TYING ARRANGEMENTS AND ANTITRUST HARM

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A tying arrangement is a seller's requirement that a customer may purchase its "tying" product only by taking its "tied" product. In a variable proportion tie the purchaser can vary her purchases of the tied product. For example, a customer might purchase a single printer, but either a contract or technological design requires her to purchase varying numbers of printer cartridges from the same manufacturer. Such arrangements are widely considered to be price discrimination devices, but their economic effects have been controversial.

Tying has been attacked on the theory that price discrimination of this sort reduces consumer welfare. We show that this argument is based on a misunderstanding of the kind of price discrimination that is involved in variable proportion ties. The great majority of them almost certainly produce both welfare gains and net consumer benefits.

We also consider and reject the argument that tying produces greater welfare losses when viewed from an ex ante rather than an ex post perspective. That argument rests on a flawed premise about the sources of the increased returns to innovations whose distribution requires tying. Further, it ignores the important role of fixed costs in producing innovation incentives. We also show that tying in concentrated markets produces significant benefits from the elimination of double marginalization. Then we extend our analysis to bundled discounts, focusing on the possibility of increased harm that can occur if the monopolist increases the standalone price of one good when inaugurating the bundled discount.

Antitrust's per se rule is reserved for practices that are so likely to cause antitrust harm and have so little to defend them that detailed case-by-case assessment is thought to be unnecessary. They can be condemned categorically simply upon a showing that a few basic conditions are satisfied and that they belong in a particular class of restraints. No kind of unilaterally imposed tying arrangement, even by a monopolist, falls into that category.

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INTRODUCTION

A tying arrangement is a seller's requirement that before a customer may purchase the seller's "tying" product, she must also take one or more units of the seller's "tied" product. The tying and tied products are typically complements in use, which means that they are consumed together.[1] Most ties are contractual in the sense that the thing that binds the tying and tied products together is a contract or perhaps an intellectual property license. Some ties are "technological," which means that the two products are tied together by virtue of product design. For example, the owner of a Kodak Instamatic camera may be able to use only Kodak's own film cartridges designed to fit that camera,[2] or the owner of a Lexmark computer printer may be limited by virtue of product design to the use of Lexmark ink cartridges.[3] Regardless of the type, anticompetitive tying arrangements have been illegal under United States antitrust law ever since the *Motion Picture Patents* case in 1917,[4] in which the Supreme Court prohibited the owner of a patented movie projector from forcing purchasers to agree to use the projector only to show the projector seller's films.

This Article examines the presumption that tying arrangements are harmful and offers several conclusions about the kind of antitrust analysis that should be applied to them. Nearly all the competitive harm that results from tying can be divided into two types: (1) foreclosure; and (2) extraction, or "leverage."

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1. The products can also be complements in production or distribution; that is, costs are lower when two products are produced or distributed together. *See, e.g.*, Times-Picayune Publ'g Co. v. United States, 345 U.S. 594, 613 (1953) (refusing to condemn tying of advertising in morning and evening newspapers where defendant set type a single time for both editions); Brief for 98 Newspaper Publishers as Amicus Curiae, Times-Picayune Publ'g Co. v. United States, 354 U.S. 594 (1953) (Nos. 374–75), 1953 WL 78355, at *13 (stating that once type is set, cost of printing additional issues is "hardly any more expense than the cost of ink and paper").

2. *See, e.g.*, Berkey Photo v. Eastman Kodak Co., 603 F.2d 263, 275 (2d Cir. 1979), *cert. denied*, 444 U.S. 1093 (1980) (refusing to condemn technological tie of camera and film).

3. Static Control Components, Inc. v. Lexmark Int'l, Inc., 615 F. Supp. 2d 575, 588 (E.D. Ky. 2009) (printer manufacturer's post-sale tying restriction violated first sale doctrine); *see also, e.g.*, Static Control Components, Inc. v. Lexmark Int'l, Inc., 2008 WL 4542735, at *8 (E.D. Ky. Oct. 3, 2008) (declining to reach whether printer–cartridge tie constituted patent misuse); Static Control Components, Inc. v. Lexmark Int'l, Inc., 487 F. Supp. 2d 861, 877–80 (E.D. Ky. 2007) (denying summary judgment on antitrust challenge to printer–cartridge tie). On so-called "technological" as opposed to contractual ties, see 10 PHILLIP E. AREEDA, HERBERT HOVENKAMP & EINER ELHAUGE, ANTITRUST LAW ¶ 1757 (2d ed. 2004).

4. Motion Picture Patents Co. v. Universal Film Mfg. Co., 243 U.S. 502, 516 (1917) (holding that a projector/film tie violated patent law's first sale doctrine, but stating that it was "confirmed" in its conclusion by the passage of the Clayton Act); *see* Christina Bohannan, *IP Misuse as Foreclosure*, 96 IOWA L. REV. (forthcoming 2010), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1474407. On the scope of the first sale doctrine in early twentieth century challenges to patent ties, see Herbert Hovenkamp, *Post-Sale Restraints and Competitive Harm: The First Sale Doctrine in Perspective*, 66 N.Y.U. ANN. SURV. AM. L. (forthcoming 2010), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1540527.

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Foreclosure occurs when a tie ousts or unreasonably limits the opportunities of rivals, typically in the tied product market. For example, if a monopoly hospital ties anesthesiology services, there may be no market remaining for independent anesthesiologists.[5] The second type of antitrust harm is extraction, which involves overcharges that purchasers of tied packages are forced to pay. This Article is concerned almost exclusively with injuries of this latter type, although foreclosure concerns occasionally become relevant as well.

We do not take a position on the question whether antitrust's primary concern is with "total welfare" (the sum of producers' and consumers' surplus) or with "consumer welfare" (which considers consumers' surplus alone). However, we do illustrate the various effects that ties have on welfare as measured by either type. We also conclude that a per se rule or "quasi per se" rule has no place in tying analysis.[6] The great majority of ties are beneficial or at least benign, measured by either welfare standard, and this is true without even considering production efficiencies that many ties produce.

To demonstrate that tying arrangements should not be presumptively illegal under antitrust law, we examine the confusion over the difference between second- and third-degree price discrimination, which can lead to the erroneous conclusion that ties are harmful because they transfer output from high-value to low-value customers.[7] We also consider the relationship between the output effects of variable proportion ties on consumer welfare, finding that consumers likely benefit most of the time.[8] For these two queries our focus is mainly on variable proportion ties, which are ties in which the usage of the tied product varies from one person to another. Next we consider whether the antitrust analysis of tying arrangements should differ if one looks at the problem from an ex ante rather than an ex post perspective. An ex ante perspective is one that looks over the long run at the inducements to engage in product innovation where part of the anticipated gains result from tying.[9] By contrast, an ex post approach takes established products and technologies as given and then compares the economic effects of tying as opposed to separate sales. We also analyze the problem of double marginalization when two linked markets are both noncompetitive and consider how tying benefits consumers by creating a sort of "reverse leveraging."[10] Then we extend our analysis to bundled discounts, a form of tying in which the customer's inducement to purchase two goods together is a discount rather than an absolute contractual requirement. In particular, we consider the possibility of increased harm that can occur if the monopolist increases the standalone price of one good

5. *See* Jefferson Parish Hosp. Dist. v. Hyde, 466 U.S. 2, 44–45 (1984).

6. For a contrary argument, see Einer Elhauge, *Tying, Bundled Discounts, and the Death of the Single Monopoly Profit Theory*, 123 HARV. L. REV. 397, 431 & n.89 (2009).

7. *See infra* text accompanying note 57.

8. *See infra* text accompanying note 90.

9. *See infra* text accompanying notes 92–108.

10. *See infra* text accompanying notes 118–27.

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when inaugurating the bundled discount.[11] Finally, we briefly consider the role of efficiencies in justifying ties.[12]

At least since the 1950s it has been clear that tying arrangements can be used as price-discrimination devices—that is, as devices for obtaining different prices or different rates of return from different customers.[13] In a variable proportion tie, the seller has a monopoly in a tying product, such as a printer, which uses some consumable product, such as ink, that consumers purchase as they need it. The seller then reduces the price of the tying product, sometimes to cost or even to zero,[14] but requires purchasers to use its tied product and sells it at a premium over the market price. The seller then earns varying amounts of profit from different customers, depending on the amount of the tied product that they consume.

The economic effects of price-discrimination ties have provoked considerable debate. Specifically, there is confusion about what type of price discrimination results from ties. The answer to that question is critical, because different types of price discrimination produce very different effects on general or consumer welfare. As developed below, the literature on the effects of price discrimination strongly distinguishes between second- and third-degree price discrimination.[15] Third-degree price discrimination that does not increase output necessarily decreases welfare.[16] This is not true of second-degree price discrimination, though, and the economic consensus is that most instances of it are probably welfare increasing,[17] particularly in the presence of fixed costs.[18] As we show below, variable proportion ties are a form of second-degree price discrimination. Further, they only harm consumer welfare in the most flagrant situations, and they often increase welfare even if output falls. Equally important is the fact that third-degree price discrimination transfers output from higher-value to

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11. *See infra* text accompanying notes 133–34.

12. *See infra* text accompanying note 82.

13. Ward Bowman, *Tying Arrangements and the Leverage Problem*, 67 YALE L.J. 19, 21–23 (1957); *see also* Richard Markovits, *Tie-Ins, Reciprocity and the Leverage Theory*, 76 YALE L.J. 1397 (1967).

14. *See infra* text accompanying notes 74–75.

15. *See infra* text accompanying notes 56–58.

16. *E.g.*, Hal R. Varian, *Price Discrimination*, *in* 1 HANDBOOK OF INDUSTRIAL ORGANIZATION 600 (Richard Schmalensee & Robert D. Willig eds., 1989); Kathleen Carroll & Dennis Coates, *Teaching Price Discrimination: Some Clarification*, 66 S. ECON. J. 466 (1999); Stephen K. Layson, *Third-Degree Price Discrimination with Interdependent Demands*, 46 J. INDUS. ECON. 511 (1998); Richard Schmalensee, *Output and Welfare Implications of Monopolistic Third-Degree Price Discrimination*, 71 AM. ECON. REV. 242 (1981).

17. *See* FREDERIC M. SCHERER & DAVID ROSS, INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE 495 (3d ed. 1990) ("First- or second-degree discrimination usually leads to larger output than under simple monopoly, and from there to lower dead-weight losses and improved allocative efficiency."); *see also* MASSIMO MOTTA, COMPETITION POLICY 494–95 (2004) (second-degree price discrimination tends to improve welfare); *infra* Appendix.

18. *See infra* text accompanying notes 100, 108, 109 (on relevance of fixed costs).

lower-value customers, thus reducing welfare even if output remains constant. Second-degree price discrimination does not have this effect.[19]

The term "welfare" has a relatively fixed meaning in economics. It equals the sum of consumer and producer surplus, assuming no one else is affected.[20] The antitrust literature has seen a great deal of debate, however, over whether "total surplus," which is the same thing as the economist's "welfare," should govern antitrust policy, or whether antitrust should limit its concern to "consumer welfare."[21] A consumer welfare standard seeks to maximize consumer surplus without regard to effects on producer surplus. For example, under the consumer welfare standard a merger that simultaneously increases productive efficiency and raises price would be unlawful, even if the profit gains to the merging firms were greater than the higher prices to consumers.[22] This is because the merger increases total welfare but reduces consumer welfare. We do not express any opinion on this issue, but throughout this Article we make several observations about both the general welfare effects and the consumer welfare effects of ties. Clearly, however, a practice that increases *both* total welfare and consumer welfare should not be condemned under either of these tests, while a practice that reduces both might be. Importantly, a firm imposes tying only if it is profitable to do so. As a result, a tie that increases consumer welfare *necessarily* increases general economic welfare as well, assuming the welfare of third parties is not negatively affected.

The antitrust laws do not speak of either measure of welfare and, indeed, never use the term "welfare" at all. The provisions that are most relevant to tying are section 1 of the Sherman Act[23] and section 3 of the Clayton Act.[24] The

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19. *See infra* text accompanying notes 55–58.

20. A "surplus" is the difference between the amount someone is willing to accept or pay for something and the amount he or she must actually accept or pay. For example, if a consumer is willing to pay $3 for a loaf of bread but the grocery store price is $2, the consumer receives a surplus of $1.

21. *See, e.g.*, Albert A. Foer, *The Goals of Antitrust: Thoughts on Consumer Welfare in the US*, *in* HANDBOOK OF RESEARCH IN TRANS-ATLANTIC ANTITRUST (PHILIP MARSDEN ed., 2006) (arguing for consumer welfare standard); HERBERT HOVENKAMP, FEDERAL ANTITRUST POLICY: THE LAW OF COMPETITION AND ITS PRACTICE § 3.1 (3d ed. 2005) (summarizing the debate); John B. Kirkwood & Robert H. Lande, *The Chicago School's Foundation is Flawed: Antitrust Protects Consumers, not Efficiency*, *in* HOW THE CHICAGO SCHOOL OVERSHOT THE MARK: THE EFFECT OF CONSERVATIVE ECONOMIC ANALYSIS ON U.S. ANTITRUST 89 (Robert Pitofsky ed., 2008); Dennis W. Carlton, *Does Antitrust Need to be Modernized?*, 21 J. ECON. PERSP. 155 (2007) (arguing for total welfare); Alan J. Meese, *Debunking the Purchaser Welfare Account of Section 2 of the Sherman Act: How Harvard Brought Us a Total Welfare Standard and Why We Should Keep It*, 85 N.Y.U. L. REV. 659 (2010); *see also* Joseph Farrell & Michael L. Katz, *The Economics of Welfare Standards in Antitrust*, 2 COMPETITION POL'Y INT'L 3 (2006) (presenting a balanced discussion evaluating both standards).

22. *See* Oliver E. Williamson, *Economies as an Antitrust Defense: The Welfare Tradeoffs*, 58 AM. ECON. REV. 18 (1968).

23. 15 U.S.C. § 1 (2006).

24. 15 U.S.C. § 14 (2006). The case of a monopolist under section 2 of the Sherman Act, 15 U.S.C. § 2 (2006), could also be relevant. However, section 2's requirement of "monopolizing" conduct presumably refers only to "foreclosing" ties, or ties that cause harm by excluding rivals. These are not the subject of this Article.

Sherman Act provision extends to conduct "in restraint of trade," and the Clayton Act provision reaches conduct where "the effect . . . may be substantially to lessen competition."[25] A natural meaning of conduct that "restrains trade" is conduct that reduces market output below the level it would otherwise be. In the case of variable proportion ties, however, we show that output effects are not the same as either general-welfare or consumer-welfare effects. A tie that reduces output might increase both general welfare and consumer welfare, while a tie that increases output might conceivably harm both, although this is less likely.[26] Further, the term "output" itself requires further clarification because a variable proportion tie typically affects two different outputs: that of the tying product and that of the tied product. It typically *increases* the output of the tying product, such as a printer. In some cases it decreases the volume of the tied product, such as ink cartridges, although in other cases it increases tied product volume as well.

Nonforeclosing ties, or those that do not cause competitive harm by excluding rivals,[27] may extract higher prices from some customers, but they also charge lower prices to others and typically bring new customers into the market. As a result, the case for condemning them is very weak. The principal means of extraction is price discrimination.[28] While the economic literature on price discrimination and tying focuses on monopolists, most challenged ties occur in oligopoly markets where the defendant typically has no more market power than results from product differentiation.[29] Indeed, many franchise ties, which are of variable proportions, occur in competitive or even highly competitive product-differentiated markets and involve nondominant firms.[30] In those cases a tie that includes a substantial price reduction in the tying product can increase the number of sales significantly. The true monopoly case is the rare, but hardly unheard of, worst case scenario. However, even if output of the tied product falls

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25. 15 U.S.C. §§ 1, 14.

26. *See infra* Appendix.

27. The foreclosure rationale for condemning ties is that they exclude, or foreclose, rivals in the tied product market. For example, by requiring all those who use its surgical facilities to purchase its anesthesiologist services, a hospital might be able to exclude rival anesthesiologists from the market. *See* Jefferson Parish Hosp. Dist. v. Hyde, 466 U.S. 2 (1984) (refusing to condemn a hospital's surgical facility/anesthesiologist tie where hospital did not have dominant market share for surgical admissions; plaintiff was excluded rival anesthesiologist). By contrast, when a maker of salt-injection machines requires users to purchase its salt, foreclosure cannot be a threat, since such machines process only a miniscule percentage of the salt market. *See* Int'l Salt Co. v. United States, 332 U.S. 392 (1947) (condemning such a tie); *see also* 9 AREEDA, HOVENKAMP & ELHAUGE, *supra* note 3, ¶¶ 1704–1709 (foreclosure and its assessment); *id.* ¶¶ 1722–1726 (nonforeclosing ties).

28. *See* HOVENKAMP, *supra* note 21, § 10.6e (discussing the basic economics of price discrimination ties); SCHERER & ROSS, *supra* note 17, § 13.

29. *See* JEAN TIROLE, THE THEORY OF INDUSTRIAL ORGANIZATION 367–74 (1988) (noting that most variable proportion ties occur in oligopoly markets).

30. *See, e.g.*, Kypta v. McDonald's Corp., 671 F.2d 1282 (11th Cir. 1982) (fast food; hamburgers and related products; tying of lease of location); Siegel v. Chicken Delight, Inc., 448 F.2d 43 (9th Cir. 1971) (minor fast food fried chicken franchisor; condemning tying of spices and supplies); Little Caesar Enters., Inc. v. Smith, 34 F. Supp. 2d 459 (E.D. Mich. 1998) (pizza; tying of paper plates and other products bearing franchisor's logo).

under variable proportion tying, it is generally impossible to demonstrate that the tie harms welfare because many of the consumers who buy fewer units under tying are nevertheless better off as a result of the tie. For these consumers, the price cut applied to the tying product contributes more to consumer surplus than is extracted by the increase in the tied product's price. If the market includes a relatively high number of these customers, it is possible that output of the tied product falls while consumer welfare increases.[31]

The traditional concern of tying arrangements was "leverage." Leverage is the fear that a firm with a monopoly in one product could create a second monopoly by requiring purchasers or lessees of the first product to purchase a second product from that firm as well. The concern over leverage first emerged in patent law.[32] For example, in the *Carbice* decision the Supreme Court condemned an arrangement under which the seller of a patented ice box required those who used it to purchase its dry ice as well.[33] The tie was nonforeclosing, since dry ice, which occurred naturally and was readily manufactured, was not patentable.[34] Nevertheless, Justice Brandeis wrote, the requirement was an unlawful leveraging of the ice box patent because it enabled the patentee to "derive its profit not from the invention on which the law gives it a monopoly, but from the unpatented supplies with which it is used."[35] If a monopoly could be contractually expanded in this way, a patentee "might conceivably monopolize the commerce in a large part of unpatented materials used in its manufacture. The owner of a patent for a machine might thereby secure a partial monopoly on the unpatented supplies consumed in its operation."[36]

Many antitrust theories prior to the 1980s were based on exaggerated views of the anticompetitive possibilities of leverage. In general, however, leverage was never a significant component in Harvard School antitrust analysis,[37] and it was enthusiastically rejected by the Chicago School of Antitrust,[38] particularly after Ward Bowman's article came out in 1957.[39] While no one disputes that a monopolist can design contractual mechanisms that exploit its monopoly position by price discrimination, attaching strong implications to this for competition policy has proven to be all but impossible.[40]

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31. *See infra* text accompanying notes 88–89.

32. *See* Bohannan, *supra* note 4, at 15.

33. Carbice Corp. of Am. v. Am. Patents Dev. Corp., 283 U.S. 27, 31–32 (1931).

34. Dry ice had been discovered in the 1830s by Charles Thilorier, a French chemist, as the residue from rapid evaporation of liquid carbon dioxide. *See* Duane H.D. Roller, *Thilorier and the First Solidification of a "Permanent" Gas (1835)*, 43 ISIS 109 (1952).

35. *Carbice*, 283 U.S. at 31–32.

36. *Id.* at 32.

37. *See* Herbert Hovenkamp, *United States Competition Policy in Crisis: 1890–1955*, 94 MINN. L. REV. 311 (2009).

38. *See* Richard A. Posner, *The Chicago School of Antitrust Analysis*, 127 U. PA. L. REV. 925, 933–35 (1979).

39. *See* Bowman, *supra* note 13.

40. *See, e.g.*, 3B PHILLIP E. AREEDA & HERBERT HOVENKAMP, ANTITRUST LAW ¶ 781 (3d ed. 2008) (product innovation as antitrust violation).

In Bowman's price discrimination model the tying arrangement served as an *alternative* to selling the machine itself at different prices to different customers. As Bowman observed, such an attempt would encounter two different problems. First, the seller would have a difficult time identifying the users who valued the product more. Second, those who paid a lower price would arbitrage the machine to higher-value users,[41] thus defeating the scheme.[42] In fact, the two strategies are often used simultaneously. For example, a printer manufacturer might engage in cartridge tying while also offering different packages to commercial and residential users, or discounts to educational institutions. This would be a combination of second- and third-degree price discrimination.[43]

One problem with the leverage argument is its ambiguity. A tie cannot create a second "monopoly" in the tied product unless the latter has no untied uses. For example, even if Justice Brandeis's ice box manufacturer[44] had an ice box monopoly, tying ice would not create a second monopoly as long as there were numerous uses of dry ice that did not involve the monopolist's ice box. Fundamentally, the leverage theory concerns "extraction," not monopoly. The monopolist is obtaining a higher price for the dry ice it sells, but the rest of the dry ice market remains unaffected, assuming it is competitive.

I. NONFORECLOSING TIES AND SECOND-DEGREE PRICE DISCRIMINATION

Ever since the time of Cambridge economist Arthur Cecil Pigou, price discrimination has been divided into three classes, or "degrees."[45] First-degree, or "perfect," price discrimination involves selling each unit of a good at the highest price any consumer is willing to pay for that unit. Output in that case rises to the competitive level because every sale is made right down to marginal cost. However, the entire surplus goes to the seller rather than to the customers.[46] Strictly speaking, neither variable proportion tying nor any other real world practice constitutes first-degree price discrimination because sellers cannot

41. "Arbitrage" in this context refers to the practice by which those who pay a lower price for a good resell it to others who are otherwise required to pay a higher price. The arbitrage price will lie between the two prices given by the monopolist.

42. Bowman, *supra* note 13, at 23 (using as an example Heaton-Peninsular Button-Fastener Co. v. Eureka Specialty Co., 65 F. 619 (C.C.W.D. Mich. 1895), in which the defendant required users of each button fastening machine to purchase its buttons).

43. *See* Allan C. Deserpa, *A Note on Second Degree Price Discrimination and Its Implications*, 2 REV. INDUS. ORG. 368 (1985) (real world practices often involve a combination of second- and third-degree discrimination).

44. Carbice Corp. of Am. v. Am. Patents Dev. Corp., 283 U.S. 27, 31–32 (1931); *see supra* text accompanying notes 33–36.

45. *See* ARTHUR CECIL PIGOU, THE ECONOMICS OF WELFARE § II.17.5 (4th ed. 1932).

46. *See* Michael Spence, *Product Selection, Fixed Costs and Monopolistic Competition*, 43 REV. ECON. STUD. 217, 219 (1976).

practically extract the highest price that the consumer is willing to pay on each sale.[47]

Even an exceptionally-finely-tuned variable proportion tie will not come very close to first-degree price discrimination. While a well executed printer–ink tie could accurately make prices proportional to the number of *copies* a person prints, it could not control for the fact that different purchasers place different values on each copy. For example, both a law firm drafting legal opinions on securities offerings and a printer of handbills about garage sales might print 1000 pages weekly. As a result, if they purchased identical printers under the same tying arrangement, they would pay the same amount per print. But given what is at stake, the law firm might value printing at many dollars per page, while the handbill printer values printed pages at only a few cents. The variable proportion tie will not capture these differences in valuation and will thus permit at least some consumers to retain surpluses.

By contrast to first-degree discrimination, second- and third-degree price discrimination are quite common. Although they are very different practices, some complex schemes may contain attributes of both.[48] In third-degree price discrimination the seller divides customers into discrete groups based on observations about their willingness to pay, and each group is charged a unique price. Prices offered to one group are not made available to the other group.[49] For example, the manufacturer of computer software might license it to commercial users at a higher rate, and to home users at a lower rate.[50] This sort of discrimination is profitable only when consumer valuations are concentrated into two or more distinct price intervals. If the monopolist were to charge a single monopoly price, it would very likely set it somewhere between the high and low

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47. The closest situation would be an auction in which each unit available in the entire market is sold to the highest bidder until every unit is sold. Even here, however, the winning bid does not represent the winner's willingness to pay, but only the fact that no other bidder was willing to pay more. For example, if bidders bid against each other until one bidder wins at a price of $50, we know that no *other* bidder was willing to pay more than $50, but the winning bidder may have been willing to pay $51 or more. The so-called "Dutch" auction, in which the auctioneer starts with a high price and then comes down until a bidder accepts it comes about as close as any real world situation to first-degree price discrimination. *See* Johannes Horner & Larry Samuelson, *Managing Strategic Buyers* (Cowles Found., Working Paper No. 1684R, 2010), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1673898.

48. *See* Deserpa, *supra* note 43.

49. In the words of Arthur Cecil Pigou:

> This degree, it will be noticed, differs fundamentally from either of the preceding degrees, in that it may involve the refusal to satisfy, in one market, demands represented by demand prices in excess of some of those which, in another market, are satisfied.

PIGOU, *supra* note 45, § II.17.5.

50. *See, e.g.*, Gen. Talking Pictures Corp. v. W. Elec. Co., 305 U.S. 124 (1938) (licensing of technology to produce sound amplifiers at different rates to producers for commercial use and for home use); ProCD, Inc. v. Zeidenberg, 86 F.3d 1447 (7th Cir. 1996) (licensing of database to commercial and residential users at different rates); *see also* Christina Bohannan, *Copyright Preemption of Contracts*, 67 MD. L. REV. 616, 632 (2008).

prices used to discriminate between groups.[51] The discrimination scheme excludes consumers whose valuations lie below the price they have been offered even if that price is higher than the nondiscriminatory monopoly price. On the other hand, the scheme ordinarily draws in some consumers who would have been unwilling to pay the monopoly price. As a result, third-degree price discrimination has the very important effect of redirecting output from consumers with relatively high valuations to those with relatively low ones. Hence, consumer welfare will be harmed even if output levels are maintained but do not increase.

To take a simple example, suppose a monopolist identifies and segregates two groups of customers, offering the first group a price of $8 and the second a price of $5. Buyers in the high price group will purchase until their marginal valuations of the good fall to $8 and then stop, because they cannot purchase at a price of, say, $7.90, even if they wish to. The $7.90 price is profitable to the seller, and the seller is actually selling to others at a profitable price of $5. As a result, the discrimination scheme takes a sale away from a high-valuation customer, willing to pay $7.90, and shifts it to a low-valuation customer. This has led economists since the time of Pigou[52] and Joan Robinson[53] to infer that third-degree price discrimination reduces welfare whenever it fails to generate more output than simple monopoly pricing.[54]

By contrast, in second-degree price discrimination everyone is offered the same price schedule, with different unit prices corresponding to different quantities or product varieties.[55] A quantity-discount scheme is one example. Another is division of transportation tickets by classes. For example, airlines might offer first-class and coach tickets, or advance-purchase and immediate-purchase fares. The same fare structure is available to everyone, but different customers make different choices based on willingness to pay, and profitability is higher for some classifications than for others. For example, the lawyer accustomed to flying first class, but facing an economic recession, might choose to shift all or part of her air travel to coach. When conditions improve she may switch back.

To be sure, second-degree price discrimination produces distortions from perfect competition, but they are much different distortions than third-degree price discrimination encounters. The one problem second-degree price discrimination

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51. In some instances the monopolist might discriminate only between customers willing to pay the monopoly price and some group of high-value customers willing to pay more.

52. In Pigou's words: "This degree [third], it will be noticed, differs fundamentally from either of the preceding degrees, in that it may involve the refusal to satisfy, in one market, demands represented by demand prices in excess of some of those which, in another market, are satisfied." PIGOU, *supra* note 45, § II.17.5.

53. *See* JOAN ROBINSON, THE ECONOMICS OF IMPERFECT COMPETITION 205–06 (1933).

54. *See* Marius Schwartz, *Third-Degree Price Discrimination and Output: Generalizing a Welfare Result*, 80 AM. ECON. REV. 1259 (1990); *see also* Schmalensee, *supra* note 16; Hal R. Varian, *Price Discrimination and Social Welfare*, 75 AM. ECON. REV. 870 (1985).

55. GORDON MILLS, RETAIL PRICING STRATEGIES AND MARKET POWER 25–26 (2002).

does *not* typically encounter is the discontinuities in marginal substitution that are characteristic of third-degree discrimination. For example, if flying first class is too straining on a person's budget as she does more of it, she is always free to shift part or all of her purchases to coach. As the number of classifications in a second-degree price discrimination scheme increases, the scheme comes closer to approximating first-degree (or "perfect") price discrimination,[56] under which each individual customer pays his or her reservation price, and output increases toward the competitive level.[57] In practice, few second-degree schemes reach anything close to that level of classification. However, variable proportion ties theoretically permit an infinite number of degrees depending on the number of tied units a consumer buys.

Variable proportion ties have been attacked on the premise that they "reallocat[e] output from high-value buyers to low-value buyers."[58] That argument is based on the faulty premise, however, that they are a form of third-degree price discrimination or that there is no real difference between second- and third-degree price discrimination. That premise can then lead to the conclusion that variable proportion ties reduce consumer welfare even if they increase output, because the increased output accrues to consumers who place a lower value on the tied product (or the tying-tied combination), while higher prices and possible reduced output accrues to other higher-value consumers.

But the argument has no application to second-degree price discrimination, which covers all ties in which the tying and tied products are offered at the same nominal price to all customers. Some ties may also contain attributes of third-degree price discrimination, but they would have to be more complex than the ordinary tie. For example, a manufacturer of printers and ink might tie printers and ink but also charge a higher price for either or both products to commercial users than to home users. In that case the printer–ink tie would be an instance of second-degree price discrimination while the differential price to commercial and home users would be an instance of third-degree price discrimination.

So what type of price discrimination are variable proportion ties? Clearly, as noted above, they are not first-degree price discrimination.[59] The economic literature generally deals with variable proportion ties as second-degree price

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56. In perfect price discrimination every individual buyer is charged his reservation price and output is restored to the competitive level. Welfare is higher than under monopoly pricing, although consumers' surplus is lower.

57. PIGOU, *supra* note 45, § II.17.11:

> It is readily seen that the effects of monopoly *plus* discrimination of the second degree approximate towards those of monopoly *plus* discrimination of the first degree, as the number of different prices, which it is possible for the monopolist to charge, increases; just as the area of a polygon inscribed in a circle approximates to the area of the circle as the number of its sides increases . . . .

58. Elhauge, *supra* note 6, at 431 & n.89.

59. *See supra* text accompanying note 47.

discrimination.[60] This is because, first, as noted above, third-degree price discrimination involves a seller's segregation of groups of customers based on willingness to pay prior to the sale.[61] Tying does not; rather, the tying firm selects the products and places them on the market, with the same price schedule to all. Customers identify themselves by selecting the portion of the schedule that they want.[62] Moreover, the profitability of a tying strategy is not affected by its ability to distinguish between consumers with different valuations. Tying can be a viable strategy even when consumers' preferences are too idiosyncratic to be discerned with any information available ex ante.

Printers and ink cartridges are near-perfect complements. Two goods are complements if the value of the pair exceeds the sum of the values the goods retain in the other's absence. Perfect complements exist where each good has no value unless used with the other. For the most part, consumers use printers and ink cartridges together.[63] Customers may all purchase a single printer but use it by differing amounts, in which case the customer's average cost of *using* the printer (i.e., the per-print price) decreases as the total amount of use increases.[64] No two consumers who do the same amount of printing will be required to pay different per-print prices, even if one consumer derives more total value from her prints. Thus, the tie operates as a quantity discount: the more you print, the less you pay per page. This is exactly the sort of situation that occurs under second-degree price discrimination.

Pigou's point in distinguishing between second- and third-degree price discrimination was to differentiate situations where customers' valuations could be identified ex ante and offers made to them separately (third degree), from situations where the seller knew something about demand generally but could not identify the specific buyers at the time of the sale.[65] As a result, the seller used the price schedule to enable buyers to self select. For these reasons the economics literature identifies two-part tariffs, which strongly resemble variable proportion ties, as forms of second-degree price discrimination.[66] In a two-part tariff a seller requires consumers to pay a "fixed" fee before they can begin purchasing

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60. *See, e.g.*, TIROLE, *supra* note 29, at 147 (ties a form of second-degree price discrimination); *see also* Richard A. Posner, *Vertical Restraints and Antitrust Policy*, 72 U. CHI. L. REV. 229, 236 (2005) (same).

61. *See* MILLS, *supra* note 55, at 26 (2002) (difference between second- and third-degree price discrimination is that in second-degree discrimination seller cannot distinguish customers into diverse groups, but rather they self-select according to a uniform pricing schedule).

62. *See id.*

63. The value of a printer without a cartridge might be a little greater than zero. For example, a printer without an ink cartridge might be used as a doorstop, or perhaps on the set of a television show like *The Office*.

64. *See infra* Table 1.

65. *See* PIGOU, *supra* note 45, § II.17.

66. *See, e.g.*, SATYA R. CHAKRAVARTY, MICROECONOMICS 355 (2002); JEAN-JACQUES LAFFONT & JEAN TIROLE, A THEORY OF INCENTIVES IN PROCUREMENT AND REGULATION 175–78 (1993); TIROLE, *supra* note 29, § 3.3.1; *see also* TIMOTHY C.G. FISHER & ROBERT G. WASCHIK, MANAGERIAL ECONOMICS: A GAME THEORETIC APPROACH 45 (2002).

individual units of the good at a constant "marginal" price. Neither the fixed fee nor the marginal price differs among consumers, regardless of how many units they buy or what valuations they maintain. However, when the one time fee is factored into the total price, the *average* price of each unit falls as more units are purchased. This causes two-part tariffs to resemble quantity discounting, which explains why they too are classified as second-degree price discrimination mechanisms. For example, a water company might charge home users a rate of ten dollars per month plus one dollar per hundred gallons of water consumed. Such tariffs are typically used in situations where fixed costs are too high to be covered under marginal-cost pricing. Further, building a fixed-cost component into the usage charge would result in higher-volume users paying much more. So the tariff effectively segregates the fixed-cost component by means of the fixed fee, while the variable costs are billed on the basis of usage.[67]

Professor Elhauge has argued that even if a price-discrimination tie should increase output, welfare consequences are negative because imperfect discrimination schemes switch output from high-value to low-value purchasers.[68] This is clearly true of *third-degree* price discrimination, and a principal reason for its inefficiencies. To return to the previous example, suppose a discrimination scheme divides customers into two discrete classes where arbitrage is impossible, and charges prices to the two classes of $8 and $5, respectively. Buyers in the first group will purchase down to the point that the marginal value they place on the incremental purchase (i.e., their marginal rate of substitution) is $8, but they will not purchase more. As a result, a sale to someone in this group at a price of $7.90 is left unmade, even as sales are being made to the lower-price group at a price of $5. So to the extent that third-degree price discrimination shifts output away from the higher-value group and toward the lower-value group, the discontinuity guarantees that the value of the marginal sale lost to the higher-priced group is greater than the value of the marginal sale made to the lower-priced group.[69]

However, this is not the case with the variable proportion tie. To be sure, the tie reduces fixed costs to the buyer (e.g., the printer) and increases marginal

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67. *See* Mark Armstrong & David E.M. Sappington, *Recent Developments in the Theory of Regulation*, *in* HANDBOOK OF INDUSTRIAL ORGANIZATION 1557, 1683 (Mark Armstrong & Robert H. Porter eds., 2007); W. KIP VISCUSI, JOHN M. VERNON & JOSEPH E. HARRINGTON, JR., ECONOMICS OF REGULATION AND ANTITRUST 348–50 (4th ed. 2005).

68. Elhauge, *supra* note 6, at 405 ("[I]mperfect price discrimination . . . reallocates some output to buyers who put less value on it."); *see also id.* at 431 (arguing that tying that achieves intraproduct price discrimination, the common result of variable proportion ties, "does not alter the profit-maximizing output, but reallocates some output from high-value buyers to low-value buyers").

69. *See* Schmalensee, *supra* note 16, at 242–43:

> For any fixed total output of the monopolized product, efficiency requires that all buyers have the same marginal valuation of additional units. (If all buyers are households, they must have the same marginal rate of substitution between the good involved and any numeraire good.) Selling the same product at different prices to different buyers induces different marginal valuations and produces what Robinson terms "a maldistribution of resources as between different uses."

(quoting ROBINSON, *supra* note 53, at 206).

costs (e.g., the ink cartridge), and any marginal-cost increase is a distortion. But under the variable proportion tie, the distortion is continuous across the demand curve and is the *same for everyone*. For example, suppose that the monopoly price for the printer is $400 and the competitive ink price is 2¢ per printed page. The dominant firm uses a variable proportion tie, cutting the printer price to $200 but tying ink and charging 4¢ per printed page for the ink. To the customer the printer is a fixed cost and the ink is variable, so the tie has the effect of reducing fixed costs but increasing variable costs.[70] The marginal cost of 4¢ per copy is the same for all buyers at all places on the demand curve, from those that print the most to those that print the least. Each buyer will print copies up to the point that marginal value for that buyer drops to 4¢ per print. As a result, in equilibrium, the less intensive user and the more intensive user both value the marginal print at 4¢ and there is no transfer at the margin from higher to lower value. On a per-page basis, the value of sales lost in the upper region of the demand curve is precisely equal to the value of sales lost in the lower region. If such a tie increases output (measured by printed pages), it very likely also increases welfare. This lack of discontinuity in marginal valuation is also why it seems appropriate to characterize variable proportion ties as instances of second-degree price discrimination.

The fact that purchases are reallocated under tying does not prima facie imply that consumer welfare is harmed. In fact, because the price cut applied to the *tying* product is more significant to lower-use customers, they often benefit from tying even if they purchase fewer units of the tied product.[71] As a result, even when a tie reduces output of the tied product, it may increase consumer welfare.

II. A CLOSER LOOK AT PRICE DISCRIMINATION TIES

Both economists and others often use the term "price discrimination" to mean charging different prices to two different groups, or for two different classes of sales. More technically, it is commonly defined as sales at differing ratios of price to marginal cost, or as prices that have different percentage markups in relation to cost.[72] While economists seem to prefer the latter definitions as a technical matter, the models generally define third-degree price discrimination as the charging of different prices to different classes of consumers. In many of the models marginal cost is simply assumed to be zero.[73] All of this is complicated by

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70. As a result of these lowered fixed costs, some purchasers who bought prior to the tie are benefitted from the arrangement; all new purchasers brought in by the tie are benefitted. *See infra* text accompanying note 86.

71. *See infra* text accompanying notes 78–79.

72. *See* GEORGE J. STIGLER, THE THEORY OF PRICE 210 (3d ed. 1966); Varian, *supra* note 16, at 597–98; S.J. Liebowitz, *Price Differentials and Price Discrimination: Reply and Extensions*, 26 ECON. INQUIRY 779 (1988).

73. *E.g.*, Mark Armstrong, *Recent Developments in the Economics of Price Discrimination*, *in* 2 ADVANCES IN ECONOMICS AND ECONOMETRICS: THEORY AND APPLICATIONS, NINTH WORLD CONGRESS 97 (Richard Blundell, Whitney K. Newey & Torsten Persson eds., 2006), *available at* http://www.econ.ucl.ac.uk/downloads/armstrong/pd.pdf ("[P]rice discrimination exists when two 'similar' products with the same marginal cost are sold by a firm at different prices."); David A. Malueg, *Bounding the Welfare Effects of Third-Degree Price Discrimination*, 83 AM. ECON. REV. 1011, 1011 (1993) (charging "different groups of customers different prices"); Schmalensee, *supra* note

the fact that real-world practices contain attributes of both definitions, often within the same scheme. For example, consider the airline that practices second-degree price discrimination by selling first-class and coach seats at different prices. At least part of the differential may be explained by differences in costs: first-class passengers receive more costly treatment. But to the extent that the airline earns more on first-class passengers notwithstanding these extra costs, differential returns are present as well. The same thing can be true of third-degree price discrimination. For example, the seller who provides software to commercial and residential customers at different prices might be earning different returns, but it might also be supplying some services to the higher-price commercial customers that the lower-price residential customers do not receive. In sum, price discrimination in practice is a more complex phenomenon than Pigou's original formulation indicated.

Variable proportion ties are also complex price discrimination arrangements. First, the components of a variable proportion tie involve price discrimination only when they are considered together. When the goods are viewed separately, the ratio of price to marginal cost is the same for all customers. For example, everyone pays the same price for the printer, and the same price for each individual ink cartridge. However, because the components of a variable proportion tie are *used* together, and often have little value when they are separated, it is much more helpful to consider the prices paid for the entire tie. This allows for comparison of the different amounts consumers pay for each unit of the tying product's *use*, which can be measured in units of the tied good. If the tie consists of a printer and ink cartridges, we should consider the different amounts consumers pay *per print*, which will vary depending on the total amount of printing a consumer does. Table 1 on the following page illustrates three different pricing scenarios for a monopoly seller of digital photograph printers and their cartridges. Because customers place little or no value on printers or cartridges separately, the relevant price is the one that they pay for a photo, which is the thing they value.

Whenever the tying product's price is above zero, the average cost of using that good falls as the total amount of use increases. Specifically, the average cost of using the tying product converges on the price of the tied product. Holding the price of the tied product constant, the variation in average cost of using the combination is smaller as the price of the tying product decreases. One can view the difference between the highest and lowest average costs within this range as a measure of how extensively a tie discriminates.

In Scenario A in Table 1, which is non-tying, the monopolist charges all purchasers its standalone profit-maximizing price for the photo printer, which is $400. Cartridges are sold under competition at a marginal-cost price that comes out to 2¢ per photo. All buyers pay the same amount for the printer and the same amount for each cartridge. In Scenario B, the monopolist drops the price of the printer to $300 but ties cartridges at a price of 4¢ per photo. Once again, everyone pays the same price for printers and for ink. Under the third scenario the

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16, at 242 ("A monopolist maximizes profit by charging different prices to different markets or classes of customers."); *see also* ROBINSON, *supra* note 53, at 192–95.

monopolist charges a price of zero for the printer but ties cartridges at a constant price of 8¢ per photo. Alternatively, it could keep the printers and simply print the photos itself from customers' emailed files, at a price of 8¢ per photo. Mail order sites such as *Snapfish.com* or *Shutterfly.com* offer such services.[74] Price–marginal cost ratios are the same for all these scenarios.

Table 1:

Total Cost Per Print at Different Consumption Levels

Total Photo Quantity	1K	2K	3K	4K	5K	6K	7K	8K	9K	10 K
A*	42¢	22¢	15.3¢	12¢	10¢	8.7¢	7.7¢	7¢	6.4¢	6¢
B*	34¢	19¢	14¢	11.5¢	10¢	9¢	8.3¢	7.7¢	7.3¢	7¢
C	8¢	8¢	8¢	8¢	8¢	8¢	8¢	8¢	8¢	8¢

Scenario A: $400 for the printer, which is its standalone profit-maximizing price; cartridges not tied and are sold at a competitive price of 2¢ per photo.

Scenario B: $300 for the printer, which is marginal cost; cartridges are tied and sold for 4¢ per photo.

Scenario C: $0 for the printer; cartridges are tied and sold for 8¢ per photo.[75]

*Costs per print are calculated by taking the price of the printer and dividing it by the output, and then adding the cartridge costs per photo.

For each scenario, the table shows the different prices per printed photo that consumers pay at different quantities of photos, which range from 1000 to 10,000 photos. We assume that the printer is an upfront cost, needs no maintenance, and is worn out and must be discarded after it prints 10,000 photos or within a finite time period such as three years.[76] In Scenario A the customer who makes 1000 photos ends up paying 2¢ in variable costs per photo, plus 400/1000, or 40¢ for the amortized costs of using the printer. If that customer increases its usage to 5000 prints, then variable costs are still 2¢ but now the amortized printer costs are 400/5000, or 8¢.

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74. *See* SNAPFISH, http://www.snapfish.com (last visited Oct. 9, 2010) (offering prints as low as 9¢); SHUTTERFLY, http://www.shutterfly.com (last visited Oct. 9, 2010) (offering prints as low as 9¢).

75. *Cf.* Xerox Corp. v. Media Scis., Inc., 660 F. Supp. 2d 535, 541 (S.D.N.Y. 2009) (observing, in a printer–ink tie situation, that Xerox and other major manufacturers offer their printers on a "cost per page" basis as an alternative to sales).

76. *Id.* at 541, 548 (observing, in a printer–ink tie situation, that the average life of a printer is three years).

The principal effect of tying in the printer–cartridge story (or numerous similar stories in the litigated cases) is that *consumers'* cost structure changes by making a larger portion of their costs variable rather than fixed. Charging the standalone monopoly price for the printer plus the competitive price for ink causes fixed costs to play a larger role in a consumer's cost structure, because printer costs do not vary with use. At the other extreme, charging zero for the printer and a high price for the cartridges makes all consumer costs variable.

The result is that, from the consumer's viewpoint, the range of discriminatory prices becomes *smaller* as the price cut in the tying product increases. Tying reduces rather than increases the disparity in what consumers pay to use the tying product. The non-tying case (Scenario A) produces printing costs that range from a high of 42¢ per photo to a low of 6¢ per photo over the output ranges in question. Scenario B, the "moderate" tying case, which entails a marginal-cost price for the printer plus 4¢ per photo for the cartridge, yields a range of 34¢ down to 7¢ per photo. And the "aggressive" tying case, which involves a price of zero for the printer and 8¢ per photo for the cartridges, produces constant costs of 8¢ per photo at all output levels. This makes it cheaper for low intensity consumers to use the tying product, because total costs are lower at low quantities of total use. To generalize, the more of the price that the monopolist transfers from the tying product (printer) to the tied product (photos), the *less* discrimination will result in the price of the tied product to the monopolist's customers. The limiting case occurs when the tying product price is reduced to zero. In that case, the price of a photo is the same at all output levels.

Note also that in our scenario the *per page* gains from consumers whose purchases are at the lower end of the scale gain far more than the purchasers at the high end lose. The most extreme tie is worth 34¢ per page to the lowest-intensity customer, while it costs the highest-intensity customer 2¢ per page. Of course, the highest-intensity customer is making ten times as many pages. Intellectual property licenses and franchise ties tend to have these characteristics. For example, a patentee might license a patent at a fixed rate of, say, $1000 per year and the licensee could produce as little or as much as it pleased during that time period. Or it could engage in two-part pricing—say, $500 upfront plus a 2% royalty on sales (similar to "moderate" tying in the above illustration). Or, as is most typical, it could charge zero upfront but a higher royalty on sales (similar to Scenario C in Table 1). The straight royalty increases the patentee's revenue from high-volume users, but it also serves to bring into the market low-volume users who are unable to pay a high fixed price up front. If the licensor's marginal costs are zero, even a licensee who produces one unit is profitable to the licensor.

If the monopolist simply printed the photos itself and mailed them to customers, then the cost structures faced by consumers become nondiscriminatory for the same reason that they are nondiscriminatory under tying when the price of the tying product is zero. In this case, the per-print price paid by consumers is the same regardless of how many prints they buy. In both Scenarios A and B in Table 1, welfare could theoretically be improved by a form of arbitrage. Low-volume purchasers could ask higher-volume purchasers to print for them. As more printing was aggregated on fewer printers, per-unit costs would decline, perhaps until every

printer was fully utilized at a price of 6¢ per photo in Scenario A. Of course, transaction costs might defeat such a scheme.

III. ASSESSING OUTPUT IN LITIGATED TYING CASES

Variable proportion ties typically involve a reduction in the price of the tying product from its standalone profit-maximizing price, with the monopoly overcharge and even part of the competitive return transferred to the tied product. Indeed, in many variable proportion ties of complementary products, such as printers and ink cartridges, the tying product is priced at or below marginal cost,[77] leaving the monopoly overcharge and even part of the competitive return to be earned on the tied product. In some cases the tying product is even sold at a price

77. *See id.* at 539 (printer–ink tie; "As is true of other printer manufacturers, Xerox generally sells its printers at a low margin or a loss, hoping to earn a profit through later sales of high margin ink."). In one of the earliest variable proportion tying cases, Henry v. A.B. Dick Co., 224 U.S. 1 (1912), the patentee sold its mimeograph machine at less than its costs but tied ink, stencils, and other supplies and assessed a high markup on those. *See* A.B. Dick Co. v. Henry, 149 F. 424, 425 (C.C.N.Y. 1907) ("The evidence establishes that the complainants sell the machines at a loss, less than the actual cost of making, relying on sales of supplies therefor for a profit. The complainants have sold about 11,000 of these machines under this license restriction."); *see also* Motion Picture Patents Co. v. Universal Film Mfg. Co., 243 U.S. 502, 516–17 (1917) (noting patentee's argument that the public benefitted "by the sale of the machine at what is practically its cost"); Cortelyou v. Charles Eneu Johnson & Co., 138 F. 110 (C.C.N.Y. 1905), *rev'd*, 145 F. 933 (2d Cir. 1906) (tie of patented duplicating machine to stencils: "The evidence is that the present selling price of the rotary neostyle machine is $50, but that its cost to the manufacturer is about $64."); Heaton-Peninsular Button-Fastener Co. v. Eureka Specialty Co., 77 F. 288, 289 (6th Cir. 1896) ("These machines have been placed in the hands of shoe dealers . . . at the actual cost of the machines to the makers, they expecting a profit on their monopoly alone from the sale of fasteners or staples to those having the machine."); Static Control Components, Inc. v. Lexmark Int'l, Inc., 487 F. Supp. 2d 830 (E.D. Ky. 2007) (printer manufacturer received lower price for cartridges subject to a restriction requiring a single use and replacement with another Lexmark cartridge than if sold without the restriction); Tony Smith, *Xbox 360 Costs Third More to Make than It Sells For*, REGISTER, Nov. 24, 2005, http://www.theregister.co.uk/2005/11/24/xbox360_component_breakdown/ (noting Microsoft's strategy of below cost sale of hardware game box, accompanied by high prices for Microsoft's own games plus royalty rates on license fees from independent game producers). In marketing this is sometimes called razor + blade pricing, and it applies to goods that are tied by technological incompatibility as well as those that are contractually tied. *See* Wesley R. Hartmann & Harikesh Nair, Retail Competition and the Dynamics of Consumer Demand for Tied Goods (Dec. 4, 2007) (unpublished manuscript), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1085009; *see also* Edward Iacobucci, *A Switching Costs Explanation of Tying and Warranties*, 37 J. LEGAL STUD. 431 (2008) (describing strategies of using low foremarket prices compensated by high aftermarket prices); Christopher Soghoian, *Caveat Venditor: Technologically Protected Subsidized Goods and the Customers Who Hack Them*, 6 NW. J. TECH. & INTELL. PROP. 46 (2007) (providing several examples, focusing on technological ties); Richard Gil & Wesley R. Hartmann, *Why Does Popcorn Cost So Much at the Movies? An Empirical Analysis of Metering Price Discrimination* (Stanford U. Graduate Sch. of Bus., Working Paper No. 1983, 2008), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1088451 (movie theaters tie concession food products by prohibiting attendees from bringing in their own; high food prices are offset by lowered admission prices).

of zero.[78] The result is typically to increase the number of consumers using the tying combination, but to decrease the number of units that previously existing customers purchased. For example, when a firm ties printers and ink cartridges, buyers do less printing on average, because ink costs per page are higher, but the number of buyers increases. This is also typically the case under franchise tying, where the entry price of the franchise is relatively low or occasionally zero, but the tied products (very common staple products or services) are sold at an overcharge.[79] The result of such arrangements is that many more potential franchisees can afford a franchise. The franchisor's profits are changed from a fixed upfront entry fee to an overcharge that varies with output. As a result, the higher the output of the franchise the more profitable it is.[80]

IV. VARIABLE PROPORTION TIES: A PRELIMINARY WELFARE ANALYSIS

One misconception about variable proportion ties is that they harm all consumers who purchase fewer units of the tied product, and that the only consumers who benefit are those who would not purchase either good under untied monopoly pricing. It is true that increasing the tied product's price reduces the surplus consumers obtain on each *tied* unit from the "but-for" (i.e., nontying) level. But consumers' surplus is also increased by the reduction in the tying product's price. Tying affects consumer welfare in two ways. First, the price increase applied to the tied product reduces the but-for surplus levels achieved by consumers who are willing to buy the goods even under monopoly pricing. This is because increasing the tied price is tantamount to increasing the marginal cost of using the tying product, which compels most buyers to use the tying product less (i.e., to buy

78. *See, e.g.*, Kentmaster Mfg. Co. v. Jarvis Prods. Corp., 146 F.3d 691 (9th Cir. 1998), *amended by* 164 F.3d 1243 (9th Cir. 1999) (defendant provided durable meat-cutting equipment at no charge to meat cutters but charged high prices for aftermarket parts). Compare a common distribution mechanism of soft drink dispensing machines, which provides the machines to owners of locations where vending occurs at a price of zero, but the machine may stock only that supplier's brand of soft drinks. *See Coke Vending Machine*, VENDINGSOLUTIONS, http://www.vendingsolutions.com/coke-vending-machines/ (last visited Oct. 9, 2010) (Coca-Cola will provide a free dispensing machine to plant locations containing forty employees or more, but only Coca-Cola products can be dispensed in the machine).

79. *E.g.*, Siegel v. Chicken Delight, Inc., 448 F.2d 43 (9th Cir. 1971) (franchisor charged no franchising fee or royalty, but required franchisees to purchase tied products at higher-than-market prices).

80. *See* ROGER D. BLAIR & FRANCINE LAFONTAINE, THE ECONOMICS OF FRANCHISING, 54–81 (2005) (most upfront franchise fees are very low in relation to value of business); Roger D. Blair & David L. Kaserman, *Vertical Integration, Tying and Antitrust*, 68 AM. ECON. REV. 397 (1978) (on equivalence of variable proportion tying and vertical integration; results in a more optimal use of downstream inputs and probable output increases); Benjamin Klein & Lester Saft, *The Law and Economics of Franchise Tying Contracts*, 28 J.L. & ECON. 345, 355 (1985); Steven C. Michael, *The Extent, Motivation, and Effect of Tying in Franchise Contracts*, 21 MANAGERIAL & DECISION ECON. 191 (2000) (tying in restaurant franchises is less a function of market power than of nature of equipment employed); *see also* Frederick R. Warren-Boulton, *Vertical Control with Variable Proportions*, 82 J. POL. ECON. 783 (1974).

fewer tied units). On the other hand, the price of the *tying* product falls, so that a smaller amount of a but-for surplus is subtracted upon buying the tie. Many consumers will be better off under tying, even though it causes them to purchase fewer tied units.[81]

Tying impacts consumers in three different ways depending on their status under a non-tying monopoly. First, there are *low intensity* consumer types who buy the two goods under tying, but not under standalone monopoly pricing of the tying product. For these consumers the tie is an unambiguous welfare improvement; they go from zero surplus to whatever surplus they achieve through purchase. Second, there are *medium intensity* consumer types who achieve more consumer surplus under tying even though it leads them to buy fewer units of the tied product. This occurs because tying increases their costs for the tied product by less than it reduces their costs for the tying product. Finally, there are *high intensity* consumer types who achieve less surplus under tying. For these buyers, the price cut applied to the tying good is too small to cover the tie's reduction of but-for surplus. From the seller's side, it generally earns greater surplus from the low intensity group, because these are sales that are not made at all prior to tying. The seller also earns greater surplus from the high intensity group, because it earns more on the higher volume of tied product that they purchase. However, the seller loses money on the medium intensity group because the losses on the tying product (printer) price cut is greater than the gains on the higher tied product (ink cartridges) price. As a result, the tie is profitable and thus will be imposed, if the gains from the first and third group exceed the losses from the intermediate group.

In this situation, the relationship between consumer welfare and output of the tied product is uncertain. Unlike situations involving only one good, a reduction in output does not imply a reduction in consumer welfare. Welfare can increase even though output of the tied product falls, provided that the number of medium-intensity consumers is sufficiently large.[82] If, on the other hand, output levels are maintained or increased, the tie should be assumed to enhance consumer welfare unless there is reason to believe that the injuries to high-intensity buyers outweigh the improvements obtained by low- and medium-intensity buyers. Finally, all this is aside from any realization of production efficiencies that commonly attend higher output, which further supports the conclusion that a tie increases welfare overall.[83]

The one case where a tie will not produce a welfare improvement is when the tie fails to serve any low intensity customers. For example, if a printer-ink tie increased the price of a single ink cartridge by the same amount that it cut the printer's price, then a buyer who buys only one ink cartridge is no better off under tying. Further, every consumer who buys more than one ink cartridge is worse off, because the average cost of printing is higher at all print quantities requiring two or more ink cartridges. In this case, tying fails to benefit any consumers, and it leaves

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81. *See infra* Appendix (showing comprehensive proof and graphical analysis).

82. *See infra* Appendix.

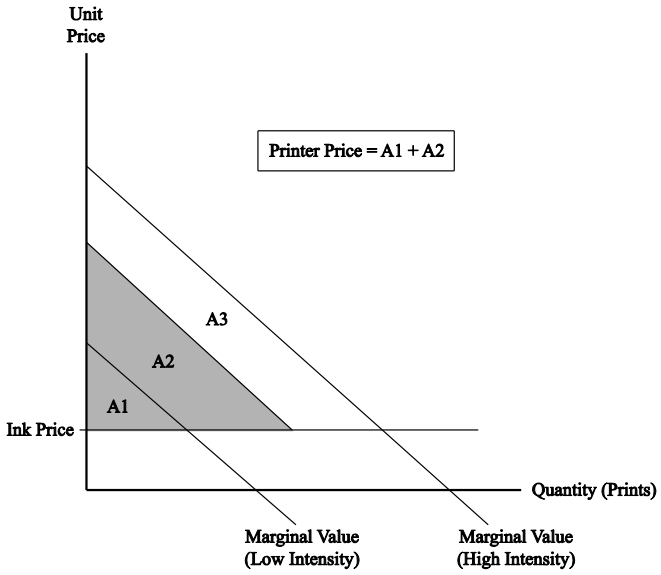
83. On the manifold sources of cost savings and product improvement that results from ties, see 9 AREEDA, HOVENKAMP & ELHAUGE, *supra* note 3, ¶¶ 1712–1718.

existing customers either indifferent or worse off.[84] Such situations are probably rare, and they can be distinguished using a simple "consumer benefit" test, which asks whether a tie succeeds in serving any low-intensity consumers, who are defined to be those who will not buy under monopoly pricing. This test is passed whenever output of the tying product increases upon tying or whenever output of the tied product does not fall as a consequence of tying, as high- and medium-intensity buyers will all reduce the number of tied units they purchase and low-intensity buyers must account for the difference. However, an increase in output of the tied product is merely sufficient for passing the consumer benefit test; it is not necessary. When a tie passes the consumer benefit test, one can be sure that it serves both low- and medium-intensity consumers, though this does not determine the proportion of buyers who maintain low- or medium-intensity levels.[85]

Graphical analysis of variable proportion ties is somewhat similar to that used to illustrate the effects of two-part tariffs. When two-part tariffs are graphed, there is typically a lump sum payment that is reflected by some area under the demand curve. This payment reduces the consumer surplus received for purchasing the good. In the case of variable proportion ties, the tying product's price is analogous to the lump sum payment used by a two-part tariff.[86]

Consider the diagram in Figure 1, which illustrates how consumers choose whether or not to buy a printer-ink tie, and how different consumers arrive at different decisions:

Figure 1



84. This is also likely to be true if the manufacturer increases the price of the tying good upon tying; however, we have not been able to find any such cases.

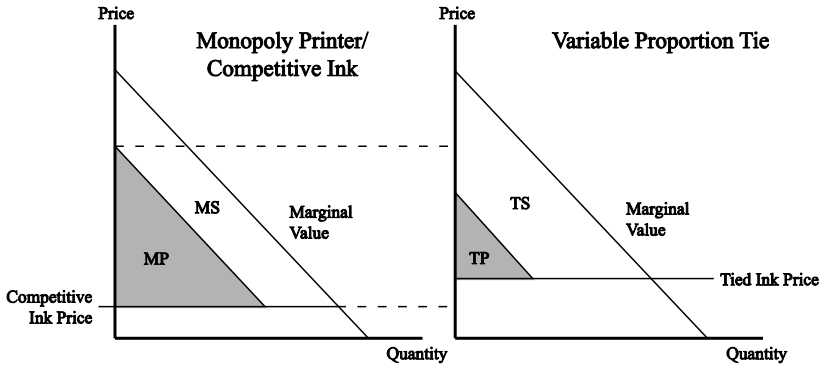
85. 9 AREEDA, HOVENKAMP & ELHAUGE, *supra* note 3, ¶¶ 1712–1718.

86. *See, e.g.*, VISCUSI, VERNON & HARRINGTON, *supra* note 67, at 412–16 (graphical and mathematical illustrations of two-part tariffs).

Figure 1 indicates the marginal price of a print as given by the price of ink,[87] plus an assumption about printer costs. The Figure considers two consumer types: high intensity and low intensity. The marginal value curves are demand curves that reflect consumers' optimal print quantities. The price of the printer, which is a fixed cost to the consumer, is given by the area of the shaded region, or A1 + A2. This area must be subtracted from a consumer's but-for surplus, which is given by the area under the marginal value curve and above price. (Recall that this is the surplus a consumer receives *but for* the price of the printer.) A consumer's surplus realization would equal her but-for surplus only if the printer was free, in which case the high intensity buyer would earn consumer surplus of A1 + A2 + A3. However, when the printer's price is subtracted, the high-intensity buyer achieves a surplus realization of only A3. This amount is positive, so she will elect to buy the tie. Conversely, even at her optimal quantity of prints, the low-intensity buyer does not achieve a level of but-for surplus that exceeds the price of the printer. The low-intensity buyer will not buy either the printer or the ink.

Assessing the impact of a tie requires comparison with the untied situation—namely, where the printer is sold at its standalone monopoly price and ink is priced competitively. We draw this comparison from the perspective of a single type of consumer, so that the marginal value curves are the same in both situations. Further, we assume the consumer-benefit test is passed, so we can see how a consumer might achieve more surplus in spite of purchasing fewer prints. Some consumers will benefit, while others are injured. Figure 2 illustrates:

Figure 2



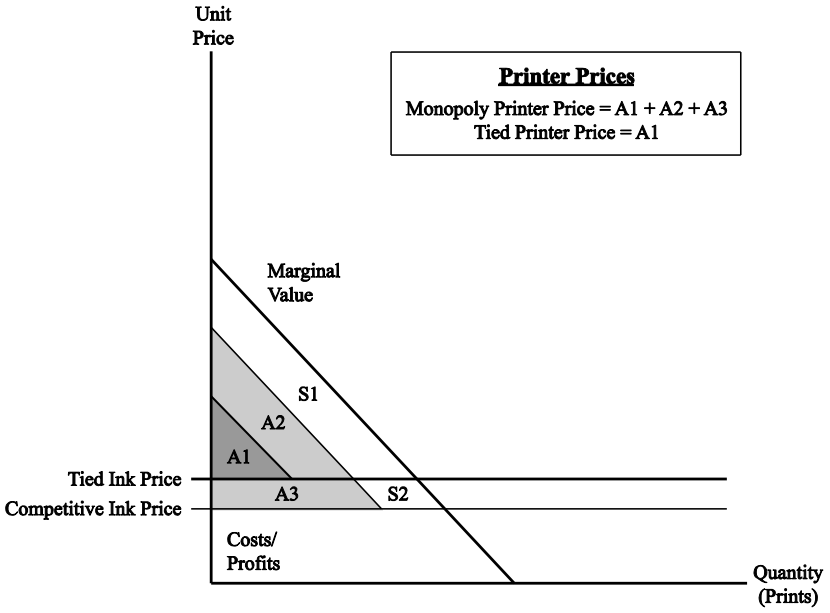
The printer prices in the monopoly and tying situation are given by the areas MP ("monopoly price") and TP ("tying price"), respectively. In the tying scenario the price of the printer (TP) is lower than the monopoly price of MP, but the price of the ink is higher. Consumers' surplus in the two situations is given by the respective areas MS and TS, where MS includes the white region above the dotted line. Because the price of the ink is the only variable cost, and thus equivalent to marginal cost, the consumer purchases less ink under the tying arrangement. Nevertheless, from this consumer's perspective, the tie is preferable

87. This is the price of an ink cartridge divided by the number of prints that can be produced from one. We ignore the price of paper, electricity, and other collateral inputs.

if the area of region TS exceeds that of MS. Thus, as Figure 2 illustrates, a consumer can be better off with the tie *even if* it leads her to consume fewer prints. These medium-intensity consumers benefit from the tie because the amount saved on the printer exceeds the tie's reduction of surplus resulting from higher ink prices.

Comparing the two situations becomes easier when they can be shown in a single diagram. This allows one to calculate exactly the welfare transfers that take place between the two situations, as Figure 3 illustrates:

Figure 3



This diagram superimposes the tying situation onto the monopoly situation. Before tying is introduced, this buyer earns a consumer surplus of S1 + S2. If the printer price under tying decreased by only A3 dollars, the consumer would lose S2 in surplus and gain nothing in return. However, if the printer price under tying falls by A2 + A3, the consumer receives a surplus of S1 + A2 under the tie. Thus, the consumer prefers the tie if A2 is larger than S2, even though she buys fewer prints.

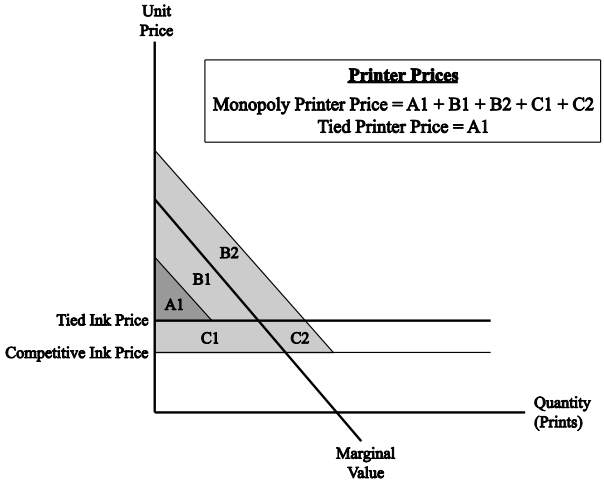
Area A2 is what incentivizes *new* consumers to buy printers and ink when the tie is introduced.[88] Upon tying, the consumer's but-for surplus on ink purchases falls by A3 + S2, while the price of the printer falls by A2 + A3. Because the

88. Suppose the tied printer price were equal to A1 + A2. In that case, the consumer depicted in Figure 3 is necessarily worse off in the tying situation, because she loses S2 in surplus and gains none back, even though the price of the printer has fallen by A3. For example, suppose that the printer manufacturer cut the price of a printer by $4 but increased the price of each cartridge by $4. This tie would reduce output to everyone except the person who never used more than the first cartridge, who would be indifferent.

difference between but-for surplus and the printer's price determines the surplus that the consumer realizes, she is better off if A2 > S2. Low intensity consumers are those whose marginal value curves run through the area A2, as these are defined to be the consumers who buy printers and ink *only* in the tying situation.

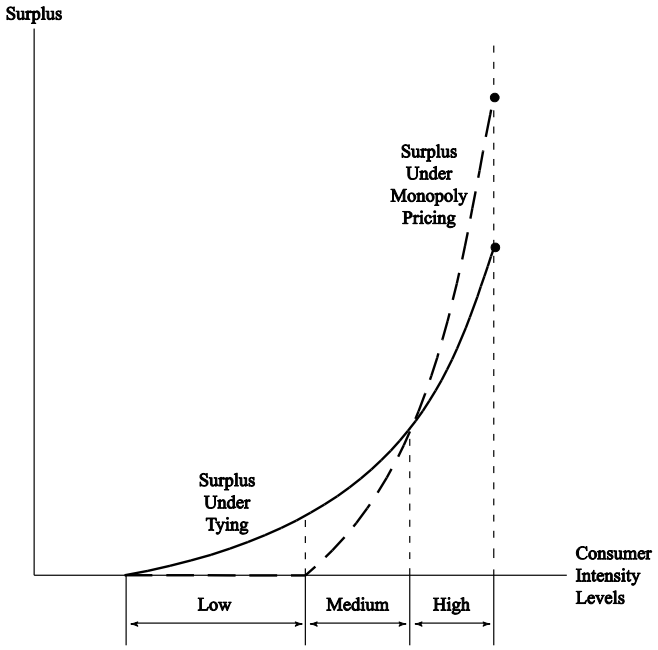
Finally, Figure 4 depicts a low-intensity consumer. In this diagram the monopoly printer price is still equal to the sum of all shaded regions, while the tied printer price is still only A1. But this graph illustrates a consumer who achieves a positive amount of consumer surplus *only* in the tying situation. In the monopoly situation, the consumer achieves a negative surplus of B2 + C2, and hence does not purchase. Under tying, however, the consumer achieves a positive surplus realization of B1 and therefore enters the market. It should be noted that all consumers whose marginal value curves run through the regions B1 or B2 will buy printers and ink only in the tying situation. For them, area B1 is a pure welfare gain and there are no offsetting losses.

Figure 4



We can demonstrate how a tie affects different consumer types differently by plotting the surplus realizations under both tying and monopoly pricing, and by contrasting them over a continuum of consumer intensity levels. This makes it easy to distinguish low-, medium-, and high-intensity consumers and to see how each type is affected by tying.

Figure 5



In Figure 5, the dashed curve represents surplus under monopoly pricing, while the solid curve represents surplus under tying. The horizontal axis plots consumer intensity levels, increasing as one moves from the origin to the right. The solid curve lies above the dashed curve over the ranges of low- and medium-intensity buyers, which reflects the fact that both of these types benefit from tying. Conversely, the dashed curve is highest over the range of high intensity buyers, as these consumers are injured by the tie. Every tie that passes the consumer-benefit test will produce a graph similar to this, because the test is used to demonstrate that low- and medium- intensity consumers are served by the tie. If the tie failed to pass the consumer-benefit test, the solid curve would not intersect the horizontal axis at a lower intensity level than the dashed curve, and the dashed curve would be above the solid curve at all intensity levels above zero. This is because, when a tie fails the consumer benefit test, no consumers are better off and most are injured. By contrast, when a tie passes the consumer benefit test, it necessarily increases the output of the tying product.

Figure 5 does not account for how many buyers or how many purchases are at each intensity level or, more importantly, how aggregate welfare is affected by a tie. In general, showing whether a tie that passes the consumer benefit test is a net benefit or a net harm to consumers is extremely difficult. If buyers are sufficiently concentrated at low- and medium- intensity levels, then their consumers' surplus gains will outweigh the consumers' surplus losses derived from high-intensity buyers. Moreover, if buyers are sufficiently concentrated over the range of medium intensity levels, then it is possible that consumer welfare increases and yet output of the tied product falls. If output of the *tied* product

increases as a result of the tie, one can be sure that there are significant numbers of buyers in the low intensity range. Their entirely new purchases of the tied product outweigh reduction in consumption by high-intensity buyers. This indicates that numerous consumers benefit from tying.

Unfortunately, an antitrust tribunal will almost never have information about how consumers are distributed over the various intensity levels. As a result, welfare effects are probably unclear unless the gains are clearly positive among all three groupings. This could happen in a situation in which all existing users benefit from the tie because the price cut in the tying product is greater for each of them than the price increase in the tied product. This would be most likely to occur when the price cut on the tying product is significant, the price increase on the tied product is fairly modest, and the tie brought in a large number of new tying-product customers.[89]

Incidentally, the assumption that medium-intensity consumers are costly to the manufacturer assumes that the tie itself does not yield any production efficiencies from economies of scale or economies of joint provision of the tying and tied product. To the extent that a reduced printer price reflects reduced printer production costs when printers are tied, medium-intensity consumers could be better off *and* those sales could be profitable to the manufacturer. For example, if tying increased the volume of printers substantially, reducing costs by, say, $40 per printer, then a $100 price cut to the buyer would represent only a $60 net revenue loss to the seller. Then, if medium-intensity buyers contribute more than $60 in profits upon buying ink cartridges, these customers will have become more profitable under the tie. That is, medium-intensity consumers would be profitable to the tying firm even though they buy fewer tied units and achieve more consumer surplus.

If the tying product is sold at cost under tying, then a small fraction of high-intensity consumers may also be less profitable under tying, while the rest increase the manufacturer's profits.[90] All of the low-intensity consumers are more profitable under tying, because they do not purchase the tying product at all under monopoly pricing. Importantly, depending on how customers are distributed among different intensity levels, it is possible that a tie increases profits and improves consumer welfare and yet fails to increase output of the tied product. This is because a consumer's profitability does not stipulate the way in which

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89. In such a case, the seller would be losing money from all existing customers but earning additional profits from all customers brought into the market by the tie. That situation would create a gain to everyone—i.e., all customers who purchased the tying product previously, all new customers who come into the market in response to the tying product price cut, and the manufacturer. It would increase both general welfare and consumer welfare.

For example, suppose the monopoly price of the printer is $200, and the tying price is $100. When the manufacturer ties, it also increases the cartridge price from $8 to $10. Over the life of the tying product, the "break even" point for all prior users would be fifty units of the tied product; for new customers, every one is profitable to the seller. If they are sufficiently numerous, the gains they produce for the manufacturer could easily exceed the losses from the preexisting users.

90. *See infra* Appendix.

tying affects her surplus or the number of tied units she buys; there is significant ambiguity in the relationships between profits, welfare, and output of the tied product. For example, some profitable consumers buy more tied units and achieve more surplus under tying (low-intensity buyers), while others buy fewer tied units and achieve less surplus (high-intensity buyers). On the other hand, all unprofitable consumers buy fewer tied units under tying, but some achieve more surplus (medium-intensity buyers), while others achieve less (high-intensity buyers). In sum, a tie that reduces output could increase consumer welfare, while one that increases output could reduce consumer welfare.

Some price discrimination strategies permit a ready assessment of welfare effects, because output levels typically serve as an indicator of consumer welfare. For example, third-degree price discrimination that fails to increase output reduces welfare.[91] Variable proportion tying presents an unusual challenge, because some consumers will typically benefit from it even though they purchase fewer tied units. Observing changes in the output of the tying product is equally unhelpful. Indeed, output of the tying product will increase under any tie that benefits at least one consumer (i.e., any tie that passes the consumer benefit test).

By contrast, output effects in the tied market may serve to make certain welfare effects more likely than others. The fact that a tie increases the output of the tied product indicates that low-intensity customers brought into the market by the tie purchase more tied units than are given up by medium- and high-intensity customers. This implies that a large portion of consumers are necessarily better off under the tie. As such, the tie should be presumed to increase welfare unless there is reason to believe that high-intensity buyers lose more surplus than is gained by low- and medium-intensity ones.

On the other hand, when tied product output is unchanged or decreased, there is no necessary reason to believe the tie reduces consumer welfare. A tied product output reduction suggests only that there are relatively few low-intensity buyers, but this does not indicate that they are more concentrated at high intensity levels than medium intensity levels, or vice versa. As such, there is still no reason to believe that high-intensity customers lose more surplus than is gained by the low- and medium-intensity ones. So the consumer-welfare effects of ties that reduce or maintain output levels should generally be considered ambiguous. In fact, the only ties that can be categorically shown to harm consumer welfare are those that fail the consumer-benefit test, which means that they do not benefit any consumers at all.

To summarize, under a variable proportion tie of printers and ink cartridges that passes the consumer-benefit test:

- Low-intensity consumers will begin buying under the tie, though they would not buy either good under monopoly pricing; for new customers brought into the market by the tie, the result is an unambiguous increase in consumer surplus.

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91. *See* discussion and sources cited *supra* note 16.

- Both medium- and high-intensity users buy fewer ink cartridges than under monopoly pricing, but medium-intensity buyers achieve more surplus under tying, while high-intensity buyers are injured by the tie; the medium-intensity buyers experience greater gains from the tying product price reduction than losses from the tied product price increase. This is most likely to occur when the tying product has a relatively short life, and there is a significant variation in customer intensity of use.[92]

- Whether the tie increases or decreases consumer welfare depends on the distribution of buyers among the three intensity levels. This ambiguity still exists if output of the ink cartridges falls, because medium intensity buyers buy fewer ink cartridges and are nevertheless benefitted by the tie. Rather, a decrease in ink sales implies only that there is a low concentration of low-intensity buyers. Welfare could still increase if medium-intensity buyers are relatively concentrated.

- And, of course, since the firm will not tie unless it earns more by doing so, producer surplus increases as well. The seller gains by tying from both the low-intensity buyers, who do not buy at all under the tie, and the high-intensity buyers, who now pay more for ink. The seller loses from the medium-intensity buyers because, for them, the cut in the printer price exceeds the increased profits on the ink cartridge price. As a result, tying is profitable if the gains from the high- and low-intensity group exceed the losses from the medium-intensity group.

V. EX ANTE VS. EX POST EFFECTS AND THE ROLE OF FIXED COSTS

To this point we have considered the welfare effects of ties of technology or products that have already been developed. The effects are ex post, in the sense that they take the status of products as given and compare the effects of tying and not-tying. In order to evaluate the full welfare effects of tying, however, one may have to step back prior to the development of the product innovations that give rise to tying.[93] The argument that harm is more apparent when viewed ex ante is that firms in search of monopoly power will be willing to devote significant resources to the development of innovations that enable them to capture monopoly returns.[94] Further, under competition to innovate, investment in innovation may be excessive in that many firms needlessly race to develop some new product, thereby duplicating efforts, but only one takes the patent prize.[95] Innovation races can

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92. *See, e.g.*, Xerox Corp. v. Media Scis., Inc., 660 F. Supp. 2d 535, 539–40, 542 (S.D.N.Y. 2009) (observing that Xerox sells printers at or below cost and hopes to make up difference on high margin ink, that the printer has useful life of three years, and that consumers tend to be very savvy about life-cycle costs).

93. *See* Elhauge, *supra* note 6, at 440–42.

94. This argument is well developed in the literature on rent seeking. *See* HOVENKAMP, *supra* note 21, § 1.3c; Herbert Hovenkamp, *Antitrust's Protected Classes*, 88 MICH. L. REV. 1 (1989); Richard A. Posner, *The Social Costs of Monopoly and Regulation*, 83 J. POL. ECON. 807, 807 (1975).

95. Elhauge, *supra* note 6, at 440 (citing SUZANNE SCOTCHMER, INNOVATION AND INCENTIVES 100–03 (2004)) (arguing that investment will be excessive because firms will

indeed be wasteful, and this explains why research and development (R&D) joint ventures are often socially valuable: they permit firms to share the cost of innovating.[96]

The argument that an ex ante view of innovation itself shows greater social harm than an ex post view is that too much of the surplus that flows from innovation goes to the manufacturers themselves rather than consumers, and it is this excess surplus that induces this wasteful competition.[97] Clearly, however, an optimal intellectual property policy does not require that innovators be able to capture the total surplus produced by their innovations.[98] If that were true, then innovation policy would benefit only innovators, not everyone else. The correct amount of return to innovation is just enough to give the innovator the ex ante incentive to innovate in the first place.[99]

The particular corollary to this argument that applies to tying arrangements that result from new products is that such ties increase the extraction of consumers' surplus, thereby increasing the social cost of innovation.[100] But the argument confuses increased expected profits to the innovator with the extraction of increased consumer surplus. To be sure, an innovator can earn more if it can extract more surplus from consumers. But it can also earn more by reducing the cost of the product it is developing or by increasing its output. Both of these methods can increase the innovator's returns even as consumer surplus is increased as well, and for reasons additional to the economies of joint provision that most tying arrangements create.

Ignoring for the moment all economies of joint production or distribution, ties can increase a firm's profits, and thus the expected profits of an innovation that involves tying, in three ways. First, they increase tying and tied product output. Second, if fixed costs are significant, the higher output will result in lower

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continue investing in innovation until private costs reach private gains, which is greater than the amount needed to equalize private social gains); Partha Dasgupta & Joseph Stiglitz, *Uncertainty, Industrial Structure, and the Speed of R&D*, 11 BELL J. ECON. 1, 18 (1980); Pankaj Tandon, *Rivalry and the Excessive Allocation of Resources to Research*, 14 BELL J. ECON. 152, 152, 156–57 (1983). The extent of wasteful investment very likely varies considerably from one industry to another, depending on whether patent duration and scope are too little, just right, or too much for that particular industry. *See* Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1577 (2003); s*ee also* Mark A. Lemley, *Ex Ante vs. Ex Post Justifications for Intellectual Property*, 71 U. CHI. L. REV. 129 (2004) (critiquing ex ante argument because it largely ignores the social value of competition for new innovation).

96. *See* 13 HERBERT HOVENKAMP, ANTITRUST LAW ¶¶ 2100, 2115, 2136 (2d ed. 2005); *see also* SCOTCHMER, *supra* note 95, at 172–75 (discussing the economics of joint ventures).

97. Elhauge, *supra* note 6, at 440.

98. *See id.* at 439–40 & n.114 (citing Dennis W. Carlton & Ken Heyer, *Extraction v. Extension: The Basis for Formulating Antitrust Policy Towards Single-Firm Conduct*, 4 COMPETITION POL'Y INT'L 285, 285, 292–93 (2008)).

99. *See* Christina Bohannan & Herbert Hovenkamp, *IP and Antitrust: Reformation and Harm*, 51 B. C. L. REV. 905 (2010); *see also* Brett M. Frischmann & Mark A. Lemley, *Spillovers*, 107 COLUM. L. REV. 257 (2007).

100. Elhauge, *supra* note 6, at 440.

per unit production costs, which is a pure welfare gain. Indeed, it is the very type of gain that Professor Elhauge cites as important when he talks about the social costs of excessive innovation.[101] The cost of innovation is measured in dollars per unit of output, not in dollars per innovator. Thus, as output increases, relevant costs decrease. Third, such ties typically result in a revenue-producing price increase in the tied product, although typically not an output reduction.[102]

It is important not to confuse higher producer returns with extraction of consumer surplus. Which of the three elements of profit just described results from extraction of wealth from consumers? Clearly it is not the increase in tying product output, which results from the price reduction in the tying product. Every consumer benefits from that price reduction: intense users pay less for the tying product; less intense users who come into the market in response to the tie go from zero surplus to their value for the tying product less its price. The reduction in per unit fixed costs also does not result from extraction of wealth from consumers, as it is universally a boon to consumers. In virtually every case, a monopolist who experiences a reduction in the cost of a product will pass at least a portion of that reduction on to consumers, making that cost reduction a strong consumer benefit. Finally, the profits that result from higher tied product prices also are not the result of extraction of wealth from consumers. Ordinarily, higher prices injure consumers, but those higher prices are also ordinarily accompanied by an output reduction. In this case, tied product output may actually increase, given that consumers who were not in the market at all until the tie took hold have entered.

Further, as noted above, the story of consumer surplus is complex. First, high intensity users are injured because they pay more for the tied product than the offsetting reduction in the price of the tying product. Second, other customers who were in the market both before and after tying took effect benefit because the price reduction in the tying product more than offset the higher tied product price.[103] Third, for all the customers who were not in the market prior to tying, sales of the tied product produce a benefit no matter what its price. As noted above, it is incorrect to conclude that the tie systematically transfers surplus from high-value to low-value users; all customers purchase the tying/tied product to the point that their marginal valuation falls to the price of the incremental unit, and that is the same for everyone.[104]

So when ties are considered ex ante rather than ex post, there is no support for thinking that they harm consumers. Ex ante implies taking long run concerns into account, and then it becomes critical not to overlook the very important role of fixed costs, which are typically quite high in the research-intensive markets that are subject to variable proportion ties.[105] A common feature

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101. *Id.*

102. That is, to the extent the lower tying product price brings more customers into the market, tied market output will go up rather than down.

103. *See supra* text accompanying notes 78–79.

104. *See supra* text accompanying notes 57–58.

105. Professor Elhauge's analysis ignores fixed costs, mentioning them only in relation to the possibility that fixed costs in the tied product market are a barrier to entry.

of markets subject to tying is intellectual property rights, and a very common feature of a market with a significant intellectual property component is substantial fixed costs. Looking ex ante, even in the absence of any joint costs or other production efficiencies that might result from tying, a firm will have an incentive to tie when the impact is to increase the output of affected products, thus reducing per-unit costs and permitting the monopolist to charge a lower price.

The larger upfront innovation costs are in relation to production (variable) costs, the more sensitive the final product's price will be to the output rate. For instance, suppose Kodak is working on the project that will become the instamatic-camera-film-cartridge package, a famous technological tie.[106] If Kodak simply put the camera on the market at its profit-maximizing price and let others make the film without royalty, Kodak could expect to sell one million cameras. However, if it can tie the camera and film, transferring part of the camera price to the film, it can cut the price of the camera to the competitive level and earn the same amount or more. But in this case—assuming a demand elasticity of one—it will sell two million cameras.[107] Fixed costs of the project are $20 million, and production costs are $3 per camera. The break-even price of the camera without the tie will be $23 ($20 in recovery of R&D costs and $3 in production costs). The break-even price of the camera with the tie will be $13. These numbers understate the price difference because in the absence of the tie the monopolist will not be selling the camera at cost, but at a substantial monopoly overcharge. In other words, if fixed R&D costs are substantial, the *in*ability to tie will decrease the returns to invention considerably, most significantly by reducing the number of customers who will purchase the innovated product. To be sure, if patent scope or duration is excessive there could still be too much investment in innovation. That is not an argument against tying, however, but rather in favor of patent reform. Indeed, the perverse quality of Professor Elhauge's argument is that it treats more valuable products as more socially costly to innovate no matter what the source of the increased value, tying or otherwise.[108]

More relevant for antitrust policy, any time one compares ex ante and ex post environments a theory of tying that neglects fixed costs is likely to severely exaggerate consumer harm.[109] It is hardly a coincidence that many variable proportion ties involving durable tying products occur in markets that are subject

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Elhauge, *supra* note 6, at 41 (citing Michael D. Whinston, *Tying, Foreclosure, and Exclusion*, 80 AM. ECON. REV. 837, 840, 846 (1990)).

106. Berkey Photo, Inc. v. Eastman Kodak Co., 603 F.2d 263 (2d Cir. 1979).

107. If the demand curve is linear, output at the competitive price is double output at the monopoly price. Alan A. Fisher, Robert H. Lande & Walter Vandaele, *Afterword: Could a Merger Lead to Both a Monopoly and a Lower Price?*, 71 CALIF. L. REV. 1697, 1699 (1983). As a result, a monopolist that tied while reducing the tying product price to the competitive level would double its tying product sales.

108. For example, if a 10% increase in innovative effort will produce a 25% increase in product value, the investment sounds like a good one for a single innovator, but would be wasteful if three or more innovators were racing to claim a prize that only one of them could win.

109. *Cf.* Posner, *supra* note 60, at 236 (observing that price discrimination ties are more likely to be welfare enhancing as the proportion of fixed costs rises, and that this is particularly true of intellectual property rights).

to significant research and development costs as well as relatively short production runs (quick obsolescence). This could include computers, printers, and medical devices. Ties in these markets can dramatically increase output of the tying product, leading to equally dramatic reductions in primary product costs. The impact of fixed costs is also likely to be large for franchise ties.[110] In franchising, the franchisor's fixed costs typically include various intellectual property rights and a business method. By tying and building the overcharge into the tied products, the franchisor typically reduces the size of the upfront franchise fee considerably, sometimes even to zero. The result is that many more franchise locations are opened. The fixed costs can then be amortized across all these franchises, and their increased output yields a lower profit-maximizing product price.

VI. THE PROBLEM OF DIFFERENTIAL CONSUMER PREFERENCES

Price discrimination from variable proportion ties is one area where ties create ambiguous effects on consumers. Professor Elhauge mentions several other situations where he believes some kind of leverage is possible. While all of these are well developed in the literature on tying,[111] none affords any general basis for believing that a class of nonforeclosing ties reduces either general welfare or consumer welfare, although one can assume particular sets of numbers in which that might occur. As Professor Elhauge notes, *foreclosing* ties, which are ties that exclude or injure rivals in the tied product market, can cause competitive harm under a set of well-established theories.[112] However, the rules he proposes to preclude this harm would also condemn many nonforeclosing ties.[113]

For example, fixed proportion tying of two goods when the dominant firm has at least some market power in both can lead to a kind of "simulated price discrimination" if the seller can take advantage of differential preferences that customers have for the two different goods. The standard example in the literature is "block booking" of motion pictures, where different theaters may place different values on different movies in the block.[114] The tying occurs because the

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110. *E.g.*, Kypta v. McDonald's Corp., 671 F.2d 1282 (11th Cir. 1982); Siegel v. Chicken Delight, Inc., 448 F.2d 43 (9th Cir. 1971); Little Caesar Enters., Inc. v. Smith, 34 F. Supp. 2d 459 (E.D. Mich. 1998).

111. *See* 9 AREEDA, HOVENKAMP & ELHAUGE, *supra* note 3, ¶ 1706 (sequential monopoly); *id.* ¶ 1710 (intensified exploitation of preexisting market power); *id.* ¶ 1711 (price discrimination).

112. *See* Elhauge, *supra* note 6, at 417. On antitrust harm from tying caused by market foreclosure effects, see 9 AREEDA, HOVENKAMP & ELHAUGE, *supra* note 3, ¶ 1704, and HOVENKAMP, *supra* note 21, § 10.6b. *See also* Daniel A. Crane & Graciela M. Murciego, *Toward a Unified Theory of Exclusionary Vertical Restraints* (Univ. of Mich. Legal Studies, Working Paper No. 24, 2010), *available at* http://law.bepress.com/umichlwps/empirical/art24 (arguing that foreclosure is the only anticompetitive rationale for exclusionary vertical restraints).

113. *See* Elhauge, *supra* note 6, at 399.

114. *See* United States v. Loew's, Inc., 371 U.S. 38 (1962); HOVENKAMP, *supra* note 21, § 10.6e; George J. Stigler, United States v. Loew's Inc.*: A Note on Block-Booking*, 1963 SUP. CT. REV. 152; *see also* William James Adams & Janet L. Yellen, *Commodity Bundling and the Burden of Monopoly*, 90 Q.J. ECON. 475 (1976); R. Preston McAfee et al.,

monopolist licenses the films in "blocks" rather than individually. The theory can work with any product.

One important fact about such a practice, however, is that it can be output increasing and actually improve consumer welfare, depending on the nature of customer demand. To illustrate, suppose a monopolist has two products, Alpha and Beta and that their costs are zero. Two customers want both products and are willing to pay more than cost, but their willingness to pay varies between the two, as shown in Table 2:

Table 2
Willingness to Pay

	Alpha	**Beta**
Customer 1	10	5
Customer 2	3	11

In this case, the optimal strategy for the dominant firm is to package the two products together at a price of 14 and sell both products to both customers. The seller's surplus is 28. Customer 1's surplus is 1; Customer 2's surplus is 0.

Now suppose that tying and bundled discounting are forbidden, which means that the seller must set a price for Alpha and Beta individually. One choice would be for the seller to set a price of 10 for Alpha and 11 for Beta. In that case only Customer 1 would purchase Alpha and only Customer 2 would purchase Beta. So the seller's surplus would be 21; and the customers' surplus would be 0.

Alternatively, the seller could charge a price of 3 for Alpha and 5 for Beta. In this case, both customers would purchase both products. The seller's surplus would be 16. Customer 1 would have a consumer surplus of 7 and Customer 2 would have a consumer surplus of 6. Total consumer surplus would be 13.

These outcomes can vary depending on the strength and direction of the buyers' preferences and also on the seller's costs.[115] But the important thing to note in this case is that if tying were not an option, a rational seller would take the first choice above, giving itself returns of 21 and customers a surplus of zero. If bundling were permitted, though, the seller's returns would increase to 28, and consumers' surplus would *also* increase from zero to 1. That is to say, not only would the tying in this case increase total welfare, but it would also increase consumers' surplus.

To be sure, we might prefer the more "competitive" outcome in which the monopolist made the separate sales at the lower prices to both customers. But a rational seller in our example would not do that. We could reach that outcome only

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Multiproduct Monopoly, Commodity Bundling, and Correlation of Values, 104 Q.J. ECON. 371 (1989); Richard Schmalensee, *Gaussian Demand and Commodity Bundling*, 57 J. BUS. S211 (1984).

115. Professor Elhauge gives an example in which consumers' surplus is reduced. Elhauge, *supra* note 6, at 406.

by regulating the seller's prices in addition to preventing it from tying. So in this case, a simple rule forbidding tying would reduce welfare (the sum of producer's and consumers' surplus) by 8, and it would also reduce consumers' surplus by 1. Despite the welfare benefits of the tie, this bundle would be unlawful under Professor Elhauge's quasi per se rule.[116]

The illustration also indicates a common theme in tying law: the increased profits very often come from increased output. In the film example involving a fixed-proportion tie, just as in the general discussion of variable proportion ties above, tying often increases output. When tying increases output of either the tying or the tied product,[117] then increases in both general welfare and consumer welfare are likely, although certainly not invariable. That makes any kind of per se rule or quasi per se rule[118] that looks exclusively at tying power rather than market foreclosure inappropriate.

VII. DOUBLE MARGINALIZATION AND "REVERSE LEVERAGING"

Any discussion of tying and leverage must consider the effects of double marginalization, which in fact makes many ties serve as "reverse leveraging" mechanisms. Double marginalization occurs when complementary goods or services are both sold in less-than-perfectly competitive markets and the two sellers are not able to coordinate their output to the joint maximizing level. The classic case involves vertical integration, in which both an upstream and a downstream firm have some measure of market power.[119] The first firm, perhaps a manufacturer, computes its monopoly output and price by equating marginal cost and marginal revenue. The second firm, perhaps a retailer which also has some market power, purchases from the manufacturer at this monopoly price and then equates its own marginal cost and marginal revenue, in the process adding on yet another monopoly markup. The result is even lower output and higher prices. One solution that benefits both the manufacturer and consumers is for the manufacturer to integrate forward and combine manufacturing and retailing services, thus reducing the number of markups from two to one. As a result, elimination of double marginalization is a procompetitive rationale for vertical mergers in relatively concentrated markets.[120] Double marginalization can occur both when the proportions of sales in the two markets are fixed and when they are variable,[121]

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116. *See* Elhauge, *supra* note 6, at 399, 402 (quasi per se rule unless the products are sold in a fixed ratio and lack separate utility; in our example the products are sold in a fixed ratio, but they have separate utility).

117. In the film example, *supra*, which is the tying and which is the tied product is difficult to say. Neither product is "unwanted," although the firms value them by different amounts.

118. *See* Elhauge, *supra* note 6, at 399, 402, 420–21 (arguing for a "quasi per se rule" for certain classes of ties).

119. *See* VISCUSI, VERNON & HARRINGTON, *supra* note 67, at 238–41.

120. *See* 4A AREEDA & HOVENKAMP, *supra* note 40, ¶ 1022.

121. For example, if a monopoly gasoline refiner is selling to gasoline stations that have formed a cartel and are extracting a high markup, the refiner can eliminate the markup and benefit both itself and consumers, even though different members of the cartel sell different amounts of gasoline. *See* James L. Hamilton & Ibrahim Mqasqas, *Double Marginalization and Vertical Integration: New Lessons from Extensions of the Classic*

so the consumer welfare savings that result from elimination of double marginalization applies to both.

Double marginalization problems are not limited to vertical integration. They can also arise when two different firms sell complementary products and are unable to coordinate their output.[122] In that case, a single firm selling both will charge a lower price than two different firms, each having market power in one of the two goods. The tie (or package discount) is necessary because single sales at the competitive price would force the firm to forgo its markup.

For example, suppose that most authors prefer to have both a dictionary and a thesaurus, and both are sold in an imperfectly competitive market, such as an oligopoly. A dictionary costs $10 to make, a thesaurus costs $8 to make, and the profit-maximizing price of a bundle is $20. Different firms selling the two products would each try to capture the overcharge. For example, the dictionary maker might charge $12 on the theory that the thesaurus maker would charge $8. But the thesaurus maker would charge $10 on the assumption that the dictionary maker would charge $10 as well. That outcome, which would yield a package price of $22, is suboptimal for everyone. Fewer consumers would buy and those who did would pay too much. Output for both the dictionary maker and the thesaurus maker would fall below the profit-maximizing level. In this case, consumer welfare would increase if a single firm sold both the dictionary and the thesaurus for a package price of $20, which would also be that firm's profit-maximizing level. The firm could either package the two together at a price of $20, or it could sell each separately at prices of $12 and $10 respectively and also bundle them at a discounted price of $20.[123]

Case, 62 S. ECON. J. 567, 581–84 (1996); Michael Waterson, *Vertical Integration, Variable Proportions and Oligopoly*, 92 ECON. J. 129 (1982).

122. This is sometimes known as the "Cournot complements" problem because it is derived from Cournot's analysis of pricing by firms that produce complements rather than substitutes. *See* AUGUSTIN A. COURNOT, RESEARCHES INTO THE MATHEMATICAL PRINCIPLES OF THE THEORY OF WEALTH 99–116 (Nathaniel T. Bacon trans., Macmillan 1897) (1838); *see also* Giuseppe Dari-Mattiacci & Francesco Parisi, *Substituting Complements*, 2 J. COMPETITION L. & ECON. 333 (2006); Herbert J. Hovenkamp, *Harvard, Chicago and Transaction Cost Economics in Antitrust Analysis*, 55 ANTITRUST BULL. (forthcoming 2010), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1592476.

123. *See generally* Bruce H. Kobayashi, *Does Economics Provide a Reliable Guide to Regulating Commodity Bundling by Firms? A Survey of the Economic Literature*, 1 J. COMP. L. & ECON. 707, 708 (2005); J.J. Spengler, *Vertical Integration and Antiturst Policy*, 58 J. POL. ECON. 347 (1950). The issue became relevant during hearings over the proposed breakup of Microsoft into an operating system company and an applications company, where a widely offered criticism was that offering of complementary products by two firms would have led to lower output and higher prices than if a single firm offered them together. *See* Richard J. Gilbert & Michael L. Katz, *An Economist's Guide to* U.S. v. Microsoft, 15 J. ECON. PERSP. 25, 41 (2001) ("[T]he sum of the operating system and application prices set by an integrated monopolist will be lower than the sum of those prices when set separately by two independent firms each with significant market power."); Stan J. Liebowitz, *An Expensive Pig in a Poke: Estimating the Cost of the District Court's Proposed Breakup of Microsoft*, 9 GEO. MASON L. REV. 727 (2001); Giuseppe Dari-Mattiacci and Francesco Parisi, *Substituting Complements*, 2 J. COMP. L. & ECON. 1 (2006);

As in the block-booking case above, a rule condemning tying would reduce both producer and consumers' surplus unless the court also forced the firms to charge less than their individual profit-maximizing prices. One might assume that the dictionary maker could charge $12 for the dictionary and separately sell the thesaurus at the marginal cost price of $8. But this result would be no better than bundling, and the seller could not be expected to do it, because some buyers would purchase its thesaurus at the competitive price and then go elsewhere for their $12 dictionary. This result very likely explains many bundled discounts that occur in markets where the rival is operating in an oligopoly market and enjoying fairly high markups—a common characteristic of even modestly concentrated American markets.[124] The firm making the two products sells them individually at the single-product oligopoly price, but bundles them at a profit-maximizing price that is lower than the sum of the individual profit-maximizing prices when offered by different firms.[125]

Results similar to this are reasonably likely whenever both the tying and tied markets are subject to pricing above the competitive level and sufficient coordination between producers of complements is unlikely—although even coordination would very likely take the form of tying.[126] The markets need not be monopolized. As a result, the savings from elimination of double marginalization can apply to almost any market in which the tied product is not a commodity sold at the competitive price. In such markets the profit-maximizing price of the tying monopolist is actually lower than that of two firms independently selling the tying and tied products.[127] Once again, however, Professor Elhauge's quasi per se rule would appear to condemn the tie.[128] A better rule would be presumptive legality for any tie linking two markets that are not highly competitive, with illegality found only in cases of provable foreclosure.

Ties that at first glance appear to be accompanied by price increases in the tying product are also used to control double marginalization. Such ties are, in fact, two-part tariffs, in which the seller charges a fixed price for one component and then sells a linked component at a competitive price. For example, suppose a firm has significant market power in its fuel efficient car, which is best distributed by independent dealers, many of which have power in their local markets. If the seller charges its monopoly price to the dealers they will assess a second markup to

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R. Venkatesh & W. Kamakura, *Optimal Bundling and Pricing Under a Monopoly: Contrasting Complements and Substitutes from Independently Valued Products*, 76 J. BUS. 211 (2003).

124. *See* Robert E. Hall, *The Relation Between Price and Marginal Cost in U.S. Industry*, 96 J. POL. ECON. 921, 946 (1988).

125. *See, e.g.*, Masimo Corp. v. Tyco Health Care Grp., L.P., No. CV 02-4770 MRP, 2004 U.S. Dist. LEXIS 26916, at *27 (C.D. Cal. June 9, 2004) (plaintiff challenging defendant's discount practices, which included bundled discounts, had profit margins of between 45% and 83% during the period of claimed exclusion). The Ninth Circuit eventually entered an order finding liability on some claims but not others. Masimo Corp. v. Tyco Health Care Grp., L.P., 350 Fed. Appx. 95 (9th Cir. 2009).

126. For example, a dictionary maker and a thesaurus maker could sell packages jointly, agreeing on how to divide the surplus.

127. Hovenkamp, *supra* note 122.

128. *See* Elhauge, *supra* note 6, at 399, 402, 420–21.

their customers, producing double marginalization, reduced output, and higher prices. Suppose, however, that the manufacturer builds the monopoly upcharge into a fixed franchise fee and then sells the cars to the dealers at the competitive price. In this case the dealer will still take its markup, but that will reflect only its own power and not that of the manufacturer. Further, because the franchise fee is a fixed cost to the dealer, the dealer can earn more by increasing the volume of cars sold in the time period covered by the fee.[129] The term "tying" is apt because the manufacturer will not sell the cars at this price to those who have not paid the fee. That is to say, the competitively priced *cars* are the tying product while the franchise fee is the tied product. The impact of tying in this case is higher output and lower car prices than would occur if the manufacturer simply sold the cars at wholesale at its profit-maximizing price.

VIII. BUNDLED DISCOUNTS: EFFECT OF PRICE INCREASE IN MONOPOLY PRODUCT

A bundled discount, which is closely related to a tie, occurs when a firm offers a discount in exchange for purchase of goods in a bundle rather than a simple refusal to sell the goods in unbundled form. Today many courts apply a cost-based test for bundled discounts that considers whether an equally efficient rival that made only one of the products in the bundle is able to match the discount.[130] The test, which has come to be known as the "attribution" test, attributes the entire discount to the good for which exclusion is claimed and then considers whether the resulting price for that good would be greater than the defendant's costs for that good.[131]

For example, suppose a firm sells Alpha and Beta at separate prices of $8 and $6, respectively, but offers them in a bundle at a price of $12. In that case the discount is $2, and one would simply ask whether the rival could sell the second product at a price of $4. If so, then customers could purchase Alpha from the monopolist at an undiscounted price of $8 and Beta from the rival at a price of $4. The rival, if equally efficient, could match the discount. A quicker way of getting the same result is to ask whether the incremental price of the bundle, when the second good is included, is sufficient to cover the costs of adding the second good to the bundle. In the above example, under the discount the price goes from $8 to

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129. *See* TIROLE, *supra* note 29, at 174–76 (noting that the theory is very general); *see also* David Gilo, *Retail Competition Percolating Through to Suppliers and the Use of Vertical Integration, Tying and Vertical Restraints to Stop It*, 20 YALE J. ON REG. 25, 54 (2003) (use of tying to limit double marginalization); Sreya Kolay & Greg Shaffer, *Bundling and Menus of Two-Part Tariffs*, 51 J. INDUS. ECON. 383 (2003) (comparing bundling and two-part tariffs). Microsoft uses such a strategy to keep computer makers from assessing too high a markup on its Windows operating system. *See* Michael P. Akemann, *Microsoft's Licensing Agreements: Theory and Evidence on the Sale of MS-DOS and Windows*, 24 J. CORP. L. 553, 561 (1999).

130. *See, e.g.*, Cascade Health Solutions v. Peacehealth, 515 F.3d 883, 906 (9th Cir. 2008) (taking this approach); *accord* Southeast Mo. Hosp. v. C.R. Bard, Inc., 616 F.3d 888 (8th Cir. 2010).

131. *Cascade*, 515 F.3d at 906–07 (quoting 3A AREEDA & HOVENKAMP, *supra* note 40, at ¶ 749); *Bard*, 616 F.3d at 893 (same).

$12 when the second good is included, so the test queries whether the $4 increment is sufficient to cover the incremental costs of including Beta in the bundle. The rationale for these tests is similar to the rationale for cost-based rules of predatory pricing: we want to protect equally efficient rivals against below cost price cuts, but we do not want to force firms to keep prices unreasonably high in order to protect less efficient rivals.[132]

Professor Elhauge opposes the attribution test, arguing that it permits dominant firms to force rivals' output so low that it denies them economies of scale.[133] He is particularly suspicious that bundled discounts are often not discounts at all because at the time the bundle is introduced the monopolist also raises the price of the primary product.[134] As a result the bundled price does not reflect a true discount from but-for prices or the prices that would have prevailed absent the bundle. He would apply a quasi per se rule to bundled discounts in such cases.[135]

It is true that a bundled discount may acquire greater exclusionary power when the dominant firm increases the price of the primary product at the same time that it offers a discount on the entire bundle. But the attribution test described above is the best device for identifying antitrust harm in such circumstances. To illustrate, suppose that the dominant firm's costs for products A and B are $8 and $5, respectively. The standalone prices are currently $10 for A and $7 for B, yielding separate prices totaling $17 for the two goods. Suppose that the defendant then cuts the price of the bundle to $16. In that case no equally efficient rival in the B product alone is excluded. Purchasers can take product A from the dominant firm at an undiscounted price of $10 and product B from the rival at a price of $6, which is above the rival's costs for B. So the attribution test is not violated, and the bundle is not counted as exclusionary.

Suppose, however, that the defendant simultaneously raises the standalone price of A to $13 and also imposes a discount on the A+B bundle to $17, which is back to the original nondiscounted prices. The customer could purchase A at $13 but then would pay only $4 for B, which is below B's costs. So this discount fails the attribution test and is "exclusionary" under the attribution test. In sum, by increasing the price of the dominant, or tying, good and simultaneously offering a discount from that increased price, the dominant firm can render a bundle exclusionary that would

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132. *See* 3A AREEDA & HOVENKAMP, *supra* note 40, ¶ 749; Erik Hovenkamp & Herbert Hovenkamp, *Exclusionary Bundled Discounts and the Antitrust Modernization Commission*, 53 ANTITRUST BULL. 517 (2008). On complex bundles with variable proportions or more than two goods, see Erik Hovenkamp & Herbert Hovenkamp, *Complex Bundled Discounts and Antitrust Policy*, 57 BUFFALO L. REV. 1227, 1229 (2009).

133. Elhauge, *supra* note 6, at 463.

134. *Id.* at 450, 476–77; *see also* Patrick Greenlee, David Reitman & David S. Sibley, *An Antitrust Analysis of Bundled Loyalty Discounts*, 26 INT'L J. INDUS. ORG. 1132, 1137 (2008); Barry Nalebuff, *Bundling as an Entry Barrier*, 119 Q.J. ECON. 159, 160–61, 168–70 (2004); Barry Nalebuff, *Exclusionary Bundling*, 50 ANTITRUST BULL. 321, 324–27 (2005); John Thorne, *Discounted Bundling by Dominant Firms*, 13 GEO. MASON L. REV. 339, 343 (2005); Barry Nalebuff, *Bundling as a Way to Leverage Monopoly* 8–11 (Yale Sch. of Mgmt. Working Paper Series ES, No. 36, 2004).

135. Elhauge, *supra* note 6, at 468–69.

not have been exclusionary absent the price increase.[136] To say it differently, in this case the simultaneous price increase in standalone A renders the bundle exclusionary, although it would not have been so absent the price increase.

However, the attribution test looks at the prices and costs of the products during the discount period, and the pricing history prior to that period is generally not relevant. The discount in the price increase example is exclusionary because it flunks the attribution test once the discount begins. The impact of the price increase in the A product is to make the discount flunk the attribution test, and thus it may explain why a dominant firm wishing to exclude a rival might exact the price increase in A. On other facts a price increase accompanying a discount will not exclude an equally efficient rival at all. For example, suppose the defendant in the above example increased the price of A from $10 to $11, resulting in standalone prices of $11 for A and $7 for B, and then offered an unbundled discount for $16. In that case a customer could purchase the defendant's product A at $11 and the rival's product B at $5, or its costs, and the discount would not be exclusionary.

In sum, a price increase in A at the time the discount is offered may make it more likely that the package discount is exclusionary as measured by the attribution test, but the price increase itself supplies no independent reason for thinking that the package discount is exclusionary. As a result, there is no warrant for a presumption that a package discount accompanied by a price increase in the standalone product is exclusionary. Package discounts are often applied in technology-rich or other complex markets, such as medical devices or health care.[137] Price changes in these markets are very common, and thus a harsh rule condemning bundled discounts anytime a price increase occurs in the primary product would create significant numbers of false positives. For example, in some medical markets annual price increases are common, generating a high likelihood that a competitively harmless bundle would be condemned.

Nevertheless, if a bundled discount flunks the attribution test and is thus considered exclusionary, then a price increase in the primary product that accompanies the inauguration of bundling requires an explanation. The explanation could be anticompetitive, such as when the purpose of the increase is to render the bundle exclusionary under the attribution test. However, the explanation could be increasing costs or increasing demand for the primary product. Increasing costs do not require any further justification for a proportionate price increase of the primary product. Increasing demand is also a benign reason, and bundling may be explained by the fact of increased demand by those who used the primary good, without the secondary good being made subject to the bundled discount, but not by those who prefer the goods together. In that case, bundling would be a price discrimination device, and there is no warrant for condemning it on that ground alone.

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136. Note that this strategy is not costless to the extent it entails that the dominant firm will be charging more than its profit-maximizing price to those that purchase its A but not its B. If a sufficient number of purchasers want standalone A, the strategy could be unprofitable.

137. *E.g.*, Cascade Health Solutions v. Peacehealth, 515 F.3d 883 (9th Cir. 2008) (bundling of different levels of health care).

IX. OTHER CONSIDERATIONS SHOWING THAT ANTITRUST HARM FROM TYING SHOULD NOT BE PRESUMED

In addition to the price and demand effects described and the effects resulting from scale economies or elimination of double marginalization, tying can produce several other benefits, most of which accrue directly to consumers. As a result, the analysis given above significantly underestimates the welfare value of ties. Namely:

- to the extent a tie lowers the customer's initial fixed cost investment and converts the investment costs to variable, it serves to reduce customer investment risk;
- economies of scale in either tying or tied product production can reduce producer, and thus consumer, costs;
- by bringing smaller firms into the market, variable proportion ties can serve to reduce concentration in the downstream market, benefitting both the monopolist and consumers; this is particularly true of franchise ties and, relatedly, of intellectual property licensing;
- many ties reflect production or provision cost savings, improvements in product quality, or overall product satisfaction.

A. Changing Fixed/Variable Cost Ratio; Risk Reduction

As noted earlier, ties tend to result in lower fixed costs to buyers, but higher variable costs. This can be particularly important when high, unrecoverable, upfront costs might serve to deter investment. Franchising is a good example. The market value of a popular fast food franchise might be $1,000,000. However, the franchisor might sell the franchise for $200,000 and tie an overcharge on various goods distributed through the franchise. The result is to reduce the costs of a business failure to the franchisee and make entry more attractive to small, typically undiversified entrepreneurs. Alternatively, if the franchise is young, the franchisor may have a more optimistic opinion of the franchisor's value than the franchisee. The tie effectively reduces the franchisee's upfront investment.[138]

B. More Competitive Downstream Markets

Variable proportion ties can also address the problem of downstream markets that are prone to oligopoly or collusion.[139] As noted previously, bundling tends to change customer costs from fixed to variable and also to make them more

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138. The literature on these various points is large. *See, e.g.*, OLIVER E. WILLIAMSON, THE ECONOMIC INSTITUTIONS OF CAPITALISM 21 (1985); Benjamin Klein, *The Economics of Franchise Contract*, 2 J. CORP. FIN. 9 (1995); G. Frank Mathewson & Ralph A. Winter, *The Economics of Franchise Contracts*, 28 J.L. & ECON. 503 (1985); Paul H. Rubin, *The Theory of the Firm and the Structure of the Franchise Contract*, 21 J.L. & ECON. 223 (1978).

139. Elimination of double marginalization does so as well, but in a different way. *See supra* text accompanying notes 116–21.

constant.[140] By contrast, unbundled pricing tends to favor large volume users because it is characterized by large, upfront, fixed costs and declining marginal costs. For example, looking at scenario A in Table 1,[141] if only three of the purchasing firms attain the 8000 mark, they will have per unit costs of 7¢ each or less, while smaller firms could have total costs as high as 42¢. The three firms could then collude, thus injuring both the supplier and consumers. In contrast, bundling tends to equalize downstream costs, making markets more competitive even if they have diverse firm sizes.

For example, a gasoline refiner may contemplate franchising gasoline stations into a particular community. The cost of building a station, coupled with a reasonable return on intellectual property rights, might well amount to a million dollars, and the franchisor might have difficulty finding potential franchisees willing to make that investment. As an alternative, however, it might finance a large portion of the fixed-cost investment itself, charging the franchisees a sum sufficient to guarantee their commitment. It would then make up the rest by tying gasoline and charging a few cents more per gallon than the wholesale price. The result could be many more franchisees in the community that behave more competitively vis-à-vis one another and sell more gasoline overall. This is why exclusive dealing or tying are so common in many franchise settings, including retail gasoline.[142]

The problem of downstream market competitiveness is also one of double marginalization. As a general matter, double marginalization problems can be addressed in two ways. One is by eliminating the circumstances under which double marginalization occurs, as previously discussed.[143] The other is by altering the structure of the other market in order to make it more competitive. Tying does this when lower tying-product prices enable a greater number of downstream sellers.

C. Economies Resulting from Joint Provision

Finally, while we do not develop the rationales here, it is worth remembering that perhaps the most important reasons for tying are reductions in cost and improvements in quality—factors that provide the rationale for most ties.[144]

CONCLUSION

Antitrust's per se rule is reserved for practices that are so likely to cause antitrust harm and have so little to defend them that detailed case-by-case

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140. *See supra* text accompanying note 70.

141. *See supra* text accompanying note 74.

142. *E.g.*, Standard Oil of Cal. v. United States, 337 U.S. 293, 318 (1949) (condemning exclusive dealing in case where there was no likely anticompetitive impact); FTC v. Sinclair Refining Co., 261 U.S. 463, 473 (1923) (refusing to condemn exclusive dealing); Omega Envtl., Inc. v. Gilbarco, Inc., 127 F.3d 1157, 1164 (9th Cir. 1997) (refusing to condemn exclusive dealing).

143. *See supra* text accompanying notes 123–29.

144. *See* 9 AREEDA, HOVENKAMP & ELHAUGE, *supra* note 3, ¶¶ 1716–1717.

assessment is thought to be unnecessary. They can be condemned categorically simply upon a showing that a few basic conditions are satisfied and that they belong in a particular class of restraints.[145] No kind of unilaterally imposed tying arrangement, even by a monopolist, falls into that category.

Rather, the case for antitrust harm from tying is ambiguous at best and requires detailed scrutiny into market power, rationales for tying, and anticompetitive effects—all the subject of antitrust's traditional rule of reason. Variable proportion tying arrangements typically injure some buyers while they benefit others. Most ties that increase output very likely also increase welfare, measured as either general welfare or consumer welfare. Further, because they are a type of second-degree rather than third-degree discrimination, reduced welfare cannot be inferred from reduced output. As a result, a court is probably wasting its time by considering the output effects of a tie unless they are dramatic and obvious.

Also important is the fact that variable proportion ties are found in both highly competitive and monopolized markets. That, in itself, suggests a great deal about consumer welfare effects. For example, Lexmark, a manufacturer of computer printers, has been embroiled in litigation concerning technological and contractual ties of its printers to cartridges.[146] But Lexmark is hardly a monopolist. It does not dominate any segment of the printer or cartridge market, and is far smaller than Hewlett-Packard, Canon, and Epson. It is consistently in fourth or fifth place in market share both in the United States and worldwide.[147] Assuming printer makers are not colluding, this means that a high-volume user who believes it is paying too much has plenty of competitive alternatives. In such a situation, serious welfare losses cannot be expected. So Lexmark's strategy must be profitable for some other reason than monopoly—most likely because it increases output. A monopolist's strategy need not be any different.

We recommend that courts in antitrust cases forget about price discrimination or leveraging as anticompetitive concerns and focus on foreclosure,

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145. On the rationales for antitrust's per se rule, see 7 PHILLIP E. AREEDA & HERBERT HOVENKAMP, ANTITRUST LAW ¶ 1509 (3d ed. 2010).

146. *See* Static Control Components, Inc. v. Lexmark Int'l, Inc., 615 F. Supp. 2d 575 (E.D. Ky. 2009) (patent exhaustion ("first sale") doctrine barred Lexmark's printer-cartridge tie); Static Control Components, Inc. v. Lexmark Int'l, Inc., Nos. 5:02-571, 5:04-84, 2008 WL 4542735, at *1 (E.D. Ky. Oct. 3, 2008) (denying judgment as a matter of law on tying misuse claim); Static Control Components, Inc. v. Lexmark Int'l, Inc., 487 F. Supp. 2d 861 (E.D. Ky. 2007) (denying summary judgment on antitrust tying claim).

147. For information on worldwide computer printer market shares, see *Color Laser Multifunction Peripherals (MFPs) Shipments Up 6%*, IDC (June 3, 2009), http://www.outlookseries.com/N1/Infrastructure/3049_Color_Laser_Multifunction_Peripherals_MFP_Shipments_Up_6%25.htm (pertaining to multifunction printers in 2009) and *Are Printer Companies Chasing the Wrong Target?*, SEEKING ALPHA (June 4, 2007), http://seekingalpha.com/article/37170-are-printer-companies-chasing-the-wrong-target (pertaining to all printers in 2007). *See also* Bob Snyder, *EMEA Printer Market Is Up*, ONCE (Mar. 4, 2008), http://on-ce.net/index.php?option=com_content&task=view&id=144&Itemid=33 (showing Lexmark fourth behind HP, Canon, and Epson in the Europe, Middle East and African shipments for 2008).

or antitcompetitive exclusion.[148] The one empirically identifiable exception we have been able to find occurs when the tie benefits no one other than the seller,[149] but such cases will almost never occur unless the tie is accompanied by a higher price for the tying product, an event that appears to be uncommon and should never be presumed. Finally, we note that even the noneconomic rationale for condemning ties, on the ground that price discrimination itself is an unappealing practice, disappears once we consider that the true impact of variable proportion ties is to reduce rather than increase the extent of price disparities to buyers.[150]

The price discrimination rationale for tying arrangements and related discounting practices has proven to be robust and covers a wide range of circumstances. The same thing is true of ties that reduce double marginalization problems, which applies when both tying and tied products are sold at prices above cost.[151] By contrast the conditions for competitive harm are restrictive and are never met in the absence of economic foreclosure.[152]

Finally, this analysis suggests that the current test for evaluating ties under the antitrust laws is wrong on two different counts. That test requires tying of separate products, substantial market power in the tying product, and a "not insubstantial" volume of tied product commerce.[153] First, by failing to assess market foreclosure in the tied–product market, the prevailing test contains no device by which anticompetitive exclusion can be assessed. Second, by misunderstanding the nature of price discrimination ties, the test incorporates exaggerated concerns about leverage.

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148. *See generally* Bohannan, *supra* note 4.

149. *See supra* text accompanying notes 72–73.

150. *See supra* text accompanying note 74 and Table 1.

151. *See supra* text accompanying notes 122–28.

152. *See* Herbert J. Hovenkamp, *Antitrust and the Costs of Movement*, 77 ANTITRUST L.J. (forthcoming 2011), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1679849.

153. *See* HOVENKAMP, *supra* note 21, §§ 10.1–.2; *see also* 10 AREEDA, HOVENKAMP & ELHAUGE, *supra* note 3, ¶¶ 1741–1751 (discussing the separate products requirement); 9 AREEDA, HOVENKAMP & ELHAUGE, *supra* note 3, ¶¶ 1731–1740 (discussing the requirement of market power in the tying product); *id.* ¶ 1721 (discussing the requirement of a "not insubstantial" amount of tied product commerce); *id.* ¶¶ 1722–1727 (discussing the absence of a coherent foreclosure requirement).

APPENDIX

The model developed here for assessing the impact of variable proportion tying on consumer welfare assumes a tying arrangement containing one fixed tying product and one tied product that can be used with the tying product in variable proportions. Consumers buy one unit of the fixed good, if at all, and they purchase the variable good only to facilitate use of the tying good. Hence consumers will never buy a unit of the fixed good without also buying some quantity of the variable good, and they will never buy units of the variable good without buying one unit of the fixed good. The model speaks of the *monopoly situation*, in which the manufacturer monopolist sells the tying good at the standalone monopoly price and the tied good is priced competitively; and also of the *tying situation*, in which the price of the fixed good is decreased from the monopoly situation and a markup is applied to the variable good. In the tying situation, profits are always earned on sales of the variable good, while they may or may not be earned on sales of the fixed good.

Consumer preferences are defined over the *use* of the fixed good. As in real world instances of tying, the variable good serves as little more than an input that must be regularly purchased to facilitate consumption of the fixed good. To that end, we will let x denote the quantity of the fixed good's use, which is described in units of the variable good. This is appropriate because the fixed good is generally useless without the variable good, and each unit of the variable good allows the same amount of consumption to be derived from the fixed good. For that reason, the model assumes that each consumer who buys a positive quantity of x also purchases one unit of the fixed good, so that the prices of both goods are always considered when a consumer determines his optimal purchase. Finally, price vectors will be given in the form $P = (p_v, p_f) \in \mathbb{R}^2_{++}$, where p_v and p_f give the prices of the variable and fixed goods, respectively. Eventually, different price vectors will be distinguished using superscripts, which will allow us to compare the monopoly and tying situations.

A set of consumer types is given by $\Sigma = [0, \overline{\sigma}] \subset \mathbb{R}$, where $\overline{\sigma} > 0$. The distribution of consumers among types is described by the probability density function $(\cdot)$ and corresponding cumulative density function $F(\cdot)$. When we begin using the model, we will typically assume that this distribution is unknown. A consumer's type determines the *intensity level* of his preferences over x, which is effectively a measure of how many units of x the consumer demands at a given price vector. The terms "intensity level" and "consumer type" are thus used interchangeably. Preferences of all consumer types are described by a surplus function, which is defined as the difference between utility (value) and expenditure. To define this surplus function, we will use the utility function u: $\mathbb{R}_+ \times \Sigma \longrightarrow \mathbb{R}$, which is defined as follows for all $\sigma \in \Sigma$:

$$u(x, \sigma) = \begin{cases} \sigma x - \frac{1}{2}\Delta x^2 & if\ x \leq {}^{\sigma}/_{\Delta} \\ \frac{\sigma^2}{2\Delta} & otherwise \end{cases}$$

where $\Delta > 0$.

The utility function's nontraditional form is intended to create a more realistic degree of heterogeneity among consumer purchasing decisions. This occurs because marginal utility does not converge to zero as x does. For that reason, we can be sure that, under any price vector, some mass of consumer types (of positive measure) will choose not to buy either good. This will allow the model to more realistically describe the influx of new consumers that typically results under variable proportion tying. Moreover, marginal utility diminishes in x at the same constant rate $\Delta > 0$ for all consumers, which allows for easy comparisons of consumer surplus realizations. This causes the graph of each consumer's marginal utility to resemble a linear demand curve, the slope of which is the same for all consumer types. In this way, a consumer's type serves to determine the height of his marginal utility curve or, more accurately, its y-intercept. This is why optimal quantities of x increase over the range of intensity levels, which is given by Σ. Of course, for a given consumer type $\sigma \in \Sigma$, marginal utility is equal to zero for all quantities $x \geq \sigma/\Delta$, so that the utility function is only once differentiable. But this was merely a precautionary measure intended to prevent marginal utility from becoming negative, and because the resulting marginal utility function is very intuitive. Consumers will always choose quantities of x over which their utility functions retain the standard properties, including strict concavity. Finally, it should be noted that functions of both utility and marginal utility are continuous.

We are now in a position to define individual realizations of consumer surplus, which will be given by the function $\mathcal{s}$: $\mathbb{R}_+ \times \mathbb{R}^2_{++} \times \Sigma \to \mathbb{R}$, where for all $\sigma \in \Sigma$ we define:

$$\mathcal{s}(x, \mathrm{P}, \sigma) = \begin{cases} u(x, \sigma) - x\mathrm{p_v} - \mathrm{p_f} & if\ x > 0 \\ 0 & otherwise \end{cases}$$

We assume that each consumer chooses the quantity of his purchase by maximizing this function, which is strictly concave over the relevant quantities of x (i.e., those at which marginal utility is positive), and weakly concave everywhere. As such, we must assume that consumer preferences are quasilinear in wealth, but this is not problematic. We can assume that all consumers are endowed with the same amount of wealth and that this amount is large enough for all consumer types to purchase x in any quantity at which marginal utility is positive. We can then further assume that consumers are always indifferent between one unit of utility and one dollar. In this way, the surplus function represents preferences over both x and wealth, while the utility function represents only the portion of surplus that is derived from the consumption of x. And, because all consumers are endowed with the same amount of wealth, we need not include it as a variable of the surplus function.

We will define the demand for x that a particular consumer type has using the function q: $\mathbb{R}^2_{++} \times \Sigma \to \mathbb{R}_+$. Using first order conditions, it is easy to show that for all $\sigma \in \Sigma$ this function is given by:

$$\mathrm{q}(\mathrm{P}, \sigma) = \begin{cases} \frac{1}{\Delta}(\sigma - \mathrm{p_v}) & if\ \sigma \geq \sqrt{2\Delta \mathrm{p_f}} + \mathrm{p_v} \\ 0 & otherwise \end{cases}$$

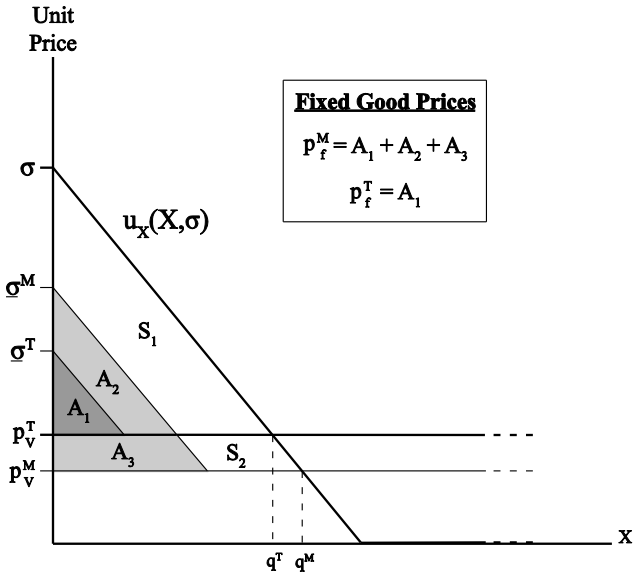
The condition that $\sigma \geq \sqrt{2\Delta p_f} + p_v$ ensures that a consumer purchases the tie only if the maximal level of surplus she can achieve is nonnegative. It should be noted that because x is described in units of the variable good, the function $q(P, \sigma)$ can also be considered as the Walrasian demand for that good that consumers of type $\sigma \in \Sigma$ have. We can further use this function to determine the unique consumer type that achieves zero surplus when behaving optimally, but whose optimal quantity of x is positive. This consumer type serves as the boundary between consumers who do not buy x (and hence achieve zero surplus), and those whose optimal quantities of x are positive and engender positive amounts of surplus. Of all consumer types that buy x in positive quantities, this is the one of lowest intensity (i.e., the one that desires to use the fixed good the least). This consumer type can be determined as a function of prices, and will be denoted as $\gamma(P)$. As the condition stipulated by the above demand function suggests, this type is defined by $(P) = \sqrt{2\Delta p_f} + p_v$. We can use this to define the mass of consumer types who buy positive quantities of x as $\Gamma(P) = [\gamma(P), \overline{\sigma}] = \left[\sqrt{2\Delta p_f} + p_v, \overline{\sigma}\right]$.

It will be helpful to define an indirect surplus function, as this will allow us to compare the optimal surplus realizations of different consumer types, and to determine how different consumer types are affected by tying. We will denote this indirect surplus function as $V: \mathbb{R}^2_{++} \times \Sigma \rightarrow \mathbb{R}_+$, which is defined for all $\sigma \in \Sigma$ as:

$$V(P, \sigma) = \mathcal{s}(q(P, \sigma), P, \sigma) = \begin{cases} \frac{1}{2\Delta}[\sigma - p_v]^2 - p_f & if\ \sigma \geq \gamma(P) \\ 0 & otherwise \end{cases}$$

It will also be helpful to provide a graphical interpretation of optimal surplus realizations in both situations. To do this, we will let P^T, $P^M \in \mathbb{R}^2_{++}$ denote the price vectors maintained in the monopoly and tying situations, respectively. To maintain generality, we assume only that $P_v^T > P_v^M$ and $P_f^T < P_f^M$. Figure 6 illustrates the marginal utility function of a single consumer type and can be treated as a demand function in order to determine the optimal quantity of his purchase, which varies between situations. This also allows us to see the optimal level of surplus that this consumer achieves in each situation.

Figure 6



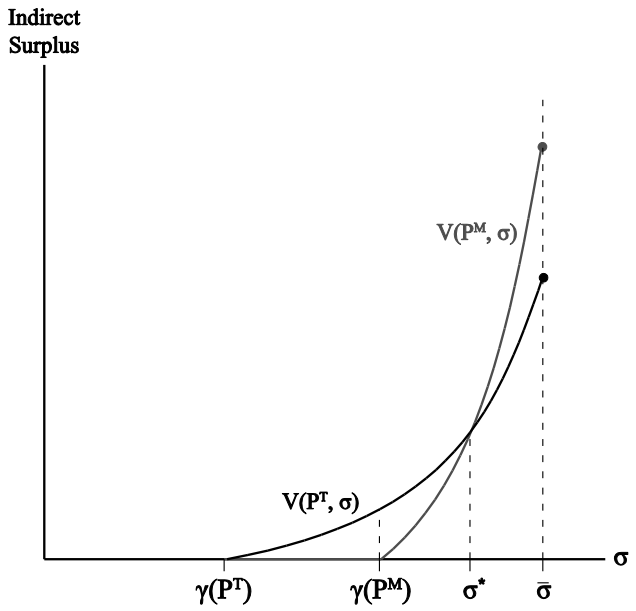
The curve labeled (x, σ) describes the marginal utility of the consumer type $\sigma \in \Sigma$. The prices of the variable good resulting under the two situations are plotted along the vertical axis. Conversely, the prices of the fixed component are described as different combinations of the areas A_1, A_2, and A_3. The optimal quantities purchased by this consumer in the two situations are found at the intersections of variable price and marginal utility. In this case, these are given by $q(P^T, \sigma) = q^T$ and $q(P^M, \sigma) = q^M$ in the tying and monopoly situations, respectively. The utility a consumer derives from a given quantity x is given by the total area under the marginal utility curve, taken over the interval $[0, x]$. To determine the consumer's surplus realization, the net expenditure on the variable good (given by the area under the variable price curve, taken up to the quantity purchased) and the price of the fixed good are subtracted from the consumer's utility. In this way, the consumer depicted here achieves optimal surplus levels of $V(P^T, \sigma) = A_2 + S_1$ in the tying situation and $V(P^M, \sigma) = S_1 + S_2$ in the monopoly situation.

As mentioned earlier, a consumer's type indicates the point at which her marginal utility function intersects the vertical axis. Because this curve has the same slope for all consumer types, Figure 6 also indicates what consumer types purchase positive quantities of x in the two situations. As the figure implies, a consumer type can receive a positive amount of surplus only if her marginal utility curve intersects the vertical axis at a point above the area of the fixed good's price. Hence any consumers of type $\sigma < \underline{\sigma}^T$ will *never* buy a positive quantity of x, because they would achieve a negative amount of surplus in both situations. Conversely, any consumer with type $\underline{\sigma}^T \leq \sigma < \underline{\sigma}^M$ will purchase positive quantities of x only in the tying situation. All remaining consumer types buy positive quantities of x in both situations, though these quantities are always

smaller under tying. In fact, all of these consumers reduce their optimal quantities of x by the same amount, as their marginal utility curves all maintain the same constant slope.

It will be useful to compare how different consumer types are affected by the transition from monopoly pricing to variable proportion tying. Figure 7 describes how surplus realizations vary among consumer types, and how those realizations compare under the different pricing situations:

Figure 7



As this graph demonstrates, this particular tie causes a larger number of consumer types to buy positive quantities of x. This is equivalent to saying that tying creates positive surplus realizations at lower levels of σ, so that $\gamma(P^T) < \gamma(P^M)$. For that reason, we will refer to consumer types located in the interval $[\ \gamma(P^T), \gamma(P^M)\ )$ as *low intensity consumer types*, which the text defines as those who buy only under tying. Trivially, all low intensity consumers buy more units of x under tying, because they buy zero units otherwise. Also, there is a unique consumer type σ* that achieves the same positive level of surplus in both situations. However, Figure 6 demonstrates that all consumers in $\Gamma(P^M)$ reduce the quantities of x they purchase in the tying situation, and by the same amount. Thus, consumer types in $\Gamma(P^M)$ and to the left of σ* buy fewer units of x under tying, but strictly benefit from the tie. Conversely, consumer types in $\Gamma(P^M)$ and to the right of σ* also buy fewer units under tying and are strictly harmed by the tie.

The tie depicted in Figure 7 causes new consumers to begin buying positive quantities of x. These new consumers obviously benefit from the tie. But the tie also provides more surplus to some consumers who already bought positive

quantities of x in the monopoly situation (i.e., some consumers in $\Gamma(P^M)$). Finally, some consumer types achieve strictly less surplus in the tying situation, though these consumers still achieve positive levels of surplus in both situations. As such, the welfare effects of the tie are not obvious, because some consumers are better off, while others are harmed. Rather, the welfare effects of a tie are obvious only in the most flagrant instances of tying, or those in which *no* consumers are better off. Fortunately, an easy test can be implemented to determine whether or not this is the case. This test, which we describe as the *consumer benefit test*, queries whether a variable proportion tie benefits any consumer types. Because the indirect surplus function merely shifts its position between the two situations, it is clear that $V(P^T, \sigma) > V(P^M, \sigma)$ at some $\sigma \in \Sigma$ if and only if it is also true that $\gamma(P^T) < \gamma(P^M)$. This means that the consumer benefit test is equivalent to the question of whether the tie brings any low intensity consumer types into the market. Accordingly, the consumer benefit test is necessarily passed if output of the fixed good increases. Importantly, if the tie passes the test, then we cannot infer that the tie decreases welfare. The following account provides a more explicit definition of the test:

Consumer benefit test: Let $P^M = (P_v^M, P_f^M) \in \mathbb{R}^2_{++}$, where P_v^M is the (perfectly) competitive price of the variable good, and where P_f^M is the monopoly price of the fixed good. Let T be a variable proportion tie that imposes the price vector $P^T = (P_v^T, P_f^T) \in \mathbb{R}^2_{++}$ in place of P^M, where $P_v^T > P_v^M$ and $P_f^T < P_f^M$. Then T passes the consumer benefit test if and only if $\Gamma(P^M)$ forms a nontrivial subset of $\Gamma(P^T)$.

This test is useful, because it implies that two sorts of consumer types are strictly better off under tying. First, the consumer types that buy positive quantities of x only under tying are obviously better off, as this allows them to achieve a positive level of surplus, which would be impossible otherwise. Second, the tie benefits some consumer types that buy positive quantities of x in both situations, even though these consumers buy fewer units of x in the tying situation. This latter sort of consumer is particularly important because those who favor a law condemning variable proportion ties have often argued that *all* of the consumers who consume less under tying are made worse off by the tie. In fact, this assertion is false whenever the consumer benefit test is passed, as the following proposition illustrates:

Proposition 1:

Fix $P^T, P^M \in \mathbb{R}^2_{++}$, where $P_v^T > P_v^M$ and $P_f^T < P_f^M$. Assume that $\Gamma(P^M)$ is nonempty. Then there is a mass of consumer types in $\Gamma(P^M)$ that achieve strictly more surplus under tying if and only if the consumer benefit test is passed.

Proof: ($\Longrightarrow$) Assume the consumer benefit test is passed, so that $\Gamma(P^M) \subsetneq \Gamma(P^T)$.

$V(P^i, \sigma)$ is strictly increasing in σ, so $\sigma \in \Gamma(P^i)$ implies $\sigma' \in \Gamma(P^i)$ for all $\sigma' > \sigma$, for any $i = T, M$. This implies $\gamma(P^T) < \gamma(P^M)$.

$V(P^T, \gamma(P^T)) = 0$, by the definition of $\gamma(P^T)$, and implies $V(P^T, \gamma(P^M)) > 0$, since $V(\cdot,\cdot)$ is strictly increasing in σ. Hence $V(P^T, \gamma(P^M)) > V(P^M, \gamma(P^M)) = 0$.

$\Longrightarrow \exists \varepsilon > 0$ such that $\sigma \in (\gamma(P^T), \gamma(P^T) + \varepsilon)$ implies $V(P^T, \sigma) > V(P^M, \sigma)$, since $V(\cdot,\cdot)$ is continuous in each of its arguments.

($\Longleftarrow$) Assume the set $\mathcal{D} = \{\sigma \in \Gamma(P^M) | \, V(P^T, \sigma) > V(P^M, \sigma)\}$ is nonempty, and has positive measure.

We have that $V_\sigma(P^T, \sigma) < V_\sigma(P^M, \sigma)$ at all σ, where $V_\sigma(\cdot,\cdot)$ denotes the partial derivative of $V(\cdot,\cdot)$ with respect σ. This implies that, for all $\sigma, \sigma' \in \Gamma(P^M)$ with $\sigma' < \sigma$, $\sigma' \in \mathcal{D}$ whenever $\sigma \in \mathcal{D}$, because the difference $V(P^T, \cdot) - V(P^M, \cdot)$ is strictly diminishing over $\Gamma(P^M)$. Thus $\mathcal{D}$ is an interval with lower bound $\gamma(P^M)$.

$\Longrightarrow V(P^T, \gamma(P^M)) > 0$, since $V(P^T, \gamma(P^M)) - V(P^M, \gamma(P^M)) > 0$.

$\Longrightarrow \exists \varepsilon > 0$ such that $\sigma \in (\gamma(P^M) - \varepsilon, \gamma(P^M))$ implies $V(P^T, \sigma) > 0 = V(P^M, \sigma)$, because $V(\cdot,\cdot)$ is continuous.

$\Longrightarrow \gamma(P^T) < \gamma(P^M)$, which implies $\Gamma(P^M) \subsetneq \Gamma(P^T)$.

This proof demonstrates that, *whenever a tie persuades new consumer types to buy positive quantities of x, some consumer types who already bought x in positive quantities under monopoly pricing are better off*. At this point it will be helpful to distinguish between different groups of consumer types according to the way in which their surplus realizations are impacted by tying. We will define $\mathcal{C}_L(P^T, P^M) = \{ \sigma \in \Sigma \mid \gamma(P^T) < \sigma < \gamma(P^M) \}$ to be the set of *low intensity consumer types* who are drawn in by the tie, or those who (i) buy positive x only in the tying situation; and (ii) achieve positive surplus only in the tying situation. One corollary of proposition 1 is that, when a tie passes the consumer benefit test, there is a unique consumer type that achieves the same positive level of surplus in both situations, provided that the upper bound of Σ is sufficiently high. This follows because, as the proof of proposition 1 states, the difference $V(P^T, \cdot) - V(P^M, \cdot)$ is decreasing in σ, and it is doing so at an increasing rate. For that reason, we will define $\sigma^*(P^T, P^M)$ to be the unique consumer type in $\Gamma(P^M)$ at which the aforementioned difference is equal to zero, but which achieves positive surplus in both situations. This consumer type is indifferent between the tying and monopoly situations, even though consumers of this type buy fewer units of x under tying. With this, we can define the set $\mathcal{C}_M(P^T, P^M) = [\gamma(P^M), \sigma^*(P^T, P^M))$ to be the set of *medium intensity consumer types* who benefit from the tie, but nevertheless buy fewer units under tying. These consumer types comprise the portion $\Gamma(P^M)$ to the left of the indifferent consumer type. Finally, we will define the set of consumers who are injured by the tie. Explicitly, we will define $\mathcal{C}_H(P^T, P^M) = (\sigma^*(P^T, P^M), \bar{\sigma}]$ to be the set of *high intensity consumer types*, who buy fewer units and achieve less surplus under tying.

Proposition 1 is useful because it demonstrates that the positive effects of tying are not limited to the surplus realizations derived from the low consumer types who only enter the market under tying. This casts additional doubt on any claim that variable proportion ties are inherently welfare reducing. Indeed, when a tie passes the consumer-benefit test, such a claim would be justified only if we have reason to believe that the welfare gains resulting from low- and medium-intensity consumers are outweighed by the welfare reductions accrued from high intensity buyers. Of course, this determination would seem to require detailed

knowledge concerning the distribution of consumers among consumer types. In fact, the following proof demonstrates that, when the distribution of consumers among types is unknown, a tie that passes the consumer benefit test has an ambiguous impact on total consumer welfare.

Proposition 2: Fix $P^T, P^M \in \mathbb{R}^2_{++}$, where $P_v^T > P_v^M$ and $P_f^T < P_f^M$. Assume that the consumer benefit test is passed, and the distribution of consumers among consumer types, denoted as f^*, is unknown. Then the welfare effects of the tie are ambiguous, meaning we cannot determine whether the tie caused total consumer welfare to increase or decrease.

Proof: Assume the consumer-benefit test is passed, and let Ψ be the space of possible (continuous) distributions of consumers among types.

Given a distribution $g \in \Psi$, let (g) define the effect of tying on total consumer welfare when consumers are distributed among types according to g. Explicitly:

$$\mathcal{W}(g) = \int_{\gamma(P^T)}^{\bar{\sigma}} g(\sigma)[V(P^T, \sigma) - V(P^M, \sigma)]d\sigma$$

$\Longrightarrow \mathcal{W}(g)$ gives the expected value of the difference $V(P^T, \sigma) - V(P^M, \sigma)$ under the distribution g, and given that $\in \Gamma(P^T)$.

$\Longrightarrow (\cdot)$ is bounded above by $V(P^T, \gamma(P^M)) - V(P^M, \gamma(P^M)) > 0$, because the consumer type $\gamma(P^M)$ benefits most from tying. (This follows from the proof of proposition 1.) Likewise, $(\cdot)$ is bounded below by $V(P^T, \bar{\sigma}) - V(P^M, \bar{\sigma}) < 0$, because the consumer type $\bar{\sigma}$ is most injured by tying.

For simplicity, let $W^+ = V(P^T, \gamma(P^M)) - V(P^M, \gamma(P^M))$, and $W^- = V(P^T, \bar{\sigma}) - V(P^M, \bar{\sigma})$.

$(\cdot)$ can get arbitrarily close to W^+ and W^- by choosing different distributions, which is possible even if density is positive at all consumer types.

$\Longrightarrow (f^*) \in (W^+, W^-) \subset \mathbb{R}$, where $W^+ > 0 > W^-$.

$\Longrightarrow$ The welfare effects of the tie are ambiguous, as it is impossible to tell whether it caused total consumer welfare to increase or decrease.

This result is important because it implies that, if a tie passes the consumer-benefit test, its effect on consumer welfare generally cannot be determined unless one has information concerning the distribution of consumers among consumer types. That is, depending on whether consumers are relatively more or less intensive, a tie might decrease or increase total consumer welfare. Moreover, this result holds regardless of any production efficiencies that might result from the tie. As such, this result would tend to suggest that government intervention is unwarranted when a tie passes the consumer benefit test, particularly if the tie results in production efficiencies.

As described earlier, new consumer types buy more units of the variable good under tying and low intensity consumer types buy fewer units of the variable

good under tying but, nevertheless, both classes of consumer benefit from the tie. This implies that one cannot determine a tie's impact on consumer welfare by merely observing what impact it has on output of the variable good. For example, it is possible most consumers are distributed along medium and high intensity ranges, and each range has the same cumulative density. Further, suppose that the medium-intensity consumers benefit by the same amount that high-intensity consumers are injured. Then, if there is even a small number of low-intensity consumers, consumer welfare is improved and output of the variable good will fall. (Of course, a tie increases total output of the *fixed* good if and only if it passes the consumer benefit test because the set of consumers who buy positive quantities of x is equivalent to the set of consumers who buy the fixed good.) This example does not suggest the tie would be less profitable than monopoly pricing, even if it does not result in production efficiencies. Indeed, it is easy to use figure A to show that when the fixed good is sold at cost under tying, low intensity consumers are profit increasing, medium-intensity consumers are profit decreasing, and high-intensity consumers are split between these possibilities. The relative profitability of all consumer types only increases when the fixed good is sold above cost under tying. In this way, it is easy to construct a distribution that makes tying profitable and welfare increasing, even though it causes output of the variable good to fall.