

## The Marketing of Hi-end or Low-end Versions of a Product: Which should be Launched First?

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*This paper probes the launching sequence of two products with cannibalization possible. We show that product cannibalization is no object for the seller in deciding which product should be launched first. The key point of determining the introduction sequence for two cannibalistic durables is not the quality but the profitability of the products. Moorthy and Png's conclusion as well as Dhebar's opinion has shown to be inadequate in some circumstances.*

### 1. Introduction

An interesting fact has been observed in the durable goods market: sellers always launch their hi-end model before the low-end version. The terms hi/low end model have been widely used in consumer behavior research (e.g. [1], [2], etc) to define two substitutable goods that are differentiated in prices and/or quality from each other. There are many examples that can be found in the consumer electronics market. For instances, Ericsson launched its cellular phone SH888 in June 1998, and 5 months later they released their model S868 which is similar to SH888 with no infrared transmission.

Reviewing earlier literature, Moorthy and Png questioned the aforementioned phenomenon. They believed that sellers adopt the sequential product introduction policy due to the cannibalization of the product, and sequential product introduction can alleviate cannibalization. They also state that if the seller launches the low-end model first, cannibalization will be aggravated [3]. Dhebar shown that the seller could introduce a high-quality version later under specific condition [4]. But we believe there are other reasons for sellers in deciding the launch sequence of their cannibalistic products.

Based on existing literature and the diffusion theory of information for the new product, we present a uniform solution of different introduction strategies that adopted by sellers in the durable goods market. Our result shows that the seller should launch the more profitable product in unit first, no matter it is a hi-end model or a low-end version, and cannibalization and product quality are not the issue for the seller in deciding which product should be launched first. Besides, our results are distribution free.

### 2. Model and assumptions

Observing the facts on the market, we find despite that leading sellers reveal the features, reference price and possible time to market of their new product before they launch it;

they do not promise the exact launch time of his product to the market. Such announcement strategy benefits sellers by reasons. First, the seller gives customers a signal that his product is coming to the market to keep them from purchasing other competitive products that are available on the market already. Second, if the seller does not promise the launch time of the product, some customers would be forced to change their product choice and seller gains an extra profit by this. Our model is built to suit the above announcement strategy.

Consider a seller who intends to launch two durables,  $g_l$  and  $g_h$ , that are continuous innovations and they are differentiated from each other.  $g_h$  (the hi-end model) is equipped with more features than  $g_l$  (the low-end model). The seller reveals the information of the products that consist of reference prices ( $p_l$  and  $p_h$ ,  $p_l \leq p_h$ ) and possible features of both products and possible time to market (time  $x$ ) to customers at time 0. The seller estimates that the demand of the products is stationary before a future time  $T$ , and he assumes that the unit costs of  $g_l$  and  $g_h$  is  $c_l$ ,  $c_h$  ( $c_l \leq c_h$ ) respectively. The seller wants to decide the launch sequence of his products to maximize his expected discount revenue in his planning horizon.

On the demand side, there are rational customers. We assume a potential customer buys a unit of the product only if the product satisfies his demand. That is, we neglect the influences of other factors, such as channel or promotion, on the customer's purchasing decision to focus our research on the interaction between the product introduction sequence of the seller and the product choice of customers.

As the seller reveals the product information to the market at time 0, the information begins to diffuse through the market as equation (1) expressed, where  $N$  is the market potential of the products at time 0, and  $n(t)$  denotes the ratio of the customers who are aware of the product information by time  $t$  with respect to  $N$ ,  $n'(t)$  denotes the change rate of  $n(t)$  at time ( $t$ ).

$$n'(t) = (a_1 + a_2 n(t))(1 - n(t)) \quad , \quad n(0) = 0 \quad (1)$$

$a_1$  and  $a_2$  are positive constants. see [5].

### 3. Purchasing policy of a rational customer

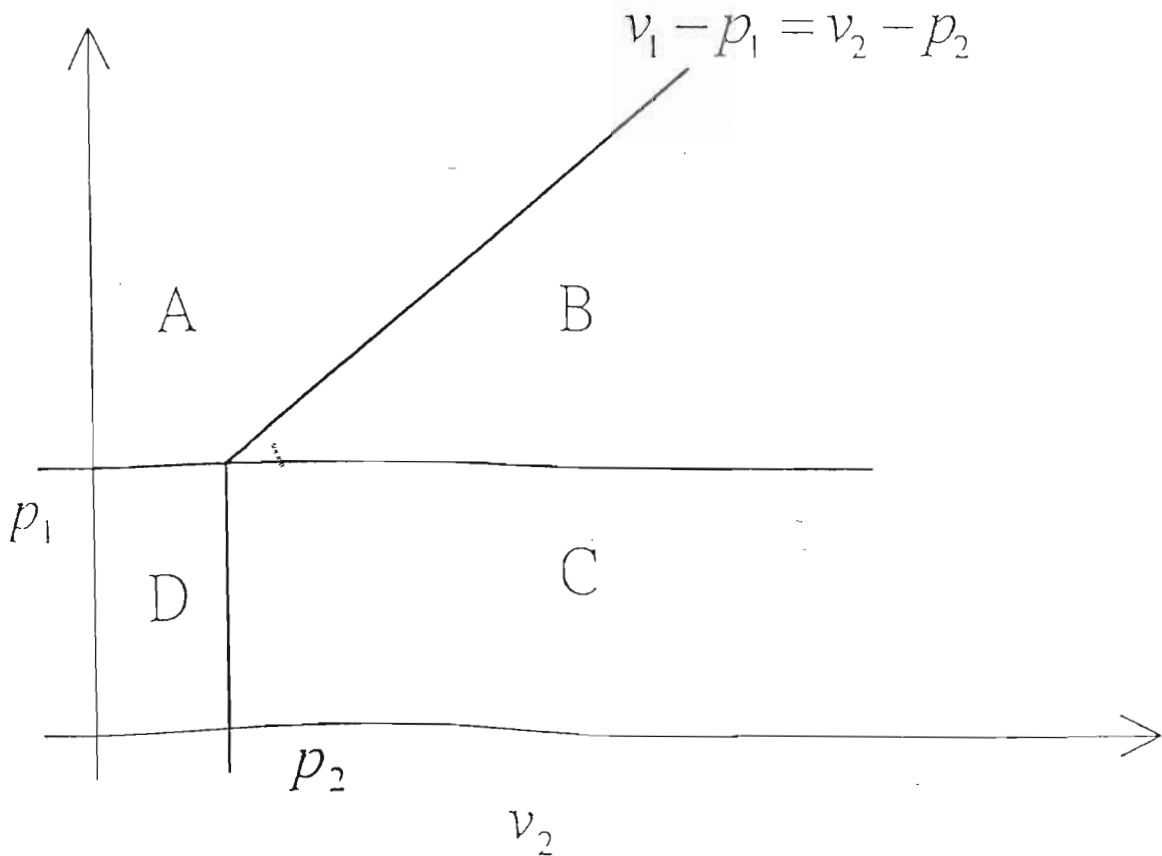
For general description of the seller's introduction policy, we define time 0 as the time when the seller launches his first product (denoted as  $g_1$ ), and  $x$  denotes the time the second product ( $g_2$ ) is launched, where  $x \in [0, T]$

Once a potential customer learns the product information, he generates a reservation price pair,  $(v_1, v_2)$ , for both products jointly for they are substitutable. The customer will make his purchase decision based on the reservation price pair of the products. We are going to illustrate the different purchase behaviors of customers by the following categories that are showed in figure 1. Suppose a customer learns the information of products at time  $t$ ,  $t \in [0, T]$

Type A. Suppose his  $(v_1, v_2) \in A$ .  $g_1$  is more worthier to purchase to the customer for his  $(v_1 - p_1) > (v_2 - p_2)$  and  $(v_1 - p_1) \geq 0$ , which implies that the customer will purchase  $g_1$  as soon as he learns the product information.

Type B. Suppose his  $(v_1, v_2) \in B$ . Since  $(v_1 - p_1) \geq 0$  and  $(v_2 - p_2) \geq 0$ , it does pay to purchase either one of the products for him. Furthermore,  $g_2$  is more attractive to him for  $(v_1 - p_1) < (v_2 - p_2)$ . If the customer knows the information when  $g_2$  has not been available on the market ( $t \in [0, x]$ ), decide to wait for purchasing  $g_2$  is a risky decision for him since he does not know when will  $g_2$  be launched or even worse whether  $g_2$  will be released. What with the risk-aversion of a rational customer under the uncertainty surrounding the launch of  $g_2$ , and what with the satisfaction in  $g_1$ , the customer will purchase  $g_1$  immediately. If the customer knows the information when both the products are available on the market ( $t \in [x, T]$ ), he will purchase  $g_2$ .

Figure 1. The classification of customers by their reservation prices per pair of products.



Type C. Suppose his  $(v_1, v_2) \in C$ .  $g_2$  is attractive to him and  $g_1$  is not worth purchasing for him since  $(v_2 - p_2) > 0 > (v_1 - p_1)$ . If he knows the product information before the seller launch  $g_2$  ( $t \in [0, x]$ ), the only choice to satisfy his demand is to wait for purchasing  $g_2$  until it is been launched at time  $x$ . If he knows the information when both the products are available on the market ( $t \in [x, T]$ ), he will purchase  $g_2$  immediately.

Type D. Suppose his  $(v_1, v_2) \in D$ . Both products do not satisfy his demand for  $(v_1 - p_1) < 0$  and  $(v_2 - p_2) < 0$ ; the customer will leave the market, no matter when he learns the product information.

#### 4. The best introduction strategy for the seller

Let  $f(v_1, v_2)$  be the joint probability density function of customers'  $(v_1, v_2)$  pair distributed in  $N$ , where  $0 \leq v_1, v_2 < \infty$ , and  $r$  denotes the seller's tolerance to postpone the profit return. Let  $\pi_i$  be the unit profit of  $g_i$ , where  $\pi_i = p_i - c_i$ ,  $i = 1, 2$ . For given  $p_1, p_2$  and  $x$ , we define  $N_i(t, x)$  as the number of the potential customer of  $g_i$ ,  $i = 1, 2$ , who learns the product information at time  $t$ .

$$N_1(t, x) = \begin{cases} N \cdot n'(t) \cdot \iint_{4UB} f(v_1, v_2) dv_2 dv_1 & 0 \leq t < x \\ N \cdot n'(t) \cdot \iint_4 f(v_1, v_2) dv_2 dv_1 & x \leq t \leq T \end{cases} \quad (2)$$

$$N_2(t, x) = \begin{cases} N \cdot n'(t) \cdot \iint_{4UC} f(v_1, v_2) dv_2 dv_1 & 0 \leq t < x \text{ (purchase } g_2 \text{ at } x) \\ N \cdot n'(t) \cdot \iint_{BUC} f(v_1, v_2) dv_2 dv_1 & x \leq t \leq T \text{ (purchase } g_2 \text{ at } t) \end{cases} \quad (3)$$

the integral regions of (2) and (3) are defined as:

$$A = A(p_1, p_2) = \{(v_1, v_2) \mid p_1 \leq v_1 < \infty, 0 \leq v_2 < v_1 - p_1 + p_2\}$$

$$B = B(p_1, p_2) = \{(v_1, v_2) \mid p_1 \leq v_1 < v_2 - p_2 + p_1, p_2 \leq v_2 < \infty\}$$

$$C = C(p_1, p_2) = \{(v_1, v_2) \mid 0 \leq v_1 < p_1, p_2 \leq v_2 < \infty\}$$

Model (4) is established for the seller to maximize the expected discount revenue of his products in  $[0, T]$ .

$$\max_x J(x) = N \cdot \left\{ \int_0^x [e^{-rt} \pi_1 n'(t) \iint_{4UB} f] dt + \int_x^T [e^{-rt} \pi_1 n'(t) \iint_4 f] dt + e^{-rx} \int_0^x [\pi_2 n'(t) \iint_C f] dt + \int_x^T [e^{-rt} \pi_2 n'(t) \iint_{BUC} f] dt \right\} \quad (4)$$

Since  $J(x)$  is a continuous function in the closed interval  $[0, T]$ , there must exist an  $x^*$  that solves (4). From (5), the differential of (4), we find (6).

$$J(x) = N \cdot [(\pi_1 - \pi_2) e^{-rx} n'(x) \iint_B f - \pi_2 e^{-rx} n(x) \iint_C f] \quad (5)$$

$$J'(x) < 0 \text{ if } \pi_1 < \pi_2 \quad (6)$$

(6) implies  $x^* = 0$  since  $J(x)$  is a strictly decreasing function in  $[0, T]$  if  $\pi_1 \leq \pi_2$ . That is, if the product ( $g_1$ ) that the seller intends to launch first is the less profitable product in unit, the seller must launch the other product ( $g_2$ ) with it simultaneously. So the seller adopts a simultaneous introduction. On the other hand, if the seller adopts a sequential introduction, he should launch the more profitable in unit product first. From the above discussion, we draw our conclusion by Table 1.

### 1. Conclusions

This study presents a consistent solution to explain ways that sellers introduce their new products in the durable goods market. We had shown that in determining the sequence of introducing two cannibalistic products, sellers should always launch their more profitable product in unit first. The reason for the strategy that systematically adopted by sellers that launch their hi-end model first is the higher added value their hi-end model contributes instead of the higher quality the model equipped.

We have an opposite conclusion with that of Moorthy and Png's result. First, they suppose that sellers should launch the hi-end model first to alleviate cannibalization. Product cannibalization will influence the time to market of their products [6], but the alleviation of cannibalization is not the decisive consideration for sellers who launch their hi-end model first. Second, they assert that launching the low-end model first is infeasible for the policy will decrease the seller's profit. According to our result, Sellers launch the low-end model first will increase their expected revenue if the low-end model brings them a higher profit when compare to the hi-end. Dhebar stated that if the quality of the later released model is not so high as that the customers perceive the product to be improving in present-value terms, sellers might launch low-end first. We emphasizes that it is not the quality but the unit profit of the products that dominates the seller in determining the introducing sequence of his product.

Suppose  $g_1$  and  $g_2$  are identical product, our main result  $\pi_1 \geq \pi_2$  shows that  $p_1 \geq p_2$  since  $c_1 = c_2$ . So the product price declines over time, the situation can be easily found in consumer electronics market [5]. Besides, if the seller want to keep his product price fixed ( $p_1 = p_2$ ) to signal his brand reputation, he should add some new features to the product ( $c_1 < c_2$ ). Customer can expect a product becoming cheaper and better if he is patient enough.

Table 1. The best new product introduction strategy of the seller.

| Seller's strategy         | Condition                                     |                 |
|---------------------------|---|-----------------|
| Simultaneous introduction | $\pi_1 = \pi_2$                               |                 |
| Sequential introduction   | Launch Hi-end first ( $g_1 \leftarrow g_H$ )  | $\pi_1 < \pi_2$ |
|                           | Launch Low-end first ( $g_1 \leftarrow g_L$ ) | $\pi_1 > \pi_2$ |

We provided useful solution for leading sellers, but there are some limitations of our result. First, we focus on the seller who concerns his short-term revenue of the product line. Sellers may launch the less profitable product first to increase the market share of his brand for long-term revenue consideration. Second, due to the more severe competition or the shorter interval between two successive generations of product, etc., the planning horizon of our research topic is getting shorter. Our assumptions will be valid to describe circumstances for a short planning horizon.

For further researches, interaction in the seller's product line as well as cannibalization between the seller's product and its competitors will be constructed later. The product prices are given in this paper for prices are controlled by market mechanism sometimes, they may be the decision variables of the seller in finding a best product introduction strategy.

### References

1. Taylor V. A., Miyazaki A. D., (1995). Assessing actual service performance: incongruities between expectation and evaluation criteria, *Advances Consumer Research*, 22:599-605.
2. D. E. Rosen, J. E. Schroeder, and Elizabeth F. Purinton (1999) Marketing high tech products: Lessons in customer focus from the marketplace, *Academy of Marketing Science Review*, 06.
3. Moorthy K. S., Png I. P. L. (1992). Market segmentation, cannibalization and the timing of product introductions. *Mgmt Sci.* 38: 345-359.
4. Dhebar A. (1994). Durable-goods monopolists, rational consumers, and improving products. *Marketing Sci.* 13: 100-120.
5. Norton J. A., Bass F. M. (1987). A diffusion theory model of adoption and substitution for successive generations of high-technology products. *Mgmt Sci.* 33: 1069-1086.
6. Mazumdar T., Sivakumar K., Wilemon D. (1996). Launching new products with cannibalization potential: An optimal timing framework. *J. Marketing Theory and Practice.* 4: 83-93.

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