

## Article

# Analysis of Impact of Network Externality Product Bundling Announcement Strategy

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**Abstract:** In the information age, typically buyers bear costs when they change their shopping habits. Therefore, it is indispensable that manufacturers know these costs during transitioning technology and brand for success in the current information economy. Previous research about switching costs emphasized corporate behavioral tactics and corporate competitiveness in the market. However, in these models, customers do not indeed change the account of the business, being charged the same price, and the switching cost is higher enough to prevent conversion. In reality, customers' brand changes. This research hypothesizes that commodity's consumption utility with externality increase with an increase of disposable income and externality but decreases with increasing of reservation utility's shadow price when concerning consumption's switching cost and endogenizing costumers behavior. When a product announcement makes a consumer group's preference for externalities greater than that of another consumer group, the externality of its brand announcement inevitably increases. However, to increase the externality, it is necessary to attract more users to join the purchase of the brand, which naturally increases the manufacturer's request for the creation of forennotice and the switching cost also increases.

**Keywords:** Network Externality, Product Announcement, Consumer Preferences

## 1. Introduction

When consumers buy a product, they frequently use information clues to gauge whether the product is worth purchasing. When consumers are exposed to incomplete information, they make inferences about the missing information (Moon and Tikoo, 1997). Therefore, the content of information disclosure affects consumers' perceived value of the product. Information asymmetry also causes the difference in opinions between buyers and sellers. Generally, sellers have more product information than buyers, so consumers take more purchase risks and have doubts about purchases. Therefore, consumers rely on product-related information to reduce purchase risk, so the provision of information becomes the main basis for consumers to make decisions (Biswas *et al.*, 2009). The research of Hou *et al.* (2009) showed that to reduce consumers' uncertainty about product quality, the industry often provides product information to reduce information asymmetry and increase the purchase intention for their operating income. Vishwanath (2004) also pointed out that companies use information disclosure to convey relevant information to improve the visibility and transparency of the consumer market. Consumers also choose appropriate terms of sale to enhance the possibility of transactions.

Research has found that price communicative strategies reduce consumer perceived sacrifice and increase perceived value and purchase intention (Estelami, 2003). When the bundle price information reduces explicit costs, consumers infer how much spending is saved, which increases the threshold for perceptual transactions (Heeler *et al.*, 2007). Therefore, clear price information enables consumers to quickly make judgments on related information which is used as an economic incentive to attract consumers to repurchase and have an information function. Simonson *et al.* (1994) believed that bundles can increase the price that consumers are willing to pay. The use of publicly marked prices shows the difference between the total price, and the individual price increases the price that consumers are willing to pay. Dodds *et al.* (1991) emphasized that price and perceived product quality have a positive relationship. A higher price has a higher quality cognition and a higher willingness to buy. However, if measured from the perspective of money, a higher price means that the amount of money to be paid for the purchase of the product is larger, which in turn reduces the probability of an enticing purchase. In addition to the total price of the bundle, the individual unit prices need to be marked separately in the pricing of the bundle so that consumers can recognize that they can buy products of equal quality at a lower price, thereby enhancing the attraction of purchase.

Viswanathan *et al.* (2007) showed that exposing price information improves consumers' judgment of product attributes and attracts consumers to make further purchases. Hsu and Mo (2009) pointed out that the price information presented in limited

promotional posters does affect consumers' buying behavior, which shows the importance of price information disclosure. It is believed that revealing the total price of a bundle increases consumer attractiveness because consumers generally believe that a bundle has good value for money. Therefore, when revealing the original pricing information, consumers infer the bundle to understand whether the bundle combination is worth buying. Raghubir (2004) also explained that price promotion is not only about discussing the amount but also enabling consumers to obtain complete product and price information and make a purchasing decision and price comparisons. Therefore, presenting original pricing information can increase consumers' attractiveness to tie-in products.

In the information age, buyers typically have to bear certain costs when they are changing their buying habits. Manufacturers understand these costs when switching technologies or switching brands, which is important to the success of today's information economy. Consumers face high costs when switching between product brands, including at least transaction costs, learning costs, and artificial and contractual costs. Even switching between identical products has transaction costs. In the past studies on switching costs, the emphasis was put on the strategic behavior of the company and the competitiveness of the company in the market where switching costs occurred. However, in these models, because the prices charged by the companies are the same, or the switching costs are high enough to prevent the conversion, consumers have not switched. However, in real life, we often see consumers' brand conversion, for example, changing different mobile phone numbers, and changing different operating systems. However, for consumers who have previously purchased or not purchased or have been exposed to a particular brand, the switching costs between them are different and important. However, due to the existence of groups that have tried and formed a certain preference, the measurement situation becomes more complicated if the price is simply used as information about product quality. That is to say, to measure the switching cost of consumers under network externalities, it may not be possible to find out the switching costs of consumers. Because under network externalities, whether consumers switch or not, in addition to the actual estimable switching costs (money, time, transportation costs, and consultation), the main reason for the switching is the size of the network. It is expected that the number of people joining the network due to the establishment of industry standards (everyone uses the same system, which means that consumers are compatible with each other) affects consumers' switching decisions.

## 2. Basic Model

It is assumed that the market structure of an external product is a duopoly market. There are two manufacturers, A and B, each producing a product. It is further assumed that the production of the two manufacturers has the same, fixed and average cost. If the average cost is fixed and underneath, it only produces a price increase, so to simplify the analysis, we treat it as zero.

Consumer X belongs to a continuous uniform distribution in the interval of [0,1], which means that consumers' preferences are evenly distributed between 0 and 1 which represent two manufacturers, A and B, respectively. Every consumer buys goods A or B only with a fixed income, and the rest buy other necessities of life. That is, consumers buy either goods A or B. Assuming that the consumer's utility composition includes the bundling consumption of goods and the externality and retention utility that it brings, the relationship between the three is incomplete substitution and incomplete complementarity. Therefore, a utility function is expressed as a Cobb-Douglas function assuming that all consumer decisions maximize their utility under income constraints.

$$U_i = X_i^{\alpha_{i1}} \gamma_i^{\alpha_{i2}} E^{\alpha_{i3}}, \alpha_{i1} + \alpha_{i2} + \alpha_{i3} = 1, i = A, B \quad (1)$$

$$p_i X_i + p_r \gamma_i = I_i, 0 \leq \gamma_i \leq G_i \quad (2)$$

where  $U_i$  respectively represents the utility of the two types of consumers,  $i = A$  and  $i = B$  respectively represent two types of consumers who buy a brand A bundle product and a B brand,  $X_i$  is the consumer demand for commodities,  $\gamma_i$  is the reserved utility of the consumer,  $E$  is the network externalities brought about by consumer goods,  $\alpha_{i1}, \alpha_{i2}, \alpha_{i3}$  is the total utility parameter,  $p_r$  is the shadow price of reserved utility and represents the opportunity cost of consuming other goods, that is, the opportunity cost of reserved utility,  $G_i$  represents the resource endowment limit, and  $I_i$  is all the disposable income including the opportunity cost of reserved utility.

The disposable income of the two types of consumers is expressed as follows.

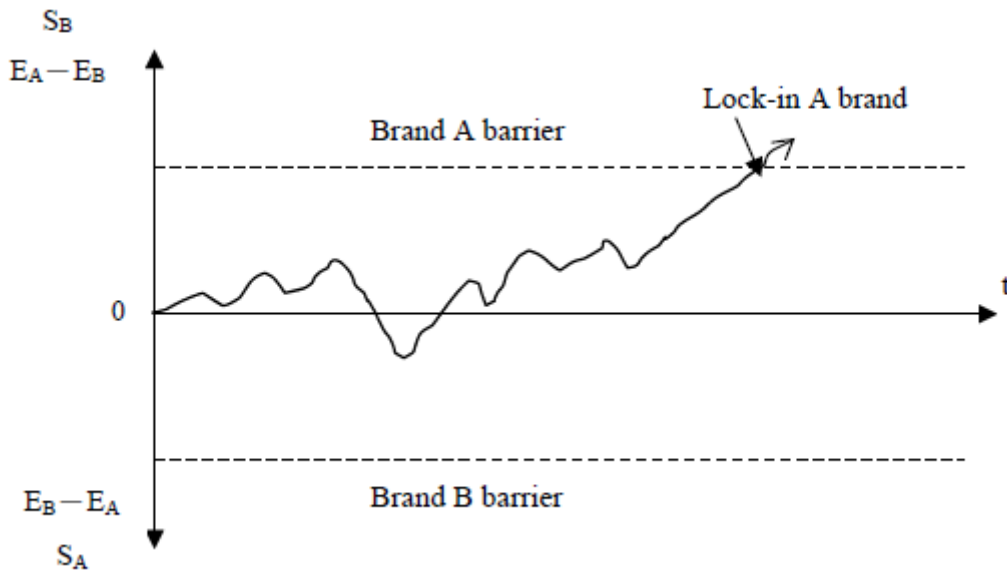
$$I_A = (1 - p_r)[G_A + S_A] \quad (3)$$

$$I_B = (1 - p_r)[G_B + S_B] \quad (4)$$

where  $S_A, S_B$  are the additional and specific transfer payment required when changing the brand, which is used to measure the switching cost, and it is assumed that it satisfies the self-financing condition, that is:  $S_A + S_B = 0$ .

Generally speaking, if  $S_A + EA < EB$ , that is,  $EB - EA > S_A$ , then those who prefer brand A switch to brand B. If  $S_B + EB < EA$ , that is,  $EA - EB > S_B$ , those who prefer brand B switch to A Brand. As illustrated in Fig. 1, the switching difference  $[S_A, S_B]$ , as long as the difference is within this range, consumers still buy their preferred brands. However, once this barrier is exceeded, consumers choose the dominant brand in the market, and this result is reinforced by subsequent consumers. In other words, there is a self-

reinforcing phenomenon. The barriers to the switching of the interval have an isolation effect. Once the industry crosses this barrier, it is called lock-in on a certain brand.



Data source: modified from Cabral (2000), p316.

**Figure 1.** Consumer brand purchases under network externalities.

### 3. Model Analysis

Since the externality is provided by the manufacturer, the optimal decision for consumers to consume goods and retain utility can be obtained by the first-order condition of utility.

$$X_i = [\alpha_{i1}/(\alpha_{i1} + \alpha_{i2})]I_i/p_i \quad (5)$$

$$\gamma_i = [\alpha_{i2}/(\alpha_{i1} + \alpha_{i2})]I_i/p_i \quad (6)$$

From Eqs. (3), (4), (5), and (6), the utility function between the two types of consumers is obtained as follows.

$$V_i = [\alpha_{i1}/(\alpha_{i1} + \alpha_{i2})]^{\alpha_{i1}} [\alpha_{i2}/(\alpha_{i1} + \alpha_{i2})]^{\alpha_{i2}} I_i^{1-\alpha_{i3}} E_i^{\alpha_{i3}} / (p_i^{\alpha_{i1}} p_\gamma^{\alpha_{i2}}) \quad (7)$$

Partial differentiation of Eq. (7) to  $I_i$  and  $E_i$  and  $p_i$ ,  $p_\gamma$  leads to the following.

$$\partial V_i / \partial I_i = (1 - \alpha_{i3}) Z I_i^{-\alpha_{i3}} E_i^{\alpha_{i3}} / (p_i^{\alpha_{i1}} p_\gamma^{\alpha_{i2}}) > 0 \quad (8)$$

$$\partial V_i / \partial E_i = \alpha_{i3} Z I_i^{1-\alpha_{i3}} E_i^{\alpha_{i3}-1} / (p_i^{\alpha_{i1}} p_\gamma^{\alpha_{i2}}) > 0 \quad (9)$$

$$\partial V_i / \partial p_i = -\alpha_{i1} Z I_i^{1-\alpha_{i3}} E_i^{\alpha_{i3}} p_i^{\alpha_{i1}-1} p_\gamma^{\alpha_{i2}} / (p_i^{\alpha_{i1}} p_\gamma^{\alpha_{i2}})^2 < 0 \quad (10)$$

$$\partial V_i / \partial p_\gamma = -\alpha_{i2} Z I_i^{1-\alpha_{i3}} E_i^{\alpha_{i3}} p_i^{\alpha_{i1}} p_\gamma^{\alpha_{i2}-1} / (p_i^{\alpha_{i1}} p_\gamma^{\alpha_{i2}})^2 < 0 \quad (11)$$

where  $Z = [\alpha_{i1}/(\alpha_{i1} + \alpha_{i2})]^{\alpha_{i1}} [\alpha_{i2}/(\alpha_{i1} + \alpha_{i2})]^{\alpha_{i2}}$ .

According to Eqs. (8) to (11), indirect utility increases with the increase of disposable income, and also increases with the increase of externality, but decreases with the increase of the shadow price of goods or reserved utility.

By Eq. (5), we obtain the following equation.

$$X_A = \tilde{\alpha}_A I_A/p_A \quad (12)$$

$$X_B = \tilde{\alpha}_B I_B/p_B \quad (13)$$

where  $\tilde{\alpha}_i = \alpha_{i1}/(\alpha_{i1} + \alpha_{i2})$ .

Substituting Eqs. (3) and (4) into Eqs. (12) and (13), the following is obtained.

$$X_A = \tilde{\alpha}_A (1 - p_r)(G_A + S_A)/p_A \quad (14)$$

$$X_B = \tilde{\alpha}_B (1 - p_r)(G_B + S_B)/p_B \quad (15)$$

From Eq. (11), and under  $\alpha_{i1} + \alpha_{i2} + \alpha_{i3} = 1$ , the real utility elasticities of consumer goods without considering the external effects are defined as

$$\alpha_A^0 = [\alpha_{A1}/(\alpha_{A1} + \alpha_{A2})]^{\alpha_{A1}} [\alpha_{A2}/(\alpha_{A1} + \alpha_{A2})]^{\alpha_{A2}} \quad (16)$$

$$\alpha_B^0 = [\alpha_{B1}/(\alpha_{B1} + \alpha_{B2})]^{\alpha_{B1}} [\alpha_{B2}/(\alpha_{B1} + \alpha_{B2})]^{\alpha_{B2}} \quad (17)$$

According to Eqs. (16) and (17), the utility of the consumer group and the externality of the consumer goods are determined by the utility function share if personal preferences are homogeneous (ie  $\alpha_{Ai} = \alpha_{Bi}$ ,  $i = 1, 2, 3$ ). When  $\alpha_{i1} + \alpha_{i2} + \alpha_{i3} = 1$ , the change of any utility elasticity coefficient of a certain brand consumer group implies that at least one other utility source parameter in the brand-consumer group also changes. In addition, the specific transfer satisfies the hypothetical self-conciliation condition  $S_A + S_B = 0$ , so changes in  $S_A$  and  $S_B$  cause any endogenous consumption choice to change in the same magnitude but in the opposite direction.

Considering the expected utility of the expected effect when any manufacturer makes a declaration,

$$\Phi = V_A^{\lambda_A} V_B^{\lambda_B}, \text{ and } \lambda_A + \lambda_B = 1 \quad (18)$$

In Eq. (18),  $\lambda_A$  and  $\lambda_B$  respectively represent the utility elasticity of the subjective evaluation of the externalities of the two commodities.

From Eqs. (7) and (19),

$$\text{Max}\Phi = \alpha_{A0}^{\lambda_A} \alpha_{B0}^{\lambda_B} E^{\sigma_3} p^{-\sigma_1} p_r^{-\sigma_2} I_i^{\lambda_i(1-\alpha_{i3})}, \quad i = A, B \quad (19)$$

where  $p x_i + p_r r_i = I_i$  and  $S_A + S_B = 0$ .

When  $\sigma_j = \lambda_a \alpha_{Aj} + \lambda_b \alpha_{Bj}$ , then

$$\alpha_{A0} = [\alpha_{A1}/(\alpha_{A1} + \alpha_{A2})]^{\alpha_{A1}} [\alpha_{A2}/(\alpha_{A1} + \alpha_{A2})]^{\alpha_{A2}}$$

$$\alpha_{B0} = [\alpha_{B1}/(\alpha_{B1} + \alpha_{B2})]^{\alpha_{B1}} [\alpha_{B2}/(\alpha_{B1} + \alpha_{B2})]^{\alpha_{B2}}$$

Thus, the following is inferred.

$$S_A^* = [\lambda_A(1 - \varepsilon_{A3})/(1 - \sigma_3)]/G_A \quad (20)$$

$$S_B^* = [\lambda_B(1 - \varepsilon_{B3})/(1 - \sigma_3)]/G_B \quad (21)$$

Because  $\lambda_A + \lambda_B = 1$ , when  $\lambda_A$  increases,  $\lambda_B$  must decrease. Therefore, when  $S_A$  increases,  $S_B$  must also decrease under self-conciliation conditions, and  $\sigma_j = \lambda_a \alpha_{Aj} + \lambda_b \alpha_{Bj}$ , if  $\alpha_j$  increases. When the preference for network externalities is greater than that of category B consumers, the externalities declared by brand A inevitably increase. However, to increase externalities, more users must join the purchase of brand A. A manufacturer for products and price inquiry  $p_r$  on the innovation notice increases, and its switching cost  $S_A$  increases. In addition, when the consumer's endowment  $G_A$  or  $G_B$  is extremely large, on the contrary, the switching cost is extremely small, which shows that there is no obstacle in the conversion when the consumer has excellent studying capacity. Such an impact is in line with the generally intuitive results.

#### 4. Conclusions

To compete in a market with switching costs, the way to win is neither to avoid switching costs nor to seize this advantage. However, for a strategic approach, forward and backward reasoning is required. The empirical study of Kim *et al.* (2001) found that the switching costs that are sufficient to hold consumers on are different in different industries and product lines. Therefore, Shy (2002) further pointed out that the task of empirical research in the field of banking and switching costs is to develop an endogenous switching cost model for consumer behavior in the banking industry and to explore related things that depend on execution. However, it is important to know when companies face the existence and importance of switching costs and how should companies respond to their strategies. Under the simple assumptions in this research, the consumption utility of external goods increases with the

increase in disposable income when the switching cost of consumption is considered and consumer behavior is endogenized and also increases with the increase in externalities. However, the consumption utility decreases when the shadow prices of goods or reserved utility are increasing.

If personal preferences are homogeneous, the utility of a certain brand consumer group with external goods and the network externality of consumer goods occupies the utility function parts, and  $\alpha_{i1} + \alpha_{i2} + \alpha_{i3} = 1$ . Then, a certain brand with the change of any utility elasticity coefficient  $\alpha_{ij}$  of the consumer group implies that the total parameter of the other sources of the utility of the brand-consumer group has not changed. In other words, when a manufacturer adopts a forecast that causes a change in consumers' expectations of the externality of the product, the share of the externality in the source of utility generated by consuming the product also changes, and the relative utility of the externalities of the two commodities is generated. Changes in the endogenous consumption choices of consumer behavior inevitably are required. Moreover, when product announcements make a consumer group have a greater preference for externalities than another consumer group, the externalities of its brand announcement inevitably increase. However, to increase externalities, it is necessary to attract more users to join the purchase. This brand naturally increases the manufacturer's request for the creation of forenotice, and its switching costs also increases..

**Conflicts of Interest:** The authors declare no conflict of interest..

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