Tying and Bundling in a Nearly Contestable Market

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Abstract: This paper presents a model of bundling and tying when the threat of entry provides the primary competitive constraint but entrants have a disadvantage with respect to the incumbent, *i.e.*, in a "nearly contestable" market. The entrant's disadvantage can be with respect to marginal costs, the fixed cost of a good, or the fixed cost of an offering (which can be interpreted as a product differentiation advantage). The incumbent's profits depend on both the nature of its cost advantage and the set of offerings. With an advantage in the fixed cost of an offering, the incumbent prefers mixed bundling if it is sustainable. With a marginal cost advantage, the incumbent prefers pure bundling, in which all customers buy both components. While the latter result might appear to formalize a commonly-alleged rationale for tying, the practice can be a Pareto improvement over mixed bundling and can cause total consumer surplus to increase relative to only selling the products separately. Mixed bundling can lower consumer surplus and be a form of product proliferation.

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I. Introduction

Tying is the practice of selling one good (the "tying good") only in conjunction with another good (the "tied good"). It is related but not identical to bundling, *i.e.*, the practice of selling two goods in combination with each other. Some firms sell bundles of goods but also sell the individual goods separately, a practice known as mixed bundling. When a firm ties, it does not sell the tying good separately.

Starting with Whinston (1990),[1] much of the modern economics literature on tying has concerned its use as an anticompetitive strategy. Carlton and Waldman (2002) extend the basic logic of the Whinston model to settings that more nearly reflected the broad facts underlying the government's allegations in *U.S. v. Microsoft.*[2] [3] Choi and Stefanadis (2001) formalize the idea that tying two monopolized complementary goods can deter entry by preventing entry with only one. Nalebuff (2004) presents a model in which bundling two economically independent[4] products reduces the profits that a single-

[1] In one of the Whinston models, a firm has a monopoly over two products, one of which is subject to entry and one of which is not. By tying the threatened product to the protected product, the monopolist commits to charging a low price for the bundle if entry occurs. The lower post-entry price of the incumbent reduces the profitability of entry and, given fixed costs for the entrant, can make the difference between entry being profitable and unprofitable. The second model in Whinston (1990) concerns a monopolist over two complementary products, "A" and "B.". One of the products (A) is susceptible to entry by a superior alternative. The other product (B) is threatened by an inferior entrant. Absent the inferior potential entrant against B, the monopolist would actually benefit from entry by a superior competitor for A. But the potential entrant against B, while inferior, nonetheless limits the incumbent's ability to raise the price of B.

[2] Carlton and Waldman analyze a two-period model in which a monopolist over two complementary products faces potential entry for one of them in period 1 and the second product in period 2. By tying its two products in period 1, the incumbent can make initial entry in the one good unprofitable in period 1. The exclusion of the one good can then make entry into the second good unprofitable in period 2. As in Whinston, the entry deterrence comes from reducing the profitability of entry below the threshold needed to cover a fixed entry cost. Carlton and Waldman show that a similar effect arises when there are network externalities associated with the complementary good.

[3] *United States v. Microsoft*, 253 F.3d 34 (D.C. Cir. 2001).

[4] Here, "economic independence" means that the goods are neither substitutes nor complements. That is, the demand for one is not a function of the price of the other. Economic independence does not imply statistical independence. There is a substantial body of literature that explores the effect of the statistical non-independence of the demand for the two products on offerings and prices.

product entrant can earn and thereby can prevent entry altogether.[5] Carlton, Gans, and Waldman (2010) present a model in which the monopolist over one good might tie an inferior complementary good to its monopolized offering to reduce the rents available to the seller of a superior version of the complementary good.

From the economics literature on tying, one might get the impression that exclusion is the primary reason that firms tie one product to another. To be sure, many of the articles point out that tying can provide convenience or lower costs, but these explanations typically receive only passing mention and, more importantly, fail to distinguish between bundling and tying. Although not, strictly speaking, an efficiency, another strand in the literature, dating back to Stigler (1963), is that tying can be a form of price discrimination. Again, though, this explanation typically fails to distinguish between bundling and tying. In fact, the economics literature does not contain an accepted general explanation for why firms tie, i.e. why they refuse to sell the tying good on a stand-alone basis even if some purchasers of the bundle do not want the tied good. By a "general explanation," I do not mean a general theory that captures all possibilities. Rather, I mean an accepted (by economists), compelling explanation for the typical case.[6] At least as it is typically articulate, the efficiency explanation is not compelling. A commonly-cited example of tying because of efficiencies is selling shoes in pairs. But the savings from placing two shoes in a box rather than in separate boxes are marginal cost savings that explain why firms sell pairs of shoes to the vast majority of people who

[5] See, also, Nalebuff (2005).

[6] A significant class of tying cases concerns durables and consumables (such as printers and ink). There is probably a consensus among economists that the typical motive for tying a consumable to a durable is to charge based on usage. I would count this "metering" explanation as a general explanation for that form of tying. What is lacking is a general explanation for "packaged tying," i.e., the sale of two goods in a package but not separately. A prominent example of packaged tying was Microsoft's decision to sell Windows only with its web browser, Internet Explorer.

want both shoes.[7] Those marginal cost savings cannot explain why most shoe manufacturers do not sell single shoes to the rare individual who wants just one. The same point applies to convenience. If people who want both goods in a bundle find it more convenient to buy them in a single package rather than separately, then bundling adds value for those who want both goods. But for people who have no use for one of the goods in the bundle, it simply creates the need to dispose of the unwanted item. Similarly, the price discrimination explanation is far more compelling as a theory of mixed bundling than it is of tying.[8]

The lack of a generally accepted explanation for tying is particularly problematic because tying can be an antitrust violation. At one point, Microsoft - at the time the world's largest company measured by market capitalization - was under a United States district court divestiture order for tying its web browser to its Windows operating system. To be sure, serious commentators understood the need to articulate what distinguished the tying of Internet Explorer to Windows not only from the ties routinely observed under competition but also the other examples of tying by Microsoft.[9] One must be cautious, however, about identifying the salient features of the rare exception without understanding the typical case.[10] In *Jefferson Parish v. Hyde*, the prevailing United States Supreme Court precedent on tying, the Court ruled, "[T]he essential characteristic of an invalid tying arrangement lies in the seller's exploitation of its control over the tying

[7] As Mark Frankena has pointed out to me, there is some demand for individual shoes. See *NLLIC ACA Fact Sheet: Mismatched and Single Shoes*, at http://www.amputee-coalition.org/fact_sheets/oddshoe.html (last visited April 1, 2011).
[8] As a further example of what I mean by a general explanation, the general explanation for why firms practice (or want to practice) minimum resale price maintenance is to prevent free riding from retailers who rely on other retailers that provide costly services that are of value to a manufacturer.
[9] Carlton and Waldman (2002) is a notable example.
[10] Some of the authors of papers on the potential anticompetitive effects of tying have been careful to point this out. See Whinston (1990) at 855-6, Whinston (2001) at p. 79, and Carlton and Waldman (2001), at pp. 215-16.

product to force the buyer into the purchase of a tied product that the buyer either did not want at all, or might have preferred to purchase elsewhere on different terms."[11] But people purchase bundles that include goods they do not want even in competitive markets. To take a prominent current example, Southwest Airlines has heavily promoted the fact that it ties the right to check two bags to its passenger service.[12] Air travelers without luggage to check would presumably decline to purchase the right to check a bag, so Southwest passengers end up purchasing something they do not want.[13] As a result, the legal standard for the essence of an invalid tying arrangement fails to distinguish it from the sorts of tying arrangements that we observe under sufficiently competitive circumstances to presume that they are efficient or, at the very least, a form of competition.

The analysis of why a firm does not offer a good separately even though there is demand for it is an issue of product selection.[14] In one strand of the literature on product selection, there are diverse customer preferences for product characteristics and scale economies that prevent companies from giving each customer the precise product characteristics he or she wants. Those models are all based on a demand structure that tries to capture general product differentiation. To adapt that broad framework to bundling and tying, two steps are essential. First, one needs a demand structure that captures multiple goods that can be sold separately or as part of a bundle; and, second,

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[11] *Jefferson Parish Hospital Dist. No. 2 v. Hyde*, 466 US 2, 12 (1984).
[12] While the airline market is neither perfectly competitive nor, as is discussed below, perfectly contestable, Southwest Airlines is neither a monopolist nor a dominant firm; and its strategy with respect to bags is almost surely aimed at increasing current profits rather than sacrificing current profits to drive out rivals.
[13] Another important feature of this example is that the change in the technology of transactions has almost surely been a key factor in making it feasible for Southwest's competitors to charge for checked bags. The traditional practice of tying the right to check two bags to passenger service reduced transactions costs by simplifying the set of product offerings.
[14] See Spence (1976), Dixit and Stiglitz (1977), and Salop (1979).

one needs to recognize that bundles are distinct product offerings from the individual goods and that there are scale economies associated with the offering (as distinct from the individual goods).

Evans and Salinger (2005, 2008) put forward a candidate general explanation for tying with these features. In the model's starkest form, the underlying assumptions are that there are two goods and three types of consumers. One of the groups wants just "good 1;" one of the groups wants just "good 2;" and the third group wants both. The seller has constant marginal cost of producing both goods and the bundle, and the marginal cost of the bundle might be (but is not necessarily) less than the sum of the marginal costs of the individual goods. The assumption that distinguishes the Evans-Salinger model from previous models of tying is that each *offering* entails a fixed cost, where the bundle is a separate offering from the individual goods.[15] They argue that a fixed offering cost is essential to understanding tying (as distinct from bundling) – i.e., the refusal to sell the precise good that some customers want. Given the scale economies implied by their technological assumptions, competition in the Evans-Salinger cannot mean perfect competition. Instead, they assume that markets are perfectly contestable.

In the Evans-Salinger model, pure bundling, a form of tying, can occur under two distinct circumstances. One is that most customers want both goods and bundling saves marginal costs. Under such circumstances, only modest fixed costs of an offering make it impossible for an entrant to profitably sell the individual goods at a price below what the incumbent charges for the bundled product. Selling shoes in pairs is the prototype of this case. In the other, pure bundling arises *even if no one wants both goods and bundling does not lower marginal cost*. While perhaps counterintuitive at first, the condition

[15] Carlton, Gans, and Waldman (2010) have since introduced this feature into their model.

generating the result turns out to be obvious. When the fixed cost of an offering is large enough, a single bundled product can be the most efficient way to meet the needs of customers with diverse tastes. Pure bundling for this reason is common. Few if any people want all of a newspaper or magazine. Few students take advantage of all the services to which they are entitled by virtue of paying university tuition.[16]

Two features of the Evans-Salinger model arguably make it problematic as a general explanation for tying. First, the assumption of perfect contestability is quite strong. It excludes by assumption any strategy to generate economic profit. Second, while the Evans-Salinger model allows for offering-specific scale economies, it assumes away product-specific scale economies. These scale economies are generally essential features of models of anticompetitive tying as in Winston (1990) and Nalebuff (2004). As a result, when both product-specific and offering-specific scale economies are present, it is not clear how one would determine whether a model of anticompetitive tying or a model of competitive tying provides the more plausible explanation.[17]

This paper generalizes the Evans-Salinger model to remedy these two shortcomings. It augments the underlying assumptions about technology by introducing a fixed cost of producing each good (regardless of whether it is sold separately or as part

[16] A relatively recent example of unbundling that is of academic interest concerns college textbooks. Many college textbooks contain more chapters than a professor can cover in a single course. Including more material than is needed for any one class allows a single textbook to meet the needs of many professors with diverse tastes for what to cover. Some college textbook publishers customize versions to include just the subset of chapters a professor wants and discount the customized versions substantially with respect to the full text. No doubt, technical change that has reduced the fixed cost associated with a version is a substantial portion of the explanation. However, from discussions with textbook representatives, my understanding is that another part of the explanation is that customized versions have much less resale value than do the full versions. Given the resale market, textbook publishers do not want a single product that meets diverse customer needs.

[17] As Winston (2001) pointed out, a rational choice between explanations for any particular instance of tying requires prior beliefs based on the relative frequency of pro- and anti-competitive tying. As objective measures of the relative frequency are not now available and are unlikely to become available in the foreseeable future, such priors must be subjective.

of a bundle). In addition, it relaxes the perfect contestability assumption by assuming that markets are "nearly contestable." While Section IV contains a more precise definition, the incumbent in a nearly contestable market has some advantage over potential entrants. As a result, the threat of entry does not compel average cost pricing and therefore does not preclude economic profits. At the same time, however, the threat of entry remains the primary competitive constraint on the incumbent's decisions about prices and product offerings.

The results in this paper stem from a simple insight about nearly contestable markets: An incumbent's profits are limited by its cost advantage, which in turn depends both on the set of offerings and on whether the cost advantage concerns marginal costs, fixed offering costs, or fixed product costs. This insight yields a rich set of results. With an advantage in fixed offering costs, the incumbent's cost advantage is greatest with mixed bundling, which does not entail tying, because mixed bundling entails the greatest number of offerings. With an advantage in marginal costs, the incumbent's cost advantage is greatest with pure bundling, which does constitute tying.

The effect on consumers of tying or untying can be counterintuitive. In cases when an incumbent chooses mixed bundling to deter entry by firms selling just the goods separately, consumer surplus can drop. Offering the bundle at a discount to the sum of the prices entrants would charge for the goods sold separately denies part of the market to the entrants and allows the incumbent to increase the price it charges for the goods sold separately. On the other hand, when the firm chooses pure bundling to deter entrants who would do mixed bundling, consumers benefit. On the surface, the practice might appear to force all consumers to buy both products because that is what maximizes the

incumbent's cost advantage. However, the strategy only succeeds if the incumbent's price for the bundle matches the price the entrants get for the individual products. Consumers who want both goods get them for the price an entrant would charge for just one.

An incumbent *advantage* with respect to fixed product costs is constant across sets of product offerings, so it does not create a preference for tying or untying. However, fixed product costs create a disadvantage for an entrant seeking to sell an offering to just one set of consumers (eg., selling product 1 to customers who want just product 1) even if the incumbent bears the same cost. With product fixed costs, there is a greater tendency for multiple sets of product offerings to be sustainable and therefore greater scope for the incumbent to choose the set it prefers.[18]

The remainder of the paper is organized as follows. The following section provides a brief summary of the controversy over the usefulness of the contestability assumption and argues that economists have been wrong to dismiss it. Section III covers bundling and tying in a perfectly contestable market. It reviews the Evans-Salinger model and then extends it to allow for fixed product costs. Section IV defines "nearly contestable markets" and analyzes the incumbent's bundling and tying decisions in them. Section V contains a summary and conclusions.

[18] That is, fixed product costs lower the marginal cost advantage an incumbent needs to choose pure bundling when entrants would choose mixed bundling. They also lower the fixed cost advantage an incumbent would need to choose mixed bundling to prevent entry by firms that would sell the goods separately.

II. The Rise and Premature Fall of the Contestability Assumption

In the late 1970's and through the 1980's, the theory of contestable markets was a hot and hotly debated topic in industrial economics.[19] Originally developed in the context of the Department of Justice's monopolization case against AT&T,[20] it played a prominent role in the debates about airline deregulation.[21] A central issue in those debates was whether market outcomes would be sufficiently competitive, particularly on routes where demand would support at most a small number of carriers. Because the opportunity to reallocate airplanes among routes made entry onto and exit from individual routes appear easy, some argued that airline markets might be perfectly contestable. That is, the threat of entry would force competitive pricing even on highly concentrated (or even monopoly) routes.

Some of the critiques of the contestability assumption were theoretical. The contestability literature made a great deal of the distinction between fixed and sunk costs. Weitzman (1983) criticized the distinction as being fundamentally illogical. Stiglitz (1987) argued that contestability models are not robust to even small sunk costs. Shwartz (1986) focused on the relative speed of entry, exit, and incumbent price responses.

[19] For background on the theory of contestable markets, see Buamol, Panzar, and Willig (1982) and Baumol (1982).

[20] Telecommunications, particularly in the 1970's and 1980's, might seem an odd application of contestability theory, as sunk costs were substantial. However, a fundamental issue in the antitrust case as well as some key regulatory proceedings that led up to it was whether financial success by an entrant would demonstrate the efficiency of entry. A major contribution of the literature was to extend the concept of natural monopoly to multi-product settings and to address the question of whether it would be possible to have a set of prices that would cover the costs of a multi-product natural monopolist and also be immune from inefficient entry.

[21] See Bailey and Panzar (1981) for the suggestion that airline markets might be contestable.

Other critiques were empirical. Because the mere threat of entry forces in effect perfectly competitive behavior, actual entry and the number of existing competitors should not affect pricing. As a result, any evidence linking actual market structure to prices contradicts the contestability hypothesis. The evidence that may have contributed most to the rejection of the contestability assumption concerns airlines, an industry for which it was considered well-suited. Several studies have obtained results that airfares are statistically related to the number of actual competitors as well as the number of likely potential competitors.[22] Morrison and Winston (1987) showed that both the number of existing competitors and the number of likely entrants were statistically significant predictors of air fares. They concluded that airline markets are "nearly contestable," a hypothesis that they considered to be dramatically different from "perfectly contestable." Writing in *The Journal of Economic Perspectives* in 1989, Gilbert wrote: "There is only weak evidence consistent with … [perfect contestability], and the amount of inconsistent evidence is substantial…." Echoing Stiglitz, Gilbert went on to argue, "[A] theory that applies only when entry and exit costs are strictly zero is of little practical use." But he then stated the key issue perfectly: "The central question is whether contestability theory makes useful predictions about markets that are close to being perfectly contestable."[p. 124]

Statistical rejection of a model simply means that it is highly unlikely to be literally true. But models are supposed to be approximations, not literal truth; so rejecting the hypothesis of perfect contestability does not resolve the question of what role entry should play in modeling markets. An important case to consider is the prices Microsoft has charged historically for its Windows operating system. This was a central

[22] See Morrison and Winston (1987), Borenstein (1989), and Borenstein (1992).

point in Microsoft's defense of the monopolization suit against it.[23] During the time at issue in the suit, the license fee Microsoft charged computer manufacturers for Windows was reputed to be $50-$65 while the typical price for a computer was $2,000. The demand for the operating system is a derived demand based on the demand for computers. Since the price of Windows represented less than 4% of the price of the typical computer, any plausible estimate of the elasticity of demand for computers would imply that Microsoft was operating in the inelastic portion of the demand curve. Taking account of the sale of complementary software would lower an estimate of the profit-maximizing price for Windows, but the effect was not nearly large enough to rationalize the price Microsoft was charging as an unconstrained monopoly price. There is little controversy that Microsoft had been highly profitable, so perfect contestability would not be a plausible assumption about Microsoft's pricing and other behavior. However, unconstrained monopoly as an assumption arguably fails even worse than perfect contestability. To the extent that Microsoft's pricing of Windows is evidence for the constraining effect of potential entry, the question then becomes how to incorporate that assumption into a tractable model.

The model presented below is tractable, allows the threat of entry to be the primary competitive constraint on the incumbent firm, but does not force it to forego all economic profits without actual competition.[24]

[23] See Reddy, Evans, and Nichols (2002).
[24] One interpretation of the results of a model of "near contestability" is that it captures what a hypothetical monopolist would do. An important avenue for future research is to incorporate oligopolistic interdependence among multiple incumbents. This might prove to be a tractable approach to simultaneously modeling the threat of entry and existing competition

III. Bundling and Tying under Perfect Contestability

The underlying assumptions of the model are similar to those in Evans and Salinger (2005, 2008). A monopolist sells two goods, 1 and 2, that it can sell separately and/or in bundled form. There are three groups of customers, denoted groups 1, 2, and B. Members of group 1 want just good 1. Members of group 2 want just good 2. Members of group B want both. Members of all three might obtain the good(s) they want in one of two ways. Members of groups 1 and 2 might buy just the good they want or they might buy the bundle and discard the good they do not want. Members of group B might buy the bundle or the two goods separately.

To make the exposition clearer, I make four simplifications. First, I consider only symmetric parameters (in which the demand for and the cost of the two goods sold separately) are equal. Second, I assume that each group's demand for the good it wants is perfectly inelastic. Let X_S be the size of groups whose members get value from a single product (*i.e.*, Groups 1 and 2) and X_B be the size of the group that wants both products. Third, consumers in each group are indifferent between purchasing the good(s) they want separately or in bundles. These assumptions make it possible to illustrate the points with simple numerical examples.[25] Fourth, with one exception in Section IV, I consider only symmetric strategies.[26]

A. Costs

The incumbent incurs a constant marginal cost c_S for the production of separate good and c_B for the production of the bundled product. Assume $c_S \leq c_B \leq 2c_S$. The

[25] Evans and Salinger (2008) relax all these assumptions for perfect contestability.
[26] That is, by assumption, the incumbent does not offer the bundle and just one of the separate products.

incremental (and wasted) marginal cost of providing the bundle to consumers who want just one product is $c_B - c_S$. The marginal cost savings from providing the bundle rather than the separate products to consumers who want both is $2c_S - c_B$. A key assumption is that the incumbent incurs a fixed cost, F, for each offering, where Goods 1 and 2 and the bundle are separate offerings. This fixed cost is associated with the offering, not the production of Goods 1 and 2. I also allow for a fixed product (or good) cost, G.[27]

B. Sustainability conditions under perfect contestability

A possible market outcome is a set of offerings and associated prices that are "sustainable," which means that the offerings and prices are immune from entry either by a company offering the same set of offerings or an alternative set that would allow it to undercut the incumbent and break even. Given the symmetry assumption, there are three possible sets of offerings. Under "mixed bundling," all three offerings are available. Only the bundle is available under "pure bundling." The two goods are available separately but not bundled under "components selling."

To be sustainable against entry by a firm with the same set of offerings as the incumbent, prices must result in zero economic profits. Under both pure bundling and components selling, there is a unique "break-even" price (equal to average cost) for each offering. Let B be the price of the bundle under pure bundling and P be the price of each good sold separately under components selling. For mixed bundling, there is a range of break-even prices depending on the allocation of the fixed product costs between the bundle and the individual products. Because of the break-even constraint, there is a trade-off between the prices of the separate products and the price of the bundle within

[27] To keep the notation simple, I assume entrants' fixed cost disadvantages are equal across offerings and products.

this range. With k ($0 \le k \le 1$) being the fraction of fixed product costs allocated to the separate products under mixed bundling, let $M_S(k)$ and $M_B(k)$ represent the range of break-even prices for the separate products and the bundle, respectively, under mixed bundling.[28]

1. No Fixed Product Costs

The analysis of what product offerings are sustainable is simpler when there are no fixed product costs. In that case, which product configurations are sustainable depends on which of three basic conditions hold.[29] The first is the "separate products stand-alone condition":[30]

Error! Bookmark not defined.(1) $M_S(1) < B.$

The left-hand side of (1) is the price an entrant would have to charge if it tries to sell just a separate product to the group that wants just that product. The right-hand side is the price of the bundle under pure bundling. If equation (1) holds, any sustainable set of product offerings must include the separate products,[31] which rules out pure bundling.

Similarly, the "bundle stand-alone condition" is:

(2) $M_B(0) < 2P.$

[28] As is explained below, the entire range is not necessarily sustainable under mixed bundling. An entrant seeking to sell one offering to one group would, however, have to allocate the entire fixed product cost(s) just to that offering.
[29] Without the symmetry assumption, there are six conditions. See Evans and Salinger (2008).
[30] With no fixed product costs, the prices under mixed bundling do not depend on k. However, equations (1) and (2) are stated with values of k that generalize to when there are fixed product costs.
[31] With asymmetric demand and costs, there is both a strong and weak version of the stand-alone conditions for separate products.

The left-hand side of (2) is the price an entrant would have to charge to sell the bundle just to the group that wants both products. If it holds, pure components selling is not sustainable.

The third condition is the "pure bundling sufficiency condition:"

(3) $B < P$.

If it holds, a firm selling the bundle to all can undercut a firm selling the goods separately even for the customers who want just one of the goods.

With these conditions, we can state Theorem 1:

> **Theorem 1**: Assume there are no fixed product costs. Equation (3) implies that pure bundling is the only sustainable set of product offerings. If equation (3) does not hold, then: a) if equations (1) and (2) hold, mixed bundling is the only sustainable set of product offerings; b) if equation (1) holds but equation (2) does not, components selling is the only sustainable set of product offerings; c) if equation (2) holds but equation (1) does not, pure bundling is the only sustainable set of product offerings; and (d) if neither equation (1) nor (2) holds, both pure bundling and components selling are sustainable, but mixed bundling is not.

The proof is evident given the definition of sustainability and the equations.

Tables 1-5 contain numerical examples of the five possible qualitative outcomes. In Table 1, mixed bundling is the sustainable outcome. The marginal cost of a separate product is 25. The marginal cost of the bundle is 35, so bundling entails marginal cost savings of 2 x 25 – 35 = 15. Fixed offering costs are 1,500. 100 customers want each separate product; 50 customers want both. The break-even prices are 35 for the separate products under components selling, 40 for the separate products and 65 for the bundle under mixed bundling, and 41 for the bundle under pure bundling. Equation (1) holds because the price of separate products under mixed bundling (40) is less than the bundle price under pure bundling. Equation (2) also holds because the price of the bundle under mixed

bundling (65) is less than the sum of the prices of the separate goods under components selling (2 x 35 = 70).

In Table 2, the parameters are the same as in Table 1 except that the marginal cost of producing the bundle is 45, not 35. With a smaller marginal cost savings from bundling, components selling is the unique sustainable outcome. The bundle price under mixed bundling, 75, is greater than the sum of the prices of the separate products under components selling. Thus, equation (2) does not hold, but equation (1) does.

In Table 3, the parameters are the same as in Table 2 except for the size of the different customer groups. 200 consumers want both goods is 200 while demand for each separate good is only 50. Equation (1) does not hold, but equation (2) does, so pure bundling is the only sustainable outcome.[32]

Table 4 exemplifies the other class of pure bundling cases. In Table 3, most customers want both products. Some want the separate products, but not enough to sustain separate offerings in light of the fixed offering cost (as well as the marginal cost savings from bundling). In Table 4, no customer wants both products and bundling does not save marginal costs. Yet, pure bundling is the only sustainable outcome. The price of the bundle under pure bundling is 80, which is less than the price of 85 for the individual products under components selling.[33] Because of the high fixed offering cost of 6,000, equation (3) holds. Having a single bundled product satisfies the needs of both groups of customers with a single offering.

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[32] Mixed bundling is not sustainable because the price of 50 with pure bundling is lower than the price of the separate products under mixed bundling (which is why equation (1) does not hold). Those who want just one of the products would prefer components selling with $P = 31$ to pure bundling. That outcome is not sustainable, however, because it is not immune from entry by a company selling the bundle just to those who want both products.

[33] Since no one wants both products, mixed bundling would not be feasible since there would be no demand for the bundle.

Table 5 illustrates the final qualitative possibility. None of equations (1) – (3) hold, so components selling and pure bundling are both sustainable. Multiple outcomes can be sustainable in a contestable market because a successful entrant has to beat the incumbent with respect to all its (i.e., the entrant's) intended customers. Thus, in Table 5, customers who want both products prefer the bundle at 52, the price under pure bundling, to the two separate products at 45 each. However, if the incumbent charges 45 for the components, an entrant cannot offer the bundle at 52 because the customers who want just one of the products will not purchase from the entrant. Without selling to those customers, the entrant cannot achieve average costs of 52.

Given the assumption of perfectly inelastic demand, welfare maximization is equivalent to cost minimization. Under the assumptions above, pure bundling and components selling are efficient when they are the unique sustainable outcome.[34] When pure bundling and components selling are both sustainable, which one entails lower costs depends on the precise parameters. In these cases, the efficient outcome is sustainable, but so is a less efficient outcome. There is no compelling reason under perfect contestability why one outcome should prevail over the other. Under near contestabity, however, the firm will generally have a preference among multiple sustainable outcomes.

Again given perfect contestability, mixed bundling occurs when it is efficient, but the converse is not true. Mixed bundling can be sustainable even though it is inefficient because of a type of negative externality from the addition of an offering. Consider, for example, adding the bundle when the two goods are available separately. Doing so is efficient if the average cost of the bundle (including the average fixed offering cost) is less

[34] See Evans and Salinger (2008) for an analysis of the relationship between sustainable and efficient outcomes in their modeling of bundling and tying.

than the sum of the marginal costs. The bundle is sustainable, however, as long as the average cost of the bundle is less than the sum of the average costs, which include an allocation of the fixed offering costs, of the two components. Ths savings to group B from not having to share in the fixed offering costs of the individual goods is not a social benefit. Instead, the consumers who want just one of the goods have to pay for the portion of the fixed offering costs that the members of group B would have paid under components selling.

2. Fixed Product Costs

With fixed offering costs but no fixed product costs, there are no joint costs between offerings. Thus, an entrant with a single offering has no inherent total cost disadvantage compared with an incumbent that can sell to all groups of customers.[35] With mixed bundling, however, fixed product costs are joint between the bundle and the separate product. An incumbent practicing mixed bundling would therefore have an advantage over an entrant with a single offering aimed at a single customer group. Formally, a firm seeking to sell just a single product to the group that wants it must charge $M_S(1)$ (because $k = 1$ means that the entire fixed product cost is allocated to the separate product); and a firm seeking to sell the bundle just to Group B must charge $M_B(0)$. In contrast, the incumbent can capture part of the fixed product costs with sales to the other group that wants the product(s).

With fixed product costs, equation (1) still implies that pure bundling is not sustainable. However, entry by a firm selling a separate product at average cost is no

[35] The incumbent's first mover advantage does give it an average cost advantage.

longer the only competitive threat to a pure bundler. It also faces potential competitive from a mixed bundler. In analyzing this threat, the entire feasible range of prices is relevant. However, even though we can define $M_S(k)$ and $M_B(k)$ over $0 \le k \le 1$, not all values are feasible because $M_B(k)$ must fall within the range $[M_S(k), 2\ M_S(k)]$. If $M_B(k)$ were below that range, customers who want just one product would buy the bundle. If it were above that range, customers who want both products would buy them separately. Define k_L^* and k_H^* so that they satisfy:

(4) $M_S(k_L^*) = M_B(k_L^*)$

(5) $M_B(k_H^*) = 2\ M_S(k_H^*)$.

Then, $k_L = \max(0, k_L^*)$ and $k_H = \min(1, k_H^*)$ define the feasible range for k.

For an entrant that practices mixed bundling to succeed against an incumbent practicing pure bundling, it must beat the incumbent with respect to all groups. Since a feasible mixed bundling strategy requires $M_B(k) > M_S(k)$, an entrant that provides group B with a better price will necessarily do so for groups 1 and 2 as well. The lowest feasible price for the bundle under mixed bundling is $M_B(k_H)$, so equation (6) is a condition under which pure bundling is not sustainable:

(6) $M_B(k_H) < B$.

The other possibility to consider for how pure bundling might be susceptible to entry is for an entrant to sell just the two components. However, unless $c_B > 2\ c_S$, in which case bundling would increase marginal costs, $2\ P > B$, so a firm selling the two separate products cannot offer a better price to group B than it gets under pure bundling.

Thus, we can state the following theorem:

> **Theorem 2:** Pure bundling is not sustainable if either equation (1) or equation (6) holds. If neither is true, pure bundling is sustainable.

Now consider components selling. Without fixed product costs, components selling is not sustainable if either equation (2) or (3) holds. Either remains sufficient for components selling not to be sustainable. However, components selling is also susceptible to entry if:

(7) $M_S(k_L) < P$

This implies:

> **Theorem 3:** Components selling is not sustainable if equations (2), (3), or (7) hold. If none holds, components selling is sustainable.

Finally, consider mixed bundling. First note under mixed bundling, an entrant cannot succeed simply by choosing a different value for k. A successful entrant has to attract all groups and a different value for k would necessarily offer a worse deal to at least one.

If equations (1) and (2) both hold, mixed bundling is sustainable (and, indeed, the only sustainable outcome). Without fixed product costs, mixed bundling would not be sustainable when (1) or (2) do not hold. However, with fixed product costs, mixed bundling can occur in a wider range of circumstances. Define k_B and k_C as:

(8) $M_S(k_B) = \mathrm{B}$

(9) $M_B(k_C) = 2P$.

Equation (8) defines an allocation of the product fixed costs between the components and the bundle so that the price of the components matches what a pure bundler can offer (to those who want just one of the products). Any lower price for the separate products (based on $k < k_B$) insulates a mixed bundling incumbent from entry by a pure bundler. Equation (9) defines an allocation so that the price of the bundle matches the sum of the

prices under components selling. Any lower price of the bundle (based on a $k > k_C$) insulates the incumbent from entry by a firm that practices components selling. Thus, as long as $k_B > k_C$, $k_B > k_L$, and $k_C < k_H$, then mixed bundling is sustainable. This implies:

> **Theorem 4:** Mixed bundling is sustainable if both equations (1) and (2) hold. It is also sustainable if $k_B > k_C$, $k_B > k_L$, and $k_C < k_H$, where equations (4), (5), (7), and (8) define k_L, k_H, k_B, and k_C.

To understand the effect of fixed product costs, modifications of the examples in Tables 1, 3 and 5 are useful. In Table 6, the parameters are similar to Table 1 except that there are fixed product costs of 600 and the fixed offering cost of 1,500 is reduced to 900. The combination leaves the average cost under components selling unchanged, so $P = 35$, just as in Table 1. When $k = 0$, *i.e.*, when the entire fixed product costs are allocated to the bundle, the bundle price of 77 is more than double 34, the price of the separate products.[36] Thus, $k = 0$ is not feasible. The minimum feasible value for k is 0.25, which yields a price for the separate products of 35.5 and a bundle price of 71. The value for k_C is 0.29, which gives a bundle price of 70 and a price for a separate product of 35.8. Any higher value of k gives a lower bundle price and therefore a price below the sum of the prices of the separate products under components selling. The prices for $k = 1$ are feasible, so $k_H = 1$. The value for k that equalizes the prices of a separate product and the bundle is 1.60, which is outside the feasible range.

Recall that in Table 1, mixed bundling is the unique sustainable outcome. This is no longer the case. Equation (1) holds. A firm selling a single product just to the group that wants just that product can charge 40, which is less than 43.4, the price of the bundle

[36] Recall that with $k = 0$, the product fixed costs are allocated entirely to the bundle. Thus, buying the products separately is the better option for those who want both goods. The strategy would fail because it is premised on recouping the fixed product costs from Group B by getting them to pay 77 for the bundle, which they would not do.

under pure bundling. Thus, pure bundling is not sustainable. However, equation (2) does not hold. A firm seeking to enter with just the bundle to sell to Group B would have to charge 77, which would not capture group B from a firm selling the two separate products for 35. Thus, components selling is sustainable. Mixed bundling is also sustainable with $k > k_C = 0.29$, which ensures that the price of the bundle is less than the sum of the prices of the separate goods under components selling.[37]

Table 7 is based on Table 3 but with product fixed costs of 300 and offering fixed costs of only 1,200. As in Table 3, components selling is not sustainable because equation (2) holds. Equation (1) does not. In addition, at the highest feasible value of k, the price of the bundle (as well as a separate product) is 52.3, which exceeds the price of the bundle under pure bundling of 51. Thus, pure bundling is immune from entry by a firm practicing mixed bundling. In contrast to Table 3, however, mixed bundling (with $k < 0.33$) is sustainable. With sufficiently low portions of the fixed product costs allocated to the separate products, a firm practicing mixed bundling can charge low enough price for the separate products that a firm practicing pure bundling cannot attract Groups 1 and 2.

Table 8 has parameters similar to Table 5 except that there are fixed product costs of 700 and fixed offering costs are 2,300 rather than 3,000. Recall that in Table 5, both pure bundling and components selling are sustainable, but mixed bundling is not. In Table 9, components selling and pure bundling remain sustainable, but mixed bundling is sustainable as well with $0.86 < k < 0.97$.

[37] Modifying Table 2 in a similar way – *i.e.*, by adding fixed product costs of 600 and reducing fixed offering costs by the same amount – also results in both components selling and mixed bundling being sustainable.

While Tables 6-8 do not exhaust the possible outcomes with fixed product costs, they demonstrate the sense in which fixed product costs make it more "likely" that there are multiple sustainable outcomes. Without fixed product costs, mixed bundling is either the only sustainable outcome or it is not sustainable. With fixed product costs, mixed bundling can be sustainable for parameters where other outcomes are also sustainable, and all three qualitative outcomes can be sustainable for some parameter values.

IV. Near contestability

In a perfectly contestable market, the threat of entry is the operative constraint on the incumbent's prices and potential entrants are just as efficient as the incumbent. As a result, the incumbent cannot charge a price above its own average cost or earn economic profits. The assumption of "near contestability" preserves the first of these assumptions but not the second. Potential entrants constrain prices, but they have some cost disadvantage relative to the incumbent. As a result, the incumbent is not forced to lower its prices to its own average cost.

The cost disadvantage can take one of three forms: marginal costs, fixed offering costs, and fixed product costs. Let c_s^D be an entrant's marginal cost disadvantage for a separate product, c_B^D be the entrant's marginal cost disadvantage in producing the bundle, F^D be the entrant's fixed offering cost disadvantage, and G^D be the entrant's cost disadvantage with respect to fixed product costs.[38] While the fixed offering cost is essential for understanding tying, the possibility that an entrant's disadvantage might stem from this type of cost might seem contrived at first. However, what matters about

[38] The difference between these fixed offering costs and fixed product costs is that the latter is a common cost for product sold separately and as part of a bundle.

the fixed cost is its size relative to the number of purchases. Suppose that some customers would be unwilling to purchase the entrant's product. That is, suppose there is a product differentiation barrier to entry. If so, the entrant would need a higher price to break even than would the incumbent to cover its higher fixed cost per customer.

Under "near contestability" with a single product, the incumbent charges the entrant's average cost and earns an economic profit per unit equal to the difference between the entrant's average cost and its own.[39] To extend the analysis to the multiproduct, define "entrant sustainable" prices as:

Definition: Suppose an incumbent faces potential entrants with costs that are 1) equal to each other and 2) weakly greater than the incumbent's. Prices (and the associated set of product offerings) are "entrant sustainable" if they would be sustainable if 1) all firms (including the incumbent) had costs equal to those of the potential entrants and 2) the market was perfectly contestable.

Given this definition, all the results from the previous section about sustainable outcomes in a perfectly contestable market apply to Entrant Sustainability in a nearly contestable market with the qualification that the conditions depend on entrants' costs, not the incumbent's.

We can establish the following lemma:

Lemma 1: If the market is nearly contestable, any Entrant Sustainable set of offerings and prices is feasible for the incumbent. If it chooses an Entrant Sustainable set of offerings and prices, the incumbent's economic profits are equal to its cost advantage over the potential entrants given the set of offerings.

The first part of the lemma is an obvious implication of the definition of entrant sustainable prices. The second part follows because the revenues from an entrant sustainable set of offerings and prices equal to the entrant's costs.

[39] In the model of perfect contestability, ties go to the incumbent by assumption. Thus, the incumbent can charge the entrant's average cost rather than undercutting it slightly.

While the incumbent can choose any entrant sustainable set of offerings, it is not limited to them. Suppose, for example, that given entrant costs, pure bundling is the unique entrant sustainable offering. From the definition of entrant sustainability, any entrant choosing mixed bundling would be unable to break even. Because it has lower costs, however, an incumbent might be able to earn a profit with mixed bundling even if an entrant could not. Thus, in analyzing what set of product offerings and prices maximizes the incumbent's profits, the entrant sustainable offering(s) provides a useful starting point. From there, though, one must consider whether an alternative set of product offerings could yield still higher profits. In analyzing such decisions, the following lemma is useful:

Lemma 2: If the incumbent chooses a set of product offerings that is not entrant sustainable, its profits must be strictly less than its cost advantage with respect to the entrants for the set of offering it chooses.

Lemma 2 follows from the definition of entrant sustainability. The incumbent can only earn profits equal to its cost advantage if it can charge prices equal to the average cost of the entrants. For a set of product offerings that is not entrant sustainable, charging prices that just cover an entrant's costs would result in entry by a firm offering a different set of products.

A. Incumbent profit maximization

The incumbent's opportunity to earn economic profits in a nearly contestable market lies in its cost advantage over entrants. In general, the incumbent's advantage depends both on the nature of its cost advantage and the set of product offerings. If the

incumbent has an offering specific cost advantage, then the absolute size of its advantage is proportional to the number of product offerings. Its cost advantage is 3 F^D for mixed bundling, 2 F^D when the firm chooses pure components selling, and F^D for pure bundling. In contrast, if the firm has a marginal cost advantage over entrants and if its marginal cost advantage with respect to the bundle is at least as great as the sum of its marginal cost advantages with respect to the goods sold separately, its cost advantage is greatest under pure bundling because all three groups by both goods in that case. As a result, to analyze the profit-maximizing product offerings and prices, we treat the three possible types of cost advantages separately.

1. Fixed Product Cost Advantage

The easiest case to consider is when the incumbent has an advantage in the fixed good costs (as distinct from fixed offering costs). When it does, its cost advantage is 2 G^D for any set of product offerings. From this observation, the following theorem follows:

Theorem 5: When the incumbent has only a fixed product cost advantage over entrants, its profit-maximizing strategy is to choose an entrant-sustainable set of offerings and prices. When two sets of offerings are entrant-sustainable, the incumbent is indifferent between them.

Proof: By lemma 1, profits are 2 G^D if the incumbent chooses an entry sustainable set of offerings and prices. By lemma 2, any other set of product offerings would yield profits less than 2 G^D. *qed*

An implication of Theorem 5 is that when multiple sets of product offerings are entrant sustainable, an advantage in fixed product costs does not make the company prefer one over the other. Similarly, whether or not there is a unique entrant sustainable

set of product offerings, an advantage in fixed good costs would not cause the firm to switch to a set of product offerings that is not entrant sustainable. As a result, exploiting an advantage in fixed product costs is not the basis for a decision to tie or not to tie.

Even though an advantage in fixed product costs does not affect an incumbent's choice of product offerings, fixed product costs (that are the same for entrants as for the incumbent) do. Just as fixed product costs affect what outcome(s) is (are) sustainable in a perfectly contestable market, they effect the entrant sustainable outcome(s) in a nearly contestable market. As a result, they affect the feasible options for the incumbent. In Table 8, for example, pure bundling, components selling, and mixed bundling are all sustainable. If those parameters applied to entrants, then the incumbent would be able to choose whichever one gives it the highest profits based on the nature of its cost advantage.

2. Fixed Offering Cost Advantage

As noted above, when the incumbent has lower fixed offering costs, its cost advantage is proportional to the distinct number of offerings. It immediately follows from lemmas 1 and 2 that when mixed bundling is Entrant Sustainable, the incumbent chooses mixed bundling and gets a profit of 3 F^D. It has no reason to consider alternatives that are not entrant sustainable because 1) its cost advantage would be lower and 2) it would not even be able to get its cost advantage (because of lemma 2).

Whenever components selling is entrant sustainable but mixed bundling is not,[40] the incumbent can earn at least 2 F^D with components selling. It might, however, be able

[40] When pure bundling and components selling are both entrant-sustainable, the incumbent prefers components selling, which generates a profit of 2 F^D.

to do still better with mixed bundling even though it cannot earn 3 F^D . Table 9 illustrates the point. The top portion of the table gives the assumed parameters.[41] In this example, fixed product costs are 0, bundling does not lower marginal costs, and entrants' marginal costs equal the incumbent's. There are, however, fixed offering costs; and they are higher for entrants than for the incumbent.

The middle section of Table 9 gives break-even prices for an entrant conditional on the set of product offerings. In this example, components selling is entrant sustainable. Mixed bundling is not because the sum of the individual goods prices under components selling is 90, which is less than the bundle price under mixed bundling.[42] Pure Bundling is not because the individual goods prices under mixed bundling (55) are less than the bundle price under pure bundling (62).

The bottom panel shows why the incumbent can make more with mixed bundling than with components selling. Components selling with prices equal to break-even prices for the entrants is feasible and yields profits equal to the incumbent's cost advantage.[43] The incumbent cannot choose mixed bundling with prices equal to those that would allow an entrant to break even. Because it has lower costs, however, it can offer lower prices than an entrant would need to break even with mixed bundling. Moreover, to prevent entry by a firm offering the two separate goods at a price of 45 each, it does not have to offer every group a "better" deal than the entrant does. It only has to offer a "better" deal to one group. Specifically, if it sells the bundle at 90, the entrant would not attract Group

[41] The structure of the table allows both the incumbent's and entrants' offering fixed costs to vary by offering, but all the examples in this paper follow the simplifying assumption that they are constant across offerings.

[42] With fixed offering costs and $X_B > 0$, the components prices are lower under components selling than under mixed bundling.

[43] The incumbent's cost advantage is 1,250 per offering. Components selling entails two offerings, so the incumbent's total advantage is 2,500.

B. Without Group B, however, it cannot achieve an average cost for the individual goods sold separately of 45. To break even selling to Groups 1 and 2, it would have to charge 55 for each. Thus, with mixed bundling, the incumbent can charge 90 for the bundle and 55 for the goods sold separately. As the last column of the last line indicates, its profits from doing so are 2,750.[44]

When components selling is entrant sustainable and the incumbent uses mixed bundling, consumer surplus is lower than it would be with the entrant's offerings. The incumbent only has to match the entrant for sales to one group. Given that it does so, it can increase prices to the other groups relative to what an entrant would charge. Thus, consumer surplus for one group is the same with the entry-deterring mixed bundling prices but consumer surplus for the other groups is lower. Costs are also higher (and total welfare is therefore lower) with the incumbent's strategy than they would be with an entrant's.[45]

This result is reminiscent of Schmalensee's (1978) result about the use of brand proliferation as a device to deter entry and elevate prices. The demand structure is different than in the Schmalensee model, but the effect is the same. By incurring more fixed costs to have more distinct product offerings, the incumbent insulates itself from entry and can charge higher prices accordingly.

[44] Mixed bundling is not always the profit-maximizing strategy whenever the incumbent's advantage is with respect to fixed offering costs and components selling is entrant sustainable. Consider, for example, modifying the example in Table 10 so that the incumbent's fixed offering cost is 2,250 and the entrants' disadvantage is 750 per offering. The change would not affect break-even prices for entrants or, therefore, entry-deterring prices for the incumbent. However, the additional 500 in fixed cost per offering would lower the incumbent's profits by 1,000 (to 1,500) for components selling and by 1,500 (to 1,250) for mixed bundling. The incumbent's ability to choose mixed bundling at prices lower than an entrant could charge arises from its advantage in offering fixed costs. However, it still has to incur an additional offering fixed cost for mixed bundling rather than components selling. If that fixed cost is too high (because its advantage over entrants is too small), then components selling is the better option.

[45] In this example, there are no marginal cost savings from bundling. Even though the incumbent has an advantage with respect to fixed offering costs, entrants selling just the separate products would only incur two fixed offering costs whereas the incumbent incurs three under mixed bundling.

Table 10 shows an example in which pure bundling is entrant-sustainable and the incumbent's optimal strategy is components selling.[46] The parameters are largely the same as in Table 10 with two key differences. First, the marginal cost of the bundle, 35, is less than the sum of the marginal cost of the individual goods sold separately. As a result, offering the bundle lowers the marginal cost of supplying consumers who want both products, and the marginal cost savings from bundling reduce the inefficiency associated with supplying consumers who want just one of the products with the product they do not want. Second, an entrant's fixed offering cost disadvantage is 2,750 rather than 1,250, which makes its total fixed offering cost 4,500, compared with 3,000 in Table 10.

With a bigger fixed offering cost and substantial marginal cost savings from bundling, pure bundling is the unique Entrant Sustainable product offering. As the middle portion of the table indicates, the break-even price for an entrant pursuing pure bundling is 53. This is less than the break-even prices for the individual goods sold separately for an entrant that pursues components selling (55), so an entrant selling a bundle at 53 would be immune from entry by another firm seeking to sell the individual goods.

The bottom portion of Table 10 shows options for the incumbent to deter entry. One option is pure bundling with a price of 53. The profit from doing so is 2,750, which is exactly the incumbent's cost savings relative to the entrant's. Another option is mixed bundling. To do so, it must match the entrant's potential bundle price for at least one group. Suppose it does so by offering a price of 53 to Group 1. It does not have to offer a price as low as 53 to Group 2. However, it must offer a price that would deter an

[46] Table 11 is the one example in the paper in which I consider asymmetric strategies.

entrant seeking to sell Good 2 to both Groups 2 and B. That price is 55. Given those prices, the most it can charge Group B is 108 (because it cannot stop Group B from buying the individual components). With that set of prices, its profits are 4,200.

Yet another alternative is components selling. Compared with mixed bundling, revenues are the same. The difference between them therefore reflects costs, and there are two effects that go in opposite directions. Components selling saves a fixed offering cost but sacrifices the marginal cost savings from offering the bundle. In this case, the former is the bigger effect, so components selling maximizes the incumbent's profits. Also, pure bundling minimizes the incumbent's costs for satisfying all demand.

3. Marginal Cost Advantage

The third possible type of incumbent cost advantage concerns marginal cost. Again, the incumbent's profits cannot be greater than its cost advantage for its set of product offerings. This advantage is c_B^D $(2\ X_S + X_B)$ under pure bundling, $2\ c_S^D$ $(X_S + X_B)$ under components selling and $2c_S^D\ X_S + c_B^D\ X_B$ under mixed bundling.

A natural base case to consider is $c_B^D = 2c_S^D$. In that case, the incumbent's cost advantage is greatest for pure bundling. Its cost advantage for mixed bundling and components selling are equal to each other. The source of the higher cost advantage with under pure bundling is that all consumers buy both goods and the incumbent has a cost advantage with respect to each good each customer buys. Thus, in the base case, the incumbent chooses pure bundling if it is entrant sustainable.

The question then becomes whether the incumbent can improve upon mixed bundling or components selling when pure bundling is not entrant sustainable. In Table

11, the incumbent's advantage is with respect to marginal costs and mixed bundling is the only entrant sustainable set of product offerings.[47] .

If the incumbent chooses mixed bundling, its profit is 6,000, which of course is equal to its cost advantage. If instead it chooses pure bundling, it can only charge 55 for the bundle because it cannot charge more than an entrant could charge for good 1 or good 2. Even at that lower price (relative to the price an entrant could charge for the bundle under mixed bundling or even relative to what an entrant could charge for the bundle under pure bundling), the incumbent's profits are higher under pure bundling.

In this example, the incumbent appears to force consumers in groups 1 and 2 to buy a good they do not want. However, the incumbent's pure bundling is Pareto superior to the entrant's mixed bundling. Consumers in group 1 and 2 are just as well off, consumers in group B pay less, and the incumbent earns higher profits. The increase in consumer surplus implies that the incumbent's revenues are lower under pure bundling than under mixed bundling. The increase in profits comes, therefore, from the cost reduction due to the lower number of fixed offering costs. At least for the symmetric case, this result is completely general. When mixed bundling is entrant sustainable, pure bundling has to make consumers better off because the incumbent has to match what an entrant could charge for goods 1 and 2 sold separately. Those who want both goods in effect get the second one for "free" relative to what an entrant would charge.

Table 12 presents a case in which components selling is entrant sustainable. With $c_B^D = c_1^D + c_2^D$, the incumbent has the same marginal cost advantage with mixed

[47] Components selling is not because the price of the bundle under mixed bundling (78) is less than the sum of the prices of Goods 1 and 2 under components selling (40 + 40 =80). Pure Bundling is not entrant sustainable either because the prices of products 1 and 2 under mixed bundling (55) are less than the bundle price under pure bundling (58).

bundling as it does with components selling. Since the incumbent can get its full cost advantage with components selling and would get less than its full cost advantage under mixed bundling, it has no reason to offer the bundle in addition to the separate components.

The question then becomes whether pure bundling can generate higher profits than components selling. If it chooses pure bundling, the incumbent does not have to choose a bundle price equal to the price of Goods 1 and 2 under components selling. An entrant's ability to break even at those prices requires inducing Group B to buy the goods separately. Since consumers in Group B buy both Goods 1 and 2 under components selling, the incumbent can attract that group with a bundle price equal to the sum of the prices of the individual goods under components selling. In the Table, a price of 74 for the bundle attracts Group B and then makes the prices of 37 for the individual goods unsustainable.

If the incumbent chooses pure bundling, however, the most it can charge is 45, the price of the separate goods under mixed bundling. Comparing components selling with pure bundling, consumers in groups 1 and 2 pay more. Consumers in group B pay less because they pay 45 each for goods 1 and 2 under components selling compared with 45 total for the bundle under pure bundling. In contrast to the case in Table 11, the incumbent's choice of pure bundling is not a Pareto improvement compared with components selling because consumers in groups 1 and 2 pay more. However, the gains to group B outweigh the costs to groups 1 and 2, so pure bundling causes an increase in aggregate consumer surplus. Moreover, producer surplus also increases, so pure bundling results in a total welfare improvement.

V. Conclusions

This paper extends the Evans-Salinger model of bundling and tying in a perfectly contestable market to allow for the presence of fixed product costs and to allow for the market to be nearly rather than perfectly contestable.

Many of the insights from the Evans-Salinger model hold in this more general setting. First, the analysis of bundling and tying should be viewed in the context of the literature on product selection. That is, given diverse customer tastes and scale economies that limit the number of distinct product offerings, which offerings are available in the market? Second, pure bundling, a form of tying, can emerge for two quite distinct reasons. One is that most people want all the goods included in the bundle and the number of people who want just one of the components, while not 0, is too small to justify a distinct product offering. Think "shoes." The other is when the fixed cost of a product offering is so large that a single tied product is the efficient way to meet the needs of a diverse group of customers. Think "newspapers."

In addition, some effects rise under near contestability that are not present under perfect contestability. A key result is that the incumbent's profits cannot exceed its cost advantage over entrants. As its cost advantage varies across sets of product offerings depending on the precise nature of the cost advantage, the incumbent can have a preference among the sets. With an advantage in fixed offering costs, it prefers mixed bundling. With an advantage in marginal costs, it prefers pure bundling.

Fixed product costs tend to result in multiple sustainable sets of offerings. Thus, the presence of these costs increases the scope for the incumbent to pick the set of offerings it prefers.

When the incumbent has a marginal cost advantage, it benefits from having people buy as many goods as possible including those they do not want. Pure bundling can bring about this effect. However, consumers may benefit when a firm chooses pure bundling even when entrants would opt for mixed bundling (and therefore sell the individual products separately). The incumbent might charge for the bundle what the entrants would charge for the individual goods. In effect, they give consumers the second good for "free" (whether they want it or not).

In this model, an incumbent's choice of mixed bundling to exploit its advantage in fixed offering costs can be more harmful to consumers. By tailoring its offerings to the desires of each group, the incumbent makes it harder for entrants to gain adequate scale. This allows the incumbent to charge higher prices.

Even with the spare set of assumptions in this paper, this general framework generates a rich set of results. Further generalization of the assumptions would therefore seem to be a promising avenue for research.

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Table 1
Mixed Bundling
(Perfect Contestability, No Fixed Product Costs)

Assumed Values	*Separate Product*	*Bundle*
Demand (X_S, X_B)	100	50
Marginal Cost (c_S, c_B)	25	35
Fixed Offering Cost (F)	1,500	1,500
Break-Even Prices		
Components	35	
Mixed Bundling	40	65
Pure Bundling		41

Table 2
Components
(Perfect Contestability, No Fixed Product Costs)

Assumed Values	*Separate Product*	*Bundle*
Demand (X_S, X_B)	100	50
Marginal Cost (c_S, c_B)	25	45
Fixed Offering Cost (F)	1,500	1,500
Break-Even Prices		
Components	35	
Mixed Bundling	40	75
Pure Bundling		51

Table 3
Pure Bundling (1)
(Perfect Contestability, No Fixed Product Costs)

Assumed Values	*Separate Product*	*Bundle*
Demand (X_S, X_B)	50	200
Marginal Cost (c_S, c_B)	25	45
Fixed Offering Cost (F)	1,500	1,500
Break-Even Prices		
Components	31.0	
Mixed Bundling	55.0	52.5
Pure Bundling		50.0

Table 4

Pure Bundling (2)
(Perfect Contestability, No Fixed Product Costs)

Assumed Values	*Separate Product*	*Bundle*
Demand (X_S, X_B)	100	0
Marginal Cost (c_S, c_B)	25	50
Fixed Offering Cost (F)	6,000	6,000
Break-Even Prices		
Components	85	
Mixed Bundling	85	∞
Pure Bundling		80

Table 5

Multiple Sustainable Outcomes
(Perfect Contestability, No Fixed Product Costs)

Assumed Values	*Separate Product*	*Bundle*
Demand (X_S, X_B)	100	50
Marginal Cost (c_S, c_B)	25	40
Fixed Offering Cost (F)	3,000	3,000
Break-Even Prices		
Components	45	
Mixed Bundling	55	100
Pure Bundling		52

Table 6

Fixed Product Costs
Components Selling and Mixed Bundling Sustainable

Assumed Values	*Separate Product*	*Bundle*	*k*
Demand (X_S, X_B)	100	50	
Marginal Cost (c_S, c_B)	25	35	
Fixed Offering Cost (F)	900	900	
Fixed Product Cost (G)	600	600	
Break-Even Prices			
Components	35.0		
Mixed Bundling ($k = 0$)	34.0	77.0	0.00
Mixed Bundling ($k = k_L$)	35.5	71.0	0.25
Mixed Bundling ($k = k_C$)	35.8	70.0	0.29
Mixed Bundling ($k = k_B$)	43.4	39.4	1.60
Mixed Bundling ($k = k_H$)	40.0	53.0	1.00
Mixed Bundling ($k = 1$)	40.0	53.0	1.00
Pure Bundling		43.4	

Table 7

Fixed Product Costs
Pure Bundling and Mixed Bundling Sustainable

Assumed Values	*Separate Product*	*Bundle*	*K*
Demand (X_S, X_B)	50	200	
Marginal Cost (c_S, c_B)	25	45	
Fixed Offering Cost (F)	1,200	1,200	
Fixed Product Cost (G)	300	300	
Break-Even Prices			
Components	31.0		
Mixed Bundling ($k = 0$)	49.0	54.0	0.00
Mixed Bundling ($k = k_L$)	49.0	54.0	0.00
Mixed Bundling ($k = k_C$)	33.0	62.0	-2.67
Mixed Bundling ($k = k_B$)	51.0	53.0	0.33
Mixed Bundling ($k = k_H$)	52.3	52.3	0.56
Mixed Bundling ($k = 1$)	55.0	51.0	1.00
Pure Bundling		51.0	

Table 8

Fixed Product Costs
All Three Sets of Offerings Sustainable

Assumed Values	*Separate Product*	*Bundle*	*K*
Demand (X_S, X_B)	100	50	
Marginal Cost (c_S, c_B)	25	40	
Fixed Offering Cost (F)	2,300	2,300	
Fixed Product Cost (G)	700	700	
Break-Even Prices			
Components	45.0		
Mixed Bundling ($k = 0$)	48.0	114.0	0.00
Mixed Bundling ($k = k_L$)	51.0	102.0	0.43
Mixed Bundling ($k = k_C$)	54.0	90.0	0.86
Mixed Bundling ($k = k_B$)	54.8	86.8	0.97
Mixed Bundling ($k = k_H$)	55.0	86.0	1.00
Mixed Bundling ($k = 1$)	55.0	86.0	1.00
Pure Bundling		54.8	

Table 9

Mixed Bundling with Entrant Sustainable Components Selling

Assumed Values	*Separate Product*	*Bundle*	*Profits*
Demand (X_S, X_B)	100	50	
Incumbent			
Marginal Cost (c_S, c_B)	25	50	
Fixed Offering Cost (F)	1,750	1,750	
Entrant' s Disadvantage			
Marginal Cost (c_S^D, c_B^D)	0	0	
Fixed Offering Cost (F^D)	1,250	1,250	
Entrant Break-Even Prices			
Components	45		
Mixed Bundling	55	110	
Pure Bundling		62	
Incumbent's Options			
Components	45		2,500
Mixed Bundling	55	90	2,750

Table 10

Components Selling With Entrant Sustainable Pure Bundling

	Good (i)			Profits
Assumed Values	*1*	*2*	*Bundle*	
Demand (X_i)	100	100	50	
Incumbent				
Marginal Cost (c_i)	25	25	35	
Fixed Offering Cost (F)	1,750	1,750	1,750	
Entrant' s Disadvantage				
Marginal Cost (c_i^D)	0	0	0	
Fixed Offering Cost (F^D)	2,750	2,750	2,750	
Entrant Break-Even Prices				
Components	55	55		
Mixed Bundling	70	70	125	
Pure Bundling			53	
Incumbent's Options				
Components	53	55		5,200
Mixed Bundling	53	55	108	4,200
Pure Bundling	53			2,750

Table 11

Pure Bundling with Entrant Sustainable Mixed Bundling

Assumed Values	*Separate Product*	*Bundle*	*Profits*
Demand (X_S, X_B)	100	100	
Incumbent			
Marginal Cost (c_S, c_B)	10	18	
Fixed Offering Cost (F)	3,000	3,000	
Entrant' s Disadvantage			
Marginal Cost (c_S^D, c_B^D)	15	30	
Fixed Offering Cost (F^D)	0	0	
Entrant Break-Even Prices			
Components	40		
Mixed Bundling	55	78	
Pure Bundling		58	
Incumbent's Options			
Mixed Bundling	55	78	6,000
Pure		55	8,100

Table 12

Pure Bundling with Entrant Sustainable Components Selling

Assumed Values	*Separate Product*	*Bundle*	*Profits*
Demand (X_S, X_B)	150	100	
Incumbent			
Marginal Cost (c_S, c_B)	5	10	
Fixed Offering Cost (F)	3,000	3,000	
Entrant' s Disadvantage			
Marginal Cost (c_S^D, c_B^D)	15	30	
Fixed Offering Cost (F^D)	0	0	
Entrant Break-Even Prices			
Components	37.0		
Mixed Bundling	45.0	80.0	
Pure Bundling		57.5	
Incumbent's Options			
Components	37.0		10,000
Pure Bundling		45.0	11,000