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Optimal Pricing: The Case of Inter-temporal Effects of Snobbish and Deal-Prone Customers

Uriel Spiegel[1], *Tchai Tavor*[2], *Joseph Templeman*[3]
(1. Department of Management, Bar-Ilan University, Israel; University of Pennsylvania Philadelphia 19104, USA;
2. Department of Economics, Yisrael Valley College, Israel;
3. The College of Business Administration, Rishon LiTzion 75190, Israel)

Abstract: We expand on the work of Kahneman and Tversky and further develop the optimal pricing policy given a reference price that generates psychological effects. We suggest the possibility of the existence of an *inter-temporal effect* between two groups of customers: the snobbish customers (leaders) and the deal-prone customers (followers). The pricing trajectories of a monopoly between periods are examined for different scenarios and the cyclical fluctuations in pricing over time are developed.

Key words: optimal pricing; deal-prones; snobbish customers
JEL Codes: D42, M21, M31

1. Introduction

The behavioral economics literature has made significant progress from the time that Kahneman and Tversky (1979) published their breakthrough research. In a paper by Tversky and Kahneman (1981) the authors describe the fact that individuals' purchasing decisions are influenced by the behavior of the other individuals or by purchasing in different time periods. An example of such interdependency is the case of a new gadget or product that is innovated by a producer who may face two kinds of well-segmented customers. There is always a group of pioneering customers who want to be the first users or the leaders of the specific new item. This pioneering use creates some sense of uniqueness and prestige and increases their benefit just by the knowledge that they now have the new product while others are still refusing to try it, and may continue to postpone trying it to some future date. This idea may be further extended by pointing out that knowledge of a future expected increase in consumption affects positively the demand of the pioneering (or we may even call them "snobby") for the innovative good.

The second customers' group we may call the followers or the deal-prones. Those are the customers that enter the market and demand the gadget only during the second period of the life cycle of the good. They are motivated by the experience that was generated by the leaders of the previous period where the high prices that

Uriel Spiegel, visiting professor, Department of Economics, Univeresity of Pennsylvania; research areas: applied microeconomics, public and welfare economics, economics of crime. E-mail: uspiegel@econ.upenn.edu.
Tchai Tavor, Ph.D., Department of Economics, Yisrael Valley College; research areas: public and welfare economics, applied micro-economics. E-mail: tchai2000@yahoo.com.
Joseph Templeman, Ph.D., The College of Business Administration; research areas: applied micro-economics. E-mail: ytempelh@013net.net.

the pioneers were willing to pay encouraged the followers to enter and purchase. Moreover, they may have an additional and/or different motivation to enter, which is that the deal-prone are often also influenced and motivated by the gap between the second period price and the original first period price. A higher gap in prices generates higher motivation to buy and use the product only at the second period.

Another distinction between the two groups of customers can be in terms of risk aversion by the followers who prefer to gain information generated by the "risk takers", i.e., the pioneering customers who are taking a risk by purchasing the innovative gadget with no history or any other background information available.

The monopoly seller, with this kind of information about the two population groups, must make inter-temporal pricing decisions and determine his price trajectory based on: (1) the inter-temporal sensitivity between the two population groups, (2) the relative size of each of the two groups, (3) the sensitivity of consumption of each group with respect to prices at each period and the price gaps between periods. This model is an extension to a previous paper of Spiegel and Templeman (2009) where the monopoly faces two customers: pioneering and deal prone. In that paper the size of the group and the sensitivity of the demand interdependence were not taken into account.

2. Literature Review

The issue of inter-temporal pricing policy carried out by a monopoly has been discussed very extensively during the last decades. Some examples include the recent paper by Nair (2007) who discusses the firm's decision to set a high initiation price on consumers with high willingness to pay, and later cutting the price for other consumers with a low willingness to pay subject to the assumption that consumers look forward or anticipate future price declines and therefore delay their purchases. Another paper of Koh (2006) deals with the same question of pricing policy of durable goods that may be substituted by non durable goods, which would then pose the question as to whether optimal pricing of durable goods is decreasing or increasing over time, and whether to purchase the durable goods in the first or sequential period (s).

But we can face other aspects of pricing interdependency as a result of consumption interdependency. Addiction (vs. satiation) processes may affect the pricing strategy of the profit maximizing monopoly as well as the desire to create future brand loyalty (Paroush and Spiegel, 1995) which creates an incentive to introduce a new item at an initial low price. This last approach has been criticized in recent years by authors such as Simon et al. (1994) or Raghnbir (1998, 2004) who argue that a decline in the price of some items, even if temporary, and especially if the item is given away free to consumers, will ultimately cause a decline in consumers' willingness to pay for the item when it is sold again under normal market conditions. This is because (perhaps subconsciously) it cheapens the value and the image of the product in the eyes of the potential consumers, and represents low quality and attributes.

If indeed this is the right interpretation of consumers' behavior, i.e., using price as a proxy for quality, the custom of planning sales after seasonal holidays at department stores where clothing, shoes, dishes, other household items etc., means that this trend is even more dramatic when the original prices are attached to the new discounted price with a big X drawn across. This is because not only the discount price matters, but the gap between the original price and the new price at the sequential period matters. In "Framing Effect" terms of behavioral economics (Kahneman and Tversky,1979; Tversky and Kahneman, 1981), we argue that what "drives" people to purchase a good is not the low price itself, but the bargain they believe they achieve, i.e., the discount gain. For example, a customer feels better if he buys a Ralph Loren shirt when its price is reduced to $20, while the ticketed price (reference/original price) was $100 in comparison to a $60 original price. This issue of economics of deals was discussed recently by Spiegel and Templeman (2009) where they argue that the initial high price may be used as a a signal of high quality and so deal-prone customers will be encouraged to purchase even greater quantities of the item.

However, one factor that was not taken into consideration in the literature described above is the population character and size of the customers who buy new introductory items in the first period. If we assume that in the first period a gadget or a new fashionable item for celebrities is sold at a high price, this would send a signal as to their wealth and thereby raise their social status and standing. This is called the "Veblen Effect" and was introduced over a century ago (Veblen, 1899). However, often other people whom we call "deal prones", who cannot afford or do not want to waste money on an expensive item, will be affected later by the purchase of the celebrities at a high price and the number of the deal prones will exceed the number of the celebrities. The greater the number of people who bought those items previously (i.e., leaders) at a high price, the more likely that the deal-prones (i.e., followers) will be positively impressed. The price gap may even strengthen their attitude to buy the item, since earlier more "well-known" recognized people bought it at a high price, guaranteeing a better deal for customers in the current period.

We investigate several cases below staring with case 1.

2.1 Case 1

We start our analysis with the very simple case of two population groups. The first group (group 1) buys the product q only in period 1 with a very high reservation price, and they buy it primarily since individuals of group 2 avoid buying the product during period 1. This kind of segmentation between groups consuming at different and separate periods generates in group 1 a sense of status often referred to as a "snob effect" since they are demonstrating an ability to buy this high priced good to the exclusion of the less wealthy who can't afford to. The linear demand curve of each individual from group 1 is represented by Equation (1) where the reservation price, A, is assumed to be very high.

$$D_1:\ q_1 = A - \alpha P_1 \tag{1}$$

Since we assume n_1 identical consumers in group 1, their horizontal summation is given by (2):

$$\Sigma D_1:\ Q_1 = n_1 A - \alpha\ n_1 P_1 \tag{2}$$

The second population group (group 2) has a lower reservation price, B, and therefore they only buy the product in the second period. We term this group of purchasers "deal prone customers", and they are assumed to be positively affected by the high price of the product in period one P_1 and negatively affected by the price of the product in period 2, P_2. The coefficient γ may represent two effects: first the feeling of having gotten a good deal by having bought at the current low price when compared to the period 1 high price, and secondly the feeling that if it was sold at such a high price in period 1 it must indeed be a high quality and valuable product worthy of purchase. The demand of group 2 is given by:

$$D_2:\ q_2 = B - \beta P_2 + \gamma\ P_1 \tag{3}$$

Since we assumed n_2 identical individuals of group 2, the horizontal summation of the demand of group 2 is:

$$\Sigma D_2:\ Q_2 = n_2 B - \beta\ n_2 P_2 + \gamma\ n_2\ P_1 \tag{4}$$

The net price per unit sale in each period is P_1 and P_2. Thus, the total profit of a seller from the two periods (assuming an interest rate, r, equal to zero) is:

$$\max_{P_1,P_2} \pi = P_1(n_1 A - \alpha n_1 P_1) + P_2(n_2 B - \beta n_2 P_2 + \gamma n_2 P_1) \quad (5)$$

The derivatives with respect to the decision variables P_1 and P_2 representing the F.O.C. are:

$$\pi_{P1} = n_1 A - 2\alpha n_1 P_1 + \gamma n_2 P_2 = 0 \quad (6)$$

$$\pi_{P2} = n_2 B - 2\beta n_2 P_2 + \gamma n_2 P_1 = 0 \quad (7)$$

From (6) we can find the relationships between both decision variables that satisfied (6) and (7) at (8) and (9) below:

$$\text{RC}_1: \; P_2 = -\frac{n_1 A}{\gamma n_2} + \left(\frac{2\alpha n_1}{\gamma n_2}\right) P_1 \quad (8)$$

$$\text{RC}_2: \; P_2 = \frac{B}{2\beta} + \left(\frac{\gamma}{2\beta}\right) P_1 \quad (9)$$

While the S.O.C. is given by:

$$\pi_{P1P1} = -2\alpha n_1 < 0, \; \pi_{P2P2} = -2\beta n_2 < 0 \quad (10)$$

$$\Delta = \pi_{P1P1}\pi_{P2P2} - (\pi_{P1P2})^2 = 4\alpha\beta n_1 n_2 - \gamma^2 n_2^2 > 0 \quad (11)$$

By equating (8) and (9) we get:

$$-\frac{n_1 A}{\gamma n_2} + \left(\frac{2\alpha n_1}{\gamma n_2}\right) P_1 = \frac{B}{2\beta} + \left(\frac{\gamma}{2\beta}\right) P_1 \quad (12)$$

We therefore can find the equilibrium prices for both periods as:

$$P_1^* = \frac{2\beta n_1 A + \gamma n_2 B}{\Delta / n_2} \quad (13)$$

$$P_2^* = \frac{n_1(\gamma A + 2\alpha B)}{\Delta / n_2} \quad (13')$$

The results are introduced in Figure 1:

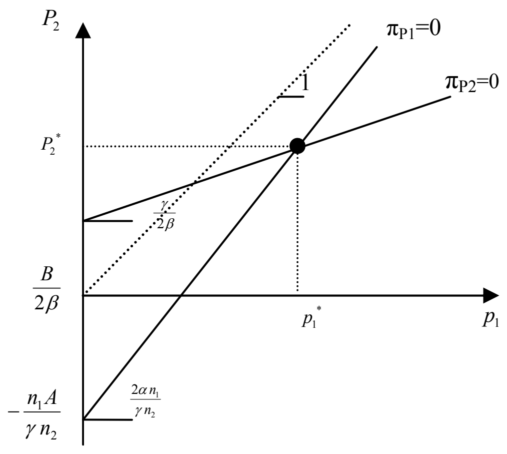


Figure 1 ISO Marginal Profit Curves–Case 1

The price gap between the two periods is:

$$P_1^* - P_2^* = \frac{(2\beta - \gamma) n_1 A + (\gamma n_2 - 2\alpha n_1) B}{\Delta / n_2} \quad (14)$$

where the gap is positive if $(2\beta - \gamma) n_1 A > (2\alpha n_1 - \gamma n_2) B$.

From (14) we conclude that relatively high reservation prices of group 1, i.e., high levels of A, combined with a small α, i.e., low price sensitivity of snobby customers is likely to result in a price reduction in period 2, although we will show later that this is not certain since the size of each group may change this conclusion. We will later analyze these results with the use of comparative static analysis. The main effects of the independent variables on the dependent variables are introduced in Table 1 below.

Table 1 The Effects of the Independent Variables on the Decision Variables

Dependent variable / Independent variable	P_1	P_2	P_1-P_2	Q_1	Q_2	π
n_1	Negative	Negative	Negative for high β and low γ Positive for low β and high γ	Positive	Negative	Positive
n_2	Positive	Positive	Positive	Negative	Positive	Positive
A	Positive	Positive	Negative for $2\beta < \gamma$ Positive for $2\beta > \gamma$	Positive	Positive	Positive
B	Positive	Positive	Negative	Negative	Positive	Positive
α	Negative	Negative	Negative	Positive	Negative	Negative
β	Negative	Negative	Positive	Positive	Negative	Negative
γ	Positive	Positive	Negative	Negative	Positive	Positive

In case 1 where P_1 serves as a good indicator of high quality for the deal-prone customers who are willing to buy more as P_2 is reduced. In this case the gap between the prices of the two periods (i.e., the discount) does not affect the demand in the second period. However, any increase of in the number of first period customers, *n*, should increase profits by lowering prices in each period. The influence of an increase in *n* on the gap between prices is ambiguous.

2.2 Case 2

In the next case we stay with the same demand of group 1, however group 2 is sensitive (to a degree given by coefficient γ) to the level of the price gap between the two periods. A larger gap reflects a better deal and therefore encourages the individuals of group 2 to buy more. The demand of individuals of each group, as well as the aggregate demand of each group, are summarized by equations (15)-(18) as follows:

$$D_1:\ q_1 = A - \alpha P_1 \tag{15}$$

$$\Sigma D_1:\ Q_1 = n_1 A - \alpha\, n_1 P_1 \tag{16}$$

$$D_2:\ q_2 = B - \beta P_2 + \gamma\,(P_1 - P_2) \tag{17}$$

$$\Sigma D_2:\ Q_2 = n_2 B - \beta\, n_2 P_2 + \gamma\, n_2\,(P_1 - P_2) \tag{18}$$

Again, we introduce at (19) the profit function of the seller.

$$\underset{P_1, P_2}{Max}\ \pi = P_1(n_1 A - \alpha n_1 P_1) + P_2[n_2 B - \beta n_2 P_2 + \gamma n_2 (P_1 - P_2)] \tag{19}$$

where the F.O.C. are:

$$\pi_{P1} = n_1 A - 2\alpha\, n_1 P_1 + \gamma\, n_2 P_2 = 0 \tag{20}$$

$$\pi_{P2} = n_2 B - 2(\beta + \gamma)\, n_2 P_2 + \gamma\, n_2 P_1 = 0 \tag{21}$$

From equations (20)-(21) we get the relationships between the prices of both periods that satisfy the F.O.C. as follows:

$$\text{RC}_1:\ P_2 = -\frac{n_1 A}{\gamma n_2} + \left(\frac{2\alpha n_1}{\gamma n_2}\right)P_1 \tag{22}$$

$$\text{RC}_2:\ P_2 = \frac{B}{2(\beta+\gamma)} + \left[\frac{\gamma}{2(\beta+\gamma)}\right]P_1 \tag{23}$$

While the S.O.C. are presented in (24)-(25)

$$\pi_{P1P1} = -2\alpha\ n_1 < 0,\ \pi_{P2P2} = -2(\beta+\gamma)\ n_2 < 0 \tag{24}$$

$$\Delta = \pi_{P1P1}\pi_{P2P2} - (\pi_{P1P2})^2 = 4\alpha(\beta+\gamma)\ n_1\ n_2 - \gamma^2\ n_2^2 > 0 \tag{25}$$

By equating (22) and (23) we get:

$$-\frac{n_1 A}{\gamma n_2} + \left(\frac{2\alpha n_1}{\gamma n_2}\right)P_1 = \frac{B}{2(\beta+\gamma)} + \left[\frac{\gamma}{2(\beta+\gamma)}\right]P_1 \tag{26}$$

The equilibrium prices P_1^* and P_2^* are;

$$P_1^* = \frac{2(\beta+\gamma)n_1 A + \gamma n_2 B}{\Delta / n_2} \tag{27}$$

$$P_2^* = \frac{n_1(\gamma A + 2\alpha B)}{\Delta / n_2} \tag{28}$$

The solution is presented in Figure 2 below:

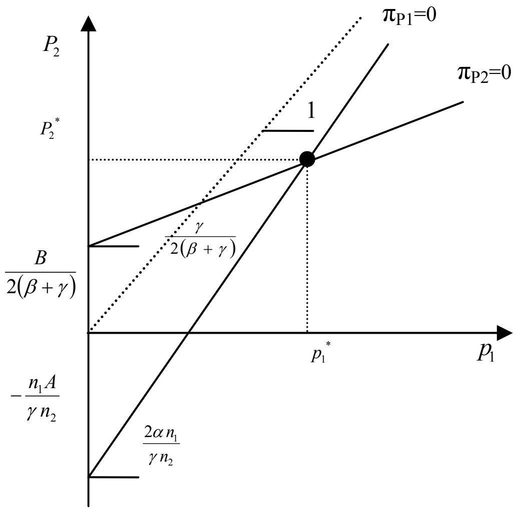


Figure 2 ISO Marginal Profit Curves–Case 2

$$P_1^* - P_2^* = \frac{(2\beta+\gamma)n_1 A + (\gamma n_2 - 2\alpha n_1)B}{\Delta / n_2} \tag{29}$$

This leads us to conclude that the second period price will be reduced when n_2 is relatively large and the reservation price of group 1 is high while that of group 2 is relatively low.

Nevertheless, it is possible that the "learning effect" may eventually lead the individuals of group 2 to pay more as they learn from the behavior of individuals from group 1 the importance and high quality of the good. A comparison of case 1 and 2 is introduced on Figure 3.

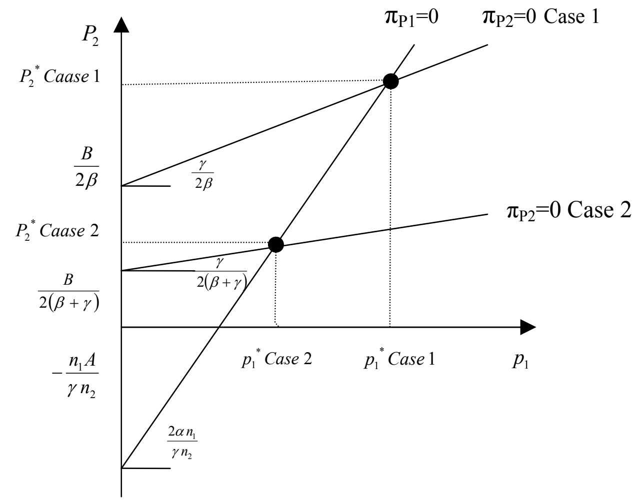


Figure 3 Comparison of ISO Marginal Profit Curves-Case 1 vs. Case 2

The main effects of the independent variables on the dependent variables are introduced in Table 2 below.

Table 2 The Effects of the Independent Variables on the Decision Variables

Dependent variable / Independent variable	P_1	P_2	P_1-P_2	Q_1	Q_2	π
n_1	Negative	Negative	Negative	Positive	Negative	Positive
n_2	Positive	Positive	Positive	Negative	Positive	Positive
A	Positive	Positive	Positive	Positive	Positive	Positive
B	Positive	Positive	Negative	Negative	Positive	Positive
α	Negative	Negative	Negative	Positive	Negative	Negative
β	Negative	Negative	Positive	Positive	Negative	Negative
γ	Positive	Negative	Positive	Negative	Positive	Positive

In contrary to the previous case (case 1 above) we find that in case 2 the price gap rather than the actual price of period one influences the deal prones customers. An increase in demand (higher A) or an increase in the number of snobby customers will definitely lead to a larger gap or a smaller gap respectively.

All other results are similar or different but are intuitively expected.

2.3 Case 3 with n1 in the Demand of Group 2

In the next case we stay with the same demand of group 1, however group 2 is sensitive (to a degree given by coefficient γ) to the level of the price gap between the two periods and to the number of buyers in group 1 (to a degree given by coefficient ε). A larger gap reflects a better deal and therefore encourages the individuals of group 2 to buy more. The demands of individuals of each group as well as the aggregate demand of each group are summarized by equations (15)-(18) as follows:

$$D_1:\ q_1 = A - \alpha P_1 \tag{15}$$

$$\Sigma D_1:\ Q_1 = n_1 A - \alpha\, n_1 P_1 \tag{16}$$

$$D_2:\ q_2 = B - \beta P_2 + \gamma\,(P_1 - P_2) + \varepsilon\, n_1 \tag{17}$$

$$\Sigma D_2:\ Q_2 = n_2 B - \beta\, n_2 P_2 + \gamma\, n_2\,(P_1 - P_2) + \varepsilon\, n_1 n_2 \tag{18}$$

Again, we introduce at (19) the profit function of the seller.

$$\max_{P_1,P_2} \pi = P_1\left(n_1 A - \alpha n_1 P_1\right) + P_2\left[n_2 B - \beta n_2 P_2 + \gamma n_2\left(P_1 - P_2\right) + \varepsilon n_1 n_2\right] \tag{19}$$

where the F.O.C. are:

$$\pi_{P1} = n_1 A - 2\alpha\ n_1 P_1 + \gamma\ n_2 P_2 = 0 \tag{20}$$

$$\pi_{P2} = n_2 B - 2(\beta + \gamma)\ n_2 P_2 + \gamma\ n_2 P_1 + \varepsilon\ n_1 n_2 = 0 \tag{21}$$

From equations (20)-(21) we get the relationships between the prices of both periods that satisfy the F.O.C. as follows:

$$\text{RC}_1\text{:}\quad P_2 = -\frac{n_1 A}{\gamma n_2} + \left(\frac{2\alpha n_1}{\gamma n_2}\right) P_1 \tag{22}$$

$$\text{RC}_2\text{:}\quad P_2 = \frac{B + \varepsilon n_1}{2(\beta + \gamma)} + \left[\frac{\gamma}{2(\beta + \gamma)}\right] P_1 \tag{23}$$

While the S.O.C. are presented in (24)-(25)

$$\pi_{P1P1} = -\ 2\alpha\ n_1 < 0\ ,\ \pi_{P2P2} = -\ 2(\beta + \gamma)\ n_2 < 0 \tag{24}$$

$$\Delta = \pi_{P1P1}\pi_{P2P2} - (\pi_{P1P2})^2 = 4\alpha(\beta + \gamma)\ n_1\ n_2 - \gamma^2\ n_2^2 > 0 \tag{25}$$

By equating (22) and (23) we get:

$$-\frac{n_1 A}{\gamma n_2} + \left(\frac{2\alpha n_1}{\gamma n_2}\right) P_1 = \frac{B + \varepsilon n_1}{2(\beta + \gamma)} + \left[\frac{\gamma}{2(\beta + \gamma)}\right] P_1 \tag{26}$$

The equilibrium prices P_1^* and P_2^* are;

$$P_1^* = \frac{2(\beta + \gamma) n_1 A + \gamma n_2 B + \gamma\varepsilon n_1 n_2}{\Delta / n_2} \tag{27}$$

$$P_2^* = \frac{n_1\left(\gamma A + 2\alpha B + 2\alpha\varepsilon n_1\right)}{\Delta / n_2} \tag{28}$$

The solution is presented in Figure 4 below:

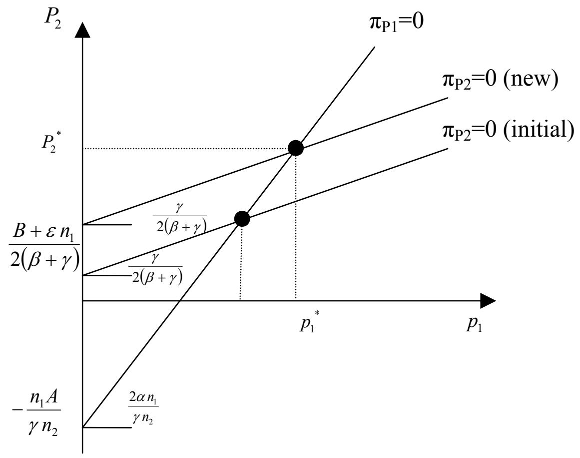


Figure 4 ISO Marginal Profit Curves–Case 2.2

$$P_1^* - P_2^* = \frac{(2\beta + \gamma) n_1 A + \left(\gamma n_2 - 2\alpha n_1\right)\left(B + \varepsilon n_1\right)}{\Delta / n_2} \tag{29}$$

This leads us to conclude that the second period price will be reduced when n_2 is relatively large and the reservation price of group 1 is high, while that of group 2 is relatively low. As before, the main effects of the independent variables on the dependent variables are introduced in Table 3 below.

Table 3 The Effects of the Independent Variables on the Decision Variables

Independent variable \ Dependent variable	P_1	P_2	P_1-P_2	Q_1	Q_2	π
n_1	Negative	Positive	Negative	Positive	Positive	Positive
n_2	Positive	Positive	Positive	Negative	Positive	Positive
A	Positive	Positive	Positive	Positive	Positive	Positive
B	Positive	Positive	Negative	Negative	Positive	Positive
α	Negative	Negative	Negative	Positive	Negative	Negative
β	Negative	Negative	Positive	Positive	Negative	Negative
γ	Positive	Negative	Positive	Negative	Positive	Positive
ε	Positive	Positive	Negative	Negative	Positive	Positive

In this case we add another factor to the willingness of deal-prones to buy since they are very impressed by the price discount, i.e., the gap between P_1^* and P_2^*. The only difference between this case and the previous case is that if the size of group 1, n_1, increases, it will also affect positively the price in the second period and definitely reduce the discount between periods, since *P*1 decreases while *P*2 increases.

Furthermore, the increase of n_1 will encourage the deal prones to buy more units at a higher price which increases profits even further. This is because deal prones tend to estimate quality levels by the initial period price and the number of initial purchasers

2.4 Case 4 Interdependency between Consumers' Groups Size

In the next case we stay with the same demand of group 1 and also group 2 is sensitive (to a degree given by coefficient γ) to the level of the price gap between the two periods and to the number of buyers in group 1 (to a degree given by coefficient ε). However, in this case there is interdependency between consumers' groups size. A larger gap reflects a better deal and therefore encourages the individuals of group 2 to buy more. The demands of individuals of each group as well as the aggregate demand of each group are summarized by equations (15)-(18) as follows:

$$D_1:\ q_1 = A - \alpha P_1 \quad (15)$$

$$\Sigma D_1:\ Q_1 = n_1 A - \alpha\, n_1 P_1 \quad (16)$$

$$D_2:\ q_2 = B - \beta P_2 + \gamma\,(P_1 - P_2) + \varepsilon\, n_1 \quad (17)$$

$$\Sigma D_2:\ Q_2 = (n - n_1)B - \beta\,(n - n_1)P_2 + \gamma\,(n - n_1)\,(P_1 - P_2) + \varepsilon\, n_1(n - n_1) \quad (18)$$

Again, we introduce at (19) the profit function of the seller.

$$\underset{P_1,P_2}{Max}\ \pi = P_1\left(n_1 A - \alpha\, n_1 P_1\right) + P_2\left[(n - n_1)B - \beta(n - n_1)P_2 + \gamma(n - n_1)(P_1 - P_2) + \varepsilon\, n_1(n - n_1)\right] \quad (19)$$

where the F.O.C. are:

$$\pi_{P1} = n_1 A - 2\alpha\, n_1 P_1 + \gamma\,(n - n_1)P_2 = 0 \quad (20)$$

$$\pi_{P2} = (n - n_1)B - 2(\beta + \gamma)\,(n - n_1)P_2 + \gamma\,(n - n_1)P_1 + \varepsilon\, n_1(n - n_1) = 0 \quad (21)$$

From equations (20)-(21) we get the relationships between the prices of both periods that satisfy the F.O.C. as follows:

$$\text{RC}_1\text{:}\quad P_2 = -\frac{n_1 A}{\gamma(n-n_1)} + \left[\frac{2\alpha n_1}{\gamma(n-n_1)}\right] P_1 \tag{22}$$

$$\text{RC}_2\text{:}\quad P_2 = \frac{B+\varepsilon n_1}{2(\beta+\gamma)} + \left[\frac{\gamma}{2(\beta+\gamma)}\right] P_1 \tag{23}$$

While the S.O.C. are presented in (24)-(25)

$$\pi_{P1P1} = -2\alpha n_1 < 0,\ \pi_{P2P2} = -2(\beta+\gamma)(n-n_1) < 0 \tag{24}$$

$$\Delta = \pi_{P1P1}\pi_{P2P2} - (\pi_{P1P2})^2 = 4\alpha(\beta+\gamma)\, n_1 (n-n_1) - \gamma^2 (n-n_1)^2 > 0 \tag{25}$$

By equating (22) and (23) we get:

$$-\frac{n_1 A}{\gamma(n-n_1)} + \left[\frac{2\alpha n_1}{\gamma(n-n_1)}\right] P_1 = \frac{B+\varepsilon n_1}{2(\beta+\gamma)} + \left[\frac{\gamma}{2(\beta+\gamma)}\right] P_1 \tag{26}$$

The equilibrium prices P_1^* and P_2^* are;

$$P_1^* = \frac{2(\beta+\gamma)n_1 A + \gamma(n-n_1)B + \gamma\varepsilon n_1(n-n_1)}{\Delta/(n-n_1)} \tag{27}$$

$$P_2^* = \frac{n_1(\gamma A + 2\alpha B + 2\alpha\varepsilon n_1)}{\Delta/(n-n_1)} \tag{28}$$

The solution is presented in Figure 5 below:

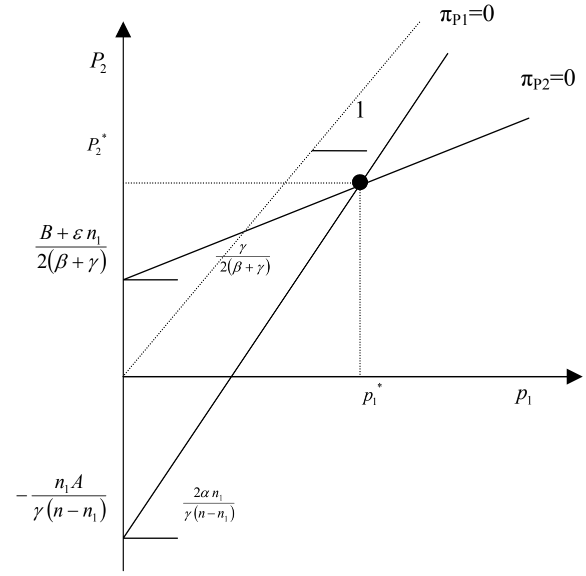


Figure 5 ISO Marginal Profit Curves–Case 2.2

$$P_1^* - P_2^* = \frac{(2\beta+\gamma)n_1 A + [\gamma(n-n_1) - 2\alpha n_1](B+\varepsilon n_1)}{\Delta/(n-n_1)} \tag{29}$$

This leads us to conclude that the second period price will be reduced when n_2 is relatively large and the reservation price of group 1 is high, while that of group 2 is relatively low. As in the previous cases the main effects of the independent variables on the dependent variables are introduced in Table 4 below.

Table 4 The Effects of the Independent Variables on the Decision Variables

Independent variable \ Dependent variable	P_1	P_2	P_1-P_2	Q_1	Q_2	π
n_1	Negative	Positive	Negative	Positive	Negative	Positive
$n_2 = n - n_1$	Positive	Negative	Positive	Negative	Positive	Negative
A	Positive	Positive	Positive	Positive	Positive	Positive
B	Positive	Positive	Negative	Negative	Positive	Positive
α	Negative	Negative	Negative	Positive	Negative	Negative
β	Negative	Negative	Positive	Positive	Negative	Negative
γ	Positive	Negative	Positive	Negative	Positive	Positive
ε	Positive	Positive	Negative	Negative	Positive	Positive

When we add n_1 to the demand of group 2 we get that both prices increase.

2.5 Case 5

Here we investigate an additional case of two segmented population groups where group 1 is the pioneering and leader group who demand the good *q* based on the current price as well as the expected future total consumption of group 2, the followers group. The negative price influence coincides with positive future expected purchases of the whole group of followers. It can be asked: how can an individual of group 1 figure out the estimated future consumption at the second period. The answer is that either the expectation is fully fulfilled based on previous experience of new gadgets that is expected and eventually indeed fully fulfilled in the second period, or we can say that the expected future consumption is "substituted" by δQ_2 where δ is a coefficient that "discounts" and under-evaluates the estimated expected consumption from the actual future consumption but still influences positively the consumption of the leader group. The intuition behind this assumption is that the snob effect of pioneering new items or gadgets is fulfilled when leaders expect to move consumption to those who follow the pioneering previous use of those items.

Thus, the demand at period 1 by individual 1 is:

$$D_1:\ q_1 = A - \alpha P_1 + \delta Q_2 = A - \alpha P_1 + \delta\ n_2 q_2 \tag{30}$$

Therefore the aggregate demand of the whole population of group 1 is:

$$\Sigma D_1:\ Q_1 = n_1 A - \alpha\ n_1 P_1 + \delta\ n_1 n_2 q_2 \tag{31}$$

While the demand of each individual of group 2 on period 2 is:

$$D_2:\ q_2 = B - \beta P_2 + \gamma\ P_1 \tag{32}$$

Therefore the aggregate demand in the second period is:

$$\Sigma D_2:\ Q_2 = n_2 B - \beta\ n_2 P_2 + \gamma\ n_2\ P_1 \tag{33}$$

Based on these demand curves of both population groups in the two periods we introduce the profit function of the seller who faces the following L

$$\underset{P_1,P_2}{Max}\ \pi = P_1\left[n_1 A - \alpha\, n_1 P_1 + \delta n_1\left(n_2 B - \beta\, n_2 P_2 + \gamma\, n_2 P_1\right)\right] + P_2\left(n_2 B - \beta\, n_2 P_2 + \gamma\, n_2 P_1\right) \tag{34}$$

where the F.O.C. of equilibrium are:

$$\pi_{P1} = n_1 A + \delta\ n_1 n_2 B + 2(\gamma\delta\ n_2 - \alpha)\ n_1 P_1 - (\beta\ \delta n_1 - \gamma)\ n_2 P_2 = 0 \tag{35}$$

and

$$\pi_{P2} = n_2 B - 2\beta\ n_2 P_2 - (\beta\ \delta n_1 - \gamma)\ n_2 P_1 = 0 \tag{36}$$

From (35) and (36) we can derive the two "reaction curves"

$$\text{RC}_1\text{:}\quad P_2 = \frac{n_1 A + \delta n_1 n_2 B}{(\beta\delta n_1 - \gamma) n_2} - \left[\frac{2(\alpha - \gamma\delta n_2) n_1}{(\beta\delta n_1 - \gamma) n_2}\right] P_1 \tag{37}$$

and

$$\text{RC}_2\text{:}\quad P_2 = \frac{B}{2\beta} - \left(\frac{\beta\delta n_1 - \gamma}{2\beta}\right) P_1 \tag{38}$$

While the S.O.C are introduced by (39) and (40)

$$\pi_{P1P1} = -2(\alpha - \gamma\delta\ n_2)n_1 < 0,\ \pi_{P2P2} = -2\beta\ n_2 < 0 \tag{39}$$

and that holds only if $\alpha - \gamma\delta\ n_2 > 0$

$$\Delta = \pi_{P1P1}\pi_{P2P2} - (\pi_{P1P2})^2 = 4\beta(\alpha - \gamma\delta\ n_2)\ n_1\ n_2 - (\beta\ \delta n_1 - \gamma)^2\ n_2^2 > 0 \tag{40}$$

By equating (37) and (38) we get:

$$\frac{n_1 A + \delta n_1 n_2 B}{(\beta\delta n_1 - \gamma) n_2} - \left[\frac{2(\alpha - \gamma\delta n_2) n_1}{(\beta\delta n_1 - \gamma) n_2}\right] P_1 = \frac{B}{2\beta} + \left(\frac{\beta\delta n_1 - \gamma}{2\beta}\right) P_1 \tag{41}$$

That allows us to determine the optimal prices P_1^* and P_2^*

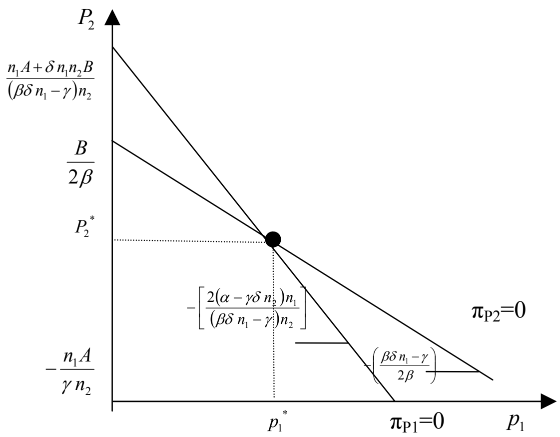
$$P_1^* = \frac{2\beta n_1 A + \gamma n_2 B + \beta\delta n_1 n_2}{\Delta / n_2} \tag{42}$$

$$P_2^* = \frac{4(\alpha - \gamma\delta n_2) n_1 B - [\delta n_1 n_2 (1 + B) + 2 n_1 A](\beta\delta n_1 - \gamma)}{2\Delta / n_2} \tag{43}$$

The price difference is introduced below:

$$P_1^* - P_2^* = \frac{[\beta(2 + \delta n_1) - \gamma] n_1 A + [\gamma n_2 - 2\alpha n_1 + (1.5\gamma + 0.5\delta\beta n_1)\delta n_1 n_2] B + [\beta(1 + 0.5\delta n_1) - 0.5\gamma]\delta n_1 n_2}{\Delta / n_2} \tag{44}$$

Equations (37) and (38) of RC_1 and RC_2 representing the F.O.C.. Iso marginal profits of equilibrium and the values of P_1^* and P_2^* of equilibrium of equations (42) and (43) are introduced at Figures 6(a) and 6(b).



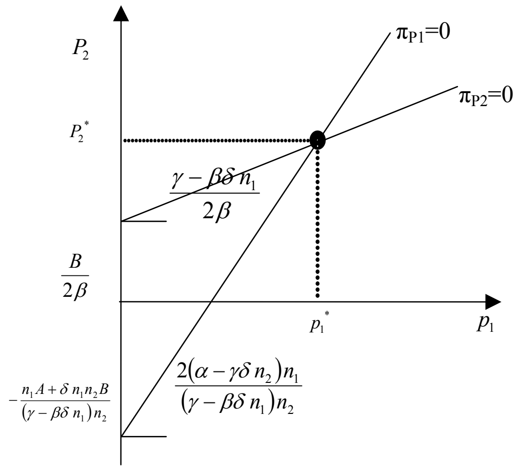


Figure 6(a) ISO Marginal Profit Curves for $\beta\ \delta n_1 - \gamma > 0$ **Figure 6(b) ISO Marginal Profit Curves for $\beta\ \delta n_1 - \gamma < 0$**

Based on the results above we introduce in Table 5 below the effects of the parameters on the pricing decisions in the two periods.

Table 5 The Effects of the Independent Variables on the Decision Variables

Independent variable \ Dependent variable	P_1	P_2	P_1-P_2	Q_1	Q_2	Π
n_1	Positive	Negative	Positive	Positive	Positive	Positive
n_2	Positive	Negative	Positive	Positive	Positive	Positive
A	Positive	* Negative for $\beta\,\delta n_1 - \gamma > 0$ * Positive for $\beta\,\delta n_1 - \gamma < 0$	* Positive for $\beta(2+\delta n_1)-\gamma > 0$ * Negative for $\beta(2+\delta n_1)-\gamma < 0$	Positive	Positive	Positive
B	Positive	* Positive for high α and low β, γ and δ * Negative for low α and high β, γ and δ	* Negative for high α and low β, γ and δ * Positive for low α and high β, γ and δ	Positive	Positive	Positive
α	Negative	Positive	Negative	Negative	Negative	Negative
β	Positive	Negative	Positive	Positive	Positive	Positive
γ	Positive	Negative	Positive	Positive	Positive	Positive
δ	Positive	Negative	Positive	Positive	Positive	Positive

Using the results of the table above we find that when the inter-temporal positive effect is inverse a higher future consumption of followers or deal-prones affects positively the desire to be prominent by the snobbish customers, leading to a higher price in the first period. However, the effect of those variables on prices charged to deal prones (followers) at the second period is not clear. A larger demand by followers can be positive too and then the optimal $\left(P_1^* - P_2^*\right)$ can be reduced or vice versa. It can also be negative which means that while P_1 increases, P_2 declines, leading to an increase in discount prices between periods.

In any case a larger number of deal prones definitely decreases the price at the second period which means that the discount in prices between periods is larger and increases significantly.

These results differ from those that we have introduced in all the previous cases above. We can summarize the main effects of the main demand independent variables on the dependent variables: P_1, P_2 and g (the gap of (P_1-P_2)) in Table 6 below.

Table 6 The Effects of the Independent Variables on Pricing Decisions

	Case 1			Case 2			Case 4			Case 3			Case 5		
	P_1	P_2	g P	1	P_2	g P	1	P_2	g P	1	P_2	g P	1	P_2	g
n_1	NE	PO	NE/PO	NE	NE NE PO			NE PO		NO	PO	NE PO		NE PO	
n_2	PO	PO PO PO			PO	PO	PO NE		PO	PO PO PO			PO NE		PO
A	PO PO		NE/PO	PO PO		PO	PO	NE/PO	NE/PO	PO PO PO			PO NE/PO		NE/PO
B	PO PO		NE	PO PO		NE	PO	PO	PO	PO PO NE			PO NE/PO		NE/PO

Note: NE–Negative; PE–Positive; NE/PO–Negative or Positive

3. Implications and Conclusions

We can see by using Table 6 above that there is a qualitative similarity in most variable effects in case 4 and in case 5. However, in all other cases those effects may influence each other in opposite directions and some of the results seem to be counter intuitive. For example, increases in the number of snob leader customers in case 2 encourages the monopoly profit maximizer to significantly reduce his original prices, and this leads to a smaller price decline in the second period. Thus, the discount is definitely smaller and the opposite occurs with respect to n_2, the number of deal prones. In other cases the directions and strength of the size of the group are different, although as can be expected, any increase in size or in quantity demanded by any group always leads to a profit increase. However, the optimal trajectory in the inter-temporal pricing is not predictable and can be changed according to the specific inter-temporal effects between groups. These results are important to practitioners who have to plan ahead when they operate in these special markets where two types of customers exist: (1) Those who like to be unique and use new items as a good device to achieve prestige and a sense of snobbery, and (2) others whom we term "followers", use items when they are proved as good, efficient and "quality proof", and what motivates them is low price combined with approved quality.

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