# Competition and Cooperation in the Bundled Software Market

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**Abstract**

We examine the effects of bundle size on the incentives for new entry (and investment in innovation) in software markets. Although an entrant who insists on competing directly with an incumbent monopoly bundler can generally expect sharply limited profitability [as in Bakos and Brynjolfsson (2000)] an entrant who, instead, possesses a truly novel innovation can be a universally welcome addition to the market; an incumbent who welcomes (or encourages) entry and then purchases these innovations for inclusion in future bundled products can achieve higher profitability than even in the no-entry case. Our analysis shows that, in addition to the standard value created by accepting a buyout (and not disrupting the incumbent bundler's demonstrated power to extract surplus from consumers), a software entrant can actively create value by adding its innovations to the next generation of bundled products. The entrant, incumbent, and certain types of consumers can all be made better off through this cooperation.

We conclude that, contrary to previous theoretical analysis [Bakos and Brynjolfsson (1999, 2000); Nalebuff (1999, 2004)], software companies offering large bundles of products – and the acquisitions of new technologies they make to extend their product offerings – provide extremely strong incentives for innovation by potential software entrepreneurs who will increase the value of the bundle. These incentives increase in the size of the incumbent's software bundle. Incremental innovations which largely overlap with the incumbent's offerings, however, have little value and are discouraged.

**Introduction**

The business software market is increasingly characterized by bundles of products offered by long-standing incumbent firms rather than individual pieces of software offered by new entrants. For example, Microsoft Office, a bundle of different productivity tools sharing a common basic interface, generated $8 billion in 2003, almost one-third of the total revenue of Microsoft, which has been in the software market since 1975 and offering the Office bundle since 1989 [Microsoft, 2003]. SAP R5, an ERP system made up of a set of interconnected modules, reported $8.8 billion in 2003 sales, representing 58% of the world market for ERP business software [Blau, 2004]. SAP entered the US software market in 1992 having previously enjoyed a dominant position in Europe.

The seminal work on bundling is Adams and Yellen (1976) which showed that a monopolist can more effectively price-discriminate among high- and low-valuation consumers by selling multiple products in a bundle as opposed to separately. McAfee et al. (1989) extended this analysis to a three-good case, characterizing conditions under which the individual goods will not be sold independently.[1] Previous work [Bakos and Brynjolfsson (1999, 2000); Nalebuff (1999, 2004] in the bundling of information goods showed that small entrepreneurs face an uphill battle against an incumbent bundler. Nalebuff (1999, 2004) showed that even small bundles can be an extraordinary deterrent against entry, as the entrant would effectively need to compete against all products simultaneously. As the size of the incumbent's bundle increases, it becomes an increasingly unlikely coincidence for any given buyer to prefer the stand-alone product to the bundle. Bakos and Brynjolfsson (2000) argue that large bundles offer even larger benefits to consumers with uniformly distributed demands for individual software components, and thus that a large bundle of mediocre software products will triumph over superior independent software offerings (or even several smaller bundles) in both market share and their propensity to innovate.

If we take these analyses at face value, an unsettling conclusion arises about the effect of bundling on future entry and innovation in the software market. An incumbent seller of information goods, such as Microsoft, could, through the power of assembling a large bundle, reduce the profitability anticipated by small entrepreneurs. This entry barrier would presumably discourage innovation by *potential* software entrepreneurs, leading to stagnation in software progress. The existing literature thus implies that the incumbent bundlers themselves must undertake virtually all future innovation, which both theory (Arrow, 1962) and empirical evidence (Christiansen, 1997) suggest will be modest compared to the constant creative destruction brought about by a vibrantly entrepreneurial software market. Antitrust authorities in both the USA and the EU are clearly taking note of this perceived threat.

Our paper demonstrates that the incentives for potential entrepreneurs to innovate in the face of competing bundles are not, in fact, destroyed, but instead grow stronger as bundles get larger. This innovation reaps its reward not from competing with the incumbent bundlers but from complementing them, pursuing an exit strategy of selling to the bundler. Managing entry correctly, where the entrant is welcomed and then bought out (with their innovations added to future versions of the bundle), can thus be even better for the incumbent than a no-entry scenario.

[1] Hitt and Chen (2001) contains a recent review of the economic bundling literature, focusing on optimal bundle pricing for surplus extraction rather than entry deterrence.

Three key questions to be answered by our analysis are: 1) How does the incentive to introduce software innovations change as the size of the bundle grows against which these innovations compete? 2) How great is the resulting reduction in profit for the small entrepreneur who seeks to compete with a larger bundle? 3) To what degree can an entrant be treated as a welcome input to future versions of the software bundle, rather than being targeted for elimination as unwelcome competition for the current version?

**The Model**

We adopt assumptions introduced in Bakos and Brynjolfsson (1999) in calculating demand for various bundled and unbundled software products: An incumbent monopoly sells *n* goods in a single bundle for price *x*. Although there may have been a cost *F* sunk to create the information goods, marginal costs of replication are zero. Consumers' values for each good in the bundle are distributed i.i.d. U[0,1]. A consumer's maximum willingness to pay for the bundle is the sum of her marginal values for each of its components. Consumers make rational purchasing decisions based on maximizing their value for consumption of various software components, unconstrained by a fixed budget.

**Case 1: The entrant's software product is a *perfect substitute* for one of the goods in the bundle.**

For the purpose of this example, imagine that a stripped-down version of Microsoft Office, consisting only of Word and Excel, is the incumbent's bundle, and a spreadsheet that has *exactly* the same functionality as Excel is the lone good competing against the bundle.[2] For simplicity, we assume there are no complementarities between Word and Excel, nor is there any correlation in value between the two goods, and thus,

(1) $$V_{Office} = V_{Excel} + V_{Word}$$

Because consumer value for either of its components is U[0,1], $V_{Office}$ is distributed triangularly [0,2].[3] Because the entrant's good is an *exact* copy of Excel, buying both Excel and Office is redundant. Let $p_e$ be the price at which the entrant prices Excel and *x* be the price at which the incumbent prices Office. The consumer chooses the product which creates maximum consumer surplus from three alternatives:

| | | |
|---|---|---|
| (2) | $V_{Excel} - p_e$ | Surplus from purchasing Excel |
| (3) | $V_{Office} - x = V_{Excel} + V_{Word} - x$ | Surplus from purchasing Office |
| (4) | 0 | Surplus from purchasing nothing |

Nalebuff (2004, p. 167) derives equilibrium prices and market share quantities in explicit detail for this case. An uncontested two-good monopolist maximizes profits at bundle price $x$ =\$0.82, generating profits of \$0.54. A consumer buys Office if $V_{Office} > \$0.82$, or nothing if $V_{Office} < \$0.82$.

If one assumes [as Nalebuff does] that the incumbent cannot or does not change prices when entry occurs, then the entrant would choose $p_e$ =\$0.30 and makes \$0.11 in profit, with incumbent profit falling to \$0.36. If the incumbent changes its price optimally to compete with the entrant (in effect, fighting a limited price war) the ensuing equilibrium is $x$ =\$0.59, $p_e$ =\$0.24 with profits for the incumbent of \$0.366 and for the entrant of \$0.064.[4] The bundler's profit clearly declines with the arrival of an entrant competing directly with one of its bundle components.

The reduced profit suffered by the incumbent, combined with the modest profit that the entrant received due to their disadvantaged competitive position, suggests that the incumbent acquire the entrant. The incumbent bundler can always find a mutually agreeable price at which the entrant's intellectual property can be acquired and discarded, leaving the incumbent's original bundle alone in the market to enjoy the "quiet life" of monopoly rents (Hicks,

[2] This good could be an exact copy of Excel or a different spreadsheet that any given consumer thinks has *exactly* the same value as Excel (perhaps because both spreadsheets perfectly satisfy that particular user's limited needs).

[3] This is no longer a uniform distribution, but triangular. After only a few goods, the bundle's value, which is the sum of *n* uniform variables, strongly resembles a normal distribution. Bakos and Brynjolfsson (1999) exploit this basic statistical convergence to normality extensively to illustrate the power of bundling to extract consumer surplus.

[4] Although Nalebuff ignores the monopolist's price response to entry, note that a active competition with the entrant increases monopoly profit slightly while greatly reducing the entrant's profit by 38% -- a strong argument for a policy of vigorous resistance by the incumbent, both to increase its own profit and to deter potential entrants whose costs to enter the market fall between \$0.07 and \$0.15. This threat is credible, unlike in analogous situations such as the chain-store paradox (Selten, 1978) where resistance is threatened but not carried out.

1935). Indeed, an entrant who anticipates being a sufficiently irritating gadfly may choose to enter solely for the purpose of being bought out [as in Gans and Stern (2003)], even though the profits from competition as a stand-alone entity would not justify its cost of entry.

In our example (using, for easy comparison, Nalebuff's (1999) assumption of a somnolescent incumbent) the incumbent would be willing to pay up to \$0.54 - \$0.36 = \$0.18 to eliminate the entrant's interference with its ongoing profit optimization. The entrant would be willing to accept any price over its anticipated profits of \$0.11. Since both sides' agreement is required and both sides are contributing equally to restoring the market structure to its original state of a single firm offering a 2-good bundle, a symmetric division of surplus from the merger (*a la* Nash bargaining) would prescribe a price of \$0.15 for the entrant's intellectual property (and a promise not to compete again in *either* the Word or Excel market), which is approximately 36% higher than the profit the entrant could achieve on her own. By vigorously defending (through the aforementioned limited price war) the incumbent can reduce the entrant's profits from competing to \$0.07, thus putting itself in an improved bargaining position when the surplus from merging is to be split equally and reducing the price to \$0.12. Although the absolute amount is smaller, the relative size of the entrant's payoff from being acquired is now 80% higher than its payoff from competing, as shown in the Appendix (Chart 1). Entrants whose cost of entering the market are between \$0.07 and \$0.15 will thus choose to enter, in hopes of being acquired [as in the Gans and Stern (2003) analysis cited above] whereas they would be deterred if competition with the incumbent bundler were a forgone conclusion.

**Case 2: Entrant good is an *imperfect* substitute for one of the goods in the bundle.**

Lotus 1-2-3 is the #2 spreadsheet program in the United States, generating a surprising dollar volume of 2003 sales for its owner (IBM) despite competing directly against Microsoft Excel as a standalone product, the Excel component of Microsoft Office, and the spreadsheet portion of Microsoft Works (included free with most Windows operating systems.) In our model, Lotus 1-2-3 as a stand-alone spreadsheet competes against Excel, which is part of the Office bundle. Since consumer values for each are distributed independently on the uniform [0,1] interval, half of consumers would prefer Lotus, and half would prefer Excel. Since they thus partially compete against one another, however, we must not assume (as we did above in equation 1) that a consumer would treat the combined value of Excel and Lotus as the sum of each individual component. Rather, we will assume that a consumer derives value from the one that gives him the maximum value and leaves the other one completely unused.

(6) $V_{Excel+Lotus} = \max(V_{Excel}, V_{Lotus})$

Thus, in the imperfect substitutes case, consumers potentially buy the entrant good *or* the bundle *or* ***both*** *or* nothing. The consumer's choice is driven by the maximum of the following surplus calculations:

| | | |
|---|---|---|
| (7) | $(V_{Lotus} - p_e) + (V_{Word} - x)$ | Surplus from Lotus plus Office |
| (8) | $V_{Lotus} - p_e$ | Surplus from Lotus only |
| (9) | $V_{Office} - x = V_{Excel} + V_{Word} - x$ | Surplus from Office only |
| (10) | 0 | Surplus from purchasing nothing |

Note well the power of bundling to sway consumer choice: even if a consumer has positive surplus for Lotus, *and* thinks Lotus is a better spreadsheet than Excel, a consumer may still choose to purchase Office and not Lotus.[5]

Chart 2 illustrates that the entrant's profitability, when acquired and added to the incumbent's bundle, *increases* in bundle size (assuming Nash bargaining). Through bundling, the incumbent can extract greater amounts of consumer surplus (as shown in Bakos and Brynjolfsson) than its previous bundle plus the entrant's stand-alone product; this increased extracted surplus can be shared with the acquired entrant. The value created from a merger is thus composed of two effects: (1) the value of removing the entrant from competition and (2) the value of adding the entrant's complementary good to the bundle – in contrast to the perfect substitutes case, where the incumbent is paying the entrant solely to disappear, and no additional value is created by expanding the bundle.

[5] Although the result may seem counterintuitive, the correct analysis is quite simple – once a customer has decided to buy Office, it's costly to throw away Excel (which is effectively free in the bundle) and buy Lotus even though Lotus is better. For example, a consumer with valuations $\{V_{Lotus}, V_{Excel}, V_{Word}\} = \{\$0.99, \$0.80, \$0.99\}$ facing a price structure of $x = \$0.70$ and $p_e = \$0.20$ will receive surplus of \$0.79 from Lotus only, \$1.09 from Office only, and \$1.08 from buying both Office and Lotus together – a powerful illustration of the power of bundling to reduce demand for superior stand-alone products.

Two effects put opposing pressures on the entrant's overall profitability if acquired. Increasing the bundle size reduces the profit that the entrant would achieve in direct competition with the incumbent bundler if the merger did not occur, thereby decreasing the entrant's "disagreement point" payoff from Nash bargaining (its BATNA -- Fisher and Ury, 1983). Second, increasing the acquiror's bundle size increases the value of adding the entrant's software product to the bundle (because, as the bundle size increases, the incumbent can extract surplus from the market increasingly efficiently.) With a 50/50 division of surplus (as prescribed by Nash bargaining), the second effect dominates the first, and the entrant's payoff thus increases in bundle size. With a hypothetical 90/10 division of surplus favoring the incumbent, the first effect dominates and thus the entrant's payoff declines in bundle size. We find numerically that the entrant requires at least 40% of the surplus to have her payoff increasing in the incumbent's bundle size – showing the tradeoff (and break-even point) between a larger bundler *qua* customer with higher value for the entrant's innovation vs. the larger bundler *qua* tougher negotiating partner with more bargaining power.

The more similar the entrant's product is to a component of the incumbent's bundle, the lower the entrant's BATNA and the less incremental value created by adding the entrant's product to a future version of the bundle. These two effects unambiguously decrease the entrant's profits. A sufficiently novel product, however, can generate both a better BATNA and higher profitability for the entrant (who shares in the improvement in the incumbent's bundle value) who envisions selling to an incumbent selling a large bundle as opposed to a small bundle. Entrepreneurs' incentives to pursue these sufficiently differentiated innovations thus grow as the incumbent's bundle size (and its willingness to pay for additional products) increases.

**Conclusions and Directions for Future Research**

We have shown that, in addition to the standard value created by accepting a buyout (and not disrupting the incumbent bundler's demonstrated power to extract surplus from consumers), a software entrant can actively create value by adding its innovations to the next generation of bundled products. It is true that an entrant who insists on competing with an incumbent monopoly bundler in an information-goods market can expect sharply limited profitability. An entrant who, instead, possesses a truly novel innovation which could be added to a future version of the incumbent's bundle, and which does not directly compete with an element of the existing bundle, can serve as a welcome addition to the market: An incumbent who welcomes (or encourages) entry and then purchases these innovations for inclusion in future products can achieve higher profitability even than in the no-entry case.

We conclude that software companies offering large bundles of products – and the acquisitions of new technologies they make to extend their product offerings – provide extremely strong incentives for innovation by potential software entrepreneurs. These incentives increase in the size of the incumbent's software bundle; incremental innovations which overlap with the incumbent's product offerings, however, have little value and are discouraged.

The assumptions in our model are not the only ones which could be made in analyzing this important problem. Our method of dividing the gains from cooperation (the Nash bargaining solution) takes into account the entrant's alternative to the buyout (competing on unfavorable terms with the incumbent) but assumes equal bargaining power once the two sides' outside reservation prices have been met. While both sides' cooperation is certainly required to create value, a continuum of bargaining alternatives might be considered, ranging from ultimatum offers made by the entrant, who possesses unique and valuable technology (in which the entrant would presumably receive more of the surplus created by the combination), to ultimatum offers made by the incumbent, who may well represent the entrant's only alternative to brutal competition (in which the incumbent would presumably receive more of the surplus created). In the Appendix (Chart 3), we illustrate the sensitivity of the conclusion that both incumbent and entrant are better off as bundle size increases to the distribution of bargaining power in the relationship. Although the *distribution* of the resulting surplus will vary, however, our claim that *total* surplus will be increased still stands.

We, like other authors in the field, have made the simplifying assumption that within-consumer valuations for component goods in the bundle are independent and identically distributed. We can easily conceive, however, that in reality these values might be strongly either positively or negatively correlated with each other – that high values for product *X* would predict either high or low values for product *Y*. It is largely irrelevant to the *pricing* of the software bundles whether this correlation arises through coincidence or demand characteristics (in which customers who have a high value for one component simply happen to have high values for other bundle components, perhaps because their needs are related to specific business or personal uses requiring multiple pieces of software) or whether it is explicitly created by common features and complementarities among the various components of the software (such as a common user interface, cut-and-paste information transfer capabilities, compatible file formats, etc.). The *design* of future software bundles, however, in terms both of their components and the ways in which these components interact, will be greatly affected by these two competing explanations.

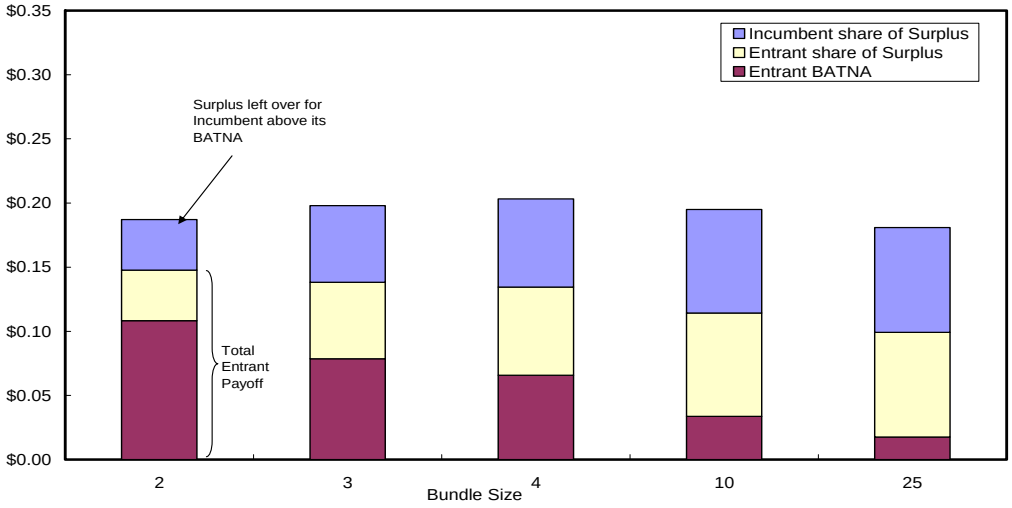
# Appendix: Graphs of Entrant Profitability, Composition of Total Surplus, and Incumbent Profitability vs. Bundle Size

## Profit of Entrant Against a Bundler

**Entrant Good is an Imperfect Substitute for a good in the Bundle. Surplus is split 50/50 with Incumbent.** Unlike the Perfect Substitutes case, the Entrant's purchase price *grows* as the bundle size gets larger.


## Composition of Total Surplus when Incumbent buys Entrant

**Entrant is a Perfect Substitute; BATNA is a "Sleeping Incumbent". Surplus is split 50/50 with Incumbent.** As the bundle size grows, the entrant BATNA shrinks, reflecting the difficulty of competing head-to-head with the Incumbent. The total surplus grows, and then ultimately shrinks as the bundle size grows. This is due to the fact that the benefits of removing a perfect substitute from competition decline against larger bundles.




## Post-Entry vs. Pre-Entry Profits for Incumbent

**BATNA is Sleeping Incumbent**. This chart compares what percentage of pre-entry (monopoly) profits and incumbent can recover by purchasing an imperfect substitute and adding it to the bundle. We see that the incumbent actually prefers entry to no-entry when gets 90% of the surplus. In the scenario when receives only 50% of the surplus, it would have been better off had entry never occured (although it still buys out the entrant because it is an improvement over head-to-head competition.)