

Incumbent sales strategy in the presence of strategic consumers*

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Abstract—It is difficult for consumers to assess the true quality of a new entrant’s products. However, with technological advancements, consumers often consult the reviews of their peers before deciding to purchase a new product through social learning. By taking digital software products as an example, this paper focuses on the implications of social learning to an incumbent firm’s sales strategies when facing a new entrant. We regard two sales strategies of the incumbent: (i) a perpetual strategy, paid upfront in one, by lump sum, and (ii) a subscription strategy, priced on a monthly or yearly basis and is an ongoing subscription. By using a game theoretical model, we find that monopolizing the market is not always beneficial for the incumbent. Instead, when the social learning effects are strong, and the incumbent offers a better product quality, he can raise the price for a greater sale margin. Moreover, when the social learning effects are weak, and consumers are less sensitive to social learning, the incumbent should adopt the perpetual strategy; however, when consumers are more sensitive to social learning, the incumbent should adopt the subscription strategy. Interestingly, when the social learning effects are low or moderate, consumers are less sticky with the incumbent’s product under the subscription.

Index Terms—social learning, new product entry, perpetual, subscription, strategic consumers

I. INTRODUCTION

The influence of consumer reviews on the purchasing decisions of potential product buyers has grown dramatically in the last decade, with a recent survey showing that up to 93% of consumers read online reviews before deciding whether to purchase a product [3]. This number can be expected to increase in the future: on the one hand, rapid innovation and technological advancements are leading more and more products increasingly complex and difficult to evaluate before purchasing, especially digital goods such as software products; on the other, the growth of platforms hosting product reviews (e.g., Amazon, Shopee, TripAdvisor, Yelp, etc.) is giving consumers unprecedented access to their peers’ post-purchase opinions. These strategic consumers make purchasing decisions to maximize their utilities. In its simplest form, strategic behavior may manifest as bargain-seeking behavior; even if the current price of a product is lower than the customer’s willingness to pay, she may delay purchasing in anticipation of a future markdown. The importance of consumer behavior in shaping firms’ pricing decisions has been widely studied in academics: to defend against its negative effects, firms invest heavily in price optimization algorithms.

From the firms’ perspective, these trends increase pressure to understand how various product policies interact with review-based social learning and to optimize these policies accordingly [1]. In this study, we focus on software products that have been sold as a property via perpetual ownership licensing model (i.e., consumers acquire the permanent right to use and own the version of software products by paying upfront) or sold as a subscription (i.e., a licensing model that allows consumers to pay regularly for a product. After that, customers will gain access to the product, and they can continue to use the software for as long as they pay) [7]. For example, Microsoft recently released office 365 with a subscription mode, but it still continues to launch the office suite software office 2021 with a perpetual [4]. Recently, Notability announced that they will change from a perpetual to a subscription sales strategy, which caused a sharp rebound among users [2]. Meanwhile, a competitor’s Notability, GoodNotes, uses perpetual that seize the opportunity to launch a half-price perpetual offer, successfully attracting consumers to switch to its products [6].

Because it can be seen that the incumbent software firm needs to carefully decide the sales strategies, i.e., perpetual or subscription to maintain his sale margin, therefore, our study will examine this worth-nothing topic to explore the following research questions: (1) When should the incumbent adopt a perpetual or subscription strategy to maximize his profit, and what does the impact have on the entrant? (2) Under different consumer behaviors, what is the relationship between the sales strategies adopted by the incumbent and the intensity of consumers’ social learning effects? (3) When an incumbent adopts a subscription or perpetual sales model, how will the two firms’ pricing, two-phase demand, and total profit change with the social learning effects?

II. MODEL DESCRIPTION

We consider a model where an incumbent firm (referred to as “he” and denoted as Firm I) offers a software product (Product I) in the form of a perpetual or a subscription, and consumers have a certain degree of quality perception of his product. When an entrant software firm (referred to as “she” and denoted as Firm E) exists in the market, she will adopt a subscription model for her product (Product E). The quality of the entrant’s product may have higher or lower than that of the incumbent’s product, and consumers do not know the

	Entrant (E)	
Incumbent (I)	Low quality (L)	High quality (H)
Perpetual (P)	PL	PH
Supscription (S)	SL	SH

Fig. 1. Four possible scenarios.

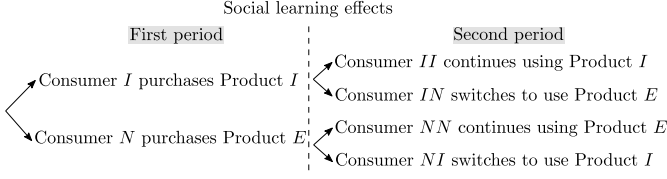


Fig. 2. Consumer buying decisions.

true quality of the entrant's product. Therefore, there are four possible scenarios as shown in Figure 1. The sequence of events is illustrated as follows: after the two firms announce their prices, consumers will choose to buy either Product I or Product E in the first period. Then, after the social learning effects occur, consumers will make a purchase decision in the second period whether to continue or switch their purchasing decisions (For simplicity See Figure 2). Throughout the paper, we make the following additional assumptions to avoid trivial cases: (1) Consumer uses only one product in each period. (2) The consumer utility in each period comes from the purchase decision. (3) The marginal production cost of the two firms are constant, and we assume that it is 0 [8]. (4) Consumers are less confident in the new product, and thus consumers will initially underestimate the quality of the entrant's product [5]. (5) The consumer purchasing decision is affected by the product price [8].

A. Market formulation

1) *When the incumbent adopts the perpetual strategy (Scenario PL , PH):* By following the work of Papanastasiou and Savva [5], we can draw the consumer utilities as follows:

$$U_{I1}^{Pkm} = \theta_k \nu - p_I^{Pkm} \quad (1)$$

$$U_{N1}^{Pkm} = \beta_k \nu - p_E^{Pkm} \quad (2)$$

From Eq. 1 and 2, we use ν to represent the consumer's initial utility of the entrant's product (i.e., Product E) after they know the true quality of the product, where $\nu \in \text{Uniform}[0, 1]$. Let θ_k be the quality difference between Product E and I , which will affect the consumer decisions in purchasing Product I in the first period. The initial utility of the product will be deducted from the initial utility of Product I after pricing. Therefore, U_{I1}^{Pkm} is the consumer utility in using Product I as shown in Eq. 1. In the first period of the entrant, when she enters the market, the consumers unknown the true product quality, such that the initial utility of the consumers who buy Product E will be affected after the consumers know the true quality. Let β be the consumers who have not used a new product and are aware of the quality Product E . Similarly, U_{N1}^{Pkm} is the consumer

utility in using Product E as shown in Eq. 2. Note that k is the index for the quality of the entrant's product (i.e., low or high quality) compared with the incumbent's product, where $k \in \{L, H\}$ and m represents the market segment, where $m \in \{A, B, C, D\}$. By solving $U_{I1}^{Pkm} = 0$, the marginal consumer whose valuation equals $V_I = \frac{p_I^{Pkm}}{\theta_k}$ is indifferent to continue buying from the incumbent's product or is not willing to buy at all. Similarly, when $U_{N1}^{Pkm} = 0$ the marginal consumer whose valuation equals $V_E = \frac{p_E^{Pkm}}{\beta_k}$ is indifferent to switching to buy the entrant's product. After that, we can obtain the indifferent point between Product I and Product E by solving equation $U_{I1}^{Pkm} = U_{N1}^{Pkm}$, then we have $V_{IE}^{Pkm} = \frac{p_I^{Pkm} - p_E^{Pkm}}{\theta_k - \beta}$ is the consumer who indifferent in terms of buying the incumbent or the entrant's product. From this, the indifference point in the first-period is $V_E < V_I < V_{IE}$ or $V_{IE} < V_I < V_E$, which is the points that they may have both Consumer I or Consumer N or only either Consumer I or Consumer N .

We then formulate the consumer utilities that used Product I in the first period and continue using the product in the second-period (Consumer II) and switch to buy Product E in the second-period (Consumer IN) as follows:

$$U_{II2}^{Pkm} = \theta_k \nu \quad (3)$$

$$U_{IN2}^{Pkm} = \beta_k \nu + \lambda q - p_E^{Pkm} \quad (4)$$

Let q is social learning effects. By solving $U_{II2}^{Pkm} = 0$, the marginal consumer whose valuation equals $V_{II}^{Pkm} = 0$ is indifferent to continue buying from the incumbent's product or is not willing to buy at all. Similarly, when $U_{IN2}^{Pkm} = 0$, the marginal consumer whose valuation equals $V_{IN}^{Pkm} = \frac{p_N^{Pkm} - \lambda q}{\beta}$ is indifferent to switching to buy the entrant's product. Last, we solve $U_{II2}^{Pkm} = U_{IN2}^{Pkm}$, then we have $V_{II,IN}^{Pkm} = \frac{p_E^{Pkm} - \lambda q}{\theta_k - \beta}$ is the consumer who indifferent in terms of continue using the incumbent's product or switching to use the entrant's product. Moreover, the indifference point is $V_{IN}^{Pkm} < V_{II}^{Pkm} < V_{II,IN}^{Pkm}$ or $V_{II,IN}^{Pkm} < V_{II}^{Pkm} < V_{IN}^{Pkm}$ are the points that they may have both consumer types or only either Consumer II or Consumer IN in the market.

Next, the consumer utilities who purchase Product E in the first period and continue using in the second-period (Consumer NN) and switch to buying Product I in the second-period (Consumer NI) as follows:

$$U_{NN2}^{Pkm} = \nu - p_N^{Pkm} \quad (5)$$

$$U_{NI2}^{Pkm} = \theta_k \nu - p_I^{Pkm} \quad (6)$$

By solving $U_{NN2}^{Pkm} = 0$, the marginal consumer whose valuation equals $V_{NN}^{Pkm} = p_N^{Pkm}$ is indifferent to continue buying from the entrant or is not willing to buy at all. Similarly, when $U_{NI2}^{Pkm} = 0$ the marginal consumer whose valuation equals $V_{NI}^{Pkm} = \frac{p_N^{Pkm}}{\theta_k}$ is indifferent to switching to buy the incumbent's product. Finally, we solve $U_{NN2}^{Pkm} = U_{NI2}^{Pkm}$, then we have $V_{NN,NI}^{Pkm} = \frac{p_I^{Pkm} - p_E^{Pkm}}{\theta_k - 1}$ is the consumer who indifferent in terms of continue using the entrant's product

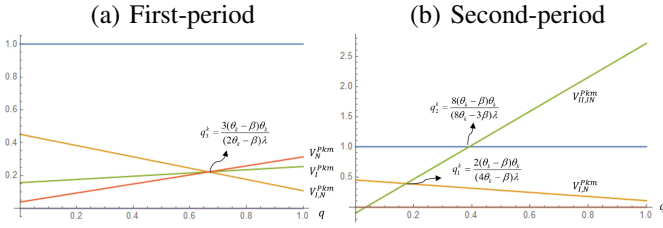


Fig. 3. The market segment when the incumbent adopts the perpetual strategy.

or switching to use the incumbent's product. From the previous arrangement, we have $V_{NN}^{Pkm} < V_{NI}^{Pkm} < V_{NN,NI}^{Pkm}$ or $V_{NN,NI}^{Pkm} < V_{NI}^{Pkm} < V_{NN}^{Pkm}$, indicating that the co-existence with Consumer NN and Consumer NI or only either Consumer NN or Consumer NI exist in the market.

Next, we let $V_I^{Pkm} = V_N^{Pkm}$, we obtain the social learning effects $q = \frac{3\theta_k(\theta_k - \beta)}{2\theta_k - \beta}\lambda$ when the two points of no difference will intersect. If $V_N^{Pkm} = V_I^{Pkm}$, then $q > \frac{3\theta_k(\theta_k - \beta)}{2\theta_k - \beta}\lambda$, the first phase of the manufacturer will monopolize the market, and vice versa, if $q < \frac{3\theta_k(\theta_k - \beta)}{2\theta_k - \beta}\lambda$, the first phase of the market will be competitive. When $V_{IN}^{Pkm} = 1$, we get $q = \frac{4\theta_k(\beta - \theta_k)}{\beta\lambda}$, mean that the two will intersect at one point. If $q < \frac{4\theta_k(\beta - \theta_k)}{\beta\lambda}$, then $V_{IN}^{Pkm} > 1$ and the market in the first-period will be monopolized by the entrant. However, because $0 < \theta, \beta, \lambda < 1$, $\theta_H > \beta$, and $\theta_L > 1$. This indicates that when the entrant enters in the market in the first-period, the market is a duopoly (See Figure 5 (a) for simplicity).

Because $V_{NN,NI}^{PLm} = \frac{p_I^{PLm} - p_E^{PLm}}{\theta_L - 1} > V_{IN}^{PLm} = \frac{p_I^{PLm} - p_E^{PLm}}{\theta_L - \beta}$ (i.e., $V_{NN,NI}^{PLm} = \frac{p_I^{PLm} - p_E^{PLm}}{\theta_L - 1} < 0$). This means the consumer who purchases the entrant's product in the first-period will continue to use Product E in the second-period. Then, we let $V_{II,IN}^{Pkm} = 1$, and thus we obtain $q > \frac{8\theta_k(\theta_k - \beta)}{\lambda(8\theta_k - 3\beta)}$. If $V_{II,IN}^{Pkm} > 1$, the consumer who purchases the incumbent's product in the first-period will switch to using Product E in the second-period. This means that only Consumer IN exists in the market. If $V_{II,IN}^{Pkm} = V_{IN}^{Pkm}$, then $q < \frac{2\theta_k(\theta_k - \beta)}{\lambda(4\theta_k - \beta)}$, the consumer who purchases the incumbent's product in the first-period will continue to use Product I in the second-period. This indicates that only Consumer II . Therefore, we can conclude that $\frac{8\theta_k(\theta_k - \beta)}{\lambda(8\theta_k - 3\beta)} > q > \frac{2\theta_k(\theta_k - \beta)}{\lambda(4\theta_k - \beta)}$ and $V_{IN}^{Pkm} < V_{II,IN}^{Pkm} < 1$, there have Consumer II and IN in the market (See Figure 5 (b) for simplicity).

2) When the incumbent adopts the subscription strategy (Scenario SL, SH): Compare with perpetual strategy, under the subscription strategy, the consumers who purchase Product I in the first-period and if they continue choosing product I in the second-period, they will be charged for subscription fee. The consumer utilities in the first-period is similar with under the perpetual strategy as follows:

$$U_{I1}^{Skm} = \theta_k \nu - p_I^{Skm} \quad (7)$$

$$U_{N1}^{Skm} = \beta_k \nu - p_E^{Skm} \quad (8)$$

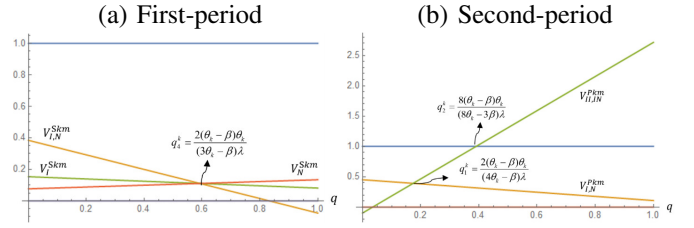


Fig. 4. The market segment when the incumbent adopts the subscription strategy.

In the second-period, the consumer utilities of Consumer II, IN, NI , and NN are as follows:

$$U_{II2}^{Skm} = \theta_k \nu - p_I^{Skm} \quad (9)$$

$$U_{IN2}^{Skm} = \beta_k \nu + \lambda q - p_E^{Skm} \quad (10)$$

$$U_{NN2}^{Skm} = \nu - p_N^{Skm} \quad (11)$$

$$U_{NI2}^{Skm} = \theta_k \nu - p_I^{Skm} \quad (12)$$

By the same step with under the perpetual strategy, we obtain the market segmentation under the subscription strategy as shown in Figure 6

III. MAIN FINDINGS

This study combines the social learning effects with the competition between the incumbent and entrant firms, and considers the perpetual and subscription sales strategies for software products to find the optimal sales strategies for the incumbent in different situations. In addition, we analyze how the marginal profits of the two firms, the demand for the two firms in two periods, and the total profit will be affected by the social learning effects. We have found interesting findings as follows:

A. When the incumbent adopts the perpetual strategy

1) Social learning effects: Regardless of the entrant's product quality, when the incumbent adopts a perpetual strategy, the demand market will be based on the social learning effects (q). In Figure 5, after social learning effects in the second-period, if social learning effects are small, i.e., $q < q_1^k$, all consumers will not change their purchasing decisions (Segment A). However, if the social learning effects are moderate, i.e., $q_1^k < q < q_2^k$, some consumers will switch to buying the entrant's product (Segment B). Interestingly, all consumers will opt for the entrant's product if the social learning effects are strong, i.e., $q_2^k < q < q_3^k$, and the entrant's product quality is high. Meanwhile, if the social learning is relatively strong, i.e., $q_3^k < q < 1$ or when the quality difference between the two firms' products, the incumbent will monopolize the market (Segment D).

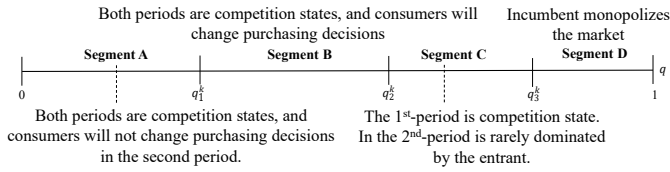


Fig. 5. Market segment under Scenario *PL* and *PH*.

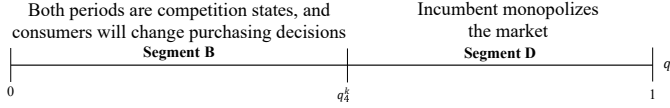


Fig. 6. Market segment under Scenario *SL* and *SH*.

2) *When to use the perpetual strategy:* We find that there have two situations that the incumbent should adopt a perpetual strategy as follows: (i) when the social learning effect are weak, and consumers are less sensitive to the social learning effect, and (ii) when the social learning effect are moderate, and consumers are more sensitive to the social learning effect.

B. When the incumbent adopts the subscription strategy

1) *Social learning effects:* Regardless of the entrant's product quality, when the social learning effects are low and moderate (i.e., $q < q_4^k$), consumers always change their purchasing decision after the social learning. In addition, when the social learning effects are relatively strong (i.e., $q_4^k < q < 1$), the incumbent will monopolize the market. By comparing Figure 5 and 6, we can see that when the social learning effects are low or moderate, consumers are less sticky with the incumbent's product under the subscription.

2) *When to use the subscription strategy:* We find that there have three situations that the incumbent should adopt a perpetual strategy as follows: (i) the social learning effect are weak, and consumers are more sensitive to the social learning effect, (ii) When the social learning effect are moderate, and consumers are less sensitive to the social learning effect, and (iii) When the social learning effect are large, the incumbent will adopt subscription strategy to monopolize the market.

IV. CONTRIBUTIONS AND FUTURE WORKS

By developing the game theoretical model to capture how the incumbent software firm should interact in adopting the sales strategies when the entrant enters the market, our work provides the following contributions: (i) indicating the effects of different sales strategies on the incumbent's equilibrium prices, demands, and profits when facing the new competitor. (ii) indicating the effects of social learning and the consumers' sensitivity to social learning on the perpetual and subscription strategies, and (iii) indicating the optimal strategy of the incumbent firm to deal with the new entrant. Next, we will examine the influence of other possible cases of the entrant's product (i.e., when the entrant's product quality is lower/higher than that of the incumbent's product) on the impact of the incumbent in adopting the sales strategies. Furthermore, we will generalize all the insights from the other parameters and

develop a new framework that can relax the assumptions to cover all possible situations.

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