Platform Pricing with Strategic Buyers

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Abstract
Digital platforms are ubiquitous. While there has been a growing academic literature on platform strategies, little is known about platform pricing when buyers are strategic. In contrast to myopic buyers—who make decisions solely based on their current period utility, strategic buyers take into account future period utility in their decision making. They may wait-and-see, enter-early, or free-ride, in responding to key platform-specific factors such as cross-side network effects, and switching cost. Using a two-period analytical model, we derive optimal buyer-side pricing strategies for a monopolistic platform owner under three prevalent pricing models: subscription-based, license-based, and time-limited freemium (TLF). Compared with myopic buyers, strategic buyers do not affect optimal pricing strategies under the subscription model or under TLF with no switching cost, but significantly change optimal pricing strategies and adoption dynamics under the license model and under TLF with positive switching costs. The three models are also compared numerically.

1. Motivation

Electronic markets based on platforms -- multi-sided networks that bring together buyers and sellers -- represent a significant and growing share of the global economy [12, 13]. Platform strategies have been ubiquitous. They are of increasing importance for practitioners. Examples include traditional software firms like Adobe and Skype, as well as emerging generation of cloud-based innovators like Apple, Amazon and Salesforce. In business practice, there are three prevalent pricing models used for digital platform owners: (1) the subscription fee model, where the platform charges a per-period fixed price to a buyer; (2) the perpetual license model, where the platform charges a one-time fixed license fee to a buyer; and (3) time-limited freemium (TLF) model, where the platform does not charge until later periods [11, 16, 17]. The platform may also use other pricing models such as a hybrid among the three.

The multi-period nature of platform use gives rise to possible strategic buyer behaviors. In contrast to non-strategic or myopic buyers -- who make decisions solely based on their current period utility [4], strategic buyers take into account future period utility into their decision making.

A strategic buyer may (1) postpone the adoption decision until the number of sellers or peer adopters is large enough (wait-and-see), (2) adopt early at a loss when he foresees that early loss can be recovered later (early entry; and myopic buyers would not behavior like this), or (3) simply enjoy the free use period but leave the platform once the owner starts charging (free ride).

Such strategic behaviors are perfectly rational in platform adoption due mainly to two platform-specific factors. First and foremost, platform growth often goes hand in hand with network effects [13]. This makes it possible for some non-adopters to adopt later when network effects elevate their utility from negative to positive. Early entry is another possibility due to network effects. Second, there are often switching costs for a buyer to leave a platform [7, 10]. When the switching cost is high, strategic buyers may not want to take the free offer in early periods because they foresee the fee charge later.

While there has been a growing academic literature on platform strategies, to the best of our knowledge, little is known about platform pricing when buyers are strategic. We aim to make the first step towards filling this gap by developing a two-period analytical framework to study pricing models for a monopolistic platform owner incorporating strategic buyer behaviors. Our framework allows us to address a central research question: Benchmarked with the case when buyers are myopic, will (and how) strategic buyer behaviors affect the platform’s optimal pricing strategies?

We study three pricing models: the subscription model, the perpetual license model, and TLF. We find that strategic buyer behavior does not affect the platform’s optimal pricing strategies under the subscription model or under TLF with no switching cost, but significantly changes the optimal pricing strategies and adoption dynamics under the license model and under TLF with positive switching costs. We also illustrate with numerical examples how our theoretical results may be used to help the platform to choose among the above three models.

The rest of the paper is organized as follows. We briefly review relevant literature in Section 2. The model setup is introduced in Section 3. We
investigate three pricing schemes respectively in Section 4, 5 and 6. Section 7 provides some numerical results and Section 8 concludes.

2. Literature Review

Two streams of research are related to ours: platform pricing and strategic purchasing behavior.

Despite growing academic interests in pricing information goods \([6, 16]\), the impact of strategic buyer behaviors remains largely unexplored in the software or platform pricing literature. While there have been a few platform pricing models in the literature \([8, 9, 13]\), as we summarize in Table 1, the majority of these models focuses on comparing pricing models with and without network effects. Most of the extant literature restricts to a single-period setting \([12]\), which makes it infeasible to examine forward-looking buyer behaviors.

Strategic purchasing behaviors are mostly studied in the operations management (OM) literature. A key finding of this literature is that strategic buyers often lead to lower prices, because the retailer competes with itself across different periods when buyers have the option to wait until a later period to purchase when price is lower \([1, 3, 4, 14]\). In this literature, strategic buyers are defined as those who take the utility of both periods into consideration while myopic ones are those who only concern about the utility of the current period \([4]\). Our model of buyer behaviors (strategic vs. myopic) is consistent with this stream of literature.

Our paper intends to contribute to both streams of literature by studying platform pricing with strategic buyers. While strategic buyers wait in anticipation of possible future price markdowns in inventory models in the OM literature \([15]\), in platform setting, their behaviors are richer due to platform-specific factors. As discussed earlier, they may: wait-and-see due to potential WTP increase rather than price cut, or take a loss by adopting early, or only take the free offer. Such strategic buyer behaviors are rarely modeled in the platform (or OM) literature. Our model is capable of capturing such platform adoption behaviors driven by key platform-specific factors such as cross-side network effects, and switching costs.

<table>
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<tr>
<th>Platform Provider</th>
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<th>Multi-sided</th>
<th>Network Effects</th>
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<tr>
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<td>Rochet and Tirole (2006) ([13])</td>
<td>Fixed fee Usage-based fee</td>
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<td>Choudhary (2007) ([17])</td>
<td>License fee SaaS</td>
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<td>Parker and Van Alstyne (2005) ([12])</td>
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<td>Farrell and Klemperer (2007) ([11])</td>
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<td>Niculescu and Wu (2011) ([11])</td>
<td>Charge-for-everything Freemium</td>
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<td>This paper</td>
<td>Subscription fee License fee Freemium</td>
<td></td>
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<td>Strategic behaviors will change the optimal pricing strategies of license and TLF models</td>
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3. The Model Setup

Consider a two-sided software platform that connects buyers and sellers. We assume the platform has a lifecycle of two periods. The platform owner wishes to maximize its total profit over two periods by charging buyers and sellers access fees. Since we are primarily interested in platform pricing with strategic buyers (and in comparison with non-strategic buyers), we assume a fixed per-period fee \(A\) for each seller throughout this paper.

We assume a unit mass of buyers with type \(v\) uniformly distributed on \([-k, 1]\). Type \(v\) represents the buyer’s initial per-period willingness-to-pay (WTP) to access the platform. We assume \(k\) is sufficiently

\[\text{This implies that the number of buyers on } \{a, b\} = (b-a)/(1+k)\,.

For simplicity, we scale to \(b-a\) and omit the constant scale factor \((1+k)\) throughout this paper, as it does affect any of our results.
large such that there are always some customers who would not buy.

We denote $U_i(p_i,v)$ as a buyer’s utility function in each period $i \in \{1,2\}$; $p_i$ as the platform’s pre-announced access fees; $e^\theta > 0$ ($e^\phi > 0$) as the strength of positive cross-side seller (buyer) network effect to the buyer (seller); $N^B_i$ as the number of buyers (after scaling by a factor of $1 + k$) at the end of period $i$.

We assume there are $N^S_i = I$ (after scaling by a factor of $1 + k$) sellers at the beginning of period 1. At the beginning of period 2, more sellers are attracted to join the platform due to increased installed base of buyers such that $N^S_2 = I + e^\phi N^B_1$.

Some period 1 non-adopters may adopt in period 2 due to increased WTP $v + e^\theta N^S_2$. Therefore, the buyer’s utility functions are:

\[
U_1(p_1,v) = v - p_1^S;
\]
\[
U_2(p_2,v) = v + e^\theta N^S_2 - p_2 = v + e^\theta (I + e^\phi N^B_1) - p_2.
\]

We assume switching cost $c$ if a buyer opts out in period 2. We denote $\lambda \in [0,1]$ as a buyer’s “strategicness”, patience or discount factor for future utility. A buyer with $\lambda = 0$ is non-strategic, myopic or extremely impatient, as his adoption decision at the beginning of each period depends solely on his current period utility. A myopic buyer adopts if and only if his current period utility is non-negative. In contrast, a buyer with $\lambda = 1$ is strategic, or extremely patient, as he computes his total utility from the current period to the end, taking into account future period utilities when making a decision at the beginning of each period. A strategic buyer adopts if and only if his total utility at each period is non-negative.

Figure 1 depicts a buyer’s decision tree (choices and payoffs) in our two-period framework. At the beginning of each period, the buyer decides whether to adopt $\{a\}$ or not $\{n\}$. A buyer has four possible strategies: $\{a,a\}$, $\{a,n\}$, $\{n,a\}$ and $\{n,n\}$. We assume that the payoff of never-adopt strategy $\{n,n\}$ is zero. We are interested in the implications of strategic buyers to platform pricing models, in comparison with non-strategic (or myopic) buyers. For this reason, we shall restrict our attention to the buyer’s side. We compare and contrast three platform pricing models: the subscription model ($p_1 = p_2 = p^S$), the license model $p^L$, and a popular form of low-high ($p_1 = 0$, $p_2 = p^S$) penetrating pricing model when the platform offers free access in the first period and charges in the second period (TLF). We have put all the proofs in the appendix.

### 4. Subscription Model

Under the subscription pricing model, the platform charges each buyer a fixed access fee $p^S$ per period. This pricing model is used by many Internet service platform providers who usually charge each buyer a flat monthly fee. For example, Netflix, the leading Internet streaming media provider, offer buyers unlimited TV stream for a monthly flat fee of $7.99. *Economist* magazine offers unlimited access to its electronic version for an annual fee of $110.

**Proposition 4.1.** Under the subscription model, $\{a,n\}$ is a dominated strategy for any buyer.

Under the subscription model, second period utility of any first period adopter is non-decreasing, because

\[
U_1(p^S,v) = v - p^S + e^\theta N^S_2 \geq v - p^S = U_1(p^S,v).
\]

If a buyer follows strategy $\{a,n\}$ then

\[
U_1(p^S,v) - \lambda c \geq 0,
\]

which is in turn dominated by $\{a,a\}$ because $U_2(p^S,v) \geq U_1(p^S,v) \geq \lambda c > 0 > -c$.

Proposition 4.1 implies that the number of adopters in neither period is affected by the switching cost $c$, because switching is ruled out as an option. Given this, as can be seen from the buyer’s decision tree (Figure 1), adoption at the beginning of period 2 is driven solely by second period utility. Using backward induction, at the beginning of period 1, adoption is driven solely by utility functions. Patience or discount factor $\lambda$ does not play a role in either period’s decision making. Put it differently, under the subscription model, a myopic and a strategic buyer ends up making identical decisions, thus the platform does not need to price differentiate between them.
Proposition 4.2. Under the subscription model, optimal platform pricing is

\[ p^* = \frac{2 + e^\delta (1 + e^\delta) - A e'}{2(2 + e^\delta e')} \]

Given Proposition 4.2, we prove the following comparative statics (see Figure 2 for illustration):

\[ \frac{\partial N_s^a}{\partial e^\delta} < 0; \frac{\partial N_b^a}{\partial e^\delta} > 0; \frac{\partial (N_s^a - N_b^a)}{\partial e^\delta} > 0. \]

This gives the following insights: under the subscription model, cross-side seller network effect \( e^\delta \) drives buyer-side adoption from first period towards second period, whether buyers are strategic or myopic.

Figure 2. Adoption under subscription model

\( (e^\delta = 1, I = 0.1, A = 1) \)

5. License Model

Under the license model, the platform charges each buyer a one-time fixed perpetual license access fee \( p^L \). The buyer needs to pay only once. License model has been used by many software platform providers. Microsoft, for example, charges a perpetual license fee for its operating system Windows and development platform Visual Studio.

Proposition 5.1. Under the license model, \( \{a, n\} \) is a dominated strategy for any buyer.

This can be shown using a similar argument for Proposition 4.1. Given Proposition 5.1, which says that no buyer would consider adopting only in the first period, there are only two possible pricing strategies, relative to a common threshold. Above this threshold, is a high price Strategy A that focuses on profiting from the first period, below which is a low price Strategy B that balances profits from both periods.

(i). Strategy A (High Price): \( \lambda P^A_s > e^\delta (I + e^\delta) \). It can be shown that, under Strategy A, adoption follows:

\[ N_s^a = N_b^a = 1 - \frac{p^A_s - A e'}{1 + \lambda}. \]

(ii).Strategy B (Low Price): \( \lambda P^B_s \leq e^\delta (I + e^\delta) \).

Under Strategy B, adoption occurs in both periods:

\[ N_s^b = 1 - (1 - \lambda) p^B_s, N_b^b = 1 - p^B_s + e^\delta N_s^b \geq N_b^b. \]

Proposition 5.2. Under the license model, if buyers are myopic (\( \lambda = 0 \)), optimal platform pricing is

\[ p^* = \frac{1 + e^\delta (I + e^\delta) - A e'}{2(I + e^\delta e')} \]

Given Proposition 5.2, for myopic buyers under the license model, we prove the following comparative statics (See Figure 4a for illustration):

\[ \frac{\partial N_s^a}{\partial e^\delta} < 0; \frac{\partial N_b^a}{\partial e^\delta} > 0; \frac{\partial (N_s^a - N_b^a)}{\partial e^\delta} > 0. \]

Proposition 5.3. Under the license model, if the buyers are strategic (\( \lambda = 1 \)), optimal platform pricing strategy is either Strategy A or B given below, whichever gives the higher profit.

Strategy A (High Price):

\[ p^A_s = \begin{cases} e^\delta (I + e^\delta) - A e', & \text{if } e^\delta (I + 2e^\delta) + A e' \geq 2, \\ 2 + e^\delta I - A e', & \text{otherwise}. \end{cases} \]

Strategy B (Low Price):

\[ p^B_s = \begin{cases} 1 + e^\delta (I + e^\delta), & \text{if } e^\delta (I + e^\delta) > 1, \\ e^\delta (I + e^\delta), & \text{otherwise}. \end{cases} \]

Figure 3. Optimal strategy under license model: strategic buyers (\( \lambda = 1, I = 0.1, A = 1 \))

It follows directly from Proposition 5.3 that: (1) if \( e^\delta (I + 2e^\delta) + A e' \geq 2 \), Strategy B is optimal; (2) if \( e^\delta (I + 2e^\delta) + A e' < 2 \) and \( e^\delta (I + e^\delta) < 1 \), Strategy A is optimal; (3) otherwise both Strategy A and Strategy B could be optimal, depending on the profit comparison. We use Figure 3 to illustrate theoretical results from Proposition 5.3. Strategy B (Strategy A) is optimal when \( e^\delta, e^\delta \) or their combination is sufficiently large (small). Again, cross-side network effects play a central role in the platform’s choice of
pricing strategies (high price Strategy A vs. low price Strategy B), and consequently adoption dynamics.

Given the optimal pricing strategy as specified in Proposition 5.3, for strategic buyers under the license model, we prove the following comparative statics (see Figure 4b for illustration):
\[
\frac{\partial N^B}{\partial e^B} \leq 0, \quad \frac{\partial N^B}{\partial e^S} \geq 0, \quad \text{and} \quad \frac{\partial (N^B_2 - N^B_1)}{\partial e^S} \geq 0.
\]

Figure 4 compares myopic buyers’ adoption dynamics with those of strategic buyers. When buyers are myopic, adoption dynamics under the license model are similar to those under the subscription model. When buyers are strategic, first period adoption increases (until saturation) as \(e^B\) increases. New adoption in the second period does not kick in (due to platform’s high priced Strategy A) until \(e^S\) exceeds a certain threshold (due to platform’s switch to the low priced Strategy B).

![Figure 4. Adoption under license model](image)

**Proposition 5.4.** Under the license model, optimal pricing when buyers are strategic is higher compared with the case when buyers are myopic.

The intuition behind Proposition 5.4 is as follows. When buyers are strategic, at the beginning of period 1, their total utility is higher than the utility when buyers are myopic, because a strategic buyer foresees that he can “borrow” from his second period increased utility (due to increase WTP and no need to pay). Taking this into account, the platform raises the price when buyers are strategic.

6. Time-limited Freemium

Time-limited freemium (TLF) is a popular form of low-high \([0, p^S]\) penetrating pricing strategy when the platform offers free access in the first period but charges in the second period. Examples abound (e.g., [3]), such as Salesforce.com.

**Proposition 6.1.** Under the TLF model, if there is no switching cost \(c = 0\), optimal platform pricing is not affected by buyer patience factor \(\lambda\).

When there is no switching cost, \(c = 0\), we see from the decision tree in Figure 1 that a buyer’s adoption decision at each period does not depend on \(\lambda\). Put it differently, under TLF with zero switching cost, a myopic and a strategic buyer ends up making identical decisions, thus the platform does not need to price discriminate between them, other things equal. This intuition can be shown by comparing the following Proposition 6.2 and Proposition 6.3, which are identical if \(c = 0\).

**Proposition 6.2.** If buyers are myopic \((\lambda = 0)\), optimal platform pricing strategy is either Strategy A or B given below, whichever gives the higher profit.

- **Strategy A (High Price):**
  \[
p^{A^*} = \begin{cases} 
  \frac{1 + e^A(1 + e^B) + c}{2}, & \text{if } e^A(1 + e^B) + c \leq 1, \\
  e^A(1 + e^B) + c, & \text{otherwise}.
  \end{cases}
\]

- **Strategy B (Low Price):**
  \[
p^{B^*} = \begin{cases} 
  \frac{1 + e^B(1 + e^B)}{2}, & \text{if } e^B(1 + e^B) > 1, \\
  e^B(1 + e^B), & \text{otherwise}.
  \end{cases}
\]

Given Proposition 6.2, for myopic buyers under TLF, we prove the following comparative statics (see Figure 7a for illustration):
\[
\frac{\partial N^B_1}{\partial e^B} = 0, \quad \frac{\partial N^B_2}{\partial e^S} \geq 0, \quad \text{and} \quad \frac{\partial (N^B_2 - N^B_1)}{\partial e^S} \geq 0.
\]

We use Figure 5 to illustrate the insights from Proposition 6.2. When buyers are myopic, both Strategy A and Strategy B can be optimal, depending on the strength of the network effects. Strategy B (Strategy A) is optimal if \(e^B, e^S\) or their combination is sufficiently large (small).

This contrasts with the license model in the presence of myopic buyers, where the high price Strategy A is ruled out regardless of network effects; Here the high price Strategy A is optimal when network effects are low.

Clearly, the difference is driven by the switching cost, as \([a, n]\) now becomes a viable option for the buyers. Recall that it is dominated in the license (and the subscription) model. As switching cost increases from \(c = 0.2\) in Figure 5a to \(c = 0.8\) in Figure 5b, meaning it becomes more costly for those first-period adopters to leave the platform, a high price strategy A becomes even more desirable to squeeze more profit from these captive early buyers.

**Proposition 6.3.** If buyers are strategic \((\lambda = 1)\), optimal platform pricing strategy is among Strategy
A, B or C given below, whichever gives the highest profit.

Strategy A (High Price):
\[
p_A^* = \begin{cases} 
1 + e^a (I + e^a) + [1 - e^a e'] c, & \text{if } e^a (I + e^a) + (3 - e^a e') c \leq 1 \\
e^a (I + e^a) + (2 - e^a e') c, & \text{otherwise.}
\end{cases}
\]

Strategy B (Low Price):
\[
p_B^* = \begin{cases} 
1 + e^a (I + e^a), & \text{if } e^a (I + e^a) > 1 \\
\frac{e^a (I + e^a) + (2 - e^a e') c}{2}, & \text{otherwise.}
\end{cases}
\]

Strategy C (Medium Price):
\[
p_C^* = \begin{cases} 
e^a (I + e^a), & \text{if } e^a (I + 2 e^a) + A e^2 \geq 2 \\
e^a (I + e^a) + (2 - e^a e') c, & \text{if } e^a (I + 2 e^a) + A e^2 + 2 (2 - e^a e') c < 2 \\
1 + (e^a I - A e^2) / 2, & \text{otherwise.}
\end{cases}
\]

Figure 5. Optimal strategy under TLF model:
myopic buyers (\(\lambda = 0, I = 0.1, A = 1\))

We use Figure 6 to illustrate the insights from Proposition 6.3. When buyers are strategic, Strategy A, B, C all can be optimal, depending on the strength of the network effects. The low price Strategy B is optimal when network effects are large. The high price Strategy A is optimal when network effects are low. In-between is the medium price Strategy C, which is optimal when network effects are medium. As switching cost increases from \(c = 0.2\) in Figure 6a to \(c = 0.4\) in Figure 6b, the medium price Strategy C becomes more desirable.

Figure 6. Optimal strategy under TLF model:
strategic buyers (\(\lambda = 1, I = 0.1, A = 1\))

This is so because a strategic buyer will not take the free offer in the first period when the switching cost is high, if he foresees a high price in the second period. To mitigate this concern of strategic buyers and boost period 1 adoption, the platform lowers the price.

Given Proposition 6.3, for strategic buyers under TLF, we prove the following comparative statics (see Figure 7b for illustration):
\[
\frac{\partial N_B}{\partial e^a} \geq 0, \quad \frac{\partial N_B}{\partial e^b} \geq 0, \quad \text{and } \frac{\partial (N_B - N_C)}{\partial e^a} \geq 0.
\]

Figure 7 illustrates adoption dynamics under TLF. The dotted line represents \(N_B\). When buyers are myopic (Figure 7a), \(N_B^* = 1\). When network effects are high, we see an increased installed base in the second period due to the low price Strategy B (see Figure 5a). When network effects are low, we see a decreased installed base in the second period due to the high price Strategy A (see Figure 5a) – some free riders are priced to leave in period 2.

7. Model Comparison

We illustrate comparisons among three pricing models with numerical examples.

When buyers are myopic, as we illustrate in Figure 8a, the subscription model is preferred over the license model overall. Here is the intuition. Given the same price charge, the number of first-period adopters under each model is the same but the subscription model can “double dip” (in contrast, the license model cannot), as we know from Proposition 4.1 that first-period adopters would not leave. The license model, however, may win when \(e^a\) is sufficiently large and \(e^b\) is very small. In this case, second period adoption outnumbers significantly that under the subscription model. When this happens, the license model is in turn dominated by the TLF model, as we shall now explain.
Table 2. Summary of optimal pricing strategies

<table>
<thead>
<tr>
<th>Condition</th>
<th>Optimal price</th>
</tr>
</thead>
<tbody>
<tr>
<td>(4)</td>
<td>$1 + e^A(I + e')$ / 2</td>
</tr>
<tr>
<td>(5)</td>
<td>$1 + e^A(I + e') + c$ / 2</td>
</tr>
<tr>
<td>(6)</td>
<td>$e^A(I + e') + c$</td>
</tr>
</tbody>
</table>

**Myopic Buyers $\lambda = 0$**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Optimal price</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>$1 + e^A(I + e')$ / 2</td>
</tr>
<tr>
<td>(2)</td>
<td>$e^A(I + e')$</td>
</tr>
<tr>
<td>(3)</td>
<td>$2 + e^A(I + e')$ / 2</td>
</tr>
</tbody>
</table>

$e^A(I + 2e') + Ae' \geq 2$ and $e^A(I + e') > 1$; (2): $e^A(I + 2e') + Ae' \geq 2$ and $e^A(I + e') \leq 1$; (3): $e^A(I + 2e') + Ae' \leq 2$ and $e^A(I + e') \leq 1$; (4): $c < [1 - e^A(I + e')]^2 / 4$ and $e^A(I + e') > 1$; (5): $e^A(I + e') + c < 1$; (6): $e^A(I + e') + c > 1$ and $e^A(I + e') < 1$, or $c \geq [1 - e^A(I + e')]^2 / 4$ and $e^A(I + e') > 1$; (7): $e^A(I + 2e') + Ae' \geq 2$ and $e^A(I + e') > 1$.

**Strategic Buyers $\lambda = 1$**

Figure 8. Model comparison: myopic buyers ($\lambda = 0, I = 0.1, A = 1$)

Under both the license model and TLF, the total number of paying adopters equals to the number of second-period adopters. However, the installed base of TLF model is largest among the three models due to first period give-away. For the same price, this gives TLF an edge over the license model. In short, the license model is least favored with myopic buyers. When the network effects are small, the subscription model wins over TLF because the number of paying adopters under TLF is smaller (due to optimality of the high price Strategy A). Otherwise, TLF is favored most. These insights are illustrated in Figure 8b.

When buyers are strategic, the comparison of the subscription model with the license model flips. If network effects are low, the high price Strategy A of the license model drives all adoptions in the first period ignoring adoption from period 2. When network effects are high, the low price Strategy B makes the subscription model more appealing as it balances profits over two periods.

Figure 9. Model comparison: strategic buyers ($\lambda = 1, I = 0.1, A = 1$)

We illustrate this trade-off in Figure 9a. When this happens, the subscription model is in turn dominated by the TLF model. TLF wins again due to its largest installed base. However, when network effects are low, strategic buyers may free ride, hurting TLF. In this case, the license model is favored most. These insights are illustrated in Figure 9b.

8. Conclusion

Despite a growing literature on platform strategies, when buyers are strategic, optimal platform pricing remains largely unexplored, to the best of our knowledge. In this paper, we intend to fill this gap by developing an analytical framework of platform pricing when buyers are strategic. In the process, we compare with the case when buyers are non-strategic (or myopic).

One contribution of this paper is an integrative framework that enables a head-to-head comparison of three popular platform pricing models used in
business practice: subscription, license, and time limited freemium. Our model is capable of capturing several distinct strategic behaviors observed in platform adoption: Wait-and-see, enter-early and free-ride. We investigate implications of such strategic buyer behaviors on platform pricing. We find that the platform does not need to price discriminate strategic vs. myopic buyers, under the subscription model or under TLF when there is no switching cost, because strategic and myopic buyers behave exactly the same. In sharp contrast, they behave rather differently under the license model and under TLF with positive switching cost. As a consequence, the platform should price discriminate between them. We summarize our key findings in Table 2. Finally, we illustrate with numerical examples on how our theoretical framework maybe used to help practitioners to compare and select among the three pricing models.

For future research, we intend to extend our findings to alternative forms of cross-side networks and information structure. Another interesting extension is to see if and how the optimal pricing on the seller side is affected by the buyer's strategic behaviors. While the latter problem will quickly become analytical intractable, numerical approaches may be viable.

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9. References


Appendix

Proof of Proposition 4.1. See the text immediate after this proposition. Q. E. D.

Proof of Proposition 4.2. Given any \( p^s \), we have

\[ N_i^s = 1 - p^s, N_j^s = 1 + \epsilon' (1 - p^s), N_2^s = 1 - p^s + \epsilon^s [1 + \epsilon' (1 - p^s)]. \]

The platform's total profit is,

\[ p^s (N_1^s + N_2^s) + A(N_1^s + N_2^s) = (p^s + \epsilon A') N_1^s + p^s N_2^s + 2AI. \]

Note that, throughout this paper, we shall drop the
constant term \( 2AI \) from the profit function since it does not affect the optimal solution.

The platform’s problem is equivalent to:
\[
\max_{\rho'} (p^x + Ae^x) (1 - p^x) + p^x [1 - p^x + e^x I + e^x (1 - p^x)].
\]

Solving, gives the optimal solution in the text. The following comparative statics are immediate:
\[
\frac{\partial N^2}{\partial e} = \frac{\partial N^2}{\partial e} = \frac{\partial N^2}{\partial e} = 0; \quad \frac{\partial N^2}{\partial e} = \frac{\partial N^2}{\partial e} > 0;
\]
\[
\frac{\partial (N^2 - N^s)^2}{\partial e} = I + e^x \\
> 0.
\]

Proof of Proposition 5.1. Under the license model, second period utility of any first period adopter is not decreasing. \( U_1 (0, v) = v + e^x N^2 \geq v - p^x = U_1 (p^x, v) \).

If a buyer follows strategy \( \{a, n\} \) then \( U_1 (p^x, v) = \lambda e \geq 0 \), which is in turn dominated by \( \{a, a\} \) because \( U_2 (0, v) = U_1 (p^x, v) \). R. E. D.

Proof of Proposition 5.2. If \( \lambda = 0 \), only Strategy B is feasible. We have
\[
N^s = 1 - (1 - \lambda) p^x; \quad N^x = 1 - p^x + e^x N^x.
\]

Platform’s profit is
\[
p^x N^x + A (N^x + N^s) = p^x N^x + Ae^x N^x = 2AI.
\]

Proof of Proposition 5.3.
(i). Strategy A: \( p^x \geq e^x (I + e^x) \).

Under Strategy A, adoption follows:
\[
N^s = N^2 = 1 - \frac{p^x - e^x N^s}{2}.
\]

Platform’s problem is
\[
\max_{\rho'} (p^x + Ae^x) (1 - p^x - e^x N^s) = \frac{p^x + Ae^x (2 - p^x + e^x I)}{2 - e^x e^x}.
\]

Solving, yields the optimal solution. It follows immediately that, if
\[
p^x = e^x (I + e^x); \quad N^s = N^2 = 1 - \frac{p^x - e^x N^s}{2} = 1;
\]
otherwise if \( p^x = \frac{2 + e^x I - Ae^x}{2 - e^x e^x} \).

(ii). Strategy B: \( p^x < (I + e^x) \).

Under Strategy B, adoption follows:
\[
N^s = 1, \quad N^2 = 1 - p^x + e^x N^2.
\]

Platform’s problem is
\[
\max_{\rho'} p^x (1 - p^x + e^x (I + e^x)) + Ae^x
\]
s.t. \( p^x \leq e^x (I + e^x) \).

Solving, yields the optimal solution. It follows immediately that, if
\[
p^x = e^x (I + e^x); \quad N^s = N^2 = 1 - \frac{p^x - e^x N^s}{2} = 1;
\]
otherwise if \( p^x = \frac{2 + e^x I - Ae^x}{2 - e^x e^x} \).

Proof of Proposition 5.4. Consider the four cases in the proof of Proposition 5.3.
Case (i): \(e^b(I + 2e') + Ae' \geq 2 \) and \(e^b(I + e') \geq 1\).

\[
p^*_b = \frac{1 + e^b(I + e')}{2} = \frac{1 + e^b(I + e') - Ae'}{2(I + e')} = p^*.
\]

Case (ii): \(e^b(I + 2e') + Ae' \geq 2 \) and \(e^b(I + e') < 1\).

\[
p^*_b = e^b(I + e') \geq 0, \quad \frac{1 + e^b(I + e')}{2(I + e')} = p^*.
\]

First inequality is trivial. Second inequality is due to \(1 - Ae' < e'e'\), a direct consequence of \(e^b(I + 2e') + Ae' \geq 2 \) and \(e^b(I + e') < 1\).

Case (iii): \(e^b(I + 2e') + Ae' < 2 \) and \(e^b(I + e') < 1\).

\[
p^*_b = e^b(I + e') - Ae' \geq 0, \quad \frac{1 + e^b(I + e') - Ae'}{2(I + e')} = p^*.
\]

The inequality holds as long as \(e^b < 1\) which is a direct consequence of \(e^b(I + e') < 1\).

Case (iv): \(e^b(I + 2e') + Ae' < 2 \) and \(e^b(I + e') \geq 1\).

\[
p^*_b > p^*_b = e^b(I + e') \geq 0, \quad \frac{1 + e^b(I + e')}{2(I + e')} = p^*.
\]

Solving, yields the optimal solution in the text. It follows immediately that, if \(p^* = e^b(I + e') + (2 - e'e')c\), \(N^b_i = N^b_2 = 1 - c\); otherwise if \(p^* = \frac{1 + e^b(I + e') + (2 - e'e')c}{2}\).

Case (ii): \(p^* < e^bN^b_2\). Adoption follows.

\[
N^b_i = 1, N^b_2 = 1 - p^* + e^bN^b_2 .
\]

The platform’s problem

\[
\max_{p^*} p^*[1 - p^* + e^b(I + e')] + Ae'
\]

s.t. \(p^* < e^b[I + e']\).

Solving, yields the solution in the text. It follows immediately that, if \(p^* = e^b(I + e')\), \(N^b_i = N^b_2 = 1\); otherwise if \(p^* = \frac{1 + e^b(I + e')}{}\), \(N^b_i = N^b_2 = 2 + e^b(I + Ae')\).

Combine Case (i), (ii) and (iii), we have

\[
\frac{\partial N^b_i}{\partial e^b} = 0, \quad \frac{\partial N^b_2}{\partial e^b} = 0, \quad \text{and} \quad \frac{\partial (N^b_i - N^b_2)}{\partial e^b} \geq 0. \text{ Q. E. D.}
\]