg and Robertson, 1988; Mishra and Bhabra, 2001). A different goal of the preannouncement strategy is to influence consumers on the timing of purchase (Gerlach (2004); Lilly and Walters (1997); Guiltinan (1999); Brockhoff and Rao (1993); Eliashberg and Robertson (1988); Prentice (1996)). Consumers with foresight and the ability to postpone purchase must weigh the benefits from purchasing one of the currently available products against waiting for the new product to come into the market. As a practical matter we know that consumers anticipate future product introductions and also pay attention to product preannouncements.

In this paper we study the consequences of a firm's product preannouncement by focusing on its effect on consumer choice. The firm stands to benefit from consumers postponing their purchase in favor of an "improved" new product that results in sufficiently higher profit margins to offset delayed realization of sales. In other words the firm could preannounce a new product if it can profitably cannibalize sales of its current products by future products. A different motivation would be to get consumers to not purchase a competitor's product and instead wait for the firm's new product that is "better" than the competitor's offering. The incremental profits to the firm in this case result from both greater sales and possibly higher profit margins. This would be especially true if the firm's current offering is "inferior" to the competitor's. Said differently the firm's preannouncement strategy is designed to cannibalize sales of the competitor's current product by the firm offering a product superior to the competitor's.

Suppose we ignored the effect of delayed realization of profits. Then, would a firm always prefer to preannounce its improved product? To answer this question we must first establish equilibrium prices and margins taking into account not just the presence of the new product but also whether or not the firm chooses to preannounce. Once prices are known it is possible to evaluate the profitability of preannouncement. Such an analysis is predicated on how we model foresighted consumer behavior. In our research we wish to incorporate context-dependent preferences resulting from the effect on consumers' current utility that the knowledge of a future choice alternative has, even if that alternative is currently not available. Behavioral scientists have documented, through experiments, that when choosing among a set of objects consumers evaluate options by considering both the absolute utilities and their relative standing in the choice set, and this process leads to context-dependent preferences (Huber et al. (1982); Tversky and Simonson (1993); Simonson and Tversky (1992); Drolet et al. (2000); Bhargava et al. (2000)). It has been argued that consumers compare each option with a reference point that is endogenous to the choice set (Kivetz et al. (2004a); Kivetz et al. (2004b)) and further in comparative valuation losses loom larger than gains. The reference dependence and loss aversion together cause choice reversals across contexts (i.e., context-dependent preferences). More interestingly, Simonson and Tversky (1992) experimentally show that even if an option added to the choice set is currently unavailable and consumers are not informed about when it will be available for purchase, that option affects consumers' comparative judgement of all options in the choice set and can cause choice reversals. There is considerable experimental and field evidence for reference-dependence and loss aversion. Ho et al. (2006) (see Table 2) and DellaVigna (2009) (see pages pages 324-336) provide a comprehensive list of experimental and field work showing reference-dependence and loss aversion in various types of economic domains and choices.

Context-dependent preferences are likely to have force in any model of product preannouncement because they affect the way equilibrium prices are determined. And that in turn influences the firm's decision to preannounce. We know from casual empiricism that once consumers expect a future product innovation their value for current offerings tends to diminish. However, this change in consumers' valuation for current offerings should not be seen as being just relative to the future product. When consumers' preferences are context-dependent, an expectation of a future product innovation affects the choice set and hence also the consumers' valuation of the current offerings relative to each other. And so the researcher's challenge is to invoke a context-dependent preferences model that is valid in light of past behavioral findings and at the same time that permits a game-theoretic analysis of firms' pricing. We meet this challenge by analyzing a vertically differentiated duopoly with one firm offering a "higher" quality product than the other. We study the situation in which one of the firms has a future product that exceeds in quality both current offerings, and must decide whether or not to preannounce. In our model consumers are either of high type who have high willingness to pay for extra quality or low type who have low willingness to pay for extra quality with high (low) type being served by the higher (lower) quality product. We consider in turn the focal firm to have either the lower or higher quality in the current period. We then solve for equilibrium prices in the market first assuming that consumer preferences are not context-dependent and then that they are. The equilibrium we use is sub-game perfect with consumers having rational expectations. For the sake of completeness we also analyze the monopoly case. Specifically, we would like to understand how the existence of context-dependent preferences alters firms' decision to preannounce. Is preannouncement more or less profitable in the presence of context-dependent preferences than in their absence? And, does the effect of context-dependent preferences depend on the competitive setting and/or the preannouncing firm's competitive advantage?

If preferences are not context-dependent we find, as expected, that in equilibrium the monopolist strongly prefers to preannounce its new product because knowing that there will be a higher quality product in the future consumers who are able to postpone their purchase prefer to wait; and cannibalizing current lower margin product by future higher margin product is obviously profitable. This turns out to be true also under competition but only if the firm's current quality is lower than its competitor's. This is because knowing that there will be a higher quality product in the future the high type consumers who are able to postpone their purchase prefer to wait to buy the firm's new product rather than to buy the rival's existing product. Why is this not necessarily true for the firm with the current higher quality product? If the firm's current quality is higher then for high type consumers who can delay their purchase preannouncement offers a choice of two high quality products one that can be bought currently (at lower price) and one that can be bought in the future (at higher price). The firm cannot commit to future price and so preannouncement may not cause consumers to postpone their purchase. In that case the preannouncement does not increase profits.

If, on the other hand, preferences are context-dependent then under certain conditions in equilibrium both the monopolist and the lower quality firm prefer not to preannounce. In other words it is not prudent for managers to preannounce without a careful analysis of consumer preferences. When a firm preannounces the availability of its new product, consumers' current choice set expands and includes also the new product which will be sold in the future. With the addition of a higher quality new product the reference quality shifts upward. Due to loss aversion the utility consumers derive from the existing product of the monopolist and of the lower quality firm decreases and as a result consumers become less willing to pay for these firms' existing products, which in turn decreases their profits. If the consumers' loss aversion is high the negative effect of preannouncement dominates any positive effect and so, these firms do not want to preannounce. On the other hand, if the preannouncing firm is the higher quality firm then since the preannouncement makes the consumers to become less willing to pay for the lower quality firm's product the higher quality firm is able to charge more for its existing product before the new product is launched. This means that even if no consumer postpones his purchase after hearing the preannouncement the higher quality firm would still gain from preannouncing and hence strongly prefers to preannouce. Therefore, the existence of context-dependent preferences makes preannouncement relatively less profitable for the monopolist and the lower quality firm while making it relatively more profitable for the higher quality firm. In this way we see that context-dependent preferences affect preannouncement strategies in important ways.

We also study an extension of our basic model and integrate the effect of new product preannouncements on entry. In the extension, the incumbent firm faces a rival entrant who is contemplating entry with a higher quality product. The extant literature shows that new product preannouncements can deter rival entries and help preempt rivals. Given our finding that context-dependent preferences can lead the monopolist firm not to preannounce, it is not obvious how the threat of entry interacts with context-dependent preferences on the monopolist's decision to preannounce. When the incumbent faces a rival entrant, will context-dependent preferences render it more inclined to preannounce its superior new product so as to deter entry? Surprisingly, we find that when consumers exhibit context-dependent preferences, incumbent's preannouncement can make it even more profitable for the rival to enter. Therefore, the threat of entry may add to the effect of context-dependent preferences in the sense that preannouncement becomes unprofitable under more scenarios.

Our work provides new results on preannouncement strategies and thus adds to the growing literature of strategic analysis of firm decisions after incorporating findings of behavioral economics (Amaldoss and Jain (2005b); Amaldoss and Jain (2005a); Amaldoss and Jain (2008b); Amaldoss and Jain (2008a); Chen et al. (2010); Cui et al. (2007); Feinberg et al. (2002); Hardie et al. (1993); Ho and Zhang (2008); Jain (2009); Lim and Ho (2007); Orhun (2009); Syam et al. (2008); Rooderberk et al. (2011); Grubb (2009); Greenleaf (1995); Kopalle et al. (1996); Heidhues and Koszegi (2008)). The reminder of the paper is organized as follows. In the next section, we explore the benchmark case in which preferences are context independent. In Section 3 we study the case in which consumers exhibit context-dependent preferences and investigate its implications for firms' preannouncement decision. Then, in Section 4 we extend our basic model and integrate the entry effect of new product preannouncement and investigate how the threat of entry interacts with context-dependent preferences on the firms' decision to preannounce. Finally, Section 5 summarizes our results and discusses managerial implications and directions for future work.

2 Benchmark Case - No Context-Dependent Preferences

We begin by examining firms' decision to preannounce their new product when consumers do not exhibit context-dependent preferences.

2.1 Monopoly

First, we study a monopolist's strategy of preannouncing its new product. We next describe our model set up and then present the results of our analysis.

2.1.1 Model

In our model the focal firm is assumed to have a current product of quality q and is contemplating preannouncing a product of quality $q + \Delta$. The incremental quality Δ in our model is exogenous. This keeps the analysis tractable. It also captures the reality that while the preannouncement decision follows and is conditional on Δ, firms' choice of quality depends on technology and costs rather than on whether or not it will preannounce at a later stage. We assume that the marginal cost of both product is equal, and without loss of generality set it to zero.

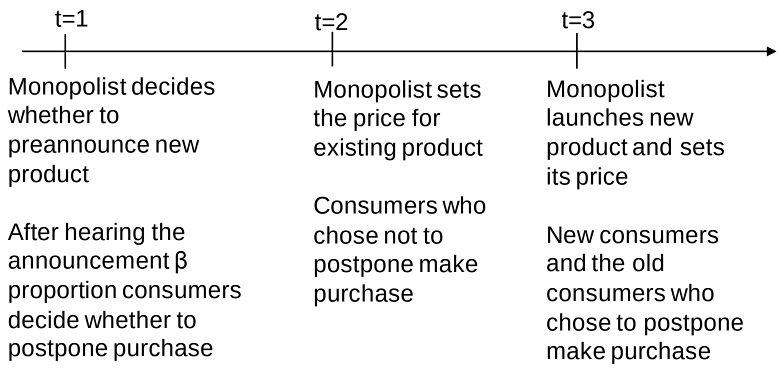
We envision consumer purchases and firm decisions as occurring over three periods. Let t denote the period. The new product is assumed to be available in the final period, t=3. However, the monopolist may choose to preannounce it at t=1. Consumer purchase occurs at t=2 and at t=3. This may or may not take into account the new product depending on the preannouncement decision. In our model there are two types of consumers. One type, the high type, has a valuation of $\overline{Q}$ for unit quality while the low type has a valuation of $\underline{Q} < \overline{Q}$. Denoting Q as valuation then we have $Q \epsilon \left\{ \overline{Q}, \underline{Q} \right\}$. We assume that at t=2 the market consists of a unit mass of consumers and a unit mass of new consumers enters at t=3. Each type of consumer is assumed to constitute half of the market. This assumption allows us to capture the effect of context-dependent preferences and competition without the preference distribution driving our results.

How does preannouncement affect consumers? When there is no preannouncement at t=1, consumer choice is predicated on quality of available products and their prices given consumers' valuation of quality. This changes when there is preannouncement of a new product. Some consumers, a fraction β, has the option of postponing their purchase. This fraction will form rational expectation of future prices in the event of a preannouncement and then choose from among the current products at t=2 or may choose to wait till t=3 to make a purchase. The purchasing decision of remaining fraction $(1 - \beta)$ is unaffected by the preannouncement. We incorporate this in our model to capture the reality that for some consumers the need for the product is urgent while for others it is not. This depends often on current ownership and whether or not a product consumers own is in working condition. We could have endogenized the postponement decision for all the consumers by alternatively modeling this reality as a fraction $(1 - \beta)$ consumers having a low discount factor.

Figure 1 depicts the unfolding of events in our model. At t=2 the monopolist sets the price for its existing product and following this consumers who decided not to postpone make their purchase. At t=3 the monopolist launches it new product and sets its price. Following this the consumers who decided to postpone their purchase at t=1 and the unit mass of new consumers who entering the market at t=3 purchase and the game ends.

We assume that in a given period a firm can manufacture and sell only one type of product. Furthermore, in our model firms are assumed to not discount future cash flows allowing us to maintain focus on context-dependent preferences and competition. Obviously if the discount factor is sufficiently small future events will have no effect on current decisions.

Figure 1: The Timeline of The Game - Case of Monopoly



Based on the model setup given above, consumers' utility is equal to $Q * quality - price$, where $Q \epsilon \left\{\overline{Q}, \underline{Q}\right\}$ and $quality \epsilon \left\{q, q+\Delta\right\}$.

Proposition 1 *Absent context-dependent preferences the monopolist strictly prefers to preannounce in equilibrium.*

When the monopolist preannounces the availability of its new product at t=1, knowing that there will be a higher quality product at t=3 consumers who are able to postpone their purchase may choose to wait till t=3 to buy the new product. Since the monopolist's profit margin from the new product is higher than the profit margin from the existing one this causes it to earn higher profits. For that reason, the monopolist always prefers to preannounce.

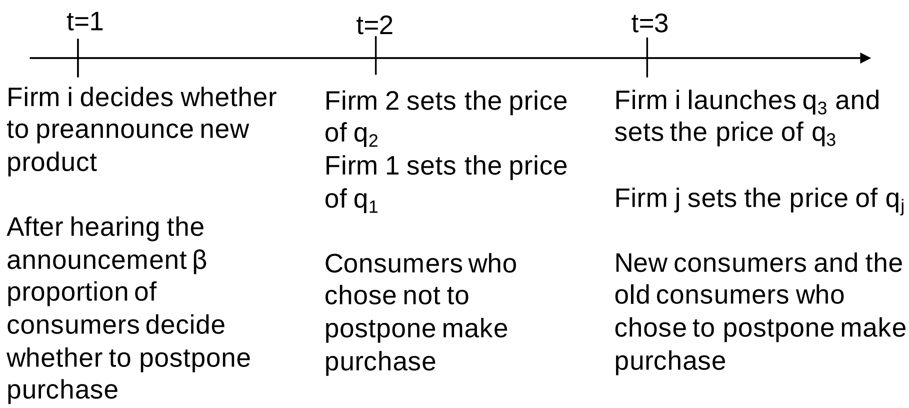
2.2 Competition

Next we investigate a firm's decision to preannounce its new product when it faces a rival. As in the monopoly case, first we describe the model set up and then present the results of our analysis.

2.2.1 Duopoly Model

There are two firms (firm 1 and firm 2) currently selling products q_1 (with quality q) and q_2 (with quality $q+\Delta$) respectively. One of these firms is planning to launch a new product with quality $q+2\Delta$. We denote the new product by q_3. As before we assume that the manufacturing cost of each of the products is equal and set to zero. At t=1 firm i decides whether to preannounce or not the availability of its new product q_3 at t=3. If it preannounces its new product β proportion of consumers decides whether to postpone purchase and wait till t=3 for the new product or to purchase one of the currently available products at t=2. We model the price setting as follows. At t=2 the higher quality firm, firm 2, chooses its price p_2 and then firm 1 chooses its price p_1. This sequential choice of prices has two advantages. First, it allows us to investigate equilibrium in pure strategies. Second, it is more profitable for both firms to follow such a sequential price setting, and moreover it is often found in practice. Following this price setting consumers who decided not to postpone make their purchase. At t=3 the new product q_3 is launched and its price, p_3, is set. Note that once again we have the higher quality firm set price first and then the rival firm j set the price for its product q_j ($\hat{p}_2$ as the price of q_2 or $\hat{p}_1$ as the price of q_1). Now the consumers who decided to postpone their purchase at t=1 and the unit mass of new consumers who enter the market at t=3 make their purchase. Figure 2 exhibits the details of the timeline of the game.

Figure 2: The Timeline of The Game - Case of Duopoly



Consumers' utility functions are as in the monopoly case. Furthermore, to make our analysis meaningful we focus on the parameter space in which the low type consumers prefer to buy q_1 and the high type consumers prefer to buy q_2, assuming no context-dependent preferences.

Note that in such a setting there can exist four different pure strategy equilibria. These are: 1. the β proportion of both high type and low type consumers postpones purchase to t=3; 2. the β proportion of only the high type consumers postpones purchase to t=3; 3. the β proportion of only the low type consumers postpones purchase to t=3; and 4. No one postpones purchase to t=3. In other words, the subgame following the preannouncement decision has different kinds of equilibria depending on the parameters. In the following analysis we characterize all these equilibria.

Proposition 2 *Absent context-dependent preferences, in equilibrium firm 1 strictly prefers to preannounce but firm 2 strictly prefers to preannounce only if* $\frac{\overline{Q}}{\underline{Q}} > \frac{3-\beta}{2-\beta}$ *and* $0.56 > \beta > 0.33$.

What is the implication of Proposition 2? Since firm 1 currently lags behind in quality it cannot serve the high type consumers with its existing product. If firm 1 preannounces the availability of its new and higher quality product q_3 and high type consumers are willing to postpone their purchase then it can serve these consumers at t=3. Obviously when consumers hear such a preannouncement at t=1, they also expect that the price of q_2 (i.e., currently the higher quality product) will be less at t=3 than at t=2. This may encourage the low type consumers not to buy q_1 at t=2, but postpone their purchase and wait till t=3 to buy q_2 at a lower price. However, since the gain in profits from the high type consumers offsets the loss in profits from the low type consumers firm 1 always strictly prefers to preannounce.

Why does not firm 2 prefer to preannounce its plans to launch q_3? When firm 2 announces the availability of q_3, the high type consumers may want to postpone their purchase and wait till t=3 to buy q_3. However, if the proportion of high type consumers who postpone their purchase is low (i.e., $\beta < 0.33$) then at t=3 the price competition between q_1 and q_3 is not intense so that the price of q_3 is too high relative to the price of q_2 at t=2. Hence, the high type consumers do not want to wait for q_3. On the other hand, if the proportion of high type consumers postponing purchase is high (i.e., $\beta > 0.56$) then at t=3 the price competition between q_1 and q_3 becomes very intense such that the price of q_1 becomes less at t=3 than at t=2. In this case, the low type consumers would also want to postpone their purchase. But, if both segments choose to postpone their purchase the prices at t=3 will be much higher than the prices at t=2- i.e., the price of q_1 will be higher at t=3 than at t=2 and price of q_3 will also be much higher than the price of q_2. This happens because q_1 and q_3 are more differentiated from each other on the quality dimension than q_1 and q_2 are. Thus, such an equilibrium cannot exist. If only the high type consumers postpone their purchase and the difference between the high type consumers' and the low type consumers' willingness to pay for quality is low (i.e., $\frac{\overline{Q}}{\underline{Q}} < \frac{3-\beta}{2-\beta}$) then firm 2 prefers to serve the whole market at t=2 to compensate for the loss of β proportion of high type consumers who prefers to wait till t=3. In this case, the price of q_2 becomes too low to make the β proportion of high type consumers not want to postpone. Finally, note that firm 2 would strictly prefer to preannounce its new product only if some consumers postpone their purchase to buy q_3. Otherwise, firm 2 would be indifferent to preannouncing or not. This also means that if there were any cost to preannouncing in equilibrium when no one postpones firm 2 would strongly prefer not to preannounce. As a result, in equilibrium firm 2 strictly prefers to preannounce only if $\frac{\overline{Q}}{\underline{Q}} > \frac{3-\beta}{2-\beta}$ and $0.56 > \beta > 0.33$. In such equilibrium only the high type consumers postpone their purchase and wait for the new product.

3 Consumers' Preferences Are Context-Dependent

In the following we investigate how a firm's incentive to preannounce changes when consumers exhibit context-dependent preferences. We adopt the linear Loss Aversion Model (LAM) to implement context-dependent preferences. In this model a consumer's utility is the sum of absolute utilities of each attribute and comparative utilities that consist of gains and losses on each attribute compared to a reference point. Furthermore, in comparative valuation losses loom larger than gains. In this model the reference point is endogenous to the choice set (Kivetz et al. (2004a); Orhun (2009)) and as the set's composition changes the reference point changes and hence, consumers' preferences. This means that consumers' preferences are context-dependent. Linear LAM model has been shown to be one of the better models to implement context-effects (see Kivetz et al. (2004a) and Kivetz et al. (2004b))[1] and has been used in recent work such as Koszegi and Rabin (2006), Orhun (2009), and Ho et al. (2006) for modeling purposes.

In this model when a consumer buys product i, the comparative utility from the quality dimension is equal to $\lambda Q(quality_i - reference\ quality)$ if $quality_i > reference\ quality$ and to $\gamma Q(quality_i - reference\ quality)$ if $quality_i < reference\ quality$, where λ and γ denote consumers' gain and loss sensitivies respectively. Since losses loom larger than gains $\gamma > \lambda$. Similarly, when a consumer buys product i the comparative utility from the price dimension is equal to $\lambda(reference\ price - price_i)$ if $reference\ price > price_i$ and to $\gamma(reference\ price - price_i)$ if $price_i > reference\ price$. To simplify our analysis we normalize λ to zero. Kivetz et al. (2004b) and Orhun (2009) show that the linear LAM model with a reference point as the centroid of all products is a robust representation of context-dependent preferences. Linear LAM model can capture all the context effects such as extremeness aversion, asymmetric dominance, asymmetric advantage, enhancement and detraction effects (Huber et al. (1982); Simonson and Tversky (1992)). Since the reference point is the centroid of all products it is affected by any changes in the choice set (even by the changes which do not affect the range of attributes) and hence, it can accommodate various context-effects. Therefore, consistent with previous work we use average quality in the choice set as the reference quality and average price in the choice set as the reference price (see Narasimhan and Turut (2012) and Chen and Turut (2012) for similar treatment).

As we did in the benchmark case we will start with monopoly setting and then analyze the competitive scenario.

[1] Kivetz et al. (2004a) show that validation and fit measures indicate that LAM is one of the three models that outperform the rest.

3.1 Monopoly

When the firm is a monopolist, since at t=3 there is only the one new product in the market the reference quality is $q + \Delta$ and the reference price is the price of the new product. If the monopolist firm does not announce the availability of the new product then at t=2 consumers' choice set would consist of only the currently existing product and hence, the reference quality would be q and the reference price would be its price. On the other hand, if the monopolist announces the availability of the new product then at t=2 consumers' choice set would consist of both the currently existing product and the future product and hence, the reference quality would be $\frac{2q+\Delta}{2}$ and the reference price would be the average of the price of the currently existing product and the price of the new product that will be launched at t=3.

In the following we will write consumer utility functions. To make it easy for the reader to follow we will write the comparative utility component in parentheses. Let p_1 and p_2 denote the price of the monopolist's existing product at t=2 and the price of its new product at t=3 respectively.

At t=3 a consumer's utility from buying the new product is equal to

$$Q(q + \Delta) - p_2$$

There is no comparative utility part because the reference quality is equal to $q + \Delta$ and the reference price is equal to p_2.

If the monopolist does not preannounce then at t=2 a consumer's utility from buying the existing product is equal to

$$Qq - p_1$$

There is no comparative utility part because the reference quality is equal to q and the reference price is equal to p_1.

If the monopolist preannounces then at t=2 a consumer's utility from buying the existing product is equal to

$$Qq - p_1 + \gamma[Q(q - \frac{2q + \Delta}{2}) + (\frac{p_1 + p_2}{2} - p_1)I(\frac{p_1 + p_2}{2} < p_1)],$$
$$\text{where } I(.) = 1 \text{ if } \frac{p_1 + p_2}{2} < p_1 \text{ and } I(.) = 0 \text{ otherwise.}$$

Proposition 3 *There exists a γ^* such that the monopolist prefers not to preannounce if $\gamma > \gamma^*$.*

We know from Proposition 1 that in the absence of context-dependent preferences the monopolist always prefers to preannounce. However, according to 3 when consumers exhibit context-dependent preferences, the monopolist does not always prefer to preannounce. This means that context-dependency decreases the monopolist's incentives to preannounce. Why does this occur? When the monopolist preannounces the availability of its new product at t=1, two things happen. On one hand, as we know from Proposition 1, knowing that there will be a higher quality product at t=3 consumers who are able to postpone their purchase may choose to wait till t=3 to buy the new product, which causes the monopolist to earn higher profits. On the other hand, when the monopolist preannounces the availability of its new product, consumers' choice set at t=2 expands and includes also the new product which will be sold at the price of p_2 at t=3. In this case, if the consumers' preferences are context-dependent, with the addition of higher quality new product the reference quality shifts upward (from q to $\frac{2q+\Delta}{2}$). Due to loss aversion this causes the utility consumers derive from the existing product to decrease and as a result consumers become less willing to pay for the existing product at t=2, which in turn decreases the monopolist's profits. If the consumers' loss aversion is high (i.e., γ is high) the negative effect of preannouncement dominates the aforementioned positive effect and thus, the monopolist does not want to preannounce.

3.2 Case of Competition

As we did in the benchmark case we will examine in turn the case in which firm 1 launches the new product with quality $q+2\Delta$ and the case in which firm 2 launches the new product with quality $q+2\Delta$.

3.2.1 Firm 1 launches the new product with quality $q+2\Delta$

In this case, at t=3 since there are q_3 and q_2 the reference quality is $\frac{2q+3\Delta}{2}$ and the reference price is $\frac{p_3+\hat{p}_2}{2}$. If the firm does not preannounce the availability of the new product then at t=2 consumers' choice set would consist of q_1 and q_2 and hence, the reference quality would be $\frac{2q+\Delta}{2}$ and the reference price would be $\frac{p_1+p_2}{2}$. On the other hand, if the firm preannounces the availability of the new product then at t=2 consumers' choice set would consist of q_1 at the price of p_1, q_2 at the price of p_2, q_2 at the price of $\hat{p}_2$, and q_3 at the price of p_3. Thus, the reference quality would be $q+\Delta$ and the reference price would be $\frac{p_1+p_2+\hat{p}_2+p_3}{4}$. In the following we will write consumer utility functions when consumers exhibit context-dependent preferences.

A consumer's utility at t=3 is

$$Q(q+2\Delta) - p_3 + \gamma(\frac{p_3 + \hat{p}_2}{2} - p_3) \text{ if he buys } q_3$$

and

$$Q(q+\Delta) - \hat{p}_2 + \gamma[Q(q+\Delta - \frac{2q+3\Delta}{2})] \text{ if he buys } q_2.$$

If firm 1 does not preannounce then a consumer's utility at t=2 is

$$Q(q+\Delta) - p_2 + \gamma(\frac{p_1 + p_2}{2} - p_2) \text{ if he buys } q_2$$

and

$$Qq - p_1 + \gamma[Q(q - \frac{2q+\Delta}{2})] \text{ if he buys } q_1.$$

If firm 1 preannounces then a consumer's utility at t=2 is

$$Q(q+\Delta) - p_2 + \gamma[(\frac{p_1 + p_2 + \hat{p}_2 + p_3}{4} - p_2)I(\frac{p_1 + p_2 + \hat{p}_2 + p_3}{4} < p_2)],$$
$$\text{where } I(.) = 1 \text{ if } \frac{p_1 + p_2 + \hat{p}_2 + p_3}{4} < p_2 \text{ and } I(.) = 0 \text{ otherwise, if he buys } q_2.$$

and

$$Qq - p_1 + \gamma[Q(q - (q+\Delta)) + (\frac{p_1 + p_2 + \hat{p}_2 + p_3}{4} - p_1)I(\frac{p_1 + p_2 + \hat{p}_2 + p_3}{4} < p_1)],$$
$$\text{where } I(.) = 1 \text{ if } \frac{p_1 + p_2 + \hat{p}_2 + p_3}{4} < p_1 \text{ and } I(.) = 0 \text{ otherwise, if he buys } q_1.$$

Proposition 4 *There exists a $\hat{\gamma}^*$ such that firm 1 prefers not to preannounce if $\gamma > \hat{\gamma}^*$ and $\beta < \frac{2(\overline{Q}-\underline{Q})}{2\overline{Q}-\underline{Q}}$.*

Recall from Proposition 2 that in the absence of context-dependent preferences firm 1 always prefers to preannounce its new product. However, Proposition 4 tells us that when consumers exhibit context-dependent preferences, firm 1 does not always prefer to preannounce. Therefore, the existence of context-dependent preferences decreases firm 1's incentive to preannounce. The intuition for this result is as follows. When firm 1 preannounces q_3, at t=2 consumers' choice set consists of (q_1, p_1), (q_2, p_2), $(q_2, \hat{p}_2)$, and (q_3, p_3), where $\hat{p}_2$ and p_3 are the expected prices of q_2 and q_3 respectively at t=3. With the addition of $(q_2, \hat{p}_2)$ and (q_3, p_3) to the choice set the reference quality shifts upwards (from $\frac{2q+\Delta}{2}$ to $q+\Delta$). Due to this upward shift in the reference quality when a consumer buys q_1 he experiences a higher loss on the quality dimension ($\gamma Q\Delta$ rather than $\frac{\gamma Q\Delta}{2}$), which in turn decreases his willingness to pay for q_1 at t=2. In this case, if consumers' loss aversion is high (i.e., $\gamma > \hat{\gamma}^*$) then firm 2 prefers to price q_2 such that it can serve the whole market at t=2. Thus, preannouncing the availability of q_3 at t=3 causes firm 1 to lose the low type consumers. Even though firm 1 gains in profits from the high type consumers who choose to postpone their purchase and wait till t=3 if the proportion of these consumers is not high (i.e., $\beta < \frac{2(\overline{Q}-\underline{Q})}{2\overline{Q}-\underline{Q}}$) the loss of low type consumers at t=2 would dominate the gain in the high type segment and as a result firm 1 would not want to preannounce.

3.2.2 Firm 2 launches the new product with quality $q + 2\Delta$

In this case, at t=3 since there are q_3 and q_1 the reference quality is $q + \Delta$ and the reference price is $\frac{p_3+\hat{p}_1}{2}$. If the firm does not preannounce the availability of the new product then at t=2 consumers' choice set would consist of q_1 and q_2 and hence, the reference quality would be $\frac{2q+\Delta}{2}$ and the reference price would be $\frac{p_1+p_2}{2}$. On the other hand, if the firm preannounces the availability of the new product then at t=2 consumers' choice set would consist of q_1 at the price of p_1, q_1 at the price of $\hat{p}_1$, q_2 at the price of p_2, and q_3 at the price of p_3. Thus, the reference quality would be $\frac{4q+3\Delta}{4}$ and the reference price would be $\frac{p_1+\hat{p}_1+p_2+p_3}{4}$.[2]

A consumer's utility at t=3 is

$$Q(q + 2\Delta) - p_3 + \gamma(\frac{p_3 + \hat{p}_1}{2} - p_3) \text{ if he buys } q_3$$

and

$$Qq - \hat{p}_1 + \gamma[Q(q - (q + \Delta))] \text{ if he buys } q_1.$$

If firm 2 does not preannounce then a consumer's utility at t=2 is

$$Q(q + \Delta) - p_2 + \gamma(\frac{p_1 + p_2}{2} - p_2) \text{ if he buys } q_2$$

and

$$Qq - p_1 + \gamma[Q(q - \frac{2q + \Delta}{2})] \text{ if he buys } q_1.$$

If firm 2 preannounces then a consumer's utility at t=2 is

[2] Alternatively we could have modeled the reference quality as $\frac{q_1+q_2+q_3}{3}$-i.e., $q+\Delta$, even if q_1 appears twice (with different prices) in the choice set. Our results turn out to be qualitatively robust to the choice of reference quality modeling.

$$Q(q+\Delta) - p_2 + \gamma[(\frac{p_1+\hat{p}_1+p_2+p_3}{4} - p_2)I(\frac{p_1+\hat{p}_1+p_2+p_3}{4} < p_2)],$$

where $I(.) = 1$ if $\frac{p_1+\hat{p}_1+p_2+p_3}{4} < p_2$ and $I(.) = 0$ otherwise, if he buys q_2.

and

$$Qq - p_1 + \gamma[Q(q - \frac{4q+3\Delta}{4}) + (\frac{p_1+\hat{p}_1+p_2+p_3}{4} - p_1)I(\frac{p_1+\hat{p}_1+p_2+p_3}{4} < p_1)],$$

where $I(.) = 1$ if $\frac{p_1+\hat{p}_1+p_2+p_3}{4} < p_1$ and $I(.) = 0$ otherwise, if he buys q_1.

Proposition 5 *There exist γ values for which in equilibrium firm 2 strictly prefers to preannounce for any β if $\frac{\overline{Q}}{\underline{Q}} > R^*(\gamma)$.*

As we know from Proposition 2 that in the absence of context-dependent preferences firm 2 prefers to preannounce only if $\frac{\overline{Q}}{\underline{Q}} > \frac{3-\beta}{2-\beta}$ and $0.56 > \beta > 0.33$. However, according to Proposition 5 the existence of context-dependent preferences expands the region in which firm 2 prefers to preannounce. Why do context-dependent preferences increase firm 2's incentive to preannounce? When preferences are context-dependent and firm 2 preannounces the availability of q_3, at t=2 consumers' choice set consists of (q_1, p_1), (q_2, p_2), $(q_1, \hat{p}_1)$, and (q_3, p_3), where $\hat{p}_1$ and p_3 are the expected prices of q_1 and q_3 respectively at t=3. With the addition of (q_3, p_3) to the choice set the reference quality shifts upwards (from $\frac{2q+\Delta}{2}$ to $\frac{4q+3\Delta}{4}$). Due to this upward shift in the reference quality when a consumer buys q_1 he experiences a higher loss on the quality dimension ($\frac{3\gamma Q\Delta}{4}$ rather than $\frac{\gamma Q\Delta}{2}$), which in turn decreases his willingness to pay for q_1 at t=2. Thus, firm 2 is able to charge a higher price for q_2 at t=2. Due to this increase in the price of q_2 at t=2, in equilibrium even if no one postpones his purchase after hearing the preannouncement firm 2 would still strictly prefer to preannounce.

Moreover, since the preannouncement decreases the consumers' willingness to pay for q_1 at t=2 unless the difference between the high type consumers' and low type consumers' willingness to pay is too low (i.e., $\frac{\overline{Q}}{\underline{Q}} > R^*(\gamma)$) firm 2 prefers to serve only the high type consumers and charge a higher price for q_2, which in turn increases the β proportion of high-type consumers' willingness to wait for q_3 till t=3. Furthermore, note that at t=3 the reference quality is $q + \Delta$ and at t=2 the reference quality is $\frac{4q+3\Delta}{4}$ if firm 2 preannounces its new product and $\frac{2q+\Delta}{2}$ otherwise. Thus, at a given price consumers will derive less utility from buying q_1 at t=3 than at t=2, which in turn causes the price of q_1 to be less at t=3 than at t=2. In this case, the β proportion of low type consumers to become more willing to postpone purchase. As a result, when preferences are context-dependent, the equilibrium in which firm 2 announces and the β proportion of both types of consumers postpones can exist.

Thus, our analysis shows that taking into account existence of context-dependent preferences significantly alters a firm's decision whether to preannounce its new product or not. Furthermore, we also discovered that the direction of this impact on the firm's preannouncement decision depends on whether the firm faces a competitor or not and whether the firm is currently competitively advantaged or not. We have thus been able to obtain sharp insight into the effect of context-dependent preferences on preannouncement decision.

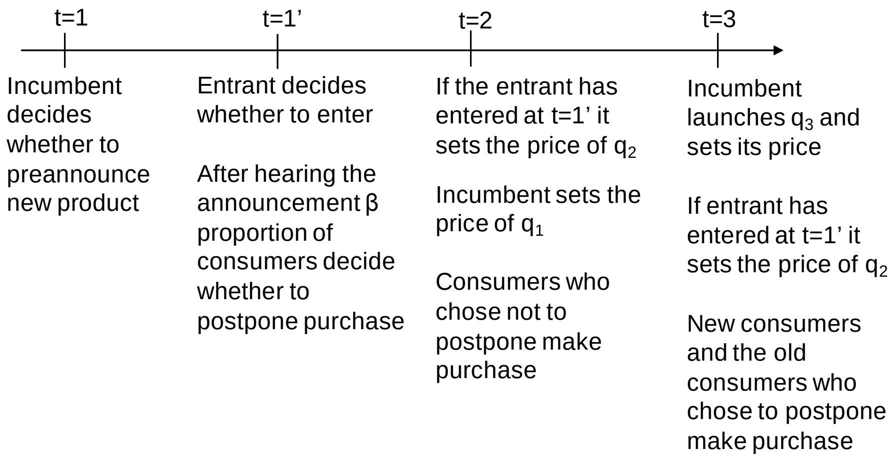
So far we have focused on the effect of new product preannouncements on consumers and whether they would postpone purchase if they learn the availability of a better product in the future. However, when a firm preannounces its new product, this may also affect the entry of new firms. It has been documented that new product preannouncements can deter rival entries and help preempt them. Thus, we might expect that if the entry effect of new product preannouncements is integrated a firm should be even more willing to preannounce. In the next section we investigate this by integrating entry into our basic model. Recall that our analysis in Section 3 showed that when consumers are the only concern context-dependent preferences decrease the monopolist firm's incentives to preannounce. We now ask whether the entry concern lessens or amplifies the aforementioned negative effect of context-dependent preferences on the incumbent firm's willingness to preannounce.

4 Preannouncement and Entry

An incumbent firm can deter entry of a rival by preannouncing its new product because such preannouncement would encourage consumers to postpone their purchase and hence make it less profitable for the rival firm to enter. In the following we use our basic model to investigate this effect of preannouncement on the rival entrant. Figure 3 depicts the timeline of the entry game. At t=1 the incumbent firm with product q_1 (quality of q) decides whether to preannounce or not its new product q_3 (quality of $q + 2\Delta$). At t=$1'$ a rival entrant with product q_2 (quality of $q + \Delta$) decides whether to enter or not. We assume that the entrant needs to incur a fixed cost F to enter. If the entrant chooses to enter the game unfolds as in Section 2.2. If, on the other hand, the entrant chooses not to enter the game unfolds as in Section 2.1. Note that the β proportion of consumers who can postpone purchase decide whether to postpone or not after the incumbent's preannouncement decision *and* the entrant's decision to enter or not.

Recall from Section 2.1 that in the absence of context-dependent preferences the monopolist always prefers to preannounce so as to encourage consumers to postpone purchase. Will this change if there is a potential entrant? To answer this question we first characterize the effect of incumbent's preannounce-

Figure 3: The Timeline of The Entry Game



ment on the entry decision in Lemma 1.

Lemma 1 *In the absence of context-dependent preferences the incumbent's preannouncement makes it less profitable to enter for the rival.*

When the incumbent preannounces the availability of q_3 and the entrant enters, either both types of consumers postpone or only the high type consumers postpone. In the former case firms' prices are same as when the incumbent does not preannounce. However, since the price of q_2 at t=3 is less than at t=2 and the β proportion of consumers postpone their purchase to t=3 the entrant loses profits from the β proportion of consumers. In the latter case, the price of q_2 both at t=2 and at t=3 is lower when the incumbent preannounces q_3 than when it does not preannounce. Even if in equilibrium the entrant serves the whole market at t=2 it cannot compensate the loss in profits due to decrease in its price. Hence, the entrant receives lower profits when the incumbent preannounces. This means that the monopolist's decision whether to preannounce remains as in Section 2.1.

Thus, according to Lemma 1 in the absence of context-dependent preferences preannouncement can deter entry. Will this hold when consumers' preferences are context-dependent?

Proposition 6 *The incumbent's preannouncement can make it more profitable for the rival to enter.*

When the incumbent preannounces q_3 and entry occurs, if the β proportion of both types of consumers postpone purchase firms' prices at t=3 are same as when the incumbent does not preannounce and the price of q_2 at t=3 is less than at t=2. However, as we know from Proposition 4, in case of preannouncement at t=2 the reference quality shifts upward, which in turn decreases consumers' willingness to pay for q_1. As a result of this, at t=2 the entrant can either charge a higher price for q_2 than when firm 1 does not preannunce or serve the whole market. Unless β is too high this gain in profits dominates the loss in profits from the β proportion of consumers who postpone purchase to t=3, which in turn makes it more profitable to enter. If the β proportion of only the high type consumers postpones the entrant's price at t=3 is less than its price at t=3 when there is no preannouncement. But, the upward shift in the reference quality at t=2 due to the preannouncement decreases consumers' willingness to pay for q_1 and hence the entrant becomes to be able to serve the whole market at t=2. Thus, unless β is too high the entrant's gain in profits at t=2 offsets its loss in profits at t=3, which in turn makes it more profitable to enter. Finally, if no one postpones firms' prices at t=3 are same as when the incumbent does not preannounce. Furthermore, due to the decrease in consumers' willingness to pay for q_1 at t=2 the entrant can serve the whole market at t=2. Therefore, the entrant receives higher profits in total when the incumbent preannounces.

Recall from Proposition 3 that due to demand-related concerns context-dependent preferences discourage the monopolist to preannounce. Therefore, the result stated in Proposition 6 implies that if the proportion of consumers who can postpone purchase is not too high the entry-related concern amplifies the negative effect of context-dependent preferences on the monopolist's desire to preannounce. In other words, a monopolist who account for context-dependent preferences realizes that preannouncement may encourage entry rather than deter it.

5 Conclusion and Managerial Implications

When a firm preannounces a new product one consequence, intended or not, is that some consumers may postpone purchase. Behavioral science research also suggests that the preannouncement has a systematic effect on consumer preferences owing to context-dependent preferences. We developed a model of firm preannouncement that incorporates both context-dependent preferences and purchase postponement by consumers. We then used a game-theoretic framework to derive the equilibrium preannouncement and pricing strategies and purchase postponement of consumers.

We considered a model of a vertically differentiated duopoly with one firm offering a "higher" quality than the other. Should a firm preannounce a future product that exceeds in quality both current offerings? As a benchmark we also investigated the monopolistic case. We found that in the absence of context-dependent preferences the firm strictly prefers to preannounce if it is a monopolist; and the result extends to a duopoly for the firm with lower quality in the current period. However, when consumers' preferences are context-dependent, there exist a set of conditions under which either the monopolist's or the firm with lower current quality does not want to preannounce, i.e., the existence of context-dependent preferences decreases these firms' relative profitability of preannouncement. This is because when a firm preannounces the availability of its new product, consumers' current choice set expands to include also the new product which will be available in the future. With the addition of a higher quality new product the reference quality shifts upward. Due to loss aversion this leads to a decrease in the utility consumers derive from the monopolist's existing product and of the lower quality firm in a duopoly. As a result consumers' willingness to pay for these firms' existing products is lower, which in turn decreases profits. If the consumers' loss aversion is high the negative effect of preannouncement dominates any positive effect and so these firms do not want to preannounce. However, if the preannouncing firm is the higher quality one it is able to charge a higher price since preannoucement lowers consumers' willingness pay for the lower quality firm's product. In other words, even if no consumer postpones his purchase after preannouncement the higher quality firm would still gain from preannouncing and hence strongly prefers to preannouce. Therefore, the existence of context-dependent preferences makes both the monopolist and the lower quality firm less willing to preannounce, while it makes the higher quality firm more willing to preannounce.

Do context-dependent preferences also affect preannouncement decision to meet threat of rival entry? To answer this question we explored our model after integrating potential entry into it. We found that in the absence of context-dependent preferences, as expected, the incumbent firm's preannouncement has preemptive effect on the entrant and discourages the entrant to enter. However, when consumers' preferences are context-dependent, we found that the incumbent's preannouncement can actually encourage the rival to enter. This means that when consumers' preferences are context-dependent, the competitive concerns coupled with the consumer related concerns can decrease the incumbent firm's willingness to preannounce.

We believe that our findings provide insights to managers as they contemplate their new product preannouncement strategies. It is important for them to realize that the consumers' preferences are context-dependent and this has force in the preannouncement decision. Moreover, we are able to clearly identify the direction of the effect of context-dependent preferences.

The future work on preannouncement could model competition to two or more firms all of whom can preannounce. In our model we restricted the ability to preannounce to a single firm. Richer consumer models that incorporate consumer heterogeneity in context-dependent preferences will help in learning the robustness of our results. Finally, empirical work on new product preannouncement will find in our work guidance on specifying the appropriate asymmetry among firms and relating it to loss aversion of consumers.

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Appendix:

Proof of Proposition 1:

The monopolist does not preannounce

For $\frac{\overline{Q}}{\underline{Q}} > 2$ the monopolist charges prices of $\overline{Q}q$ and $\overline{Q}(q+\Delta)$ at t=2 and at t=3 respectively. The monopolist's total profits are $\frac{(\overline{Q}q+\overline{Q}(q+\Delta))}{2}$. For $\frac{\overline{Q}}{\underline{Q}} < 2$ the monopolist charges prices of $\underline{Q}q$ and $\underline{Q}(q+\Delta)$ at t=2 and at t=3 respectively. The monopolist's total profits are $\underline{Q}q + \underline{Q}(q+\Delta)$.

The monopolist preannounces

There can exist multiple equilibria. In the following we will characterize the one in which the β proportion of both high type and low type consumers postpones. In this equilibrium prices at t=2 and at t=3 would be same as in no announcement case. For $\frac{\overline{Q}}{\underline{Q}} > 2$ the low type consumers never buy. Since the high type consumers' utility is arbitrarily close to zero in either period the β proportion of high type consumers is indifferent to deviate. Since $\frac{(\overline{Q}q+\overline{Q}(q+\Delta))}{2} < \frac{(\overline{Q}q(1-\beta)+\overline{Q}(q+\Delta)(1+\beta))}{2}$ the monopolist prefers to preannounce. For $\frac{\overline{Q}}{\underline{Q}} < 2$ since the low type consumers' utility is arbitarily close to zero in either period the β proportion of low type consumers is in different to deviate. Furthermore given that $(\overline{Q}-\underline{Q})q < (\overline{Q}-\underline{Q})(q+\Delta)$ the β proportion of high type consumers does not want to deviate. Since $\underline{Q}q + \underline{Q}(q+\Delta) < \underline{Q}q(1-\beta) + \underline{Q}(q+\Delta)(1+\beta)$ the monopolist prefers to preannounce. Thus, this equilibrium exists for any parameter value.□

Proof of Proposition 2:

Firm 1 develops q_3 **:**

Case 1: Firm 1 does not preannounce

At t=2 if firm 2 does not want to serve the whole market it will set its price such that $p_2 - \overline{Q}(q_2 - q_1) < 0.5(p_2 - \underline{Q}(q_2 - q_1))$. In this case, $p_2 = (2\overline{Q} - \underline{Q})\Delta$ and $p_1 = 2(\overline{Q} - \underline{Q})\Delta$. If firm 2 wants to serve the whole market it will charge $\underline{Q}\Delta$. Thus, if $\overline{Q} > \frac{3}{2}\underline{Q}$ firm 2 does not want to serve the whole market.

At t=3 since firm 1 sets the price of q_3 first, it will set its price such that $p_3 - \overline{Q}(q_3 - q_2) < 0.5(p_3 - \underline{Q}(q_3 - q_2))$. In this case, $p_3 = (2\overline{Q} - \underline{Q})\Delta$ and $\hat{p}_2 = 2(\overline{Q} - \underline{Q})\Delta$. Note that $\overline{Q} > \frac{3}{2}\underline{Q}$ is also sufficient condition for firm 1 not want to serve the whole market at t=3.

To avoid corner solutions- i.e., for $p_2 < \overline{Q}q_2$, $p_1 < \underline{Q}q_1$, $p_3 < \overline{Q}q_3$, and $\hat{p}_2 < \underline{Q}q_2$, we need $\frac{\underline{Q}q}{2(\overline{Q}-\underline{Q})} > \Delta$.

Case 2: Firm 1 preannounces

In the following we will only solve for pure strategy equilibria in which firm 1 preannounces.

Equilibrium 1 - β proportion of both types of consumers postpones: In this equilibrium prices at t=2 and at t=3 would be same as in no announcement case. Since $p_2 = (2\overline{Q} - \underline{Q})\Delta > \hat{p}_2 = 2(\overline{Q} - \underline{Q})\Delta$ the β proportion of both types would like to postpone purchase. Finally, since $p_3 > p_1$ firm 1 would like to preannounce. Thus, for $\frac{\underline{Q}q}{2(\overline{Q}-\underline{Q})} > \Delta$ and $\overline{Q} > \frac{3}{2}\underline{Q}$ this equilibrium can exist without any additional conditions.

Equilibrium 2 - only the β proportion of high type consumers postpones: In this equilibrium at t=3 firm 1 sets the price of q_3 such that $(p_3 - \overline{Q}(q_3 - q_2))(1 + \frac{\beta}{2}) < 0.5(p_3 - \underline{Q}(q_3 - q_2))$. Thus, at t=3 $p_3 = \frac{(\overline{Q}(2+\beta)-\underline{Q})}{1+\beta}\Delta$ and $\hat{p}_2 = \frac{(2+\beta)(\overline{Q}-\underline{Q})}{1+\beta}\Delta$. Note that since $\overline{Q} > \frac{3}{2}\underline{Q}$ firm 1 does not want to sell q_3 to the whole market. $p_3 < \overline{Q}q_3$ and $\hat{p}_2 < \underline{Q}q_2$ if $\underline{Q}(1+\beta)q > \Delta(\overline{Q}(2+\beta) - \underline{Q}(3+2\beta))$.

At t=2 if firm 2 wants to serve only to the high type consumers then it sets its price such that $(p_2 - \overline{Q}(q_2 - q_1))(1 - \frac{\beta}{2}) < 0.5(p_2 - \underline{Q}(q_2 - q_1))$. In this case, $p_2 = \frac{(\overline{Q}(2-\beta)-\underline{Q})}{1-\beta}\Delta$ and $p_1 = \frac{(2-\beta)(\overline{Q}-\underline{Q})}{1-\beta}\Delta$. For firm 2 not to sell to the whole market we need $\overline{Q} > \underline{Q}\frac{(3-\beta)}{(2-\beta)}$. For $\overline{Q} > \underline{Q}\frac{(3-\beta)}{(2-\beta)}$, $p_2 < \overline{Q}q_2$ and $p_1 < \underline{Q}q_1$

if $\frac{\underline{Q}(1-\beta)q}{(2-\beta)(\overline{Q}-\underline{Q})} > \Delta$. Since $p_3 < p_2$ and $\hat{p}_2 < p_1$ the β proportion of both types of consumers would like to postpone their purchase. This means that this equilibrium cannot exist for $\overline{Q} > \underline{Q}\frac{(3-\beta)}{(2-\beta)}$.

For $\overline{Q} < \underline{Q}\frac{(3-\beta)}{(2-\beta)}$ firm 2 prefers to serve the whole market at t=2. In this case, $p_2 = \underline{Q}\Delta$. For $\overline{Q} < \underline{Q}\frac{(3-\beta)}{(2-\beta)}$, the β proportion of high type consumers postpones if $\overline{Q}(q_3 - q_2) > p_3 - p_2$. This would happen if $2 + \beta > \frac{\overline{Q}}{\underline{Q}}$. For $\overline{Q} < \underline{Q}\frac{(3-\beta)}{(2-\beta)}$, the β proportion of low type consumers does not postpone if $p_2 < \hat{p}_2$ and $\underline{Q}(q_3 - q_2) < p_3 - p_2$. This would happen if $\frac{\overline{Q}}{\underline{Q}} > \frac{3+2\beta}{2+\beta}$. Finally, for firm 1 to preannounce we need $p_1^{NA} + p_3^{NA} < (1+\beta)p_3^{A}$, where p_1^{NA} is the price of q_1 at t=2, p_3^{NA} is the price of q_3 when firm 1 does not preannounce, and p_3^{A} is the price of q_3 when firm 1 preannounces. This would happen if $\frac{\overline{Q}}{\underline{Q}} < \frac{2}{2-\beta}$. Since $\frac{(3-\beta)}{(2-\beta)} > \frac{2}{2-\beta}$ this equilibrium exists if $\frac{3+2\beta}{2+\beta} < \frac{\overline{Q}}{\underline{Q}} < \frac{2}{2-\beta}$.

Equilibrium 3 - only the β proportion of low type consumers postpones: Note that for such equilibrium to exist $\underline{Q}q_2 - \hat{p}_2 > \underline{Q}q_1 - p_1$, $\underline{Q}q_2 - \hat{p}_2 > \underline{Q}q_2 - p_2$, $\overline{Q}q_3 - p_3 > \overline{Q}q_2 - \hat{p}_2$, and $\overline{Q}q_2 - p_2 > \overline{Q}q_3 - p_3$. Obviously these conditions cannot hold simultaneously.

Equilibrium 4 - no one postpones: In this equilibrium prices at t=2 and at t=3 would be same as in no announcement case. For high type consumers not to want to postpone we need $\overline{Q}q_2 - p_2 > \overline{Q}q_3 - p_3$. This cannot happen. For low type consumers not want to postpone we need $\underline{Q}q_1 - p_1 > \underline{Q}q_2 - \hat{p}_2$. This cannot happen either. Therefore, this equilibrium cannot exist.

Summary: When preferences are not context-dependent, firm 1 would always like to preannounce. If $\frac{3+2\beta}{2+\beta} < \frac{\overline{Q}}{\underline{Q}} < \frac{2}{2-\beta}$ then Equilibria 1 and 2 coexist. For other $\frac{\overline{Q}}{\underline{Q}}$ values Equilibrium 1 uniquely exists.

Firm 2 Develops q_3 :

Case 1: Firm 2 does not preannounces

At t=2: Since firm 2 sets the price first, it will set its price such that $p_2 - \overline{Q}(q_2 - q_1) < 0.5(p_2 - \underline{Q}(q_2 - q_1))$. In this case, $p_2 = (2\overline{Q} - \underline{Q})\Delta$ and $p_1 = 2(\overline{Q} - \underline{Q})\Delta$. For $\overline{Q} > \frac{3}{2}\underline{Q}$ firm 2 would not want to serve the whole market at t=2. For $p_2 < \overline{Q}q_2$ and $p_1 < \underline{Q}q$ we need $\frac{\underline{Q}q}{2(\overline{Q}-\underline{Q})} > \Delta$.

At t=3: Since firm 2 develops q_3 firm 2 will set the price first. Firm 2 sets p_3 such that $p_3 - \overline{Q}(q_3 - q_1) < 0.5(p_3 - \underline{Q}(q_3 - q_1))$. In this case, $p_3 = 2(2\overline{Q} - \underline{Q})\Delta$ and $\hat{p}_1 = 4(\overline{Q} - \underline{Q})\Delta$. Finally, for $\hat{p}_1 < \underline{Q}q_1$ and $p_3 < \overline{Q}q_3$ we need $\frac{\underline{Q}q}{4(\overline{Q}-\underline{Q})} > \Delta$. Thus, $\frac{\underline{Q}q}{4(\overline{Q}-\underline{Q})} > \Delta$ is the binding condition.

Case 2: Firm 2 preannounces

In the following we will solve for pure strategy equilibria in which firm 2 preannounces.

Equilibrium 1 - the β proportion of both types of consumers postpones: In this equilibrium prices at t=2 and at t=3 would be same as in no preannouncement case. Lets check whether the β proportion of both types of consumers would postpone their purchase. Since $p_1 < \hat{p}_1$ the low type consumers does not postpone. Similarly, since $p_3 > p_2 + \overline{Q}(q_3 - q_2)$ the high type consumers does not postpone either. Therefore, this equilibrium cannot exist.

Equilibrium 2 - only the β proportion of high type consumers postpones: In this equilibrium at t=3 firm 2 sets p_3 such that $(p_3-\overline{Q}(q_3-q_1))(1+\frac{\beta}{2}) < 0.5(p_3-\underline{Q}(q_3-q_1))$. Thus, at t=3 $p_3 = \frac{2(\overline{Q}(2+\beta)-\underline{Q})}{1+\beta}\Delta$ and $\hat{p}_1 = \frac{2(2+\beta)(\overline{Q}-\underline{Q})}{1+\beta}\Delta$. For $\hat{p}_1 < \underline{Q}q_1$ and $p_3 < \overline{Q}q_3$ we need $\frac{\underline{Q}q(1+\beta)}{2(2+\beta)(\overline{Q}-\underline{Q})} > \Delta$.

At t=2 if firm 2 does not want to serve the whole market then it sets its price such that $(p_2-\overline{Q}(q_2-q_1))\frac{(2-\beta)}{2} < 0.5(p_2-\underline{Q}(q_2-q_1))$. In this case, $p_2 = \frac{((2-\beta)\overline{Q}-\underline{Q})\Delta}{1-\beta}$ and $p_1 = \frac{(2-\beta)(\overline{Q}-\underline{Q})\Delta}{1-\beta}$. If firm 2 wants to serve the whole market then $p_2 = \underline{Q}\Delta$. Thus, firm 2 prefers to serve only to the high type consumers if $\frac{\overline{Q}}{\underline{Q}} > \frac{3-\beta}{2-\beta}$ and prefers to serve the whole market otherwise.

For $\frac{\overline{Q}}{\underline{Q}} > \frac{3-\beta}{2-\beta}$, $p_2 < \overline{Q}q_2$ and $p_1 < \underline{Q}q$ if $\frac{\underline{Q}(1-\beta)q}{(2-\beta)(\overline{Q}-\underline{Q})} > \Delta$. The low type consumers do not want to postpone if $p_1 < \hat{p}_1$. This would happen if $\beta < 0.56$. The high type consumers prefer to postpone if $p_3-p_2 < \overline{Q}(q_3-q_2)$. This would happen if $\beta > 0.33$. In this case, since $p_2^{NA}+p_3^{NA} < (1-\beta)p_2^A+(1+\beta)p_3^A$, where p_2^{NA} and p_3^{NA} are the price of q_2 at t=2 and the price of q_3 respectively when firm 2 does not preannounce and p_2^A and p_3^A are the price of q_2 and the price of q_3 respectively when firm 2 preannounces, firm 2 would like to preannounce.

For $\frac{\overline{Q}}{\underline{Q}} < \frac{3-\beta}{2-\beta}$, the high type consumers prefer to postpone if $p_3-p_2 < \overline{Q}(q_3-q_2)$. However, this inequality cannot hold. Therefore, this equilibrium can exist only if $\frac{\overline{Q}}{\underline{Q}} > \frac{3-\beta}{2-\beta}$ and $0.56 > \beta > 0.33$.

Equilibrium 3 - only the β proportion of low type consumers postpones: For low type consumers to postpone $\hat{p}_1$ must be smaller than p_1. Since $\hat{p}_1 = p_3-2\underline{Q}\Delta$ and $p_1 = p_2-\underline{Q}\Delta$ for the low type consumers to postpone $p_3-2\underline{Q}\Delta$ must be smaller than $p_2-\underline{Q}\Delta$. This means that $p_3-p_2 < \underline{Q}\Delta$. But, in this case $p_3-p_2 < \overline{Q}(q_3-q_2)$-i.e., $\overline{Q}\Delta > p_3-p_2$ and hence the high type consumers would also like to postpone. Therefore, this equilibrium cannot exist.

Equilibrium 4 - no one postpones: In this equilibrium prices at t=2 and at t=3 would be same as in no preannouncement case. For high type consumers not to want to postpone we need $\overline{Q}q_2-p_2 > \overline{Q}q_3-p_3$. This inequality holds. For low type consumers not want to postpone we need $\hat{p}_1 > p_1$. This inequality holds. In this case, firm 2 is indifferent between preannouncing and not.

Summary: Equilibrium 4 always exists. Equilibrium 2 exists if $\frac{\overline{Q}}{\underline{Q}} > \frac{3-\beta}{2-\beta}$ and $0.56 > \beta > 0.33$. Equilibria 1 and 3 cannot exist.□

Proof of Proposition 3:

In the following we will characterize all the pure strategy equilibria in which the monopolist preannounces.

Equilibrium 1 - the β proportion of both types of consumers postpones: at t=3 $p_2 = \underline{Q}(q+\Delta)$ if $\frac{\overline{Q}}{\underline{Q}} < 2$ and $p_2 = \overline{Q}(q+\Delta)$ otherwise. At t=2, $p_1 = \frac{\underline{Q}(2q-\gamma\Delta)}{2}$ if $\frac{\overline{Q}}{\underline{Q}} < 2$ and $p_1 = \frac{\overline{Q}(2q-\gamma\Delta)}{2}$ otherwise.

For $\frac{\overline{Q}}{\underline{Q}} > 2$ the low type consumers can never buy. Since the high type consumers' utility is arbitrarily close to zero in either period the β proportion of high type consumers is in different to deviate. The monopolist's total equilibrium profits are equal to $\frac{\overline{Q}(2q-\gamma\Delta)}{2}\frac{1-\beta}{2}+\overline{Q}(q+\Delta)\frac{1+\beta}{2}$. If the monopolist deviates and does not preannounce its total profits are equal to $\frac{\overline{Q}q}{2}+\frac{\overline{Q}(q+\Delta)}{2}$. The monopolist would not deviate if $\gamma < \frac{2\beta}{1-\beta}$.

For $\frac{\overline{Q}}{\underline{Q}} < 2$ the low type consumers' utility is arbitrarily close to zero in either period the β proportion of low type consumers is in different to deviate. Since $(\overline{Q}-\underline{Q})\frac{(2q-\gamma\Delta)}{2} < (\overline{Q}-\underline{Q})(q+\Delta)$ the β proportion of high type consumers would not deviate. The monopolist's total equilibrium profits are equal to $\frac{\underline{Q}(2q-\gamma\Delta)}{2}(1-\beta)+\underline{Q}(q+\Delta)(1+\beta)$. If the monopolist deviates and does not preannounce its total profits are equal to $\underline{Q}q+\underline{Q}(q+\Delta)$. The monopolist would not deviate if $\gamma < \frac{2\beta}{1-\beta}$.

Equilibrium 2 - only the β proportion of high type consumers postpones: at t=3 $p_2 = \underline{Q}(q+\Delta)$ if $\frac{\overline{Q}}{\underline{Q}} < \frac{2+\beta}{1+\beta}$ and $p_2 = \overline{Q}(q+\Delta)$ otherwise. At t=2, $p_1 = \frac{\underline{Q}(2q-\gamma\Delta)}{2}$ if $\frac{\overline{Q}}{\underline{Q}} < \frac{2-\beta}{1-\beta}$ and $p_1 = \frac{\overline{Q}(2q-\gamma\Delta)}{2}$ otherwise.

For $\frac{\overline{Q}}{\underline{Q}} < \frac{2+\beta}{1+\beta}$ since $(\overline{Q}-\underline{Q})\frac{(2q-\gamma\Delta)}{2} < (\overline{Q}-\underline{Q})(q+\Delta)$ the β proportion of high type consumers would not deviate. Since the low type consumers' utility is arbitarily close to zero in either period the β proportion of low type consumers is in different to deviate. The monopolist's equilibrium profits are equal to $\frac{\underline{Q}(2q-\gamma\Delta)}{2}\frac{2-\beta}{2} + \underline{Q}(q+\Delta)\frac{2+\beta}{2}$. If the monopolist deviates and does not preannounce it total profits are $\underline{Q}q+\underline{Q}(q+\Delta)$. The monopolist would not deviate only if $\gamma < \frac{2\beta}{2-\beta}$.

For $\frac{2+\beta}{1+\beta} < \frac{\overline{Q}}{\underline{Q}} < \frac{2-\beta}{1-\beta}$ if the β proportion of high type consumers deviates these consumers receive utility of $(\overline{Q}-\underline{Q})\frac{(2q-\gamma\Delta)}{2} > 0$. However, in equilibrium these consumers' utility is arbitrarily close to zero. Thus, the β proportion of high type consumers deviates.

For $\frac{2-\beta}{1-\beta} < \frac{\overline{Q}}{\underline{Q}}$ the low type consumers cannot buy in either period. Since the high type consumers' utility is arbitarily close to zero in either period the β proportion of high type consumers is in different to deviate. The monopolist's equilibrium profits are equal to $\frac{\overline{Q}(2q-\gamma\Delta)}{2}\frac{1-\beta}{2}+\overline{Q}(q+\Delta)\frac{1+\beta}{2}$. If the monopolist deviates and not preannounces it total profits are $\frac{\overline{Q}q}{2}+\frac{\overline{Q}(q+\Delta)}{2}$. The monopolist would not deviate only if $\gamma < \frac{2\beta}{1-\beta}$.

Therefore, this equilibrium can exist if $\frac{\overline{Q}}{\underline{Q}} < \frac{2+\beta}{1+\beta}$ and $\gamma < \frac{2\beta}{2-\beta}$ or if $\frac{2-\beta}{1-\beta} < \frac{\overline{Q}}{\underline{Q}}$ and $\gamma < \frac{2\beta}{1-\beta}$.

Equilibrium 3 - only the β proportion of low type consumers postpones: at t=3 $p_2 = \underline{Q}(q+\Delta)$ if $\frac{\overline{Q}}{\underline{Q}} < 2+\beta$ and $p_2 = \overline{Q}(q+\Delta)$ otherwise. At t=2, $p_1 = \frac{\underline{Q}(2q-\gamma\Delta)}{2}$ if $\frac{\overline{Q}}{\underline{Q}} < 2-\beta$ and $p_1 = \frac{\overline{Q}(2q-\gamma\Delta)}{2}$ otherwise.

For $\frac{\overline{Q}}{\underline{Q}} < 2-\beta$ if the β proportion of high type consumers deviates and postpones purchase these consumers' utility is equal to $(\overline{Q}-\underline{Q})(q+\Delta)$. Since their equilibrium utility is equal to $(\overline{Q}-\underline{Q})\frac{(2q-\gamma\Delta)}{2}$ and $(q+\Delta) > \frac{(2q-\gamma\Delta)}{2}$ the β proportion of high type consumers always deviates.

For $2-\beta < \frac{\overline{Q}}{\underline{Q}} < 2+\beta$ the β proportion of high type consumers' equilibrium utility is equal to zero. However, if they deviate and postpone purchase their utility is equal to $(\overline{Q}-\underline{Q})(q+\Delta)$. Thus, the β proportion of high type consumers always deviate.

For $2+\beta < \frac{\overline{Q}}{\underline{Q}}$ the low type consumers cannot buy. Since the high type consumers' utility is arbitrarily close to zero in either period the β proportion of high type consumers is in different to deviate. The monopolist's total equilibrium profits are equal to $\frac{\overline{Q}(q+\Delta)}{2}+\frac{\overline{Q}(2q-\gamma\Delta)}{4}$. If the monopolist deviates and does not preannounce its total profits are equal to $\frac{\overline{Q}(q+\Delta)}{2}+\frac{\overline{Q}q}{2}$. Since $\frac{\overline{Q}(q+\Delta)}{2}+\frac{\overline{Q}q}{2} > \frac{\overline{Q}(q+\Delta)}{2}+\frac{\overline{Q}(2q-\gamma\Delta)}{4}$

the monopolist prefers not to preannounce. Hence, this equilibrium cannot exist.

Equilibrium 4 - no one postpones: at t=3 $p_2 = \underline{Q}(q+\Delta)$ if $\frac{\overline{Q}}{\underline{Q}} < 2$ and $p_2 = \overline{Q}(q+\Delta)$ otherwise. At t=2, $p_1 = \frac{\underline{Q}(2q-\gamma\Delta)}{2}$ if $\frac{\overline{Q}}{\underline{Q}} < 2$ and $p_1 = \frac{\overline{Q}(2q-\gamma\Delta)}{2}$ otherwise.

For $\frac{\overline{Q}}{\underline{Q}} > 2$ the monopolist's total equilibrium profits are equal to $\frac{\overline{Q}(2q-\gamma\Delta)}{4} + \frac{\overline{Q}(q+\Delta)}{2}$. If the monopolist deviates and does not preannounce its total profits are equal to $\frac{\overline{Q}q}{2} + \frac{\overline{Q}(q+\Delta)}{2}$. Since $\frac{\overline{Q}q}{2} + \frac{\overline{Q}(q+\Delta)}{2} > \frac{\overline{Q}(2q-\gamma\Delta)}{4} + \frac{\overline{Q}(q+\Delta)}{2}$ the monopolist prefers not to preannounce.

For $\frac{\overline{Q}}{\underline{Q}} < 2$ the monopolist's total equilibrium profits are equal to $\frac{\underline{Q}(2q-\gamma\Delta)}{2} + \underline{Q}(q+\Delta)$. If the monopolist deviates and does not preannounce its total profits are equal to $\underline{Q}q + \underline{Q}(q+\Delta)$. Since $\underline{Q}q + \underline{Q}(q+\Delta) > \frac{\underline{Q}(2q-\gamma\Delta)}{2} + \underline{Q}(q+\Delta)$ the monopolist prefers not to preannounce. Thus, this equilibrium cannot exist.

This means that for $\gamma > \gamma^* \equiv \frac{2\beta}{1-\beta}$ the monopolist would deviate and not preannounce.□

Proof of Proposition 4:

Firm 1 does not preannounce

At t=2 the reference price is $\frac{p_2+p_1}{2}$ and the reference quality is $\frac{2q+\Delta}{2}$. At t=3 the reference price is $\frac{p_3+\hat{p}_2}{2}$ and the reference quality is $\frac{2q+3\Delta.}{2}$

In this case, the prices both at t=2 and at t=3 are the same as in no context-dependent case. Thus, $p_2 = (2\overline{Q}-\underline{Q})\Delta$ and $p_1 = 2(\overline{Q}-\underline{Q})\Delta$. Similarly, $p_3 = (2\overline{Q}-\underline{Q})\Delta$ and $\hat{p}_2 = 2(\overline{Q}-\underline{Q})\Delta$. For $p_2 < \overline{Q}q_2 - \gamma\frac{(p_2-p_1)}{2}$, $p_1 < \underline{Q}q_1 - \gamma\underline{Q}\frac{\Delta}{2}$, $p_3 < \overline{Q}q_3 - \gamma\frac{(p_3-\hat{p}_2)}{2}$, and $\hat{p}_2 < \underline{Q}q_2 - \gamma\underline{Q}\frac{\Delta}{2}$, we need $\Delta < \frac{2\underline{Q}q}{4\overline{Q}-(4-\gamma)\underline{Q}}$.

Firm 1 preannounces

In the following we will characterize all the pure strategy equilibria in which the firm 1 preannounces.

Equilibrium 1 - β proportion of both types of consumers postpones: In this equilibrium prices at t=3 would be same as in no context-dependent case. Thus, $p_3 = (2\overline{Q}-\underline{Q})\Delta$ and $\hat{p}_2 = 2(\overline{Q}-\underline{Q})\Delta$.

However, at t=2 the reference price is $\frac{p_3+p_1+p_2+\hat{p}_2}{4}$ and the reference quality is $q+\Delta$. If $p_1 < \frac{p_3+p_1+p_2+\hat{p}_2}{4} < p_2$ low type consumers' utility from buying q_1 and q_2 will be $\underline{Q}q - p_1 - \gamma\underline{Q}\Delta$ and $\underline{Q}(q+\Delta) - p_2 - \gamma(p_2 - \frac{p_3+p_1+p_2+\hat{p}_2}{4})$ respectively and high type consumers' utility from buying q_1 and q_2 will be $\overline{Q}q - p_1 - \gamma\overline{Q}\Delta$ and $\overline{Q}(q+\Delta) - p_2 - \gamma(p_2 - \frac{p_3+p_1+p_2+\hat{p}_2}{4})$ respectively. In this case, if firm 2 does not want to serve the whole market then the prices will be $p_2 = \frac{\left(\overline{Q}(8+12\gamma)-\underline{Q}(4+7\gamma)\right)\Delta}{4+3\gamma}$ and $p_1 = \frac{8(\overline{Q}-\underline{Q})(1+\gamma)\Delta}{4+\gamma}$ for $\frac{\overline{Q}}{\underline{Q}} < \frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)}$. Note that as in the previous cases if Δ is sufficiently smaller than q then $\underline{Q}q - p_1 - \gamma\underline{Q}\Delta > 0$ and $\overline{Q}(q+\Delta) - p_2 - \gamma(p_2 - \frac{p_3+p_1+p_2+\hat{p}_2}{4}) > 0$. On the other hand, if firm 2 wants to serve the whole market then $p_2 = \frac{\left(4\gamma\overline{Q}+\underline{Q}(4+\gamma)\right)\Delta}{4+3\gamma}$ if $\frac{\overline{Q}}{\underline{Q}} < \frac{6+3\gamma}{4}$ and $p_2 = \underline{Q}(1+\gamma)$ otherwise. Since $\frac{\left(4\gamma\overline{Q}+\underline{Q}(4+\gamma)\right)\Delta}{4+3\gamma}.2 > \frac{\left(\overline{Q}(8+12\gamma)-\underline{Q}(4+7\gamma)\right)\Delta}{4+3\gamma}$ for $\frac{\overline{Q}}{\underline{Q}} < \frac{12+9\gamma}{8+4\gamma}$, where $\frac{12+9\gamma}{8+4\gamma} < \frac{6+3\gamma}{4}$, firm 2 prefers to serve the whole market and sets its price to $\frac{\left(4\gamma\overline{Q}+\underline{Q}(4+\gamma)\right)\Delta}{4+3\gamma}$ for $\frac{\overline{Q}}{\underline{Q}} < \min\left\{\frac{12+9\gamma}{8+4\gamma}, \frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)}\right\}$. In this case, β proportion of consumers would like to postpone if $p_2 > \hat{p}_2$. Note that $\frac{\left(4\gamma\overline{Q}+\underline{Q}(4+\gamma)\right)\Delta}{4+3\gamma} > 2(\overline{Q}-\underline{Q})\Delta$ for $\frac{\overline{Q}}{\underline{Q}} < \frac{12+9\gamma}{8+4\gamma}$. Firm 1 would like to preannounce if $p_1^{NA} + p_3^{NA} < (1+\beta)p_3^{A}$. Since $p_3^{NA} = p_3^{A}$ firm 1 would announce if $(2\overline{Q}-\underline{Q})\Delta\beta > 2(\overline{Q}-\underline{Q})\Delta$-i.e., $\beta > \frac{2(\overline{Q}-\underline{Q})}{2\overline{Q}-\underline{Q}}$. This means that if $\frac{\overline{Q}}{\underline{Q}} < \min\left\{\frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)}, \frac{12+9\gamma}{8+4\gamma}\right\}$ and $\beta < \frac{2(\overline{Q}-\underline{Q})}{2\overline{Q}-\underline{Q}}$ firm 1 would not want to preannounce and hence this equilibrium cannot exist. Note that $\frac{12+9\gamma}{8+4\gamma} > \frac{3}{2}$ and $\frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)} > \frac{3}{2}$ for $\gamma < 2$.

For $\frac{12+9\gamma}{8+4\gamma} < \frac{\overline{Q}}{\underline{Q}} < \min\left\{\frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)}, \frac{6+3\gamma}{4}\right\}$ firm 2 does not want to serve the whole market, and $p_2 = \frac{\left(\overline{Q}(8+12\gamma)-\underline{Q}(4+7\gamma)\right)\Delta}{4+3\gamma}$ and $p_1 = \frac{8(\overline{Q}-\underline{Q})(1+\gamma)\Delta}{4+\gamma}$. Since $p_2 = \frac{\left(\overline{Q}(8+12\gamma)-\underline{Q}(4+7\gamma)\right)\Delta}{4+3\gamma} > \hat{p}_2$ and $p_1 = \frac{8(\overline{Q}-\underline{Q})(1+\gamma)\Delta}{4+\gamma} > \hat{p}_2$ the β proportion of both types of consumers would postpone. In this case, since $p_3^{NA} = p_3^A$ and $p_1^{NA} = 2(\overline{Q}-\underline{Q})\Delta < p_1^A = \frac{8(\overline{Q}-\underline{Q})(1+\gamma)\Delta}{4+\gamma}$ firm 1 would want to preannounce $\forall\beta$.

For $\frac{6+3\gamma}{4} < \frac{\overline{Q}}{\underline{Q}} < \frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)}$ since $2\underline{Q}(1+\gamma)\Delta < \frac{\left(\overline{Q}(8+12\gamma)-\underline{Q}(4+7\gamma)\right)\Delta}{4+3\gamma}$ firm 2 does not want to serve the whole market and sets its price to $p_2 = \frac{\left(\overline{Q}(8+12\gamma)-\underline{Q}(4+7\gamma)\right)\Delta}{4+3\gamma}$. In this case, $p_1 = \frac{8(\overline{Q}-\underline{Q})(1+\gamma)\Delta}{4+\gamma} > \hat{p}_2$. Since $p_2 = \frac{\left(\overline{Q}(8+12\gamma)-\underline{Q}(4+7\gamma)\right)\Delta}{4+3\gamma} > \hat{p}_2$ the β proportion of both types of consumers would postpone. Given that $p_3^{NA} = p_3^A$ and $p_1^{NA} = 2(\overline{Q}-\underline{Q})\Delta < p_1^A = \frac{8(\overline{Q}-\underline{Q})(1+\gamma)\Delta}{4+\gamma}$ firm 1 would want to preannounce $\forall\beta$.

For $\frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)} < \frac{\overline{Q}}{\underline{Q}} < \frac{6+3\gamma}{4}$ firm 2 serves the whole market and $p_2 = \frac{\left(4\gamma\overline{Q}+\underline{Q}(4+\gamma)\right)\Delta}{4+3\gamma}$. In this case $p_2 = \frac{\left(4\gamma\overline{Q}+\underline{Q}(4+\gamma)\right)\Delta}{4+3\gamma} > \hat{p}_2$ if $\frac{\overline{Q}}{\underline{Q}} < \frac{12+7\gamma}{8+2\gamma}$, where $\frac{12+7\gamma}{8+2\gamma} < \frac{6+3\gamma}{4}$. Thus, for $\frac{\overline{Q}}{\underline{Q}} < \frac{12+7\gamma}{8+2\gamma}$ the β proportion of both types of consumers would postpone. Firm 1 would like to preannounce if $p_1^{NA} + p_3^{NA} < (1+\beta)p_3^A$. Since $p_3^{NA} = p_3^A$ firm 1 would preannounce if $(2\overline{Q}-\underline{Q})\Delta\beta > 2(\overline{Q}-\underline{Q})\Delta$-i.e., $\beta > \frac{2(\overline{Q}-\underline{Q})}{2\overline{Q}-\underline{Q}}$. This means that if $\frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)} < \frac{\overline{Q}}{\underline{Q}} < \frac{12+7\gamma}{8+2\gamma}$ and $\beta < \frac{2(\overline{Q}-\underline{Q})}{2\overline{Q}-\underline{Q}}$ firm 1 would not want to preannounce and hence this equilibrium cannot exist. It is obvious that this equilibrium would not exist if $\max\left\{\frac{12+7\gamma}{8+2\gamma}, \frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)}\right\} < \frac{\overline{Q}}{\underline{Q}} < \frac{6+3\gamma}{4}$ because the low type consumers would not want to postpone.

Finally, for $\max\left\{\frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)}, \frac{6+3\gamma}{4}\right\} < \frac{\overline{Q}}{\underline{Q}}$ firm 2 serves the whole market and $p_2 = \underline{Q}(1+\gamma)\Delta$. In this case for the low type consumers to postpone we need $p_2 = \underline{Q}(1+\gamma)\Delta > \hat{p}_2$. This would happen if $\frac{\overline{Q}}{\underline{Q}} < \frac{3+\gamma}{2}$. However, since $\frac{3+\gamma}{2} < \frac{6+3\gamma}{4}$ this equilibrium cannot exist for $\max\left\{\frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)}, \frac{6+3\gamma}{4}\right\} < \frac{\overline{Q}}{\underline{Q}}$.

As a result, this equilibrium cannot exist for $\frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)} < \frac{\overline{Q}}{\underline{Q}} < \frac{12+7\gamma}{8+2\gamma}$ and $\beta < \frac{2(\overline{Q}-\underline{Q})}{2\overline{Q}-\underline{Q}}$ and for $\frac{\overline{Q}}{\underline{Q}} < \min\left\{\frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)}, \frac{12+9\gamma}{8+4\gamma}\right\}$ and $\beta < \frac{2(\overline{Q}-\underline{Q})}{2\overline{Q}-\underline{Q}}$ because firm 1 does not want to preannounce. Note that $\frac{12+7\gamma}{8+2\gamma} > \frac{12+9\gamma}{8+4\gamma}$. This means that this equilibrium cannot exist for $\frac{\overline{Q}}{\underline{Q}} < \frac{12+9\gamma}{8+4\gamma}$ and $\beta < \frac{2(\overline{Q}-\underline{Q})}{2\overline{Q}-\underline{Q}}$.

Equilibrium 2 - only the β proportion of high type consumers postpones: In this equilibrium prices at t=3 would be same as in no context-dependent case. Thus, at t=3 $p_3 = \frac{(\overline{Q}(2+\beta)-\underline{Q})}{1+\beta}\Delta$ and $\hat{p}_2 = \frac{(2+\beta)(\overline{Q}-\underline{Q})}{1+\beta}\Delta$.

However, at t=2 the reference price is $\frac{p_3+p_1+p_2+\hat{p}_2}{4}$ and the reference quality is $q+\Delta$. If $p_1 < \frac{p_3+p_1+p_2+\hat{p}_2}{4} < p_2$ and firm 2 does not want to serve the whole market then $p_1 = \frac{4(\overline{Q}-\underline{Q})(1+\gamma)(2-\beta)\Delta}{(4+\gamma)(1-\beta)}$. Since $p_1 = \frac{4(\overline{Q}-\underline{Q})(1+\gamma)(2-\beta)\Delta}{(4+\gamma)(1-\beta)} > \hat{p}_2 = \frac{(2+\beta)(\overline{Q}-\underline{Q})\Delta}{1+\beta}$ the low type consumers would also want to postpone. If $p_1 < p_2 < \frac{p_3+p_1+p_2+\hat{p}_2}{4}$ and firm 2 does not want to serve the whole market then $p_1 = \frac{(\overline{Q}-\underline{Q})(1+\gamma)(2-\beta)\Delta}{(1-\beta)}$. Since $p_1 = \frac{(\overline{Q}-\underline{Q})(1+\gamma)(2-\beta)\Delta}{(1-\beta)} > \hat{p}_2$ the low type consumers would also want to postpone.

If $\frac{p_3+p_1+p_2+\hat{p}_2}{4} < p_1 < p_2$ and firm 2 does not want to serve the whole market then $p_1 = \frac{(\overline{Q}-\underline{Q})(2-\beta)\Delta}{(1-\beta)}$. Since $p_1 = \frac{(\overline{Q}-\underline{Q})(2-\beta)\Delta}{(1-\beta)} > \hat{p}_2$ the low type consumers would also want to postpone. If firm 2 wants to serve the whole market then $p_2 = \frac{\overline{Q}\gamma(4+2\beta)+\underline{Q}(4(1+\beta)+\gamma(1+3\beta))}{(4+3\gamma)(1+\beta)}\Delta$ if $\frac{\overline{Q}}{\underline{Q}} < \frac{6+4\beta+3\gamma(1+\beta)}{4+2\beta}$ and $p_2 = \underline{Q}(1+\gamma)\Delta$ otherwise. Note that if $p_2 = \frac{\overline{Q}\gamma(4+2\beta)+\underline{Q}(4(1+\beta)+\gamma(1+3\beta))}{(4+3\gamma)(1+\beta)}\Delta > \hat{p}_2$ the low type consumers would also want to postpone. This happens if $\frac{\overline{Q}}{\underline{Q}} < \frac{12+8\beta+\gamma(7+6\beta)}{8+4\beta+\gamma(2+\beta)}$. For the high type consumers to postpone we need $\overline{Q}q_3 - p_3 - \gamma(p_3 - \frac{p_3+p_1+p_2+\hat{p}_2}{4}) > \overline{Q}q_2 - p_2 - \gamma(p_2 - \frac{p_3+p_1+p_2+\hat{p}_2}{4})$. This would hold if $\frac{\overline{Q}}{\underline{Q}} < \frac{(1+\gamma)(8+4\beta+\gamma(4+3\beta))}{4+\gamma(7+2\beta)+\gamma^2(2+\beta)}$. Furthermore, $p_2 = \underline{Q}(1+\gamma)\Delta < \hat{p}_2$ for $\frac{\overline{Q}}{\underline{Q}} > \frac{6+4\beta+3\gamma(1+\beta)}{4+2\beta}$. However, $\overline{Q}q_3 - p_3 - \gamma(p_3 - \frac{p_3+p_1+p_2+\hat{p}_2}{4}) < \overline{Q}q_2 - p_2$ for $\frac{\overline{Q}}{\underline{Q}} > \max\left\{\frac{6+4\beta+3\gamma(1+\beta)}{4+2\beta}, \frac{8+4\beta+\gamma(6+4\beta+\gamma(1+\beta))}{4+2\gamma(2+\beta)}\right\}$. This means that the high type consumers would not postpone if $p_2 = \underline{Q}(1+\gamma)\Delta$ and $\frac{\overline{Q}}{\underline{Q}} > \max\left\{\frac{6+4\beta+3\gamma(1+\beta)}{4+2\beta}, \frac{8+4\beta+\gamma(6+4\beta+\gamma(1+\beta))}{4+2\gamma(2+\beta)}\right\}$. This proves that this equilibrium cannot exist for $\frac{\overline{Q}}{\underline{Q}} < \min\left\{\frac{6+4\beta+3\gamma(1+\beta)}{4+2\beta}, \frac{12+8\beta+\gamma(7+6\beta)}{8+4\beta+\gamma(2+\beta)}\right\}$ and for $\frac{\overline{Q}}{\underline{Q}} > \max\left\{\frac{6+4\beta+3\gamma(1+\beta)}{4+2\beta}, \frac{8+4\beta+\gamma(6+4\beta+\gamma(1+\beta))}{4+2\gamma(2+\beta)}\right\}$. Note that $\frac{6+4\beta+3\gamma(1+\beta)}{4+2\beta} > \frac{3}{2}$ and $\frac{12+8\beta+\gamma(7+6\beta)}{8+4\beta+\gamma(2+\beta)} > \frac{3}{2}$. Furthermore, for $\frac{6+4\beta+3\gamma(1+\beta)}{4+2\beta} < \frac{\overline{Q}}{\underline{Q}} < \frac{8+4\beta+\gamma(6+4\beta+\gamma(1+\beta))}{4+2\gamma(2+\beta)}$ firm 1 would preannounce only if $p_1^{NA} + p_3^{NA} < (1+\beta)p_3^A$. For this to happen we need $2(\overline{Q}-\underline{Q})\Delta + (2\overline{Q}-\underline{Q})\Delta < (\overline{Q}(2+\beta)-\underline{Q})\Delta$. This condition holds only if $\beta > \frac{2(\overline{Q}-\underline{Q})}{\overline{Q}}$, where $\frac{2(\overline{Q}-\underline{Q})}{\overline{Q}} > \frac{2(\overline{Q}-\underline{Q})}{2\overline{Q}-\underline{Q}}$. Similarly, for $\frac{12+8\beta+\gamma(7+6\beta)}{8+4\beta+\gamma(2+\beta)} < \frac{\overline{Q}}{\underline{Q}} < \min\left\{\frac{6+4\beta+3\gamma(1+\beta)}{4+2\beta}, \frac{(1+\gamma)(8+4\beta+\gamma(4+3\beta))}{4+\gamma(7+2\beta)+\gamma^2(2+\beta)}\right\}$ firm 1 would preannounce only if $p_1^{NA} + p_3^{NA} < (1+\beta)p_3^A$. For this to happen we need $2(\overline{Q}-\underline{Q})\Delta + (2\overline{Q}-\underline{Q})\Delta < (\overline{Q}(2+\beta)-\underline{Q})\Delta$. This condition holds only if $\beta > \frac{2(\overline{Q}-\underline{Q})}{\overline{Q}}$.

Equilibrium 3 - only the β proportion of low type consumers postpones: Note that for the low type consumers to postpone, regardless of p_1 is positive or not, p_2 should be less than $\hat{p}_2$. In that case the high type consumers would also want to postpone. Thus, this equilibrium cannot exist.

Equilibrium 4 - no one postpones: Note that for this equilibrium to exist we need $p_1^{NA}+p_3^{NA} < p_1^A+p_3^A$, where p_1^{NA} and p_3^{NA} are the price of q_1 at t=2 and the price of q_3 respectively when firm 1 does not preannounce and p_1^A and p_3^A are the price of q_1 and the price of q_3 respectively when firm 1 preannounces. Since p_3^{NA} is equal to p_3^A for this equilibrium to exist p_1^A should be greater than p_1^{NA}. In this equilibrium $\hat{p}_2^A = p_1^{NA} = 2(\overline{Q}-\underline{Q})\Delta$. Since $p_1^A < p_2^A$ and $p_1^A > p_1^{NA}$ it means that $p_2^A > \hat{p}_2^A$. But, if $p_2^A > \hat{p}_2^A$ the high type consumers would want to postpone purchase. Therefore, this equilibrium cannot exist.

Summary: we showed that for $\frac{\overline{Q}}{\underline{Q}} < R^* \equiv \frac{12+9\gamma}{8+4\gamma}$ and $\beta < \frac{2(\overline{Q}-\underline{Q})}{2\overline{Q}-\underline{Q}}$ there cannot exist an equilibrium in which firm 1 preannounces. Since $\frac{\partial R^*}{\partial \gamma} > 0$ for a given $\frac{\overline{Q}}{\underline{Q}}$ there exists a $\hat{\gamma}^*$ such that for $\gamma > \hat{\gamma}^*$ and $\beta < \frac{2(\overline{Q}-\underline{Q})}{2\overline{Q}-\underline{Q}}$ there cannot exist an equilibrium in which firm 1 preannounces.□

Proof of Proposition 5:

Firm 2 does not preannounce

At t=2 the reference price is $\frac{p_2+p_1}{2}$ and the reference quality is $\frac{2q+\Delta}{2}$. For $\overline{Q} > \frac{3}{2}\underline{Q}$ firm 2 does not want to serve the whole market and the prices are $p_2 = (2\overline{Q}-\underline{Q})\Delta$ and $p_1 = 2(\overline{Q}-\underline{Q})\Delta$. For

$0 < \overline{Q}q_2 - p_2 - \gamma(\frac{p_2-p_1}{2})$ and $0 < \underline{Q}q_1 - p_1 - \gamma\underline{Q}(\frac{q_2-q_1}{2})$ we need $\frac{2\underline{Q}q}{4\overline{Q}-(4-\gamma)\underline{Q}} > \Delta$.

At t=3 the reference price is $\frac{p_3+\hat{p}_1}{2}$ and the reference quality is $q+\Delta$. Prices are $p_3 = 2\Delta(2\overline{Q}-\underline{Q})$ and $\hat{p}_1 = 4\Delta(\overline{Q}-\underline{Q})$. For $0 < \underline{Q}q_1 - \hat{p}_1 - \gamma\underline{Q}\Delta$ and $0 < \overline{Q}q_3 - p_3 - \gamma(\frac{p_3-\hat{p}_1}{2})$ we need $\frac{\underline{Q}q}{4\overline{Q}-(4-\gamma)\underline{Q}} > \Delta$.

Firm 2 preannounces

Equilibrium 1 - the β proportion of both types of consumers postpones: In this equilibrium prices at t=3 would be same as in no preannouncement case.

However, at t=2 the reference price is $\frac{p_3+p_1+p_2+\hat{p}_1}{4}$ and the reference quality is $\frac{4q+3\Delta}{4}$. If $p_1 < \frac{p_3+p_1+p_2+\hat{p}_1}{4} < p_2$ low type consumers' utility from buying q_1 and q_2 will be $\underline{Q}q - p_1 - \gamma\frac{3\underline{Q}}{4}\Delta$ and $\underline{Q}(q+\Delta) - p_2 - \gamma(p_2 - \frac{p_3+p_1+p_2+\hat{p}_1}{4})$ respectively and high type consumers' utility from buying q_1 and q_2 will be $\overline{Q}q - p_1 - \gamma\frac{3\overline{Q}}{4}\Delta$ and $\overline{Q}(q+\Delta) - p_2 - \gamma(p_2 - \frac{p_3+p_1+p_2+\hat{p}_1}{4})$ respectively. In this case, if firm 2 does not want to serve the whole market then the prices will be $p_2 = \frac{(\overline{Q}(8+14\gamma)-\underline{Q}(4+9\gamma))\Delta}{4+3\gamma}$ and $p_1 = \frac{2(\overline{Q}-\underline{Q})(4+3\gamma)\Delta}{4+\gamma}$ for $\gamma = 4$. Note that if Δ is sufficiently smaller than q then $\overline{Q}(q+\Delta) - p_2 - \gamma(p_2 - \frac{p_3+p_1+p_2+\hat{p}_1}{4}) > 0$ and $\underline{Q}q - p_1 - \gamma\frac{3\underline{Q}}{4}\Delta > 0$. On the other hand, if firm 2 wants to serve the whole market then $p_2 = \frac{(8\gamma\overline{Q}+\underline{Q}(4-3\gamma))\Delta}{4+3\gamma}$ if $\frac{\overline{Q}}{\underline{Q}} < \frac{36+9\gamma}{32}$ and $p_2 = \frac{\underline{Q}(4+3\gamma)\Delta}{4}$ otherwise.

Since $\frac{\underline{Q}(4+3\gamma)\Delta}{4}.2 < \frac{(\overline{Q}(8+14\gamma)-\underline{Q}(4+9\gamma))\Delta}{4+3\gamma}$ for $\gamma = 4$ and $\frac{\overline{Q}}{\underline{Q}} > \frac{21}{8}$ firm 2 prefers not to serve the whole market for $\gamma = 4$ and $\frac{\overline{Q}}{\underline{Q}} > \frac{21}{8}$. In that case, since $p_1 = \frac{2(\overline{Q}-\underline{Q})(4+3\gamma)\Delta}{4+\gamma}$ is equal to $\hat{p}_1 = 4\Delta(\overline{Q}-\underline{Q})$ for $\gamma = 4$ the β proportion of low type consumers is indifferent between postponing and not purchase. However, since $\overline{Q}(q+\Delta) - p_2 - \gamma(p_2 - \frac{p_3+p_1+p_2+\hat{p}_1}{4}) < \overline{Q}(q+2\Delta) - p_3 - \gamma(p_3 - \frac{p_3+p_1+p_2+\hat{p}_1}{4})$ for $\gamma = 4$ and $\frac{\overline{Q}}{\underline{Q}} > \frac{21}{8}$ the β proportion of high type consumers strictly prefers to postpone purchase. Finally, since $p_2^{NA} + p_3^{NA} < (1-\beta)p_2^A + (1+\beta)p_3^A$, where $p_3^{NA} = p_3^A$, for $\gamma = 4$ and $\frac{\overline{Q}}{\underline{Q}} > \frac{21}{8}$ firm 2 prefers to preannounce. This means that this equilibrium can exist for $\gamma = 4$ and $\frac{\overline{Q}}{\underline{Q}} > \frac{21}{8}$.

Equilibrium 4 - no one postpones: At t=3 the reference price is $\frac{p_3+\hat{p}_1}{2}$ and the reference quality is $q+\Delta$. Prices are $p_3 = 2\Delta(2\overline{Q}-\underline{Q})$ and $\hat{p}_1 = 4\Delta(\overline{Q}-\underline{Q})$. For $0 < \underline{Q}q_1 - \hat{p}_1 - \gamma\underline{Q}(\frac{q_3-q_1}{2})$ and $0 < \overline{Q}q_3 - p_3 - \gamma(\frac{p_3-\hat{p}_1}{2})$ we need $\frac{\underline{Q}q}{4\overline{Q}-(4-\gamma)\underline{Q}} > \Delta$.

At t=2 the reference price is $\frac{p_3+p_1+p_2+\hat{p}_1}{4}$ and the reference quality is $\frac{4q+3\Delta}{4}$. If firm 2 prefers not to serve the whole market and $\gamma < \frac{4}{3}$ then $p_1 = \frac{(4+3\gamma)(\overline{Q}-\underline{Q})\Delta}{2}$ and $p_2 = \frac{(4+3\gamma)(2\overline{Q}-\underline{Q})\Delta}{4}$. Note that if Δ is sufficiently smaller than q then $\overline{Q}(q+\Delta) - p_2 > 0$ and $\underline{Q}q - p_1 - \gamma\frac{3\underline{Q}}{4}\Delta > 0$. Since $p_1 = \frac{(4+3\gamma)(\overline{Q}-\underline{Q})}{2} < \hat{p}_1 = 4\Delta(\overline{Q}-\underline{Q})$ the low type consumers prefer not to postpone their purchase. The high type consumers prefer not to postpone purchase if $\overline{Q}q_3 - p_3 - \gamma(p_3 - \frac{p_3+p_1+p_2+\hat{p}_1}{4}) < \overline{Q}q_2 - p_2$-i.e., $\overline{Q}(4-38\gamma-12\gamma^2) > \underline{Q}(4-31\gamma-9\gamma^2)$. Note that $\overline{Q}(4-38\gamma-12\gamma^2) > \underline{Q}(4-31\gamma-9\gamma^2)$ holds for $\gamma \leq 0.1$. For $\gamma \leq 0.1$ and $\frac{\overline{Q}}{\underline{Q}} > \frac{4-31\gamma-9\gamma^2}{4-38\gamma-12\gamma^2}$ if firm 2 serves the whole market then $p_2 = \frac{(4+3\gamma)\underline{Q}\Delta}{4}$. Since $\frac{(4+3\gamma)\underline{Q}\Delta}{4}.2 < \frac{(4+3\gamma)(2\overline{Q}-\underline{Q})\Delta}{4}$ firm 2 prefers not to serve the whole market.

Since $p_3^{NA} = p_3^A = 2\Delta(2\overline{Q}-\underline{Q})$ and $p_2^{NA} = (2\overline{Q}-\underline{Q})\Delta < p_2^A = \frac{(4+3\gamma)(2\overline{Q}-\underline{Q})\Delta}{4}$ for $\gamma \leq 0.1$ and $\frac{\overline{Q}}{\underline{Q}} > \frac{4-31\gamma-9\gamma^2}{4-38\gamma-12\gamma^2}$ firm 2 strictly prefers to preannounce if $\gamma \leq 0.1$ and $\frac{\overline{Q}}{\underline{Q}} > \frac{4-31\gamma-9\gamma^2}{4-38\gamma-12\gamma^2}$ $\forall\beta$.

Recall that in case of no context-dependent preferences in equilibrium firm 2 preannounces if $\frac{\overline{Q}}{\underline{Q}} > \frac{3-\beta}{2-\beta}$ and $0.56 > \beta > 0.33$. However, when consumers exhibit context-dependent preferences in equilibrium firm 2 preannounces if $\gamma = 4$ and $\frac{\overline{Q}}{\underline{Q}} > R^* \equiv \frac{21}{8}$ $\forall\beta$ and if $\gamma \leq 0.1$ and $\frac{\overline{Q}}{\underline{Q}} > R^* \equiv \frac{4-31\gamma-9\gamma^2}{4-38\gamma-12\gamma^2}$ $\forall\beta$. This means that in the $(\beta, \frac{\overline{Q}}{\underline{Q}})$ space the total region in which in equilibrium firm 2 preannounces is bigger when consumers exhibit context-dependent preferences.□

Proof of Lemma 1:

When the incumbent does not preannounce and entry happens, as we know from the proof of Proposition 2 at t=2 the incumbent sells q_1 to low type consumers at $p_2 = (2\overline{Q} - \underline{Q})\Delta$ and the entrant sells q_2 to high type consumers at $p_1 = 2(\overline{Q} - \underline{Q})\Delta$. In that case, the entrant's profits are equal to $\frac{(2\overline{Q}-\underline{Q})\Delta}{2}$. At t=3 the incumbent sells q_3 to high type consumers at $p_3 = (2\overline{Q} - \underline{Q})\Delta$ and the entrant sells q_2 to low type consumers at $\hat{p}_2 = 2(\overline{Q} - \underline{Q})\Delta$. Thus, the entrant's profits are equal to $(\overline{Q} - \underline{Q})\Delta$. This means that the entrant's total profits are equal to $\frac{(4\overline{Q}-3\underline{Q})\Delta}{2}$.

Let $F = \frac{(4\overline{Q}-3\underline{Q})\Delta}{2} - \varepsilon$. In this case, the entrant would enter when the incumbent does not preannounce. In the following we will check whether when the incumbent preannounces and the entry happens, the entrant's profits are higher than F or not.

When firm 1 preannounces and entry happens, from the proof of Proposition 2

If β proportion of both types of consumers postpones: prices at t=2 and at t=3 would be same as in no preannouncement case. Thus, the entrant's total profits are equal to $\frac{(4\overline{Q}-(3+\beta)\underline{Q})\Delta}{2}$.

If only the β proportion of high type consumers postpones: At t=3 $p_3 = \frac{(\overline{Q}(2+\beta)-\underline{Q})}{1+\beta}\Delta$ and $\hat{p}_2 = \frac{(2+\beta)(\overline{Q}-\underline{Q})}{1+\beta}\Delta$. At t=2 the entrant prefers to serve the whole market with $p_2 = \underline{Q}\Delta$. Thus, entrant's total profits are equal to $\frac{((2+\beta)\overline{Q}-\beta^2\underline{Q})\Delta}{2(1+\beta)}$.

We know from the proof of Proposition 2 that there cannot exist a case in which only the β proportion of low type consumers postpones or a case in which no one postpones. Thus, we are not considering them.

Note that $\frac{(4\overline{Q}-(3+\beta)\underline{Q})\Delta}{2} < \frac{(4\overline{Q}-3\underline{Q})\Delta}{2}$ and $\frac{((2+\beta)\overline{Q}-\beta^2\underline{Q})\Delta}{2(1+\beta)} < \frac{(4\overline{Q}-3\underline{Q})\Delta}{2}$. This means that the entrant would not enter at F when the incumbent preannounces.□

Proof of Proposition 6:

When the incumbent does not preannounce and the entry happens, as we know from the proof of Proposition 4 the prices both at t=2 and at t=3 are the same as in no context-dependent case; $p_2 = (2\overline{Q} - \underline{Q})\Delta$, $p_1 = 2(\overline{Q} - \underline{Q})\Delta$, $p_3 = (2\overline{Q} - \underline{Q})\Delta$, and $\hat{p}_2 = 2(\overline{Q} - \underline{Q})\Delta$. This means that the entrant's total profits are equal to $\frac{(4\overline{Q}-3\underline{Q})\Delta}{2}$.

Let $F = \frac{(4\overline{Q}-3\underline{Q})\Delta}{2} - \varepsilon$. In this case, the entrant would enter when the incumbent does not preannounce. In the following we will check whether when the incumbent preannounces and the entry happens, the entrant's profits are higher than F or not.

When the incumbent preannounces and the entry happens, from the proof of Proposition 4

If β proportion of both types of consumers postpones: In this case $p_3 = (2\overline{Q}-\underline{Q})\Delta$ and $\hat{p}_2 = 2(\overline{Q}-\underline{Q})\Delta$. This case can happen if $\frac{\overline{Q}}{\underline{Q}} < \min\left\{\frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)}, \frac{12+9\gamma}{8+4\gamma}\right\}$ or if $\frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)} < \frac{\overline{Q}}{\underline{Q}} < \frac{12+7\gamma}{8+2\gamma}$. In either case $p_1 = 0$ and $p_2 = \frac{\left(4\gamma\overline{Q}+\underline{Q}(4+\gamma)\right)\Delta}{4+3\gamma}$ (i.e., the entrant serves the whole market at t=2). Thus, the entrant's total profits are equal to $\frac{\left(4\gamma\overline{Q}+\underline{Q}(4+\gamma)\right)\Delta}{4+3\gamma}(1-\beta)+(\overline{Q}-\underline{Q})\Delta(1+\beta)$. Note that $\frac{\left(4\gamma\overline{Q}+\underline{Q}(4+\gamma)\right)}{4+3\gamma} > (\overline{Q}-\underline{Q})$ for $\frac{\overline{Q}}{\underline{Q}} < \frac{12+7\gamma}{8+2\gamma}$ and $\left(\frac{\left(4\gamma\overline{Q}+\underline{Q}(4+\gamma)\right)\Delta}{4+3\gamma}(1-\beta)+(\overline{Q}-\underline{Q})\Delta(1+\beta)\right)|_{\beta=0} > \frac{(4\overline{Q}-3\underline{Q})\Delta}{2}$. Therefore, there exists a β_{E1} such that for $\beta < \beta_{E1}$ the entrant would enter at F.

We also know from the proof of Proposition 4 that this equilibrium can also exist if $\frac{12+9\gamma}{8+4\gamma} < \frac{\overline{Q}}{\underline{Q}} < \min\left\{\frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)}, \frac{6+3\gamma}{4}\right\}$ or if $\frac{6+3\gamma}{4} < \frac{\overline{Q}}{\underline{Q}} < \frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)}$. In either case, $p_3 = (2\overline{Q}-\underline{Q})\Delta$, $\hat{p}_2 = 2(\overline{Q}-\underline{Q})\Delta$, $p_2 = \frac{\left(\overline{Q}(8+12\gamma)-\underline{Q}(4+7\gamma)\right)\Delta}{4+3\gamma}$, and $p_1 = \frac{8(\overline{Q}-\underline{Q})(1+\gamma)\Delta}{4+\gamma}$ (i.e., the entrant does not serve the whole market at=2). In this case, the entrant's total profits are equal to $\frac{\left(\overline{Q}(8+12\gamma)-\underline{Q}(4+7\gamma)\right)\Delta}{4+3\gamma}\frac{(1-\beta)}{2}+(\overline{Q}-\underline{Q})\Delta(1+\beta)$. Note that $\frac{\left(\overline{Q}(8+12\gamma)-\underline{Q}(4+7\gamma)\right)\Delta}{2(4+3\gamma)} > (\overline{Q}-\underline{Q})$ and $\left(\frac{\left(\overline{Q}(8+12\gamma)-\underline{Q}(4+7\gamma)\right)\Delta}{4+3\gamma}\frac{(1-\beta)}{2}+(\overline{Q}-\underline{Q})\Delta(1+\beta)\right)|_{\beta=0} > \frac{(4\overline{Q}-3\underline{Q})\Delta}{2}$. Hence, there exists a β_{E2} such that for $\beta < \beta_{E2}$ the entrant would enter at F.

If only the β proportion of high type consumers postpones: In this case $p_3 = \frac{(\overline{Q}(2+\beta)-\underline{Q})}{1+\beta}\Delta$ and $\hat{p}_2 = \frac{(2+\beta)(\overline{Q}-\underline{Q})}{1+\beta}\Delta$, $p_1 = 0$, and $p_2 = \frac{\overline{Q}\gamma(4+2\beta)+\underline{Q}(4(1+\beta)+\gamma(1+3\beta))}{(4+3\gamma)(1+\beta)}\Delta$ if $\frac{12+8\beta+\gamma(7+6\beta)}{8+4\beta+\gamma(2+\beta)} < \frac{\overline{Q}}{\underline{Q}} < \min\{\frac{6+4\beta+3\gamma(1+\beta)}{4+2\beta}, \frac{(1+\gamma)(8+4\beta+\gamma(4+3\beta))}{4+\gamma(7+2\beta)+\gamma^2(2+\beta)}$ and $p_2 = \underline{Q}(1+\gamma)\Delta$ if $\frac{6+4\beta+3\gamma(1+\beta)}{4+2\beta} < \frac{\overline{Q}}{\underline{Q}} < \frac{8+4\beta+\gamma(6+4\beta+\gamma(1+\beta))}{4+2\gamma(2+\beta)}$. If $p_2 = \underline{Q}(1+\gamma)\Delta$ then the entrant's total profits are equal to $\underline{Q}(1+\gamma)\Delta\frac{2-\beta}{2}+\frac{(2+\beta)(\overline{Q}-\underline{Q})}{1+\beta}\Delta\frac{1}{2}$. $\underline{Q}(1+\gamma)\Delta\frac{2-\beta}{2}+\frac{(2+\beta)(\overline{Q}-\underline{Q})}{1+\beta}\Delta\frac{1}{2} > \frac{(4\overline{Q}-3\underline{Q})\Delta}{2}$ if $\frac{\overline{Q}}{\underline{Q}} < \frac{3+\beta-\beta^2+\gamma(2-\beta+\beta^2)}{2+3\beta}$. Note that $\frac{\partial\left(\frac{6+4\beta+3\gamma(1+\beta)}{4+2\beta}\right)}{\partial\beta} > 0$, $\left(\frac{3+3\beta-\beta^2+\gamma(2+\beta-\beta^2)}{2+3\beta} > \frac{6+4\beta+3\gamma(1+\beta)}{4+2\beta}\right)|_{\beta=0}$, $\left(\frac{3+\beta-\beta^2+\gamma(2-\beta+\beta^2)}{2+3\beta} < \frac{6+4\beta+3\gamma(1+\beta)}{4+2\beta}\right)|_{\beta=1}$. This means that for $\frac{6+4\beta+3\gamma(1+\beta)}{4+2\beta} < \frac{\overline{Q}}{\underline{Q}} < \frac{8+4\beta+\gamma(6+4\beta+\gamma(1+\beta))}{4+2\gamma(2+\beta)}$ the entrant can enter at F only for small enough β values. On the other hand, if $p_2 = \frac{\overline{Q}\gamma(4+2\beta)+\underline{Q}(4(1+\beta)+\gamma(1+3\beta))}{(4+3\gamma)(1+\beta)}\Delta$ then the entrant's total profits are equal to $\frac{(\overline{Q}\gamma(4+2\beta)+\underline{Q}(4(1+\beta)+\gamma(1+3\beta)))\Delta}{(4+3\gamma)(1+\beta)}\frac{2-\beta}{2}+\frac{(2+\beta)(\overline{Q}-\underline{Q})\Delta}{1+\beta}\frac{1}{2}$. Next we will check whether $\frac{(\overline{Q}\gamma(4+2\beta)+\underline{Q}(4(1+\beta)+\gamma(1+3\beta)))\Delta}{(4+3\gamma)(1+\beta)}\frac{2-\beta}{2}+\frac{(2+\beta)(\overline{Q}-\underline{Q})}{1+\beta}\Delta\frac{1}{2} > \frac{(4\overline{Q}-3\underline{Q})\Delta}{2}$. This inequality is same as $\overline{Q}\gamma(8-2\beta^2)+\underline{Q}(4(2+\beta-\beta^2)+\gamma(2+5\beta-3\beta^2)) > \overline{Q}(2+3\beta)(4+3\gamma)-\underline{Q}(1+2\beta)(4+3\gamma)$. Note that $\frac{\partial(\overline{Q}(2+3\beta)(4+3\gamma)-\underline{Q}(1+2\beta)(4+3\gamma))}{\partial\beta} = \overline{Q}(12+9\gamma)-\underline{Q}(8+6\gamma)$ and $\frac{\partial(\overline{Q}\gamma(8-2\beta^2)+\underline{Q}(4(2+\beta-\beta^2)+\gamma(2+5\beta-3\beta^2)))}{\partial\beta} = 4\beta\gamma\overline{Q}+\underline{Q}(4-8\beta+\gamma(5-6\beta))$.
It is obvious that $\frac{\partial(\overline{Q}(2+3\beta)(4+3\gamma)-\underline{Q}(1+2\beta)(4+3\gamma))}{\partial\beta} > \frac{\partial(\overline{Q}\gamma(8-2\beta^2)+\underline{Q}(4(2+\beta-\beta^2)+\gamma(2+5\beta-3\beta^2)))}{\partial\beta}$. Furthermore, this inequality holds if $\overline{Q}(8-2\gamma) < \underline{Q}(12+5\gamma)$ and $\beta = 0$ and cannot hold for any $\frac{\overline{Q}}{\underline{Q}}$ if $\beta = 1$, and $\frac{12+5\gamma}{8-2\gamma} > \left(\frac{12+8\beta+\gamma(7+6\beta)}{8+4\beta+\gamma(2+\beta)}\right)|_{\beta=0,\gamma<4}$. Therefore, for $\frac{12+8\beta+\gamma(7+6\beta)}{8+4\beta+\gamma(2+\beta)} < \frac{\overline{Q}}{\underline{Q}} < \min\left\{\frac{6+4\beta+3\gamma(1+\beta)}{4+2\beta}, \frac{(1+\gamma)(8+4\beta+\gamma(4+3\beta))}{4+\gamma(7+2\beta)+\gamma^2(2+\beta)}\right\}$ the entrant can enter at F only for small enough β values.

We know from the proof of Proposition 4 that there cannot exist a case in which only the β proportion of low type consumers postpones.

If no one postpones: In this case $p_3 = (2\overline{Q}-\underline{Q})\Delta$, $\hat{p}_2 = 2(\overline{Q}-\underline{Q})\Delta$, $p_1 = 0$, $p_2 = \frac{\left(4\gamma\overline{Q}+\underline{Q}(4+\gamma)\right)\Delta}{4+3\gamma}$ if $\frac{6+3\gamma}{4} > \frac{\overline{Q}}{\underline{Q}} > \max\left\{\frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)}, \frac{12+7\gamma}{8+2\gamma}, \frac{8+12\gamma+4\gamma^2}{4+7\gamma+2\gamma^2}\right\}$, and $p_2 = \underline{Q}(1+\gamma)\Delta$ if $\max\left\{\frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)}, \frac{6+3\gamma}{4}, \frac{8+6\gamma+\gamma^2}{4(1+\gamma)}\right\}$

$< \frac{\overline{Q}}{\underline{Q}}$ (i.e., the entrant always serves the whole market at t=2). Note that for $p_2 = \frac{(4\gamma\overline{Q}+\underline{Q}(4+\gamma))\Delta}{4+3\gamma}$ the condition that $\frac{\overline{Q}}{\underline{Q}}$ must be greater than $\frac{8+12\gamma+4\gamma^2}{4+7\gamma+2\gamma^2}$ comes from $\overline{Q}q_3 - p_3 - \gamma(p_3 - \frac{p_3+p_1+p_2+\hat{p}_2}{4}) < \overline{Q}q_2 - p_2 - \gamma(p_2 - \frac{p_3+p_1+p_2+\hat{p}_2}{4})$ (so that the β proportion of high type consumers would not postpone). Similarly, for $p_2 = \underline{Q}(1+\gamma)\Delta$ the condition that $\frac{\overline{Q}}{\underline{Q}}$ must be greater than $\frac{8+6\gamma+\gamma^2}{4(1+\gamma)}$ comes from $\overline{Q}q_3 - p_3 - \gamma(p_3 - \frac{p_3+p_1+p_2+\hat{p}_2}{4}) < \overline{Q}q_2 - p_2$ (so that the β proportion of high type consumers would not postpone).

If $\max\left\{\frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)}, \frac{6+3\gamma}{4}, \frac{8+6\gamma+\gamma^2}{4(1+\gamma)}\right\} < \frac{\overline{Q}}{\underline{Q}}$ then the entrant's total profits are equal to $\underline{Q}(1+\gamma)\Delta + (\overline{Q}-\underline{Q})\Delta$. $\underline{Q}(1+\gamma)\Delta + (\overline{Q}-\underline{Q})\Delta > \frac{(4\overline{Q}-3\underline{Q})\Delta}{2}$ if $\frac{\overline{Q}}{\underline{Q}} < \frac{3+2\gamma}{2}$. This means that the entrant can enter at F for any β values if $\max\left\{\frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)}, \frac{6+3\gamma}{4}, \frac{8+6\gamma+\gamma^2}{4(1+\gamma)}\right\} < \frac{\overline{Q}}{\underline{Q}} < \frac{3+2\gamma}{2}$.

If $\frac{6+3\gamma}{4} > \frac{\overline{Q}}{\underline{Q}} > \max\left\{\frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)}, \frac{12+7\gamma}{8+2\gamma}, \frac{8+12\gamma+4\gamma^2}{4+7\gamma+2\gamma^2}\right\}$ then the entrant's total profits are equal to $\frac{(4\gamma\overline{Q}+\underline{Q}(4+\gamma))\Delta}{4+3\gamma} + (\overline{Q}-\underline{Q})\Delta$. $\frac{(4\gamma\overline{Q}+\underline{Q}(4+\gamma))\Delta}{4+3\gamma} + (\overline{Q}-\underline{Q})\Delta > \frac{(4\overline{Q}-3\underline{Q})\Delta}{2}$ if $\overline{Q}(8-2\gamma) < \underline{Q}(12+5\gamma)$. This means that the entrant can enter at F for any β values if $\overline{Q}(8-2\gamma) < \underline{Q}(12+5\gamma)$ and $\frac{6+3\gamma}{4} > \frac{\overline{Q}}{\underline{Q}} > \max\left\{\frac{32+88\gamma+56\gamma^2}{48\gamma(1+\gamma)}, \frac{12+7\gamma}{8+2\gamma}, \frac{8+12\gamma+4\gamma^2}{4+7\gamma+2\gamma^2}\right\}$.

This proves that in case of preannouncement the entrant's profits can be higher.□