Consumers Prefer Bundled Add-Ins

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ABSTRACT: Software such as operating systems, word processing, spreadsheets, graphics, and others often serves as a base for a number of third-party add-in products or plug-ins. These add-ins enhance the functionality of the base product. Unless protected by patents, these add-ins can potentially be bundled into the base software. The impact of this bundling on the profits of the base software producer and the consumer depends on the proportion of consumers that value the add-in and the penalty that some consumers incur from finding only a bundled product available when they do not desire the add-in. Using a model of the market, we show that the price of the bundle will be less than the sum of the prices of the base and add-in software when they are sold separately. We also show that the total consumer surplus and the social welfare increase if the base software producer's profit increases with bundling.

KEY WORDS AND PHRASES: bundled software, consumer welfare, information goods, software add-ins, supplemental goods.

BUNDLING OF ADD-IN SOFTWARE, such as an Internet browser, and base software, such as an operating system, is at the heart of the U.S. Justice Department, U.S. states, and the EU Competition Commission suits against the Microsoft Corporation. In addition to the legal issues, the economic issues arising from this case are important because the add-in market is a large and vigorous software market. In addition to browsers, virus-checkers, disk management utilities, and other add-ins for operating systems, there are add-ins and plug-ins for graphics software, word processors, spreadsheets, games, and

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other kinds of base software. These plug-ins create value by adding functionality to the base software. They are also the breeding ground for future software entrepreneurs.

An *add-in,* called supplemental software in Lee [5], is software that is only usable in conjunction with the base software. Whereas only consumers with the base software can take advantage of the add-in software, a base software user does not need to have the add-in to find some use for the base software. Indeed, a salient characteristic of add-ins is that not all users find the add-in useful: some users may find their utility for the base software product reduced by the presence of the add-in. This may occur because of increased complexity of interface or increased demands on systems resources by the bulkier software product. We address two research questions in this paper: When will the base software producer choose to bundle the base and add-in software? What effect will this have on the consumers? While these questions have also been examined by Davis and Murphy [3] and Lee [5] using different models, they assume that the base software utility is never decreased for any customer by the presence of the add-in. Consequently, they find that the base software producer *always* chooses to bundle all possible add-ins—an anomalous situation that we do not often see in practice and one that does not arise in our model, which includes this potential disutility for some consumers. The work in this paper is also related to that of Bakos and Brynjolfsson [1, 2] and Nalebuff [6] who have examined markets with bundling and competition among bundled goods. These papers, however, do not apply directly to the market for add-ins, as they ignore the dependence of the add-in software on the base software. This dependence and its economic impact are the focus of this paper.

There are many technical and human factors that affect the value of a bundle of the base software and add-in compared to the value created by separate but dependent software. Separate markets have some advantages for consumers. Consumers can pick and choose among different add-ins, purchasing, and installing only the ones they find useful. This also simplifies the base software interface, which does not have to be modified to support many different uses, and reduces the overhead in primary and secondary storage. Further, since add-in software is smaller, it is more easily produced by smaller firms that innovate and create new uses for the base software. Bundling may, however, create some new benefits for the consumer. The interface of the bundled software may be unified and made more consistent. Moreover, the add-in may be more tightly integrated with the base software, providing greater utility for the base software user. However, the bundled software saddles a user who has no use for the add-in with software that is more complex, less reliable, and larger. These create a cost for the user.

There are additional market effects when an add-in software is bundled with base software. A monopolist producer of base software will increase the price of the bundle compared to the price of the base software alone. However, since only a fraction of the base software users find the add-in software useful, we show that the increase in price *will be smaller* compared to the price charged by the add-in software producer when the products are separate. This is our first major result. We also observe this empirically. The introduction of DOS version 6 provides an example. Although DOS

Table 1. Pricing of Bundled Add-Ins: The MS-DOS 6 Example

Functionality	Product name	Street price
Hard disk compression	Stacker	$90
Memory management	QEMM386	$58
Backup	Fastback	$93
Anti-virus	Norton AV	$79
Disk management	Norton Disk	$109
Boot management	AutoCon	$19
Total		$448
DOS 5 to DOS 6 Upgrade		$49

5 was a stable operating system, it lacked or only marginally provided a number of features that were needed to manage the increasing amount of primary and secondary storage that was becoming available. A number of firms produced add-ins that provided these necessary functions. In March 1993, Microsoft produced MS-DOS 6, which included a number of bundled software components that provided the functionality provided previously by add-ins. This is described in Table 1.

Table 1 lists the functions, the names of major add-ins that provided the listed functions, and the "street price" of these add-ins obtained from past copies of the *PC Magazine.*[1] Note that although the price of the bundled add-ins was $448, the price of the upgrade from DOS 5 to DOS 6 with the functionality of these add-ins bundled in was only $49.

The lower price of the bundle increases the surplus of consumers who would have bought the add-in and the base software when sold separately. And, some others who have some value for the add-in but not high enough to cover the price of the separate add-in may now purchase the bundle and use the add-in. Hence, more users will use the add-in software and their surplus may be higher. What about consumers who do not value the add-in? Such a consumer will find that his or her surplus is reduced, perhaps even to the point of no purchase because of the price increase and disutility created by the bundling. Hence, the impact of bundling on consumers depends on whether or not they value the add-in.

A base software producer will bundle the add-in only if it is legal and it increases its profit enough to cover any development costs. Using the model in our paper, we find that the base software producer's profits increase with bundling only if a high enough proportion of users value the add-in and when the add-in does not generate too much cost for users who do not value the add-in. Moreover, we prove that aggregate user surplus is also higher with bundling in these circumstances. In other words, we show that the total consumer surplus increases if the base software producer's profit increases when the add-in is bundled with base software. This is our second major result. This is in contrast to the results in Bakos and Brynjolfsson [1, 2]. In the latter, at least in part, bundling is used to transfer surplus from the consumers to the producers, and so bundling reduces total consumer surplus.

Model

DEMAND IS SYNTHESIZED FROM THE DISTRIBUTION of value among consumers, and bundling is viewed as creating a new demand function that is the convolution of the distributions of value for the individual components. We abstract away from legal issues of tying and antitrust. We recommend Sidak's paper [7] for a comprehensive analysis of the legal issues.

To analyze the market for software add-ins, we start with a benchmark market in which the base software and the add-in are sold separately by different firms.

Separate Add-In

Customers are heterogeneous in their valuation for the base software. Specifically, we assume that the value for the base software is distributed uniformly between zero and one. This corresponds to a linear demand curve with unit slope and unit intercepts. Some of these users, but not all, have some use for an add-in software that is sold by another firm. We assume that this add-in can only be used in conjunction with the base software and is of no use by itself. With regard to value for add-in, there are two classes of customers:

- *Users who value the add-in:* These users get an additional value from the add-in that is uniformly distributed between 0 and a. These users make up γ proportion of all users.
- *Users who do not value the add-in:* These users do not value the add-in. They do not purchase the add-in when it is available separately. These consumers make up the remaining $1 - \gamma$ proportion of users.

Next, we model the profit-maximization problems that the base and add-in software producers solve jointly.

Let p_b be the price that the base software producer charges for just the base software and let p_a be the price that the add-in producer charges for the add-in software. We focus on the case when *the add-in is a minor component,* that is, no user buys the base and add-in combination to just get the benefits of the add-in. This requires that equilibrium prices, p_a and p_b, be such that $a < p_a + p_b$, that is, even the highest value for the add-in does not cover the cost of the base system and the add-in.[2] The quantity demanded and profits are computed next.

First consider the users who have some value for the add-in. These consumers, who together make up γ proportion of the population, will fall into four segments that are shown in Figure 1. The value for the base product and the add-in are distributed along the x- and y-axes in Figure 1. We note that:

1. Segment 1 has users who have value for base software that exceeds p_b but have a value for the add-in that is less than its price p_a. These users will only purchase the base software. They make up $\gamma(1 - p_b)(p_a/a)$ proportion of the total population.

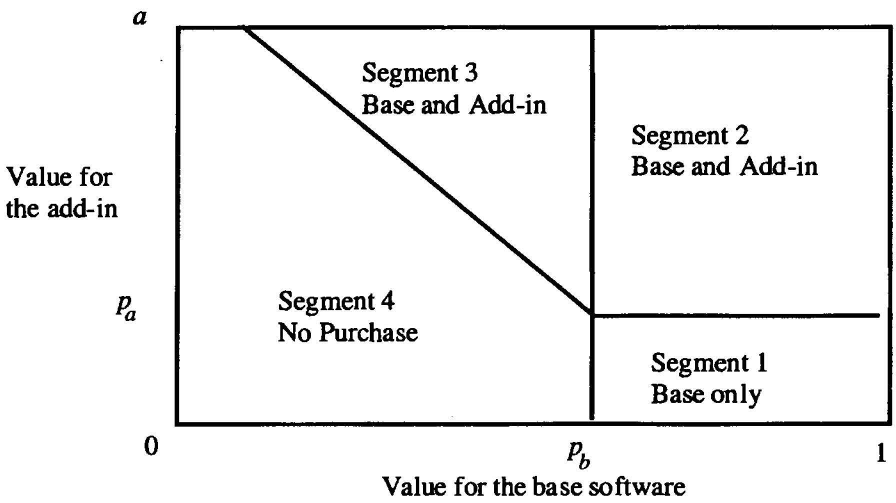

Figure 1. Software Choices by Consumers Who Value the Add-In

2. Segment 2 is made up of users who have a value for base software that exceeds p_b and a value for the add-in that exceeds p_a. These users will purchase the base and the add-in software. They make up $\gamma(1 - p_b)(1 - (p_a/a)$ proportion of the total population.
3. Segment 3 has users whose value for the base software is less than p_b but whose value for the add-in is high enough to justify the purchase of the base and add-in software. They make up $\gamma(a - p_a)^2/2a$ proportion of the total population.
4. Segment 4 is made up of users whose value for the base and add-in software is such that they do not purchase either software.

In addition to these segments, there is a segment with $1 - \gamma$ proportion of users who do not have any positive value for the add-in. Of these users, those whose value for base software exceeds p_b will buy the base software alone. These users make up $(1 - \gamma)(1 - p_b)$ proportion of all the users. Putting it all together and multiplying by the price p_b, we get the profit for the base software producer, π_b, to be

$$\pi_b = p_b\left(1 - p_b + \frac{\gamma}{2a}(a - p_a)^2\right). \tag{1}$$

Correspondingly, the profit for the add-in software producer, π_a, that reflects the demand from segments 2 and 3 is

$$\pi_a = \frac{\gamma p_a}{2a}\left(2(1 - p_b)(a - p_a) + (a - p_a)^2\right). \tag{2}$$

Note that the profit of the add-in software producer depends not only on the price of the add-in software, p_a, that it sets but also on the base software price, p_b, set by the other producer. The same is the case for the base software. The two producers pick prices to maximize their own profit while taking the other's strategy as a given. This gives rise to a Nash equilibrium in prices. This is exhibited next.

Theorem 1: When $a < 3/4$, then the prices p_a and p_b for add-in and base software satisfy the following equations:

$$p_b = \frac{1}{2} + \frac{\gamma(a-p_a)^2}{4a} \tag{3}$$

$$2\gamma p_a^3 + a(6-5\gamma)p_a^2 - 4a(1+2a-a\gamma)p_a + a^2(2+2a-a\gamma) = 0. \tag{4}$$

Proof: First consider the base software producer that is maximizing its profit. Taking the derivative of π_b with respect to p_b and setting it equal to zero, we get Equation (3). The second derivative is –2.

Next, consider the add-in producer. Note that π_a is a cubic in p_a and can be factored as:

$$\pi_a = \frac{\gamma}{2a} p_a (a-p_a)(a-p_a+2(1-p_b)).$$

This cubic has three roots: 0, a, and $a + 2(1 - p_b)$. The region of interest is $0 \le p_a \le a$, because at any higher price no consumers will buy the add-in. The first-order condition for maximization is

$$\begin{aligned} \frac{\partial \pi_a}{\partial p_a} = \frac{\gamma}{2a}\Big[&(a-p_a)(a-p_a+2(1-p_b)) \\ &- p_a(a-p_a+2(1-p_b)) - p_a(a-p_a)\Big] = 0. \end{aligned} \tag{5}$$

Substituting for p_b from Equation (3) into Equation (5) provides Equation (4).

Solving Equation (5) for p_a in terms of p_b and picking the root in region $0 \le p_a \le a$ leads to:

$$p_a = \frac{2}{3}(a+(1-p_b)) - \frac{1}{3}\sqrt{a^2+2a(1-p_b)+4(1-p_b)^2}. \tag{6}$$

Next, note that $\partial^2\pi_a/\partial p_a^2 = (\gamma/2a)(6p_a - 4(a + (1 - p_b))$, which is negative for the p_a that satisfies the first-order condition as exhibited in Equation (6).

Finally, we check the equilibrium prices to make sure that Figure 1 represents the demand. This requires that $a < p_a + p_b$. From Equation (6) we get:

$$\begin{aligned} p_a &= \frac{2}{3}(a+(1-p_b)) - \frac{1}{3}\sqrt{a^2+2a(1-p_b)+4(1-p_b)^2} \\ &\ge \frac{2}{3}(a+(1-p_b)) - \frac{1}{3}\sqrt{a^2+4a(1-p_b)+4(1-p_b)^2} \\ &= \frac{2}{3}(a+(1-p_b)) - \frac{1}{3}(a+2(1-p_b)) \\ &= \frac{1}{3}a. \end{aligned}$$

From Equation (3) we see that $p_b \geq 1/2$. Putting these together, we have $p_a + p_b \geq 1/2 + 1/3a$. The hypothesis of the theorem provides $a \leq 3/4$, that is, $1/2 \geq 2/3a$. Combining this with the previous inequality, we get $p_a + p_b \geq a$.

Bundling

If the add-in includes technology that is patented, then it is a barrier to entry for other software producers. In particular, the patent will preclude the base software producer from bundling this feature as part of the base software. Not all add-ins involve patented technology. It may be legal for the base software to re-create the software needed to provide the added functionality. This is legal under copyright laws, as ideas are not copyrighted, and only the implementations are protected. If bundling is legal, then the only constraint is economic: the base software producer will bundle the add-in functionality only if the profit increases enough to cover any development costs.

Consider the case when the add-in software is bundled with the base software. The revenue from the bundled software depends on the value of the add-in to the users who have some use for the add-in and the cost to the users who have no use for the add-in. Let c represent the additional cost imposed on users of the base software who have no use for the add-in but find the add-in bundled in.[3] The bundle is sold at a single price of p. The demand for the bundle from users who have no use for the add-in software, q_0, is $(1 - p - c)(1 - \gamma)$ if $p + c \leq 1$. The situation for consumers who have some value for the add-in is shown in Figure 2.

The value for the base software varies from 0 to 1 along the x-axis and the value for the add-in varies from 0 to a along the y-axis. The diagonal line is the line of indifference where the value for the customer is exactly equal to the price, that is, $x + y - p = 0$, where x and y are the values for the base and the add-in software, respectively. Customers to the right of the indifference line will purchase the bundle and those to the left will not. The area corresponding to the purchasers is $a(1-p + 1-p + a)/2$. Hence, the demand for the bundle from users who have some value for the add-in, q_1, is $\gamma(1 - p + a/2)$ if $a \leq p \leq 1$. Putting it all together, the profit for the software producer is

$$\pi_{ab} = p\big((1-p-c)(1-\gamma)+(a/2+1-p)\gamma\big). \qquad (7)$$

Theorem 2: If $0 \leq a \leq \min\{(1-c)/2, 2-4c\}$ *and* $c \geq 0$, *then the optimal price for the bundled software,* p_{ab}, *is*

$$p_{ab} = \frac{1}{2} + \frac{a\gamma}{4} - \frac{c(1-\gamma)}{2}. \qquad (8)$$

Proof: Taking the derivative of π_{ab} in Equation (7) with respect to p and setting it equal to zero, we get Equation (8). Since the profit function is a quadratic in price with -1 as the coefficient of p^2, the second-order condition is trivially satisfied. Now all we have to check are the limits on the parameters for Figure 2 to represent the demand. Two conditions must be satisfied:

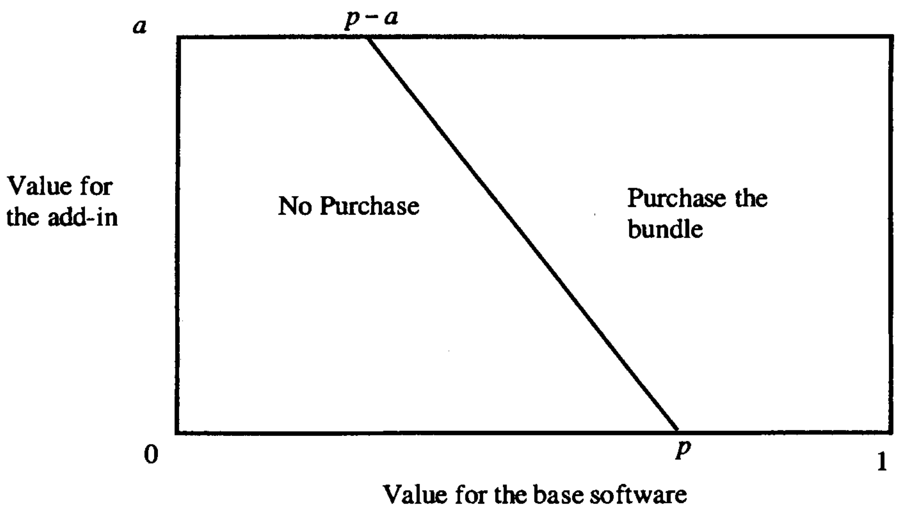

Figure 2. Reaction of Customers Who Value the Add-In to the Bundle

1. $p_{ab} + c \leq 1$. Substituting for p_{ab}, we get $p_{ab} + c = 1/2 + a\gamma/4 + c(1 + \gamma)/2$. This is largest for $\gamma = 1$. Substituting that into the condition, we get $a \leq 2 - 4c$.
2. $a \leq p_{ab}$. As before, we substitute for p_{ab} and note that the bound is tightest for $\gamma = 0$. This turns out to be $a \leq (1 - c)/2$.

It is instructive to compare the limits on a for Theorems 1 and 2 to hold. Note that $\min\{(1 - c)/2, 2 - 4c\} \leq 1/2$, and hence the limit in Theorem 2 is tighter for $c \geq 0$. For subsequent analysis, we assume that this limit is satisfied:

Assumption 1: The maximum value that any one user has for the add-in, a, is less than $\min\{(1 - c)/2, 2 - 4c\}$.

Analysis

ONE OF THE MAJOR CONCERNS IN THE SOFTWARE MARKET has been the abuse of market power by a dominant firm to raise prices, lowering consumer surplus and societal welfare. To examine this issue further, we examine the equilibria exhibited in Theorems 1 and 2. We first show that the price of the bundle is lower than the sum of the prices when the products are available separately.

Theorem 3: The profit-maximizing bundled price is lower than the sum of the prices of the base and add-in software.

Proof: Adding p_a to Equation (3), we obtain:

$$\begin{aligned} p_a + p_b &= 1/2 + \frac{\gamma}{4a}(a - p_a)^2 + p_a \\ &= 1/2 + a\gamma/4 + p_a(1 - \gamma/2 + p_a\gamma/4a) \\ &\geq 1/2 + a\gamma/4 > 1/2 + a\gamma/4 - c(1 - \gamma)/2 \\ &= p_{ab}. \end{aligned}$$

The last equality follows from Equation (8).

The impact of bundling the software on the consumers depends on whether they have any use for the bundle or not. As the bundle is priced slightly higher than the base product and the bundle imposes a cost c on users who do not desire the add-in, the surplus of consumers who have no use for the bundle decreases. In contrast, as we have shown in Theorem 3, the price of the bundle is less than the sum of the prices of the individual components. Hence, users who previously purchased the add-in pay less, and more of them utilize the add-in. Their surplus goes up. Whether the total consumer surplus increases or not depends on γ, the proportion of users who have any use for the bundle.

This is shown in Figure 3 for $a = 0.25$. There are three regions in this figure:

Region A: This is the region of high γ and low c, where most users have some value for the add-in and the penalty of bundling for those that do not have any use for the add-in is small. In this case the profits of the base software producer and the total consumer surplus increase with bundling.

Region B: This is the region of intermediate values of γ and c. This region is bounded above by the *zero profit-change contour* and bounded below by the *zero consumer-surplus-change* contour. Consequently, in this region, the base software producer will not bundle, as its profits would decrease with bundling. However, the consumers still prefer to have the bundle over separate products. Why does this happen? If the base software producer were to bundle, then it would have to drastically temper its price to account for the users who do not like the add-in bundle. This would raise the total consumer surplus.

Region C: In this case the proportion of users who have any value for the add-in, γ, is small and the penalty for bundling is large. Consequently, bundling benefits neither the base software producer nor the users.

There are several things worth noting about these results:

1. In regions B and C the base software producer's profit would *decrease* if it offered the bundle. This is in marked contrast with results in Davis and Murphy [3] and Lee [5], who find that the base software producer's profit always increase with bundling. If this were true in the real world, then no independent products would be available! One key difference between our model and those of Davis and Murphy [3] and of Lee [5] is that we include disutility for users who have no use for the add-in but find it bundled with the base software.
2. In regions A and B, the consumers prefer to have the bundled product. Their total surplus is higher. This is in marked contrast to results in Bakos and Brynjolfsson [1, 2] where bundling, in every instance, reduces consumer surplus.
3. Region B is of particular interest, as in this region the profits of the base software producer decrease with bundling but the total consumer surplus increases. In other words, in this region, the base software producer does not bundle enough!
4. If the base software producer's profits increase with bundling, then so does consumer surplus. Region A is the only region where the base software

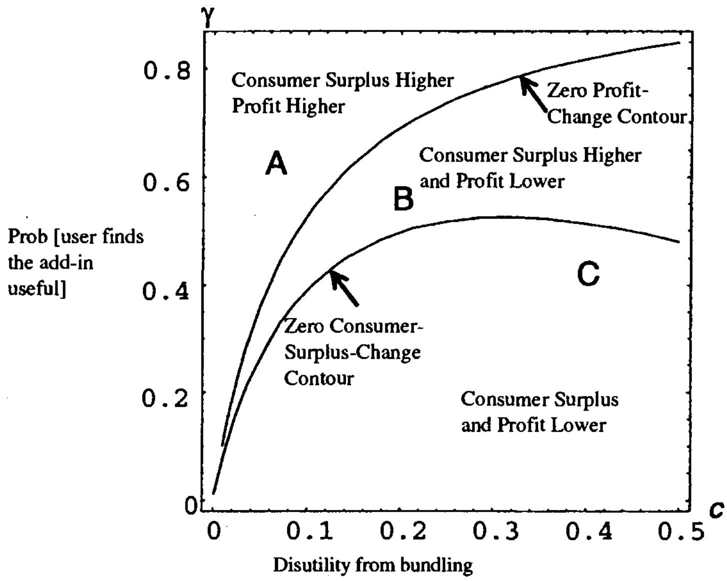

Figure 3. Impact of Bundling

producer's profits increase with bundling. This region is above the zero surplus-change contour. In other words, if a consumer ever finds the add-in bundled with the base software, and even if he or she finds that this bundling reduces his or her personal utility, then he or she can be sure that the total surplus of all users is higher with bundling. This is proved in the next theorem.

Theorem 4: The total surplus of all consumers increases with bundling if bundling increases the base software producer's profit.

Proof: Part I: (To show that $\pi_{ab}^* \geq \pi_b^* \Rightarrow p_{ab}^* \geq p_b^*$.)
In Theorem 1 we determined the optimal p_b^* as a function of the model parameters and p_a^*. Substituting into Equation (1), we get maximum profit to be $\pi_b^* = p_b^{*2}$. Similarly, we can show that the maximum profit for the base software producer when the bundled profit is offered is $\pi_{ab}^* = p_{ab}^{*2}$. Hence

$$\pi_{ab}^* - \pi_b^* = \left(p_{ab}^* - p_b^*\right)\left(p_{ab}^* + p_b^*\right).$$

This implies that $\pi_{ab}^* \geq \pi_b^*$ if $p_{ab}^* \geq p_b^*$.

Part II: (To show that $p_{ab}^* \geq p_b^* \Rightarrow cs_{ab} \geq cs_b$.)

Now, turning to the surplus, the total consumer surpluses for the separate cs_b and bundled cases cs_{ab} are:

$$cs_b = \int_{p_b}^{1} \left(x - p_b\right) dx + \gamma \int_{p_b}^{1} \int_{p_a}^{a} \frac{y - p_a}{a} dy\, dx$$

$$+ \gamma \int_{p_a + p_b - a}^{p_b} \int_{p_a + p_b - x}^{a} \frac{x + y - p_a - p_b}{a} dy\, dx$$

$$cs_{ab} = (1-\gamma)\int_{p+c}^{1}(x-p-c)\,dx + \gamma\int_{p}^{1}\int_{0}^{a}\frac{x+y-p}{a}\,dy\,dx$$
$$+\gamma\int_{p-a}^{p}\int_{p-x}^{a}\frac{x+y-p}{a}\,dy\,dx.$$

Expanding and substituting for p_b* and p_{ab}* as before, the consumer surpluses at optimal prices are:

$$\begin{aligned} cs_b &= p_b^{*2}/2 + \gamma k_b / 24a^2 \\ cs_{ab} &= p_{ab}^{*2}/2 + \gamma k_{ab}/24a^2, \end{aligned} \tag{7}$$

where

$$\begin{aligned} k_b &= \left(a - p_a^*\right)^3\left(4a - 3\gamma a - 3\gamma p_a^*\right) \\ k_{ab} &= a^2\left(4a^2 + 12ac + 12c^2 - 3\gamma(a+2c)^2\right). \end{aligned}$$

We next show that $k_{ab} - k_b$ is positive.

$$\begin{aligned} k_{ab} - k_b &= 12a^3c + 12a^2c^2 + 12a^3p_a^* - 12a^2p_a^{*2} + 4ap_a^{*3} \\ &- 3\gamma\left(\left(2a\left(a - p_a^* + c\right) + p_a^2\right)\left(p_a^*\left(2a - p_a^*\right) + 2ac\right)\right). \end{aligned} \tag{8}$$

It is easy to see that the coefficient of γ in Equation (8) is negative. Hence, $k_{ab} - k_b$ is minimum at $\gamma = 1$.

At $\gamma = 1$, the term $k_{ab} - k_b$ reduces to $p_a^{*2}(6a^2 - 8ap_a^* + 3p_a^{*2})$. This is positive for $p_a^* \leq a$.

From Equation (7) we get

$$cs_{ab} - cs_b = \left(p_{ab}^* + p_b^*\right)\left(p_{ab}^* - p_b^*\right)/2 + \left(k_{ab} - k_b\right)/24a^2.$$

We have already shown that $k_{ab} - k_b$ is positive and hence $cs_{ab} - cs_b$ is positive if $p_{ab}^* - p_b^*$ is positive.

Part III: Parts I and II together prove the theorem:

$$\pi_{ab}^* \geq \pi_b^* \Leftrightarrow p_{ab}^* \geq p_b^* \Rightarrow cs_{ab} \geq cs_b.$$

Conclusions

IN THIS PAPER, WE MODEL THE MARKET for software add-ins, such as grammar checkers, browsers, virus checkers, and so on, that enhance the functionality of base software such as word processing systems, operating systems, and others. Such add-ins can only be used in conjunction with base software and have no market independent of it. This gives the base software producer enormous market power over the add-in producers. If the base software producer bundles the add-in functionality, then it reduces the market for the third-party add-in. The add-in producer fares badly in this case. But what effect does this bundling have on the consumers? This is the question we answer in this paper. We model the effect of the bundle on the consumer in greater detail than has been done in prior literature such as Bakos and Brynjolfsson [1, 2], Davis and Murphy [3], and Lee [5]. The key difference between the consumer choice model in this paper and those in others is that we allow for some users, those who have no value for the add-in, to incur a penalty if the add-in is bundled in with the base software. This penalty captures the impact on the users of increased interface complexity and greater resource demands by the larger bundle of add-in and base software. This reasonable assumption drastically changes a number of results from earlier research that we think do not capture the reality of the software business. In particular, we show that:

- The base software producer prefers not to bundle the add-in if only a small proportion of consumers have value for the add-in and those that do not have a value for the add-in incur a large penalty from bundling. This result is in contrast with those in Bakos and Brynjolfsson [1, 2], Davis and Murphy [3], and Dewan and Freimer [4], where they find that the base software producer always chooses to bundle the add-in. If their results held, then one might expect all software to be bundled into one big massive suite. Although we do see some large bundles, such as the Microsoft Office suite, it still does not include all possible macro libraries, clip art, fonts, and so on.
- Aggregate consumer surplus increases if the base software maker chooses to offer bundles. This is in direct contrast with results in Bakos and Brynjolfsson [1, 2], in which bundling is used as a device to transfer surplus from the consumers to the vendor. We show that in the presence of the bundling penalty, the incentives of the base software producer and consumers are somewhat aligned: Circumstances in which the base software producer's profit increases with bundling are also circumstances in which the consumer surplus increases with bundling.

While we have ignored software development costs in our analysis, we note here that development costs will only make our results stronger. Since these costs are borne by the software producer, the software producer will be even less likely to bundle. And, following Theorem 4, in cases where it does choose to bundle, the consumer surplus will certainly be higher. In other words, from an aggregate consumer perspective, the base software produce will just not bundle enough!

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NOTES

1. *PC Magazine* is published 22 times a year by Ziff Davis Media Inc, New York.

2. In equilibrium, this amounts to a restriction on the size of the parameter a. In Theorem 1 we show that $a \leq 3/4$ is sufficient for this condition to hold.

3. We have taken the penalty of bundling to users who do not value the add-in to be a fixed value c. The model can easily be modified to allow for a heterogeneous penalty for consumers as long as it is in the range between zero and one. In this case, the derivations of demand and prices are similar, except that in these formulae c is replaced by its expected value.

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