Commodity Bundling and the Leverage of Market Power

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Abstract

The modern literature on commodity bundling argues that a monopolist may use bundling to extend its monopoly power into an otherwise oligopolistic market by foreclosing entrants or excluding rivals. This approach is contrary to the Chicago critique of Posner and Bork, who defend bundling as irrelevant to such monopolization, being incapable of extending the “one monopoly rent.” However, this paper shows that the Chicago position may actually understates the market structure case in favor of bundling. I find that bundling can enable entry; banning bundling can make feasible the extension of monopoly power via entry deterring. I first investigate the basic two-good model of Nalebuff (2004) where demands are independently distributed, and potential entry occurs in either market, and argue that bundling is never relevant to entry deterrence if the entrant’s product is a perfect substitute for the incumbent’s. I then show how bundling might be used as an entry-enabling device, if the incumbent and the potential entrant have differentiated products in one of the two markets. Finally I relate my analysis to the Microsoft case and to the genetically modified seed industry and discuss the relevant anti-trust policy implications.

1 If the monopolist were to earn a higher profit by selling a bundle in which the bundled product is also sold at marginal cost in a competitive market, it can make the same profits by pricing its monopolized product at the bundle price minus the marginal cost of the bundled product, without practicing bundling. Since the monopoly rent is the highest return the firm could get in the monopolized market, bundling is not leading to higher profits than the monopoly rent. The monopolist makes “only one monopoly rent”, therefore bundling cannot leverage market power from one market to another.
1. Introduction

Commodity bundling is a common marketing practice in today’s economy. A firm practicing bundling sells different commodities together in a package\(^2\). For example, MS Office is a bundle of Word, Excel, and Powerpoint, etc., a genetically modified seed is a bundle of basic seed and the added trait. The conventional interpretation of leverage theory is that bundling enables the monopolist to foreclose or exclude entry into the bundled good market (e.g. Kaysen and Turner 1959, Whinston 1990, and Nalebuff 2004). In this paper, however, I find that conceptually this interpretation is not always true and largely depends on the way the model is set up. In particular, I find that banning bundling may make feasible the extension of monopoly power via entry deterrence. Bundling can actually enable entry because it induces product differentiation which avoids the suicidal Bertrand pricing in a market of otherwise perfect substitutes.

Since Whinston’s seminal work in 1990, there has been a large body of research on the strategic reasons for bundling in business practice. Bundling may be a mechanism that enables a firm with monopoly power in one market to create entry barriers or to drive out rivals in a second market, or to affect research and development competition in the upstream market (e.g. Whinston 1990, Carbajo, De Meza, and Seidman 1990, Choi 1996, Chen 1997, Carlton and Waldman 2002, and Nalebuff 2004, et al.). The strategic role of bundling is an important issue because of its direct relevance to anti-trust policy as exemplified in several famous anti-trust court cases since the 1990s such as *Image Tech Services v. Eastern Kodak Co.*, and *US vs. Microsoft*. The Chicago school, in particular Posner, has criticized leverage theory because “there is only one

\(^2\) A closely related market practice is the “tie-in” sale. With a tie-in sale, the consumer purchases one good with the obligation to purchase from the same seller a second good. For example, if a farmer purchases Roundup Ready seed from Monsanto, he is practically tied to purchase Roundup pesticide if needed. If the tied and tying goods have to
monopoly profit” (Bork 1978), and argues that the main reason for bundling is price discrimination. However, Whinston (1990) shows that the Chicago school’s criticism critically depends on the assumption of perfect competition in the market for the bundled good. If there are economies of scale and strategic interactions occur in the bundled good market, Whinston argues that bundling can be used to drive/preclude bundled good market rivals from the market.

According to Whinston, the anti-trust concern regarding the use of commodity bundling is real in markets where there exist natural or artificial market power, such as offered by patent protection. Such markets are common in the fast growing computer software and internet industries, and in the agricultural biotechnology industry and related seeds and chemical sectors. Extension of patent protection to software and life science subjects has given substantial artificial monopoly power to players in these industries. The four-firm concentration ratio (CR4) was 47% for pesticides industry in 1997, 21% for seed industry in 1999, and 100% for plant biotechnology industry in 1998 (Hayenga and Kalaitzandonakes 1999).

In this paper, I propose an alternative interpretation of the strategic role of bundling in leveraging market power in an oligopolistic market. I first investigate a simple model similar to Nalebuff (2004), in which the incumbent’s and the potential entrant’s product are perfect substitutes, and potential entry occurs in only one market, I find that bundling is not relevant to entry deterrence; rather it is a profit maximization strategy. A credible commitment not to bundle can be used to effectively deter entry. Therefore, if bundling is banned explicitly due to the anti-competition concern, the monopoly firm can credibly commit ex ante not to bundle should entry occur, and therefore can successfully preserve its market power. I then examine a modified 2-firm model in which the incumbent firm and the potential entrant each have be consumed in fixed proportions, then it is essentially a “bundling” practice. Thus, commodity bundling may be viewed as a fixed-proportion tie-in sale.
differentiated products in one of the two markets. My analysis suggests that bundling is an effective entry-enabling strategy, therefore the potential entrant’s inability to bundle actually serves as entry deterrence. Theses findings have important implications for anti-trust policies. An anti-trust policy that bans bundling explicitly may actually help the monopolist successfully preserve its market power, because not only the monopolist has no credibility problem in committing not to bundle, but also the potential entrant can not use bundling to enter the market.

The paper is organized as follows. The paper presents the basic model with entry occurring only in one market and its results in section 2. Section 3 is an extension of the basic model in which entry potentially occurs in both markets. Then a brief assessment of the empirical relevance concludes this paper, in which I relate my analysis to the Microsoft case and to the market restructuring in the genetically modified seed industry.

2. The basic model

I begin with a basic model in which an incumbent firm has monopoly power in both products A and B, and a potential entrant may produce a perfect substitute for either A or B. A consumer of type \( d \) values A at \( d_A \) and B at \( d_B \). Consumer has unit demand for either product. The total market is normalized to be of size 1, and consumer’s budget is assumed not constraining. \( d_A \) and \( d_B \) are independently and uniformly distributed over \([0, 1]\).

Production is made possible by incurring a fixed entry cost, \( E \), either entering market A or entering market B. I first assume that the marginal cost is constant at 0 for both incumbent firm and the potential entrant firm. Assuming there is no possibility of entry, the incumbent firm sets prices \( P_A \), \( P_B \), and/or \( P_{bundle} \) to maximize its total profits in the two markets. \( P_A \), \( P_B \), and \( P_{bundle} \) denote prices for product A alone, B alone, and A and B as a bundle, respectively. The
incumbent has three strategies to follow, selling A and B separately (independent pricing) or as a bundle (pure bundling), or both (mixed bundling). Figure 1 illustrates consumer’s purchase behavior given the different pricing strategies.

**Figure 1. Consumer’s choice under independent pricing, pure bundling, and mixed bundling strategies.**

If it chooses to sell the products independently, then the firm’s objective is to choose prices of products A and B so as to

\[
\text{Max } \pi_i = P_i x_i = P_i \times \Pr(d_i > P_i) = P_i (1 - P_i),
\]

where \( i = A, B \), \( x_i \) is the demand for \( i \) at \( P_i \). The first order conditions yield \( P_A^* = P_B^* = 0.5 \), \( x_A^* = x_B^* = 0.5 \), and the profits \( \pi_A^* = \pi_B^* = 0.25 \) (or total profits of 0.5).

If the incumbent firm chooses the pure bundling strategy, then its objective is to choose the price for the bundle so as to

\[
\text{Max } \pi = P_{\text{bundle}} x_{\text{bundle}} = P_{\text{bundle}} \times \Pr(d_A + d_B > P_{\text{bundle}}) = P_{\text{bundle}} (1 - 0.5 P_{\text{bundle}}^2).
\]

The first order conditions yield \( P_{\text{bundle}}^* \approx 0.816 \), \( x_{\text{bundle}}^* = 0.667 \), and the total profits = 0.544.

If the incumbent firm chooses the mixed bundling strategy, then its objective is to choose the prices of the bundle and products A and B so as to
Applying the symmetric pricing of product A and B, I find $P_{bundle}^\ast = P_A = P_B \approx 0.816$, $x_{bundle} = 0.667$, $x_A^\ast = x_B^\ast = 0$, and the total profits are 0.544. This outcome is essentially the same as that of the pure bundling strategy. Although mixed bundling is usually a dominant strategy, it does not entail any extra benefits to the firm given this simple uniform distribution of consumers. This result is consistent with Adams and Yellen (1976) statement that mixed bundling strategy is no worse than any other strategy, because it can always set the prices such that the outcome duplicates that of either pure bundling case or independent pricing case.

If, however, entry occurs, I assume that the entering firm and the incumbent firm play Bertrand competition. Without loss of generality, I assume that the entry occurs in the market for B (I shall discuss the case of entry into both A and B markets later). If the incumbent firm chooses an independent pricing strategy or a mixed bundling strategy, Bertrand competition will drive the price of B to marginal cost level (if I do not consider entry cost yet), the entrant makes zero profits in the B market, the incumbent firm makes single monopoly profits in A market, which is 0.25 (see the analysis of independent pricing strategy case earlier).

If the incumbent firm chooses pure bundling strategy, then the incumbent firm’s objective is to choose the bundle’s price so as to

$Max \pi = P_{bundle} x_{bundle} + P_A x_A + P_B x_B$

$= P_{bundle} \times Pr(d_A > P_{bundle}, d_B > P_{bundle} - P_A, and d_A + d_B > P_{bundle})$

$+ P_A \times Pr(d_A > P_A, and d_B < P_{bundle} - P_A) + P_B \times Pr(d_B > P_B, and d_A < P_{bundle} - P_B)$.

The entrant firm’s objective is to choose price of product B so as to
\[ \text{Max } \pi_{\text{entrant}} = P_B x_B \]
\[ = P_B \times \text{Pr}(d_B > P_B, \text{ and } d_B - P_B > d_A + P_B - P_{\text{bundle}}). \]

The best response function is
\[ P_B^* (P_{\text{bundle}}) = \frac{1}{3} \left(1 + P_{\text{bundle}}\right) - \frac{1}{3} \sqrt{1 - P_{\text{bundle}} + P_{\text{bundle}}^2}. \]

Substitute \( P_B \) in the first order condition of the incumbent firm’s profit maximization problem to yield \( P_{\text{bundle}}^* \approx 0.681, x_{\text{bundle}} = 0.549, P_B^* = 0.266, x_B^* = 0.305, \) and the total profits are 0.374 and 0.081 for the incumbent firm and the entrant firm, respectively.

Now I introduce the game that the firms are playing. I consider a three-stage game. In the first stage, the incumbent firm decides on bundling or not via some commitment device such as product design, and incurs the entry costs to enter the market. In the second stage, the potential entrant decides whether or not to enter the market. In the final stage, firms compete in prices if both are in the market. The entrant incurs the entry cost in this stage.

2.1. The Equilibrium

Stage 3:

I start by analyzing the equilibrium behavior at the third stage first. I first consider the case where entry occurs or is threatened in only one market. Without loss of generality, I assume that the potential entrant enters the B market. First of all, I assume that the potential entrant will enter. If the incumbent firm does not bundle, since the two firms’ products are perfect substitutes, Bertrand competition will drive the price down to the marginal cost, therefore both firms make zero profits in the B market. The entrant will bear a loss equal to the entry cost \( E \). In the A market, the incumbent firm will reap its monopoly rent by setting price at 0.5, and earn 0.25 as profits. Thus, the incumbent’s total profits are 0.25, and the entrant’s profits are \(-E\).
However, if the incumbent made the decision in the first stage to bundle, then in the third stage, the Nash-Bertrand competition equilibrium will result in profits of 0.374 for the incumbent firm and 0.081-$E$ for the entrant. Both firms’ profits are higher than earlier, 0.374 vs. 0.25 and 0.081-$E$ vs. -$E$, because bundling increases product differentiation and thus decreases the competition.

If the potential entrant does not enter, then the incumbent will make profits of 0.50 if it does not bundle, and make profits of 0.544 if it does bundle. The payoffs to both firms with incumbent firm’s different strategies (pure bundling and independent pricing) are listed in table 1 for different price levels for a bundle, gross of the entry cost.

**Table 1. Payoffs of the incumbent firm and the entrant firm**

<table>
<thead>
<tr>
<th>$P_{bundle}$</th>
<th>$\pi_{inc}$ (no entry)</th>
<th>$\pi_{inc}$ (entry)</th>
<th>$\pi_{ent}$ (entry)</th>
<th>$P_A$</th>
<th>$\pi_{inc}$ (no entry)</th>
<th>$\pi_{inc}$ (entry)</th>
<th>$\pi_{inc}$ (entry)</th>
<th>$\pi_{ent}$ (entry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>0.500</td>
<td>0.278</td>
<td>0.148</td>
<td>0.500</td>
<td>0.500</td>
<td>0.25</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>0.816</td>
<td><strong>0.544</strong></td>
<td>0.357</td>
<td><strong>0.108</strong></td>
<td>0.500</td>
<td>0.500</td>
<td>0.25</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>0.681</td>
<td>0.523</td>
<td><strong>0.374</strong></td>
<td><strong>0.081</strong></td>
<td>0.500</td>
<td>0.500</td>
<td>0.25</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>0.619</td>
<td><strong>0.500</strong></td>
<td>0.370</td>
<td>0.069</td>
<td>0.500</td>
<td>0.500</td>
<td>0.25</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>0.408</td>
<td>0.374</td>
<td>0.308</td>
<td>0.034</td>
<td>0.500</td>
<td>0.500</td>
<td>0.25</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

**Stage 2:**

In the second stage, the potential entrant’s decision on entry or not depends on its belief on the incumbent’s bundling decision in the first period and the size of the entry cost. If entry cost is high (greater than 0.081), then the potential entrant will not enter no matter whether the incumbent firm bundles or not. By examining the left half of the table (the bundling case), if the
entry cost is higher than 0.081, then there is no threat of entry to market B. Without the threat of
every, the incumbent firm will adopt a bundling strategy, set a bundling price of 0.816, and make
the maximum possible profits of 0.544. If entry occurs, the entrant firm makes gross profits of
0.108 at incumbent firm’s current price of 0.816. However, the bundle price of 0.816 is not
sustained because it is now optimal for the incumbent firm to charge 0.681, which will earn the
incumbent profits of 0.374 compared to profits of 0.357 at price 0.816. If the bundle price drops
to 0.681, the entrant’s gross profits will be 0.081, which is not sufficient to cover the entry cost.

If, however, the incumbent’s current strategy is independent pricing, and if the potential
entrant decides to enter the B market, then the incumbent firm’s profits will be eroded to 0.25,
given that it still stay with independent pricing strategy (see the right half of table 1). It is
optimal for the incumbent firm to respond by switching to pure bundling strategy. If the entry
occurs, the incumbent firm will set the bundle price at 0.681, and making profits of 0.374. Again,
the entrant firm’s profits are 0.081, insufficient to cover the entry cost. Expecting this outcome,
the potential entrant will not enter. The incumbent firm shall choose bundle price of 0.816 and
makes 0.544 as profits. Therefore, I have the following result,

Result 1. If entry cost is high (greater than 0.081), entry does not occur regardless of the
incumbent’s bundling strategy. The bundling strategy never serves as an entry deterrence device.
The incumbent firm adopts a pure bundling strategy to reap the price discrimination benefits
absent entry.

Bundling is also a best response to entry if entry should occur, but entry is not an
equilibrium outcome.

If the entry cost is low ($E < 0.081$), then the potential entrant will not enter if it believes
that the incumbent firm commits not to bundle, and it will enter if it does not believe the
incumbent firm’s non-bundling commitment is credible. If the incumbent firm could succeed in committing to independent pricing strategy, then it makes profits of 0.50 absent entry, and 0.25 if entry is not deterred. However, the potential entrant firm will make no gross profits in the B market if it does enter due to Bertrand competition. If the incumbent firm’s commitment to an independent pricing strategy is not credible, then as I discussed earlier, its post-entry optimal strategy is to respond by bundling, setting the bundle price at 0.681, and making profits of 0.374. The entrant firm will make 0.081 gross profits, sufficient to cover its entry costs. There is no need for bundling commitment because as long as the incumbent firm could not make commitment not to bundle, the entrant would expect the incumbent firm to respond by bundling (0.374 > 0.25). In fact, bundling is not an entry-deterring device, rather it both attracts and accommodates entry. Moreover, commitment not to bundle serves as an entry-deterring tool, because the “Bertrand-Nash postentry pricing is a very powerful entry deterrent tool” (Nalebuff, 2004). I have the following result,

Result 2. If entry cost is low, (lower than 0.081 in our setup), commitment to unbundling serves as an entry deterring device. A bundling strategy is the best response to entry but inability to commit not to bundle in effect serves as an entry-facilitating device.

Stage 1:

In the first stage, the incumbent firm decides on whether to bundle or not to bundle, or no commitment. My analysis above suggests that if the incumbent firm could make credible commitment not to bundle, then its payoff is always 0.5. If the incumbent chooses bundling with or without commitment, then it may get a higher profit of 0.544 absent entry, while at a risk of
earning a lower profit of 0.374 if bundling facilitates the potential entry. If the entry cost to the market is known, then results 1 and 2 suggests that

Proposition 1: If entry costs are sufficiently high, bundling strategy is irrelevant to entry deterrence. The incumbent firm bundles to maximize its profits.

In practice, entry cost may be private information to the potential entrant, or more generally may be uncertain for the incumbent. Note that the potential loss \((0.50 - 0.374 = 0.126)\) faced by the incumbent firm if entry should occur is about six times of the potential gain \((0.544 - 0.50 = 0.044)\) should entry not occur, if it adopts bundling strategy.

Product design may be a credible commitment as it usually involves long-term costs. Joining a standards association may be part of such a commitment strategy. Another commitment device might be that the incumbent firm sells its monopoly rights in the B market to a third party. For example, the incumbent firm may offer an exclusive licensing or exclusive compulsory licensing to a third party to enter B market, if its monopoly power comes from patent protection. Ironically, if the government explicitly bans bundling because of the fear that bundling may be used to leverage market power, the incumbent firm will have no problem in its credibility of commitment to unbundling, and therefore successfully preserves its market power. Therefore, I have

Proposition 2: A credible unbundling strategy successfully deters potential entry to B market.

The difference between proposition 1 and 2 is whether or not a credible unbundling strategy is necessary in deterring market entry. Proposition 2 says that a credible unbundling strategy is always successful in deterring entry to B market, thus a sufficient condition for being a market deterrence strategy, while proposition 1 says that when entry cost is high, there is no
need to use the credible unbundling strategy (entry cost itself deters entry), thus not a necessary condition for being a market deterrence strategy.

Nalebuff (2004) argues that bundling is an effective entry barrier in the same model setup as in this paper. Nalebuff first makes the key assumption that the incumbent sets its prices prior to the challenger’s entry decision, and prices are then fixed for the rest of game. Later he relaxes this assumption and argues that the entry-deterring effects of bundling do not rely on holding price fixed. His analysis in fact shows that if price is allowed to change, then it is optimal for the incumbent firm to bundle in the post-entry equilibrium, which is not a pre-entry equilibrium. My analysis suggests that it is entry cost that deters entry, while bundling actually serves as entry encouragement.

The post-entry Nash-Bertrand game analysis is not evidence for the credibility for bundling commitment as an entry deterrence strategy; rather implies that it is a best response to entry (not \textit{ex ante} deterrence). That is, bundling is a loss-mitigating strategy when the entrant already is in place.

Suppose two firms happen to enter a market simultaneously without knowing the other’s behavior beforehand. Bertrand competition leads to zero profits if both firms produce identical products at the same marginal costs. Suppose that one firm has monopoly power in another market, then the monopoly firm could use bundling to differentiate its product from the other’s, which will help the other firm too. The bundling firm will charge a bundle price of 0.681 and make profits of 0.374 instead of 0.25 (\(E\) is sunk assuming entry already occurs), the competing firm makes 0.081 instead of 0.

Following the same line of thinking, bundling may be used as an entry-enabling strategy. Suppose there are two patent holders, 1 and 2, each with monopoly power in its own market.
Following the setup I made at the beginning, each firm charges a monopoly price of 0.5 and makes profits of 0.25. Now suppose that firm 1’s patent is about to expire, and firm 2 is considering entering that market. If firms 1 and 2 would produce perfect substitutes at the same marginal cost, then firm 2 would expect to earn zero profits in firm 1’s market. Firm 2 may not enter if entry incurs any costs. However, if it chooses to bundle the two products, our analysis earlier suggests that it could make 0.374 instead of 0.25. As long as the entry costs are no more than 0.374 – 0.25 = 0.124, the entry would occur. In this case, bundling is used as an entry-enable strategy.

Result 3: A bundling strategy can serve as a product differentiation device. If entry cost is not too high, bundling could be used as an entry-enabling strategy by a monopolist to enter another otherwise monopolized market.

3. Extension: potential entry into both markets

So far my analysis is built on the assumption that entry would occur in only one market. This assumption may often be realistic for reasons not considered in the model, such as higher uncertainty or much greater cost of simultaneously entering two markets. However, it is also possible that potential entry occurs or is threatened in both markets. For example, there may be two potential entrants, one targeting market A and another targeting market B.

3.1. The basic model

I first consider the case where entrant A targets the A market and entrant B targets the B market. I follow the same setup and model assumptions as earlier, including how the game is played.
Assume, absent entry, the incumbent firm’s payoff under each strategy is the same as in
the basic model considered in section 2. Assume entry occurs in only one market (assuming in B
market), then the payoff is as given in table 1. If the entry occurs in both markets and the
incumbent firm adopts an independent pricing strategy, then Bertrand competition drives profits
in both markets to zero (assuming $E$ is sunk). Meanwhile, the entrant firms may choose to
coordinate or not. By coordination, I mean that the entrant firms could supply their products in a
bundle too. Given that the incumbent firm adopts a bundling strategy, it is straightforward to
show that the entrant firms would not choose to coordinate because the Bertrand competition will
drive the bundle price to the marginal cost, which leaves zero profits. Thus I examine the
situation where products are sold in a bundle (assuming by the incumbent firm), and separately
(assuming by the two entrant firms).

Therefore, the incumbent firm’s objective is to choose the bundle’s price so as to

\[
\begin{align*}
\text{Max } \pi_{\text{incumbent}} &= P_{\text{bundle}} \times x_{\text{bundle}} \\
&= P_{\text{bundle}} \times \Pr(d_A + d_B > P_{\text{bundle}}, d_A + d_B - P_{\text{bundle}} > d_A - P_A, \text{and } d_A + d_B - P_{\text{bundle}} > d_B - P_B),
\end{align*}
\]

where $P_A$ is entrant A’s price of product A, and $P_B$ is entrant B’s price of product B.

Since the entrant firms do not coordinate, i.e. they sell their products independently, the
entrant firm’s objective is to choose price of product A or B so as to

\[
\begin{align*}
\text{Max } \pi_{\text{entrant}_i} &= P_i x_i \\
&= P_i \times \Pr(d_i > P_i, \text{and } d_i < P_{\text{bundle}} - P_i),
\end{align*}
\]

where $i = A, B$, $x_i$ is the demand for the entrant’s product $i$ at $P_i$.

The best response function is

\[
P_i^* (P_{\text{bundle}}) = \frac{1}{3} (1 + P_{\text{bundle}}) - \frac{1}{3} \sqrt{1 - P_{\text{bundle}} + P_{\text{bundle}}^2}.
\]

Plug them back to the first order condition of the incumbent firm’s profit maximization problem,
I find that the equilibrium prices will converge to 0, essentially the same as that in the
independent pricing game. This result is due to the assumption of the uniform distribution of consumers. At any bundling price, the entrant firm has incentive to price its product low enough to steal away some marginal consumers from the incumbent firm; however, the stealing effects are so big that the incumbent firm has incentive to price the bundle lower to get those consumers back. Thus the equilibrium ends up with erosion of all the profits in both A and B markets.

Therefore, I conclude that there is no incentive for an entrant firm to enter market A, given that another entrant is in market B, no matter which strategy is currently used by the incumbent firm. Also there is no incentive for the potential entrants to coordinate in entering markets A and B.

Now I will examine the case where a single potential entrant firm is considering entering both markets. My analysis of the coordination problem above suggests that it won’t pay to enter the 2nd market. If the incumbent’s commitment not to bundle is not credible, the entrant firm expects to make 0.081 gross profits if it chooses to enter only one of the two markets. If it continues to enter the 2nd market, the market profits will be washed away entirely, including the incumbent’s profits of 0.374. Therefore, I conclude the following

Result 4: If the incumbent’s and the potential entrant’s products are perfect substitutes in both markets, then there is no incentive to enter the 2nd market, whether or not the incumbent firm practices bundling.

3.2. A modified two-firm model

So far I have focused on the simplest case where the incumbent firm and the potential entrant’s products are perfect substitutes. I will introduce some complication to the simplest model. I allow two players (two incumbents or one incumbent and one potential entrant) in the
A market, each with differentiated products, A1 and A2. I still retain homogeneous assumptions in the B market. The other assumptions remain the same as in earlier setup.

To keep my model as simple as possible and to avoid unnecessary notation, I assume that consumer has perfectly negatively correlated reservation values over A1 and A2 such that \(d_{A1} + d_{A2} = 1\). This setup is similar to the travel cost model, in which A1 and A2 lie at either end of a unit interval, and consumers are uniformly distributed along the unit interval, with travel cost at -1 per unit.

Without entry, the payoffs to the incumbent firm using different strategies are the same as what I have discussed earlier in the basic model. If the potential entrant enters market A, and the incumbent firm plays independent pricing, then the entrant firm and the incumbent firm would have to solve

\[
\begin{align*}
\text{Max } \pi_{\text{incumbent, }A1} &= P_{A1} x_{A1} \\
&= P_{A1} \times \Pr(d_{A1} > P_{A1}, d_{A1} - P_{A1} > d_{A2} - P_{A2}),
\end{align*}
\]

\[
\begin{align*}
\text{Max } \pi_{\text{entrant, }A2} &= P_{A2} x_{A2} \\
&= P_{A2} \times \Pr(d_{A2} > P_{A2}, d_{A2} - P_{A2} > d_{A1} - P_{A1}),
\end{align*}
\]

where \(P_{A1}\) is the incumbent’s price of its product A1, and \(P_{A2}\) is entrant’s price of product A2.

I derive that \(P_{A1}^* = P_{A2}^* = 0.5\), and \(\pi_{\text{incumbent, }A1} = \pi_{\text{entrant, }A2} = 0.25\). The incumbent firm’s price and market share and profits are the same as in monopoly case before. In fact, the entrant firm takes away exactly those who were not served in the monopoly case. As a result, the two firms are two local monopolists. Therefore, the incumbent firm does not care about the entrant, if the dominant strategy is independent pricing.

Next I consider the case where the incumbent firm bundles A1 and B while the entrant firm sells A2. The objective functions of both firms are
Max $\pi_{\text{incumbent}_A1} = P_{\text{bundle}}x_{\text{bundle}}$

$= P_{\text{bundle}} \times \Pr(d_{A1} + d_B > P_{\text{bundle}}, d_{A1} + d_B - P_{\text{bundle}} > d_{A2} - P_{A2})$, and

Max $\pi_{\text{entrant}_A2} = P_{A2}x_{A2}$

$= P_{A2} \times \Pr(d_{A2} > P_{A2}, d_{A2} - P_{A2} > d_{A1} + d_B - P_{\text{bundle}})$.

The first order conditions yield the following results using numerical iterations: $P_{\text{bundle}}^* \approx 0.836$, $x_{\text{bundle}} \approx 0.565$, $P_{A2}^* \approx 0.535$, $x_{A2}^* \approx 0.366$, and the total profits are 0.472 and 0.196 for the incumbent firm and the entrant firm, respectively.

Now I consider the B market. If the entrant firm also enters in B market, assuming that the incumbent firm adopts independent pricing strategy, then Bertrand competition will drive the prices down such that the profits in B market will become zero. Therefore, with independent pricing strategy, the potential entrant will find it profitable to enter the A market alone, but not worth to enter B market alone.

Next I assume that after the entrant enters both A and B markets, both the incumbent and the entrant firms sell their products in bundles only. Figure 2 illustrates the consumer’s choice in that scenario.

**Figure 2.** Consumer’s choice when A1 bundles with B and A2 bundles with B, $d_{A1} + d_{A2} = 1$. 
I follow the same steps as I solve for the equilibrium in other subgames. I find that $P_{A1/B}^* = P_{A2/B}^* = 0.934, x_{A1/B} = x_{A2/B} = 0.406$, and the total profits are 0.379 for both the incumbent firm and the entrant firm.

I then consider the case where one firm bundles if both firms are in markets A and B. Figure 3 illustrates the consumer’s choice in this scenario. The bundling firm (assume it is the incumbent firm) would like to

$$\text{Max } \pi_{\text{incumbent}} = P_{\text{bundle}} x_{\text{bundle}}$$

$$= P_{\text{bundle}} \times \Pr(d_{A1} + d_B > P_{\text{bundle}}, d_{A1} + d_B - P_{\text{bundle}} > d_{A2} - P_{A2}, d_{A1} + d_B - P_{\text{bundle}} > d_{A2} + d_B - P_B - P_{A2}).$$

The unbundled firm’s objective is to choose price of product A2 and B so as to

$$\text{Max } \pi_{\text{entrant}} = P_{A2} x_{A2} + P_B x_B$$

$$= P_{A2} \times \Pr(d_{A2} > P_{A2}, (d_{A2} - P_{A2} > d_{A1} + d_B - P_{\text{bundle}}) \text{ or } (d_{A2} - P_{A2} - P_B > d_{A1} - P_{\text{bundle}}))$$

$$+ P_B \times \Pr(d_B > P_B, (d_{A1} - P_{\text{bundle}} + P_B < 0) \text{ or } (d_{A2} - P_B - P_{A2} > d_{A1} - P_{\text{bundle}})).$$

Figure 3. Consumer’s choice when A1 bundles with B, A2 and B are independently supplied, $d_{A1} + d_{A2} = 1.$
The calculation is tedious and I use MATLAB to simulate the results. I yield $P_{\text{bundle}*} \approx 0.755$, $x_{\text{bundle}} = 0.482$, $P_B^* = 0.275$, $x_B^* = 0.348$, $P_{A2}^* = 0.52$, $x_{A2}^* = 0.48$ and the total profits are 0.364 and 0.345 for the incumbent firm and the entrant firm, respectively. I summarize the payoffs of all scenarios in table 2. The shaded columns in table 2 are cases where bundling is involved.

Table 2 suggests that the most desirable outcome for the incumbent firm is that it adopts bundling strategy given that there is no threat of entry to either market. The incumbent firm would charge 0.816 for the bundle and make profits of 0.544. However, this outcome is not sustained because if the incumbent firm adopts pure bundling strategy, then the potential entrant shall choose to enter both markets and sell its products in a bundle too. In fact, it is the most desirable outcome for the potential entrant. Both the entrant firm and the incumbent firm would charge 0.934 for the bundle, and each will earn profits of 0.379.

If, however, the incumbent firm adopts an independent pricing strategy, the potential entrant would choose between either entering market A only, or entering both markets and bundling. If the entry occurs in market A only, the potential entrant earns profits of 0.25. If the entry occurs to both markets, the entrant should bundle its products, given that the incumbent firm commits to independent pricing strategy, and earns profits of 0.364 (the profits of the bundled firm, which is assumed to be the incumbent in table 2). Given the entrant’s strategy, the incumbent firm earns profits of 0.345 if it stays with the independent pricing strategy. However, expecting that the entrant would choose bundling strategy, the incumbent firm should respond by pure bundling strategy too, and both firms will make 0.379, higher than the payoffs when only one firm bundles. Thus, if the entry costs to both markets are not too much higher than entering
only market A (less than 0.364 – 0.25 = 0.115, or even 0.379 – 0.25 = 0.129), then the potential entrant should enter both markets and adopt bundling strategy.

Result 5: If consumers’ taste for the incumbent’s and the potential entrant’s products are differentiated in market A such that \( d_{A1} + d_{A2} = 1 \), but non-differentiated in market B, then the potential entrant would use bundling strategy aggressively to enter both markets. Bundling strategy is entry facilitating.

Table 2. Payoffs of the incumbent firm and the entrant firm, \( d_{A1} + d_{A2} = 1 \)

<table>
<thead>
<tr>
<th>Entry decisions</th>
<th>Entry to A alone</th>
<th>Entry to B alone</th>
<th>Entry to both A and B</th>
<th>No entry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrant’s products</td>
<td>( A2 )</td>
<td>( A2 )</td>
<td>( B )</td>
<td>( B )</td>
</tr>
<tr>
<td>Incumbent’s products</td>
<td>( A1, B )</td>
<td>( A1/B )</td>
<td>( A1, B )</td>
<td>( A1/B )</td>
</tr>
<tr>
<td>( P_{bundle} )</td>
<td>--</td>
<td>0.836</td>
<td>--</td>
<td>0.681</td>
</tr>
<tr>
<td>( P_{A1} )</td>
<td>0.5</td>
<td>--</td>
<td>0.5</td>
<td>--</td>
</tr>
<tr>
<td>( P_{A2} )</td>
<td>0.5</td>
<td>0.535</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>( P_{B} )</td>
<td>0.5</td>
<td>--</td>
<td>0</td>
<td>0.266</td>
</tr>
<tr>
<td>( \pi_{ent} )</td>
<td>0.25</td>
<td>0.196</td>
<td>0</td>
<td>0.081</td>
</tr>
<tr>
<td>( \pi_{inc} )</td>
<td>0.5</td>
<td>0.472</td>
<td>\textbf{0.25}</td>
<td>0.374</td>
</tr>
</tbody>
</table>

It is interesting to check whether independent pricing strategy could still serve as market deterrence strategy as I have shown in the basic model. The payoff table suggests that if the incumbent firm commits to independent pricing, then the best the entrant could earn is 0.364. If the incumbent firm does not commit to independent pricing, then the entrant expects the incumbent to bundle too and makes 0.379. Commitment to independent pricing does lower the potential entrant’s expected return, but only by 4%.

Results 6: If an imperfect substitute exists for one of the two products, the effectiveness of independent pricing strategy as entry deterrence may decrease but do not disappear.
Seidmann (1991) introduced a similar model in which he argued that bundling may facilitate supra-competitive prices for the bundled product. Seidmann assumes that there are two groups of consumers who only value one version of the product A, either A1 or A2. Consumers in group 1 value A1 at the same positive constant, and assign zero value to A2, vice versa for consumers in group 2. He also assumes positive marginal production cost for product A1 and A2. I modify the two-firm model following Seidmann. I assume that half the consumers value A1 at \(a\) \((0 < a \leq 1)\) and A2 at 0, while the other half consumers value A1 at 0 and A2 at \(a\).

I derive the equilibrium payoffs of each subgame as in table 2 and summarize my results in table 3. Again, the shaded columns stands for the case where bundling is used by either or both firms. It is straightforward to verify that \(0.5a < \frac{1}{8}(1+a)^2 < 0.125 + 0.5a < 0.25 + 0.5a\) for all \(a\) lying between \((0, 1)\). I conclude that if the entry threat is only in market A, then the incumbent firm does not care about the entry and will adopt the independent pricing strategy as if absent entry. The payoff to the incumbent firm is \(0.25 + 0.5a\). The payoff to the entrant (to the market A) is \(0.5a\). If the entry threat is in market B only, then the incumbent’s commitment to independent pricing strategy could deter the entry effectively.

However, if entry occurs in either market already, the entrant always finds it optimal to enter to the other market. The best payoff of entering one market (i.e. market A) is \(0.5a\), while the payoff of entering both markets increases to \(\frac{1}{8}(1+a)^2\) if the entrant firm bundles, and \(0.125 + 0.5a\) if the incumbent firm bundles but not the entrant firm. No matter which strategy the incumbent firm will choose, the potential entrant always find it worthwhile to enter both markets if a bundling strategy is allowed because \(0.5a < \frac{1}{8}(1+a)^2 < 0.125 + 0.5a\). Thus result 5 above still holds here that entry would occur in both markets and bundling strategy facilitates the entry.
If bundling is banned universally, then the best outcome that the potential firm can get is to enter the market A only, receiving $0.5a$ while bearing entry cost to only one market. It won’t pay for the potential entrant to enter both markets, because the potential return is still $0.5a$ but the firm needs to bear entry cost twice. Given that the potential firm would choose to enter the A market only, the incumbent firm will receive the highest payoff it could get, i.e. $0.25 + 0.5a$. I conclude that

**Result 7:** Any device or policy that disables the potential entrant to bundle may serve as entry deterrence. The incumbent firm benefits from such a policy.

Furthermore, since $\frac{1}{8}(1+a)^2 < 0.125 + 0.5a$ except for $a = 1$, the firm (either the incumbent or the entrant) who is able to commit to independent pricing is better off than the firm who could not commit. If the incumbent firm could commit to independent pricing strategy, then the potential entrant’s payoff could be lowered by $\frac{1}{8}(1-a)^2$. If $a = 0.25$, then the reduction in gains of entering both markets is about 44%, which is considerable. If the entry cost to both markets is much higher than entering only one market, it is possible that the potential entrant will
enter only market A, or do not enter at all, in either case the incumbent firm could earn its highest payoff of $0.25 + 0.5a$. Thus I have

*Result 8:* If consumers’ taste follows bimodal distribution in one of the two markets, then

1. *the incumbent firm’s* ex ante commitment to independent pricing strategy may serve as an entry deterrence strategy;
2. *if entry occurs, commitment to independent pricing strategy mitigates the impact of entry;*
3. *bundling serves as a best response to the independent pricing strategy.*

Seidmann (1991) does not investigate the entry deterrence effects of firm’s bundling strategies, although he shows that bundling may facilitate supra-competitive prices for the bundled good. Whinston (1990) also mention that high levels of dispersion of valuations for good A and low levels of differentiation in market B are necessary for firms’ profits to rise if the incumbent firm bundles. However, Whinston does not consider entries into both markets and the strategic effects of bundling/unbundling in that scenario.

### 4. Conclusions and empirical relevance

In this paper, I have argued that a monopolist can use bundling to enter another monopolized market by creating product differentiation, thus avoiding the otherwise suicidal Bertrand pricing in the bundled good market. If a multiple-products monopolist would like to preserve its market power in these markets, an effective entry deterrence strategy is to commit to independent pricing strategy credibly.

I attempt to draw some empirical relevance of my analysis to the real life examples. One case is the dramatic restructuring in the agricultural biotechnology industry. A genetically modified (GM) seed may be viewed as a bundle of basic seed and the trait. Thus if the firm
supplies only the GM seed, it can be viewed as practicing pure bundling; if the firm supplies both the GM seed and the basic seed, it can be viewed as practicing mixed bundling. According to the analysis of the perfect substitute model in this paper, the most effective entry deterring strategy is a credible ex ante commitment to pure bundling (mixed bundling in the GM seed case). As I have shown in section 2 and 3, in the post-entry equilibrium, pure bundling is the best response to the entry, therefore the potential entrant always expect this outcome if the incumbent’s commitment to independent pricing (mixed bundling) is not credible. Integration forward of the gene biotech company to the seed breeder may be part of the commitment device because with integration, the gene/breeder could license the basic to a third party, thus take care of the credibility of commitment to the mixed bundling in the post-entry equilibrium. My analysis therefore provides some insights on why the vertical integration in this industry is achieved through integration forward, not through exclusive licensing.

Another real life case in which my analysis may be applicable is in the computer software industry. In the *U.S. vs. Microsoft* case, the government asserted that Microsoft engaged in anticompetitive conduct by compelling computer manufactures to license and install Internet Explorer (IE), entering into contracts that tended to exclude rivals, and practicing various forms of predatory conduct (Gilbert and Katz 2001). Microsoft defended its behavior on the grounds that the contracts enabled Microsoft to build its share in the browser market quickly to become a major competitor to Netscape. According to Ad-Knowledge, Inc., IE’s share of monthly browser usage increased from 20% in January 1997 to more than 50% by August 1998 (Gilbert and Katz 2001). This claim is consistent with the prediction of this paper, in which the monopolist of operation system will use bundling to enter the preoccupied browser market. If bundling were not allowed, neither in technical design, nor in contract, then it would be possible that IE never
gets to the browser market, and the Netscape might dominate the browser market. Initially
Netscape Navigator was priced significantly above marginal cost. So absent IE’s entry,
consumers would have been worse off.

However, Microsoft’s story is more complicated than the simple model described in this
paper. The government alleged that Microsoft’s primary purpose is not to gain market share in
the browser market, but to keep Netscape Navigator from becoming well established as a
browser so that it could not evolve into an operating system competitor.

Carlton and Waldman (2002) discussed how the bundling of complementary products in
the current period could be used to preserve monopoly power in the second period. Applying
their model to Microsoft’s case, primary good, the Windows system, and complementary good,
the browser, must be consumed together in order to generate value to the consumer. In period 1,
Microsoft has monopoly power on Windows system, while both Microsoft and Netscape could
produce browsers at the same marginal cost. However, the consumers value Netscape Navigator
more than IE (this assumption makes sense if considering Netscape Navigator’s dominant role
before IE takes over the market). In period 2, Netscape could enter the operating system market
and produce another version of operation system as Microsoft’s Windows at same marginal costs.

According to Carlton and Waldman, Microsoft should use bundling to stop Netscape’s
entry into browser market in period 1 (what is happening is that Microsoft is alleged to driving
Netscape out of the browser market). Netscape’s loss of profits from Navigator in period 1 will
make its profits in period 2 alone insufficient to cover its entry costs to both operating system
market and browser market in period 2. Therefore, Netscape will never enter the operating
system market in period 2, neither does to the browser market. While bundling makes Microsoft
unable to share the extra surplus generated by Navigator compared to IE, which is fairly big
according to its impact on Netscape’s 2nd period decision making, Microsoft ensures its monopoly profits from the Windows system, which is even bigger.

The question is: why Microsoft chooses to use bundling as a foreclosure strategy? Carlton and Waldman pointed out in their paper that if the extra surplus of Navigator is received all by Netscape, then even if Microsoft did not bundle, Netscape would never enter the operating system market. If this is true, then the payoff to Microsoft if it does not bundle and forgo the extra surplus of Navigator, is exactly the same as if it uses the bundling strategy, which is equal to the monopoly rent in the operating system market. It seems that Microsoft may even do better by producing Windows alone and charge it the monopolist price in every period. The equilibrium will be such that Microsoft produces Windows alone and receive all the monopoly profits (while saving the entry costs to the browser market), and Netscape produces Navigator alone and receive the entire surplus in every period. Another equilibrium is: Microsoft supplies both Windows and IE in period 1, and share half of the extra surplus related to Navigator with Netscape (in Carlton and Waldman’s manner), then in period 2 Microsoft withdraws from the browser market such that Netscape would now receive the entire surplus. If the half surplus is big enough to cover the entry costs to the browser market, then the 2nd equilibrium is preferred by Microsoft.

Both equilibriums do not seem plausible in the real life Microsoft case, because of the dubious assumption by Carlton and Waldman that Netscape would never enter the operating system if it receives the entire browser surplus. Microsoft’s fundamental worry is not whether or not Netscape will develop an operating system if it earns enough profits to cover the entry costs, but the existence of Navigator, that provide a carrier possibility for the development of another operating system. Therefore, if the speculation is right, then Microsoft’s purpose is to eliminate
the existence of Navigator, either by “killing it” or by buying over the technology, rather than to eliminate Netscape’s capability to enter the operating system market. This is consistent with what this paper would suggest. First, Microsoft bundles IE with Windows to enter the otherwise monopolized browser market. The price for Navigator is driven down, which may make Netscape withdraw from the browser market because of the reduced profitability in the browser market. Second, this paper suggest that if potential entry occurs in both markets, then given certain degree of product differentiation, the entrant would use bundling aggressively to enter the market. One way to stop entry is simply getting rid of the product that could be potential bundled the entrant. So, if Microsoft would like to stop entry to the operating system market, it can do so by eliminating the existence of Navigator, which is exactly what the government alleged. Finally, it seems that, according to the analysis of this paper, government’s allegation that Microsoft’s use of bundling is in violation of anti-trust is not valid. As I just discussed, its use of bundling to enter the browser market is actually for competitive. Microsoft’s practice of contracts that tended to exclude rivals, and various forms of predatory conduct, may be the focus of anti-trust attack, but not necessary the bundling practice. In fact, according to my analysis, banning bundling may actually help the monopolist to preserve market power.
References:


