Research on Price Models of Consumer Electronic Products based on Supply Chain

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Abstract: Price is the most effective weapons for the enterprises to response to changes in the competitive environment, and the most important factor for the expansion of market share and the growth of profit. With the development of supply chain and logistic, the pricing of products is important to reduce the supply chain cost and improvement the supply chain efficiency as the key tache under supply chain management. Because of the tremendous market potential, the emerging consumer electronic products attract many domestic and foreign businesses. Based on the characteristics of consumer electronic products and the price factors, we build pricing models for consumer electronic products. Finally we prove the feasibility of this model using a instance.

Key words: Consumer Electronic Products Supply Chain Pricing Factors Pricing Model

1 Introduction

Consumer electronic products have different connotations in different countries with different levels of development. In developed countries, computers, office equipment, electronic health care equipment are all classified as consumer electronic products. In China, consumer electronic product is defined as the household or personal audio or video product which is related to radio or television.

At present, consumer electronic products are rapidly developing in China. Because of the intense competition, more and more enterprises change their focus of attention from how to take over the lead in technology to how to make more reasonable marketing strategy to get more profit. It plays an important role in making a reasonable marketing strategy to set on a reasonable price for consumer electronic products.

In economics, there are a lot of specific pricing methods. For a single kind of product, there are cost-plus pricing, product-different pricing, and so on. For several kinds of products, there are multi-products cost-plus pricing and related products pricing etc.

But most of studies on pricing in economics are cross-sectional studies, and lack of longitudinal studies, especially studies on supply chain. For example, Zhang Bolun (2008) has studied the factors and methods affecting pricing of telecommunications products, Pan Yifu (2006) has
established a pricing Model of digital products, Zhang Pengxia, Han Jinghua\(^1\) (2001) have studied
the product marketing policies of the relationship between the pricing models, and the most worth
mentioning is that Bass, an American scholar, proposed a "dynamic pricing model" in 1969, and the
successor carried out on this basis for further improvements and amendments to enhance the
model's practical value.

Mathematically, the discussion of the enterprise's marginal cost and marginal profit is usually
used as a means, which separate the gaming relation between the upstream and downstream
enterprises in the supply chain, so it is not a strong guidance that is provided to the practice.
Therefore, the problem, that how to make a price for consumable electronics product from a
specific view of supply chain, needs an urgent solution.

2 Price factors

From the view of supply chain, the price factors of consumer electronic products are the cost of
production which includes technical cost and physical cost, the competitive features of the market;
the customer demand characteristics, the threat from substitutes and the pricing strategy.

Consumer electronic products have their own Life-Cycle, which is the same as traditional
products. So in order to analyze how the price factors affect the price at different stages of
life-cycle, I introduce the notion of Life-Cycle.

2.1 Guided period

Before the products being put on the market, the producers have pumped billions of dollars
into product development; and for some technical or marketing reasons, the products maybe fail in
the market. All the possibilities mentioned above increase the technical cost.

There are only a few or no competitors. Companies can price for the products without
considering the impact of competitors, and there is no need to reduce products’ prices to enhance
the products’ competitiveness.

There are relatively few promotions of the product on the market, and consumers do not
sufficiently understand the performance of products. There are only few brands to choose for
consumers and only a few pairs of consumers who have little sensitivity to the price or like trying
new things purchase the products in this period.

Generally, a substitute for the product has not yet been developed, or not listed, the threat
from substitutes basically does not exist.

In the Guided period, companies can classify the consumers basing on their preference of
different prices. For different consumer segmentation, companies adopt different pricing
strategies in order to test out the right price for the profit maximization and the success of the
product. This strategy is referred as flexible pricing strategy.

2.2 Growth period

The consumer electronics in Growth period do not require fundamental changes in technology, only need some optimization in some individual functions, or the further research and development on the product differentiation; With the increase in sales and production, raw material consumption also increased, which makes the large-scale procurement become a reality, while companies and their suppliers of raw materials will seek a series of co-operation to reduce costs for their own interests.

In this period, market growth rate raises, the industry expands, the imitators emerge on the market, product differentiation occurs, competition began to appear, the innovator and the imitators have begun to set their own competitive position, competitive pressures have led manufacturers to reduce prices to search for enhancement of product competitiveness.

At the same time, the product begin to be known by consumers, more and more consumers are beginning to show interest in buying, and the market demand is growing rapidly; with the more choice of brands on the market and the growing familiarity to consumer products, consumers can judge the products better, and the price sensitivity of consumers have begun to improve.

The substitutes begin to emerge, but the scale is small, propaganda is not enough, and consumers are not familiar with them, so their threat to the original product is low.

At this stage, enterprises generally take a moderate pricing strategy or a competitive pricing strategy. For these two kinds of pricing strategy, relying on lower product prices to get the relative price advantage and increasing the product's competitiveness in the market are their similar features.

2.3 Mature period

During this period, the product has matured, so there is not much room for technical improvement and most companies have given up investment on the R&D; instead, their funds focus on developing substitute; manufacturers and raw materials suppliers have already established a good cooperative relationship, with a stable purchasing channels and preferential purchase price.

After the fierce competition in previous phases, products on the market generally have the characteristics of mainstream. There are several co-dominant products in this period, and competition is homogeneous; the pressure of competition from similar products forces the prices down.

Most buyers who are familiar with the products will be routinely buy these products, and they have the better ability to compare the various brands on the market, who also have enough space
to make their own choices, meanwhile buyers’ product price sensitivity is also reached the highest point.

When substitutes have a certain scale, which attract some buyers who love to try new things and have low sensitivity to the price, market competition will intensify and prices will be lower.

The pricing strategy for enterprises choose the main in this period include Market differentiated pricing strategy, market leptin pricing strategy and brand pricing strategy. Which pricing strategies company chooses have different effects on the trend.

2.4 Recession

These are no obvious decline in consumer electronics products cost in Recession. As the substitutes begin to entering mature period, companies are forced to sell products at near cost as much as possible to reduce losses and gain profits, so the price competition is fiercer. More consumers turn to choose substitutes and degree of consumers’ concern for the products have also dropped to the lowest point. The product’s market position will basically be replaced by substitutes. Almost all companies choose low-cost promotion strategies, in order to sell the remaining stock as quickly as possible and transfer of funds.

Considering all factors which influence consumer electronics prices in the different phases of the life cycle, we can see that the prices of consumer electronics products have been a downward trend over time. As shown in Figure 1:

![Figure 1 Relationship between the Price and Time](image)
Through the above analysis, comparing the features and the pricing strategies in the various stages, as shown in Table 1:

Table 1 Comparison of the pricing strategy in the various phases

<table>
<thead>
<tr>
<th>Factor/Phases</th>
<th>Product Cost</th>
<th>Competition</th>
<th>Consumer demand</th>
<th>Pricing strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guided period</td>
<td>Highest Technology cost and physical cost</td>
<td>Few competitors, no substitute</td>
<td>Reluctant to purchase products, Less sensitive to the price</td>
<td>Skimming pricing, Flexible pricing strategy</td>
</tr>
<tr>
<td>Growth period</td>
<td>Technology cost and the physical cost are reducing</td>
<td>Many imitation emerge, product differentiation, competition arise</td>
<td>Needs are induction, can very well judge a good product, price-sensitive increase</td>
<td>Moderate pricing strategy, Competitive pricing strategy</td>
</tr>
<tr>
<td>Mature period</td>
<td>Cost close to the lowest point</td>
<td>Products Mainstreaming, Competitive homogeneous, Substitutes shape</td>
<td>Often buy, Have a good ability to distinguish, High Price-sensitive</td>
<td>Market leptin pricing strategy, Brand pricing strategy</td>
</tr>
<tr>
<td>Recession</td>
<td>Lowest cost</td>
<td>Fierce competition</td>
<td>Buy substitute</td>
<td>Cheap sell-off</td>
</tr>
</tbody>
</table>

3 Price Model

3.1 Modeling

When consumer electronics products enter the market, the price must be made adjustments according to the market reaction. Bass, an American scholar, proposed a "dynamic pricing model" in 1969, and the successor carried out on this basis for further improvements and amendments to enhance the model's practical value.

Dynamic pricing models can be represented by the formula $P = P_m(t) + dP(t)$. Namely, the optimal companies’ multi-stage price is the summation of the optimal short-term price ($P_m(t)$) and the price of phase adjustments item ($dP(t)$), where $dP(t)$ is the function of the commodity price.
elasticity, innovation effect, the market demand potential and the discount rate.

Based on the study of Bass and many other scholars, to improve, expand and specify the model, establish a consumer electronics products price adjustment model.

\[ dP(t) = C \times Z \times P_m(t) \left[ \theta_1(\log_{P_m} A - 1) + \theta_2(\log_{Q_{i/n}} Q_2 - 1) - \theta_3 \log_{P_n} P_n \right] \]

Where \( A = (1/n) \sum_{i=1}^{n} P_i a_i \) is the average price of the product similar to the market completely substitute

The following notations are adopted:

\( P_m(t) \) ——Optimal short-term price;
\( dP(t) \) ——Price of phase adjustments item;
\( \theta_1 \) ——Competition-oriented weighting coefficient;
\( \theta_2 \) ——Demand-driven weighting coefficient;
\( \theta_3 \) ——Stress factors of the upgrade product, \( \theta_1 + \theta_2 + \theta_3 = 1 \)
\( P_i \) ——Price of competitor i;
\( a_i \) ——Brand Assignment in market;
\( Q_1 \) ——Total market demand for similar products;
\( Q_2 \) ——Product’s market demand forecast;
\( N \) ——Number of the kind of the completely substitute;
\( C \) ——Cost Index;
\( Z \) ——Discount rate;
\( P_n \) ——The Ex-factory price of the upgrade product.

### 3.2 Model Description

There are many factors affecting \( dP(t) \), which play a decisive role are mainly cost index (C), competitive factors \( \theta_1(\log_{P_m} A - 1) \), demand-side factors \( \theta_2(\log_{Q_{i/n}} Q_2 - 1) \), threats factors of substitutes \( \theta_3 \log_{P_n} P_n \) and discount rate Z.

(1) Cost Index (C): Its value is generally between (0.8, 1.2), which is appropriate. When consumer electronics products enter in the market at the first, R & D investment in advance is relatively large and Technology in the market also has a certain degree of monopoly; at the meantime purchase of raw materials prices and procurement costs are high and cost index is the highest at this time. As time goes on, technology becomes more mature, the purchase of raw materials prices continued to decline and cost index should be lower accordingly.

(2) The more competition on the market, the smaller \( \theta_1(\log_{P_m} A - 1) \) is, which may be negative. When the other products on the market pose a tremendous pressure on products which are researched right now, if there is more than one rival product, we could find their average price
in the market, namely: \( A = (1/n) \sum_{i=1}^{n} P_{ia} \). If \( A \) is less than the current price of the product, then \( \log_{P_m} A \). (In order to maintain the comparative relationship between \( A \) and \( P_m \) and make the value of comparative relations maintained at 1, so use of \( \log \) form) must be less than 1, \( \log_{P_m} A - 1 \) is less than 0, therefore, product has the pressure of reducing the price in the market.

Among them, \( a_i \) is the brand assignment. The brand assignments of each brand in the market are generally not the same, such as the well-known brands can be assigned as 1.1, the common brand can be assigned as 1.0 and the brand whose market share is low can be assigned as 0.9. Specific assignment work should be done by experts.

(3) Use \( \theta_2(\log_{Q_{1/n}} Q_2 - 1) \) instead of demand factors, where \( Q_2 \) is the market forecast of the demand for research products, \( Q_1 \) is the total market demand of the product which is similar to similar goods, and \( n \) is the number of the completely substitute. If \( \log_{Q_{1/n}} Q_2 \) is greater than 1, indicating that the product is popular on the market and its market demand is larger than any other competitors’ average market demand, then the market demand factors form a slight upward pressure to the price in the price adjustment. If the \( \log_{Q_{1/n}} Q_2 \) is less than 1 (a common situation in the market), then \( \theta_2(\log_{Q_{1/n}} Q_2 - 1) \) is less than 0, indicating that it is necessary to lower the price a little bit in order to balance the demand for the product on the market and its competitors’ demand, if you want to expand the product’s market share, its price still going down, making the value of \( \log_{Q_{1/n}} Q_2 \) far away from 1.

(4) Stress factors of the upgrade product \( \theta_3 \log_{P_m} P_n \). If there is an upgrade of the product on the market, it is inevitable that the upgrade product would bring enormous impact to the original product, force it to cut prices and prepare to enter the next life cycle.

(5) Product discount rate \( Z \), whose general value between (0.8, 1.2) is more appropriate, is different according to the company’s pricing strategies. In general, when companies choose the skimming pricing or flexible pricing strategy, its value is larger, closing to 1.2, when companies choose the market leptin pricing strategy, its value is smaller, closing to 0.8.

Using the mode can adjust prices right after consumer electronics products entering the market to.

4 Example Analyses

4.1 Background introduction

A mobile phone manufacturer introduced a 3G smart phone which set photo, MP3, Bluetooth and other multi-function in. Mobile phone manufacturers made adequate preparation prior to the phone entering market, and do various media advocacy on the mobile phone. After an reasonable
analysis, the phone first introduced ex-factory price is 5800 Yuan.

After a period of time of the phone entering market, there are several other brands of 3G mobile phones are all listed, so the fierce competition in the market changes, which let manufacturers begin to consider adjusting the price of the phone. After investigation and research, we see that several popular mobile phones co-occupied almost the entire 3G mobile phone market. They are the cell phone (A phone), B phones, C phones and D phones. The four mobile phone prices are as follows: 5800 (known) Yuan, 4200 Yuan, 4700 Yuan, and 4300 Yuan.

After investigation and expert assessment the same time, also receive the following data:

\[ C = 1.1, Z = 1.0; \theta_1 = 0.8, \theta_2 = 0.2, \theta_3 = 0 (\text{which the upgrade mobile phone dose not enter market at this time}); \]

\[ a_1 = 0.9, a_2 = 1.0, a_3 = 0.9, a_4 = 1.1; Q_1 = 3.6 \times 10^5, Q_2 = 4.8 \times 10^4. \]

Based on the above data, how manufacturers should make the price adjustment of the phone?

4.2 Model calculation

According to the data of the phone given in the background, we can see in the growth period:

\[ A = \frac{1}{n} \sum_{i=1}^{n} P_a i = 4595; \]

Under the price adjustment model we can see:

\[ dP(t) = C \times Z \times P_{m(t)} \left[ \theta_1 (\log_{P_n} A - 1) + \theta_2 (\log_{Q_{1/n}} Q_2 - 1) - \theta_3 \log_{P_n} P_n \right] \]

\[ \approx -207.5; \]

Therefore I recommend that the price of the phone cuts 208 Yuan and the adjusted price is 5800-208 = 5592 Yuan.

5 Conclusions

This paper identified several factors that affect the prices of consumer electronics products, and analyzes how these factors impact on prices at different stages in the life cycle. On this basis, establish a consumer electronics product pricing models.

Pricing model is simple, avoiding the complexity of traditional pricing methods. Using this model, the manufacturer can make quick adjustments responding to the change of the surrounding environment and raise the market reaction rate to the environmental change of the consumer electronics products pricing strategies, which contribute immensely to the formation of the price advantage and the improvement of product competitiveness and increase economic efficiency of enterprises else.

References


