DOES ECONOMICS PROVIDE A RELIABLE GUIDE TO REGULATING COMMODITY BUNDLING BY FIRMS? A SURVEY OF THE ECONOMIC LITERATURE

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Not Ready for Prime Time? A Survey of the Economic Literature on Bundling

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ABSTRACT

This article surveys the voluminous economic literature on commodity bundling. While bundling has been widely studied, the vast majority of the papers are theoretical models of bundling. These models generally contain restrictive assumptions regarding the existence of monopoly in some markets, and the nature of rivalry in others. The models also generally ignore obvious and ubiquitous reasons firms may use bundled discounts. Moreover, these models have not been subject to robustness checks, nor have their assumptions been tested empirically.

As a result, while the literature has demonstrated that use of bundling can generate anticompetitive harm, it does not provide a reliable way to gauge whether the potential for harm would outweigh any demonstrable benefits from the practice. Thus, this review of the economic literature generally confirms the SG's position in *3M v. LePage's* regarding the underdeveloped state of the economics literature and the wisdom of delaying the promulgation of antitrust standards for bundling. In the future, economists should seek to expand their understanding of both the anticompetitive and procompetitive reasons firms engage in bundling. This will entail studying the reasons bundling is adopted by firms without market power, relaxing the assumption of monopoly in theoretical models, and generating testable hypothesis and the data to test them.

I. Introduction

Bundling is a ubiquitous phenomenon.[1] Bundling is used to sell products directly to end users, and to other firms that distribute a manufacturer's products. At the consumer level, bundling is used by a wide variety of firms.[2] Bundling is also used by businesses to sell to retailers and other firms that distribute their products. For example, performance rights are sold as a package to radio stations and businesses. Package discounts and bundled rebates are used by a wide variety of firms to give strong incentives for retailers to sell their products.

For the vast majority of cases where bundling is observed, the reason why separate goods are sold as a package is easily explained by economies of scope in production or by reductions in transactions and information costs, with an obvious benefit to the seller, the buyer or both. This is certainly the presumptive explanation for bundling when it occurs in highly competitive markets.[3] Offering discounts to consumers that purchase bundles can be an efficient form of competitive advertising that directly benefits consumers through lower prices of high value promotional items. These bundle discounts can also be used businesses to enter new markets. Moreover, bundle discounts can be used by firms to reduce the divergence in incentives that exist between manufacturers and those who distribute their products. Bundled discounts retailers strong incentives to promote and sell the manufacturer's goods and services, and can mitigate retailer free-riding and other types of agency problems. Thus, bundled discounts can serve the same efficiency promoting vertical control functions as has been identified in the economic literature on tying, exclusive dealing, and other forms of vertical restraints.[4]

Thus, the Supreme Court recognized that "there is nothing inherently anticompetitive about packaged sales," and under the antitrust laws, these packaged offerings are legal unless they constitute an illegal tie-in or otherwise represent an unlawful exercise of monopoly power.[5] However, in markets characterized by few

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[1] For other discussions of the ubiquity of bundling, *see e.g.,* THOMAS T. NAGLE & REED K. HOLDEN, THE STRATEGY AND TACTICS OF PRICING: A GUIDE TO PROFITABLE DECISION MAKING 3d ed. (Prentice Hall 2002), David S. Evans & Michael Salinger, *Why Do Firms Bundle and Tie? Evidence from Competitive Markets and Implications for Tying Law*, 22 YALE J. REG. 37 (2005), Stefan Stremersch & Gerard J. Tellis, *Strategic Bundling of Products and Prices: A New Synthesis for Marketing*, 66 J. MKT'G 55 (2002).

[2] Examples include fast food restaurants bundling sandwiches with drinks and fries, or pizzas with multiple toppings. Flights from Washington, DC to Los Angeles are bundled with flights from Los Angeles to Washington, DC; the bundled round trip flight is often bundled with a hotel. New cars are sold with various option packages that bundle options such as leather seats, DVD/Navigation Systems, and hi-end sound systems. Computers come with operating systems and software pre-loaded. Operating systems bundle different types of functionality, and computers are sold as systems that bundle memory, screens, modems, wi-fi capability, etc.

[3] *See, e.g.*, Stremersch and Tellis, *supra* note 1 at 70, David S. Evans & A. Jorge Padilla, *Designing Antitrust Rules for Assessing Unilateral Practice: A Neo Chicago Approach*, 72 U. CHI. L. REV. 27 (2005).

[4] *See* Bruce H. Kobayashi, *Two Tales of Bundling: Implications for the Application of Antitrust Law to Bundled Discounts*, GEORGE MASON UNIVERSITY LAW & ECONOMICS WORKING PAPER No 05-27 (2005)

[5] *See Jefferson Parish Hospital District No. 2 v. Hyde*, 466 U.S. 2, 25 (1984).

sellers, bundling may have strategic uses that may be scrutinized under the antitrust laws.[6] Because bundling can also be efficient practice in such markets, antitrust evaluations of bundling practices must simultaneously consider strategic and efficiency reasons for bundling.[7]

The importance of understanding why bundling occurs and how bundling affects markets has been highlighted by recent antirust cases that have examined bundling.[8] As the United States noted in its brief to the Supreme Court in *3M v. LePage's*,[9]

> [A]lthough the business community and consumers would benefit from clear, objective guidance on the application of Section 2 to bundled rebates, … the United States submits that, at this juncture, it would be preferable to allow the case law and economic analysis to develop further and to await a case with a record better adapted to development of an appropriate standard.

This paper is a first attempt to respond to the government's challenge to add to the "relatively recent and sparse" theoretical and empirical economic analysis of bundling. The goal of this paper is to provide a comprehensive survey of the current economic literature on bundling. The hope is that presenting by a comprehensive picture of the state of the current literature, both what is known and what is not known about this subject will become clearer.[10]

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[6] *See, e.g.*, Jay P. Choi, *Antitrust Analysis of Tying Arrangements,* CESIFO WORKING PAPER No. 1336 (2004), Jay P. Choi, *Antitrust Analysis of Merger with Bundling in Complementary Markets: Implications for Pricing, Innovation, and Compatibility Choice*, mimeo (2003), Thomas A. Lambert, Evaluating Bundled Discounts, 89 *Minn. L. Rev.*1688 (2005), Ian Ayres & Barry Nalebuff, *Going Soft on Microsoft? The EU's Antitrust Case and Remedy*, 2 THE ECONOMIST'S VOICE, Article 4, (2005), Richard J. Gilbert & Michael L. Katz, *An Economist's Guide to U.S. v. Microsoft,* 15 J. ECON. PERSP. 25 (2001).

[7] *See, e.g.,* Patrick Rey, Paul Seabright, & Jean Tirole, *The Activities of a Monopoly Firm in Adjacent Competitive Markets: Economic Consequences and Implications for Competition Policy*, mimeo (2001), Paul Seabright, *Tying, Bundling, Assembly: Their Economic Functions and Their Implications for Competition Policy*, mimeo IDEI, UNIVERSITY OF TOULOUSE (2001), Barry Nalebuff, *Bundling, Tying, and Portfolio Effects*, DTI ECONOMICS PAPER No. 1, (2003) at Section 4.3.

[8] *See, e.g., 3M Co v. LePage's,* 324 F.3d. 141 (2003).

[9] Brief for the United States as Amicus Curiae in *3M Co. v. LePage's*, 2004 WL 1205191, at 14-15, (recommending that the Court deny 3M's writ of certiorari). For a detailed discussion of this case and the issues involved, *see* Daniel L. Rubinfeld, *3M's Bundled Rebates: An Economic Perspective*, 72 U. CHI. L. REV. 243 (2005). *See also* Michael D. Whinston, *Exclusivity and Tying in U.S. v. Microsoft: What We Know, and Don't Know,"* 15 J. ECON. PERSP. 63 (2001) (discussing bundling and tying in the U.S. antitrust case against Microsoft).

[10] This survey also does not review the literature on monopolization standards generally, or the application of these standards to bundling. For a recent review of this literature, see Lambert, *supra* note 6, Timothy J. Muris, *Antitrust Law, Economics, and Bundled Discounts*, submitted on behalf of the UNITED STATES TELECOM ASSOCIATION IN RESPONSE TO THE ANTITRUST MODERNIZATION COMMISSION'S REQUEST FOR PUBLIC COMMENTS, (July 15, 2005), available at http://www.amc.gov/public_studies_fr28902/exclus_conduct_pdf/050715_US_Telecom-Exclus_Conduct-Bundling.pdf., Kobayashi, *supra* note 4, Herbert Hovenkamp, *Discounts and Exclusions*, UNIVERSITY OF IOWA LEGAL STUDIES RESEARCH PAPER #05-18 (2005), Herbert Hovenkamp, *Exclusion and the Sherman*

This goal is different from attempting to provide a comprehensive explanation of why bundling occurs. Because many instances of bundling occur in competitive markets[11] and are easily explained by economies of scope in production or by lowering consumer search costs,[12] such factors that lead to the ubiquity of bundling are not the centerpiece of many academic articles.[13] The obvious and transparent nature of many of these explanations for bundling does not generally elicit formal treatment by economists. Indeed, many papers explicitly rule out efficiency reasons for bundling in their analyses of the problem. Rather, it is the selected, and perhaps less common instances which are more likely to capture the attention of the academic economists.

A. Definitions and Terms.

At the most basic level, bundling is the sale of two or more separate products in a package.[14] Separate products are defined to be those where consumer demand exists for the stand alone products outside of the bundle. This requirement allows us to rule out trivial cases of perfect complements, such the sale of left shoes and right shoes.[15] This definition of bundling can include the packaging of a fixed quantity of a single good as well as the packaging of two or more separate goods.

There are two basic types of bundling. The first is pure bundling, where the firm selling the bundle chooses only to sell the package and not the stand alone goods. Some authors distinguish pure bundling from tying in the following way: Pure bundling occurs when there are no alternative sellers of the component goods, so only the *XY* bundle is available (case 3).[16]

Act, 72 U. CHI. L. REV. 147 (2005). *See* generally Einer Elhauge, *Defining Better Monopolization Standards* 56 STAN. L. REV. 253 (2003), P. AREEDA, & H. HOVENKAMP, ANTITRUST LAW (Aspen Pub. 2004 Supp.) at ¶749, Daniel A. Crane, *Multi-Product Discounting: A Myth of Non-Price Predation,* 72 U. CHI. L. REV. 27 (2005).

[11] *See* Stremersch & Tellis, *supra* note 1.

[12] *See, e.g.,* Michael A. Salinger, *A Graphical Analysis of Bundling*, 68 J. BUS. 85 (1995), Evans & Salinger *supra* note 1, Philip B. Evans & Thomas S. Wurster, *Strategy and the New Economics of Information,* HARV. BUS. REV. 71 (Sept./Oct. 1997), Asim Ansari, S. Siddarhi & Charles B. Weinberg, *Pricing a Bundle of Products of Services: The Case of Non-Profits*, 33 J MKT'G RES. 86 (1996), Robert J. Vokurka, *Supplier Partnerships: A Case Study*, 39 PROD. & INVENTORY MGMT. J. 30 (1998), Chun-Hsing Liao & Yair Tauman, *The Role of Bundling in Price Competition*, 20 INT.'L J. INDUS. ORG. 365 (2002), Ward Hanson & R. Kip Martin, *Optimal Bundle Pricing* 32 MGMT. SCI. 155 (1990)., Yannis Bakos & Eric Brynjolfsson, *Bundling Information Goods, Pricing Profits & Efficiency*, 45 MGMT. SCI. 1613 (1999).

[13] *See* Evans & Salinger *supra* note 1.

[14] *See* Stremersch & Tellis *supra* note 1.

[15] *Id*.

[16] In some cases, pure bundling is classified by some authors as a form of tying. Evans and Salinger, *supra* note 1 define tying to be the case where the multiproduct firm only offers the *XY* bundle, and at least one of the component goods is not available separately (cases 3, 4 and 5 in Table 1). Under this definition, pure bundling is not distinct from tying. Others distinguish pure bundling from tying. *See, e.g*., Nalebuff *supra* note 7, Jean Tirole, *The Analysis of Tying Cases: A Primer*, 1 COMP. POLICY INT'L 1 (2005). While some authors would classify many forms of pure bundling as tying, bundling has been distinguished from tying

The second type of bundling is mixed bundling, where both the package and the individual goods are available from the bundling firm. Table 1 lists the possible combinations in the two good case.[17]

[INSERT TABLE 1 HERE]

In addition to the above characterization, some have made other distinctions. For example, in characterizing mixed bundling, some place the further restriction that the price of the bundle must be strictly less that the sum of the component prices, *i.e.,* $P_B < P_X + P_Y$.[18] Others do not use this criterion to characterize bundling.[19] In addition, some distinguish between price and product bundling. Price bundling refers to the package sold at a discount without any integration of the products. Product bundling refers to integrated products that yield extra value to the consumer. This latter type of bundling is likely to be important in those cases where the strategic use of bundling requires that the bundling firm pre-commit to its use.[20]

B. The Organizational Approach to the Survey.

The existing economic literature on bundling does not suggest a dominant organizing principle for this survey. Some authors have written useful surveys relating to a subset of the literature.[21] Other useful surveys are organized according to the potential end uses of bundling.[22] I have organized this paper according to the assumptions regarding the degree of competition in the markets for the component goods that make up the bundle. This choice was made in part because much of the recent interest in bundling is derived from examinations of bundling under the antitrust laws. Given this interest, the use of industry structure, which is often used as a first screen by the antitrust laws, is a natural organizing principle. Beyond this direct link to antitrust, organizing the survey

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under the antitrust laws. The Supreme Court has defined tying to include those cases in which the seller conditions the sale of the tying good upon the buyer agreeing to purchase the tied product from him. See *Jefferson Parish v. Hyde*, *supra* note 5. Practices by firms with monopoly power that involve such coercion can be per se illegal. Bundling and other forms of packaged sales have generally been found to lack this coercive element. See Muris, *supra* note 10. Moreover, there are some cases of tying that are not generally characterized as bundling. For example, tying can also involve the requirement by a seller that in order to purchase *Y*, any demander also must purchase all of its variable demand for *X* from him. These contracts would include requirements contracts, and metering devices. These types of contracts have been treated separately in the literature, and will not be explicitly considered in this survey.

[17] *See* Salinger, *supra* note 12.

[18] Nalebuff, *supra* note 7. If this condition is not satisfied, Nalebuff would not characterize this type of packaging as bundling.

[19] *See, e.g.,* R. Preston, McAfee, John McMillan, & Michael D. Whinston, *Multiproduct Monopoly, Commodity Bundling, and Correlation of Values*, 104 Q. J. ECON. 371 (1989).

[20] *See* the discussion in Section IV.A*, infra.*

[21] *See, e.g.,* Stremersch & Tellis, *supra* note 1 (surveying the multiproduct monopoly literature).

[22] *See, e.g.*, Nalebuff, *supra* note 7, Barry Nalebuff, *Bundling*, in THE NEW PALGRAVE DICTIONARY OF ECONOMICS, 2D. ED. (forthcoming 2005), Jeffrey Church, *The Impact of Vertical and Conglomerate mergers on Competition,* FINAL REPORT, DG COMP (2004) at Section 6.

along these lines will also allow a clear picture of what industry structures have and have not been examined, and will also facilitate examination of the limitations and special assumptions that are embodied in the existing economic analyses of bundling.

[Insert Table 2 Here]

Table 2 lists the papers reviewed in this survey according to the type of competition in each separate market. The picture that emerges is that the current literature has almost exclusively examined the two good case. Moreover, in the overwhelming majority of papers, the degree of competition is limited in one or both markets. The modal case in the economic analysis of bundling is the 2x2 case – two goods and two firms. Much of the literature has focused on theoretical settings where one firm has an actual monopoly (the top row in Table 2, discussed in Sections II, III, & IV), or a setting where two duopolists compete in both markets (the center cell in Table 2, discussed in Section VI). Little attention has been paid to settings where both markets have more competitive market structures (discussed in Sections V and VII).

While this focus is not necessarily surprising given that the antitrust analysis of bundling is often focused on highly concentrated markets, not examining the broader use of bundling can limit our understanding of motivations for bundling that are not related to the acquisition or maintenance of monopoly power.[23] For example, many of the recent articles demonstrating that bundling can be used for exclusionary purposes assume that the firm engaged in bundling has an actual monopoly in the Y good (see the papers reviewed in Section III and IV, *infra*). In practice, however, firms rarely have market shares equal to one, and little attention has been paid to considering how relaxing the assumption of monopoly might affect the predictions of these models. This is particularly important given that under the antitrust laws, firms that face some competition can be found to possess "market power". Moreover, the possession of "market power" is often erroneously equated with "monopoly power."[24]

In addition, as noted above, the vast majority of the papers suppress the large and varied reasons why bundling is used.[25] Generally, use of bundling to induce self selection or to take advantage of economies of scale, scope, or other efficiencies from bundling are generally not considered in the models. As a result, these models as a whole do not provide a reliable way to gauge whether the potential for harm would outweigh any benefits from bundling.

II. Bundling by a Multiproduct Monopolist and Price Discrimination

[23] See Evans & Padilla, *supra* note 3. For an example of such an analysis in the context of exclusive dealing, see Jan B. Heide, Shantanu Dutta, & Mark Bergen, *Exclusive Dealing and Business Efficiency: Evidence from Industry Practice,* 41 J. L. & ECON. 387 (1998).

[24] *See* Muris, *supra* note 10, Benjamin Klein, *Market Power in Antitrust: Economic Analysis after Kodak,* 3 SUP. CT. ECON. REV. 43 (1993).

[25] *See supra* text accompanying notes 12 and 13.

An analysis of bundling by a monopoly seller can be traced to Cournot's analysis of the pricing of complementary goods.[26] Cournot noted that bundling could reduce a pricing inefficiency by solving a double marginalization problem. Specifically, two monopolists, setting prices independently, will set these prices at an inefficiently high level when the goods are complements. This effect occurs because the individual firms do not take into account the negative effect an increase in the price of one good has on the demand for the complementary good. As a result, both sellers and consumers can be better off if both prices were lowered. Having the two firms agree to bundle their individual products allow the firms to internalize this pricing externality.

While several authors have examined the effect of the degree of complementary or substitutability between goods has on the incentive to bundle,[27] the vast majority of the literature has set this issue aside. Modern treatments of bundling by a monopolist have focused on a separate pricing inefficiency issue: the use of bundling as a price discrimination device by a multiproduct monopolist.[28] These models have generally focused on how the distribution of consumers' reservation values over the multiple goods offered by the monopolist affect the monopolist's pricing decisions. In these analyses, bundling is a form of third degree price discrimination. As is the case generally, the welfare effects of bundling are ambiguous. In these models, it is generally the case that bundling is assumed not to generate efficiencies (either fixed or marginal cost savings).[29] Nor do consumers inherently value the bundle.[30] These assumptions are made to isolate the role bundling has on the monopolist's ability to extract consumer surplus.

This section reviews the literature on bundling as a price discrimination device. The section is divided into four parts. Part A reviews Stigler's classic analysis of block booking. Part B reviews articles that empirically examine the practice of the block booking of films. Part C reviews the Adams and Yellen model. Part D examines papers that have built upon the Adams and Yellen model.

A. Stigler on Block Booking

[26] AUGUSTIN, COURNOT, RESEARCH INTO THE MATHEMATICAL PRINCIPLES OF THE THEORY OF WEALTH (1838). For a recent review and analysis of this issue and the related literature see Giuseppi Dari-Mattiacci & Francesco Parisi, *Substituting Complements*, GEORGE MASON UNIVERSITY LAW & ECONOMICS WORKING PAPER No. 05-_ (2005).

[27] See, e.g., A. Lewbel, *Bundling of Substitutes and Complements,* 3 INT. J. INDUS. ORG. 101 (1985) and R. Venkatesh & W. Kamakura, *Optimal Bundling and Pricing Under a Monopoly: Contrasting Complements and Substitutes from Independently Valued Products,* 76 J. OF BUS. 211 (2003).

[28] Papers that analyze this issue include George J. Stigler, *US v. Loew's Inc.: A Note on Block Booking,* 1963 SUPREME COURT REVIEW 152 (1964), W. J. Adams and Janet L. Yellen, *Commodity Bundling and the Burden of Monopoly,* 90 Q. J. ECON. 475 (1976), McAfee *et al*., *supra* note 19, Richard Schmalensee, *Gaussian Demand and Commodity Bundling* ,J. BUS. S211 (1984) and Salinger, *supra* note 12. Stremersch & Tellis, *supra* note 1, offer a useful survey of this issue.

[29] An exception is Salinger, *supra* note 12.

[30] For an analysis of this issue, *see* Robert E. Dansby and Cecilia Conrad, *Commodity Bundling,* 74 AM. ECON. REV. 377 (1984).

The classic analysis of bundling by a multiproduct monopolist is almost universally traced to George Stigler's article on the block booking of feature films,[31] the subject of two Supreme Court antitrust cases.[32] In one of the cases, the Court struck down the use of block sales based on a leverage theory, in which the owner of a popular film forces the buyer to also purchase an inferior film. Stigler argued that there is no gain to forcing the buyer to take the inferior film – rather, any monopoly power could be exercised by appropriately pricing the popular film.[33]

After rejecting the leveraging theory of the Court, Stigler demonstrates, via an example, how the use of pure bundling of films can allow a monopoly seller to increase profits. However, the increase in profits was not from leveraging. Rather, the increase in profit resulted from the use of block booking as a subtle form of price discrimination.[34]

In order to facilitate comparison between the different models, we use the following definitions throughout the survey. Sellers are indexed by $i = 1, \ldots n$, consumers are indexed by $j = 1, \ldots j$, and goods are indexed by g = $Y, X, W, \ldots G$. Following this convention, in the Stigler example, there are two films, Y and X, and two demanders 1 and 2. Let v_{jg} denote the maximum price demanded by demander j for film g. If the films are sold separately, and both demanders are served at monopoly prices, then the price of the films if sold separately equal:

(1a) $p_X = min(v_{1X}, v_{2X})$

(1b) $p_y = min(v_{1Y}, v_{2Y})$.

If the films are sold as a block, and both demanders choose to purchase the block, then the block price will equal:

(2) $p_B = min(v_{1X} + v_{1X}, v_{2X} + v_{2Y})$.

Under these conditions, the revenues extracted through the block price p_B will be greater than the stand alone prices if consumers' valuations are negatively correlated:

(3) $v_{1X} >(<) v_{2X}$ *and* $v_{1Y} <(>) v_{2Y}$.

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[31] Stigler, *supra* note 28. A similar effect was noted by M. L. Burstein, *The Economics of Tie-In Sales,* 42 REV. ECON. & STAT. 68 (1960) (analyzing tie-in sales).

[32] *U.S. v. Loew's* 371 U.S. 38 (1962); *U.S. v. Paramount Pictures, Inc*., 344 U.S. 131 (1948).

[33] For general criticisms of the leverage theory, *see* Robert Bork, THE ANTITRUST PARADOX, (Basic 1978), Ward Bowman, *Tying Arrangements and the Leverage Problem*, 67 YALE L. J. 19 (1957), RICHARD A. POSNER, ANTITRUST LAW: AN ECONOMIC PERSPECTIVE, (U. Chicago Press 1976).

[34] Gandal et al. apply this theory to explain the bundling of applications by Microsoft in the Office Suite. *See* N. Gandal, S. Markovich, & M. Riordan, *Ain't it 'Suite'? Strategic Bundling in the PC Office Software Market,* mimeo, Columbia University (2004).

Offering films in a bundle reduces the between consumer variation in reservation values, and allows the seller to extract more of the available consumer surplus. Thus, in these models, bundling serves the same purpose as third degree price discrimination.

[Insert Figure 1 here]

Figure 1 illustrates the separate pricing equilibrium. In the figures, there are two customers (in the *Loew's* case, television stations) with valuations of films *Y* and *X* of (55, 45) and (40, 60) respectively. The valuations of the consumers are negatively correlated (as illustrated in Figure 1) so that condition (3) is satisfied. If the monopolist priced the films separately, the uniform prices of the films that would maximize profits would be $p_Y = 40$, $p_X = 45$. At these prices, both consumers choose to purchase both films. More generally, given the stand alone prices p_Y and p_X, consumers to the northeast of point $A \equiv (p_Y, p_X)$ in Figure 1 will choose to purchase both goods. Consumers to the southeast of this point will choose to purchase only *X*, and consumers to the northwest of this point will choose to purchase only *Y*. Consumers to the southwest of point *A* will not purchase either good.

[Insert Figure 2 here]

Figure 2 illustrates the pure bundling equilibrium. Consumers with reservation values for *X* and *Y* that lie above and to the right of the line $v_{1Y} + v_{1X} = 100$ will choose to consume the bundle, while those with reservation values that lie below and to the right of this line will choose not to purchase the bundle. Compared to the separate pricing equilibrium illustrated in Figure 1, some consumers that used to purchase only one of the goods under the separate pricing equilibrium will now purchase both goods, while others that used to buy either or both goods choose not to purchase the bundle.

In the two station example, the optimal bundle price P_B would equal 100. As long as the seller can accurately price the bundle, bundling allows the multiproduct monopolist to move from the per consumer iso-revenue line $R_s = 170$ that travels through point *A* (p_Y, $p_X = (40, 45)$) to the higher per consumer iso-revenue line $R_B = 200$ that travels through the points (v_{1Y}, v_{1X}) and (v_{2Y}, v_{2X}). In this example, there is no variation in the consumers' valuation of the bundle. Under these conditions, bundling allows the monopolist to extract all of the consumer surplus. Moreover, extraction of the surplus does not require that the seller have information about stations' valuations of individual films, as would be required for first degree price discrimination.

B. Kenney and Klein on Block Booking

While Stigler presented some evidence in support of his price discrimination hypothesis,[35] Kenney and Klein find that the facts surrounding the block booking of films

[35] *See* Stigler, *supra* note 28, Appendix A (showing that the share of receipts for individual movies varied widely from city to city, and citing a study that suggested the aggregate value of a television station could be reliably predicted from a few observable factors).

in the *Loew's* case were not consistent with Stigler's price discrimination explanation.[36] Prices charged for the blocks were not uniform, and varied across geographic markets. Moreover, in multiple station markets, Loew's used competitive bidding to grant the exclusive rights to broadcast the block of films to a single television station in a given geographic market. The use of these competitive bidding auctions provided an alternative mechanism through which stations' reservation prices for individual films could be revealed. Thus, in such markets, the use of competitive bidding would remove the informational advantage allegedly possessed by the television stations, thus removing the hypothesized reason for use of block booking under the price discrimination hypothesis.

In theory, the conditions for the use of block booking as a price discrimination device would remain in single station markets, where competitive bidding would not be viable. Thus, a testable implication of the price discrimination theory would be that block booking would be more prevalent in these single station markets. The evidence suggests the opposite is true. Kenney and Klein find that the blocks were broken more frequently in the single station markets than in markets where competitive bidding was used to price the block.[37] Based on these observations, they conclude that price discrimination was not the likely explanation for the use of block booking by Loew's.

Kenney and Klein argue that the average pricing of a block of films was a way to minimize information costs associated with the sale of a standardized product. Block booking lowered information costs in two ways. First, it prevented television stations from investing in information with little private or social value. The blocks of films that were the subject of the *Loew's* case were made up of low valued films primarily broadcast during late night and off-hours.[38] Because advertising rates for these off-hours were agreed to without knowing which films in the block would be actually shown, the value of individual films contained in the block was of little private or social value. Second, block booking facilitated the accurate pricing of the standardized product by increasing the number of transactions and thus the quantity of price information for sales of a like product. Both effects would be expected to reduce buyer search costs and increase the efficiency of the film distribution system.

Separate from its historical significance, the example of block booking of films illustrates several important lessons regarding the economic analysis of bundling. First, the example highlights the value of generating testable hypotheses and producing the data to carry out such tests. Whether or not the block booking of films was used as a price discrimination mechanism, price discrimination became the primary non-cost based explanation for bundling studied by economists. If Kenney and Klein are correct, and price discrimination is not the explanation for the practice in *Loew's*, then the absence of

[36] Roy W. Kenney & Benjamin Klein, *The Economics of Block Booking,* 26 J. L. & ECON. 497 (1983).
[37] *Id.*at 535.
[38] Films with high individual values, such as Gone With the Wind, were not sold as part of these blocks. *Id.*

an early in depth empirical examination may have caused a type of path dependence in the economics literature that resulted in an intense study of a phenomenon that is of little empirical relevance. Moreover, the focus on price discrimination may have diverted attention from examining the real reasons bundling was used – reasons that many not be uncovered through a cursory examination of the industry, or be contained in the records produced during an antitrust case. For example, Kenney and Klein's explanation of bundling specific cost reductions do not flow from an observable reduction in "package costs". Rather, the efficiencies result from the alteration of incentives to engage in socially wasteful quality search, which would not be obvious in the absence of an in depth examination of the institutions and markets involved.[39]

C. The Adams & Yellen Model.

With the caveat that price discrimination may not have been the explanation for the practice of block booking in the Loew's case, the early primary focus of economists in explaining bundling were derivatives of Stigler's price discrimination analysis of block booking. Stigler's analysis was expanded by Adams and Yellen.[40] In the Adams and Yellen model, consumers demand at most one unit of two goods X and Y. Units of these goods are produced at a marginal cost of c_X and c_Y respectively whether produced separately or in a bundle. The reservation price for the bundle equals the sum of the reservation prices for the individual good. Thus, there are no economies of scale or scope in the production of the bundle, nor are there complementarities in the consumption of the bundle.

The Adams and Yellen analysis extends the Stigler analysis by (i) explicitly considering the cost of producing the bundled goods,[41] (ii) considering the use of mixed bundling, and (iii) explicitly considering the static welfare implications of bundling. Using a series of discrete examples to illustrate the effects of bundling based on negative correlation between consumers' reservation values, Adams and Yellen show that use of bundling can lead to an over or undersupply of output. An oversupply of output can result when consumers that purchase the bundle value one of the goods in the bundle at less than the marginal cost of producing it.

[Insert Figure 3 here]

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[39] Kenney and Klein also explain the earlier *Paramount* case based on a factually distinct theory. In *Paramount*, Kenney and Klein argue that block booking was used to mitigate information oversearching and to control ex-post exhibitor agency costs. *Id.* This theory was criticized by F. Andrew Hanssen, *The Block Booking of Films Reexamined,* 43 J. L. & ECON. 395 (2000). Hanssen rejects their theory, as well as the Supreme Court's and Stigler's theory in favor of a theory based block booking being simply an efficient means of selling in quantity. But *see* Roy W. Kenney & Benjamin Klein, *How Block Booking Facilitated Self-Enforcing Contracts,* 43 J. L. & ECON. 497 (2000) (arguing that a closer examination of the facts are consistent with their original theory).

[40] Adams and Yellen, *supra* note 28.

[41] Stigler's analysis examined revenues and did not consider the costs producing and distributing the films. *See* Stigler, *supra* note 28. The fact that Stigler was examining the distribution and exhibition of a public good (films) may explain why his example ignored the costs of production and distribution.

Figure 3 illustrates the effect of pure bundling with four consumers.[42] In addition to the consumers depicted in Figures 1 and 2, there are two additional consumers with reservation values at $(v_{3Y}, v_{3X}) = (10, 90)$ and $(v_{4Y}, v_{4X}) = (90, 10)$ respectively. In addition, the marginal cost of producing a unit of *Y* and *X* equals 30 and 20 respectively. The stand alone prices for *Y* and *X* equal 90 and 60 respectively, with one unit of *Y* and two units of *X* being sold. In the separate pricing equilibrium, no consumer purchases both goods, and one consumer (consumer 1) purchases neither good. Profits equal 140. In contrast, the pure bundle price equals 100, with four units of each good being sold. Profits equal 200.

[Insert Figure 4 Here]

Figure 4 illustrates the above example in price quantity space. In the figure, the bundle demand curve is perfectly elastic at 100, showing the effect bundling has on reducing the variance in reservation values. If the goods are priced separately, the monopolist will choose to produce one unit of *Y* and two units of *X*. The figure also shows the aggregate components demand curve, which is the vertical sum of the two demand curves for the component products. Bundling will be profitable when the aggregate components demand curve lies below the demand curve for the bundle at the optimal bundle price.[43]

In the example, all consumers purchase the bundle. Consumer 1, who would not purchase any good in the separate pricing equilibrium, now purchases both goods. Consumer 2 adds product Y. In both these cases, the additional goods consumed as part of the bundle have reservation values greater than the marginal cost of producing them. However, the example illustrates one of the potential allocative inefficiencies of bundling. Consumers 3 and 4 both purchase the bundle and consume a good (*X* and *Y* respectively) with a reservation value (10) less than the cost of producing the good (20 and 30 respectively). Despite this inefficiency, total surplus rises with bundling. Total surplus when the goods are sold separately equals 170. When they are sold as a bundle, total surplus increases to 200.

[Insert Figure 5 Here]

In addition, Adams and Yellen consider mixed bundling, where both the bundle and the separate goods are available. With mixed bundling, the optimal bundle price is 100, and the optimal stand alone price is 90 for both goods. Two units of the bundle, along with one unit of each of the stand alone goods are sold (see Figure 5). Mixed bundling results in profits equal to 230. Since the entire surplus is extracted for the units and bundles sold, total surplus also equals 230. Thus, in the example, mixed bundling results in higher profits and higher total welfare than either pure bundling or stand alone pricing. This will be the case whenever some consumers consume goods in a pure bundle

[42] This Figure reproduces Figure 4 in Adams and Yellen, *supra* note 28.
[43] See Salinger, *supra* note 12.

that have costs of production greater than their reservation values.[44] However, as Adams and Yellen show, any profit ordering is possible, and total welfare can rise or fall depending upon the level of costs and the distribution of consumers in reservation price space.[45] Schemesch and Tellis (2002) characterize the optimality of mixed versus pure bundling. This issue has also been addressed by Pearce and Winter[46].

D. Other Treatments of the Multiproduct Monopolist

The Stigler and the Adams and Yellen articles examined bundling by a multiproduct monopolist when consumers' valuations are negatively correlated. As noted in above, when a consumer's relatively high valuation for one good (e.g, *X*) is likely to be accompanied by a relatively low valuation for the other good (e.g., *Y*), the between consumer variation in the demand for the *XY* bundle will be reduced. Bundling allows the multiproduct monopolist to take advantage of this reduction in the variation of the demand for the *XY* bundle to extract more of the consumer surplus.

In many cases, bundling involves two goods where a high value for one good is likely to be associated with a moderate to high value for the other good. For example, the bundling of Sports Channels (such as ESPN, ESPN2, CSN, Fox Sports Net) by a cable TV or Satellite TV provider plausibly involves an attempt to attract those consumers who have relatively high values for each of the individual channels in the bundle. In contrast, the Stigler example of bundling based on negative correlation would involve, for example, the bundling ESPN and the lifetime channel in an extended basic tier. To address this possibility, the literature that followed the Adams and Yellen article examined the use of bundling by a multiproduct monopolist when consumers' reservation values were uncorrelated or positively correlated. They also expanded the analysis beyond considering discrete examples.

McAfee, MacMillian, & Whinston also examine the Adams and Yellen model and provide sufficient conditions for mixed bundling to dominate unbundled sales.[47] Because of their assumptions regarding the continuity of the joint distribution of reservation values, mixed bundling dominates pure bundling in their model. Because of this, the authors focus on comparing mixed bundling with unbundled sales. However, in their model, the optimal bundle prices can exceed the sum of the prices of the individual goods. As a result, the optimal mixed bundling strategy will be effective only if the monopolist can prevent consumers from purchasing both of the separate products to make their own bundle.

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[44] Adams and Yellen, *supra* note 28 at 483. This includes the case where the joint probability density is everywhere in the first quadrant. *See* Schmalensee, *supra* note 28, at S227.
[45] Adams & Yellen, *supra* note 28 at 488.
[46] Brooks Pearce & Harold Winter, *Pure vs. Mixed Commodity Bundling,* 11 REV. IND. ORG. 811 (1996).
[47] McAfee, et al., *supra* note 19.

Treatments of bundling by a multiproduct monopolist under specific distributional assumptions include articles by Schmalensee and by Salinger.[48] Schmalensee examines the Adams and Yellen model in the context of a joint normal distribution of reservation values (Gaussian demand). Schmalensee, also considers non-negatively correlated consumer reservation values, and shows that pure bundling can be optimal under these condistions. Intuitively, bundling of independent demands reduces the variation in the buyers' reservation values in the same way holding a diversified portfolio reduces non-systematic risk. Consumer surplus decreases, but welfare generally increases.[49] Thus, even if the correlations of buyer's reservation values are non-negative, this diversification effect serves to reduce buyer diversity and allows the greater extraction of consumer surplus.

Salinger examines pure bundling in the Adams and Yellen model.[50] Salinger provides a useful general analysis of the welfare properties of bundling, and illustrates these properties using the uniform distribution and discrete examples. Salinger departs from the Adams and Yellen model by allowing bundling to result in cost savings so that $c_B < c_x + c_y$. Salinger demonstrates that when consumers' reservation values are negatively correlated, the incentive to bundle is greatest when the component costs are low. In many cases, the incentive to bundle will fall as the correlation between reservation values increases. Consider the case where reservation values of the consumers depicted in Figure 3 are reallocated so that they are positively correlated. Specifically, suppose that the reservation values are (90, 90), (55, 60), (40, 45), and (10, 10). The aggregate components demand curve is identical to the one in Figure 4, and the separate pricing equilibrium is not altered. However, the bundle demand curve now slopes downward, and coincides with the aggregate components demand curve. The monopolist will choose to produce and sell two units of the bundle. It is easy to demonstrate that the monopolist's profits fall to 130 if he bundles, whereas his profits will equal 140 if he prices the goods separately.

However, cost reductions from bundling may be most valuable in the positive correlation case. To see this, consider the case where the cost of producing the bundle falls to 40 rather than 50. In the negative correlation case, the marginal incentive to bundle is not affected (as the bundle demand curve is perfectly elastic). However, in the positive correlation case, the incentive to bundle increases. When bundling reduces the marginal cost of the bundle to 40, the optimal bundle price will be 115, resulting in two units being sold, and bundle profits rising from 130 to 150. Welfare rises relative to the separate pricing equilibrium.

Several authors have examined whether the results from this literature extend to the case of more than two goods. Some have found that the results from the multiproduct

[48] Schmalensee, *supra* note 28, Salinger, *supra* note 12
[49] Schmalensee, *supra* note 28.
[50] Salinger, *supra* note 12.

monopolist literature generally do not extend to the n-good setting.[51] However, Bakos and Brynjolfsson show that the benefits from reducing consumer variation rise with the number of goods in a bundle.[52] Indeed, in the uncorrelated demands case with zero marginal costs of production, the ability of the multiproduct monopolist to extract all of the surplus increases as the number of goods in the bundle increases. As noted above, bundling reduces the variation in the valuation of the bundle for the same reasons that holding a diversified portfolio reduces unsystematic risk. The benefits of large scale bundling will persist even in the case when consumers' reservation values are positively correlated, much in the same way that diversification still is useful in the presence of systematic or market risk. In this case, the benefits of bundling to extract surplus will be maximized if those demanders whose reservation values are correlated to the same underlying variables could be segmented according to these variables. Bakos and Brynjolfsson apply their theory to explain large scale bundling in the sale of information goods over the internet. Sales of information goods over the internet are likely to occur at low marginal costs, making conditions for bundling favorable. They also note that bundling is less frequent when the information good is embodied in a private good where the marginal costs of distribution are likely to be relatively high, (e.g., sale of videocassettes) compared to when the information good is distributed electronically (e.g., the distribution of films via cable or satellite.)

Other papers have combined examination of specific distributional assumptions with alternative assumptions regarding the whether the goods sold by the multiproduct monopolist are complements or substitutes. Ibragimov examines how optimal bundling strategies are affected by the degree of complementarity or subsitituability, and by the existence of long versus heavy tailed distributions of valuations.[53] He finds that bundling is preferred in the case of complementary goods and heavy tailed distribution. Separate sales are preferred when the buyers' valuations are not extremely heavy-tailed, and when the products are substitutes.

A recent paper by Kolay and Shaffer has examined the use of bundling as a way to induce self-selection among two distinct types of consumers.[54] They show that, when

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[51] *See* D. L. McAdams, *Multiproduct Monopoly Bundling,* working paper (1997), Hanson & Martin, *supra* note 12.

[52] *See* Bakos & Brynjolfsson, *supra* note 12. *See also* Yannis Bakos & Eric Brynjolfsson, *Aggregation and Disaggregation of Information Goods: Implications for Bundling, Site Licensing, and Micropayment Systems,* in D. HURLEY, ET AL. EDS., INTERNET PUBLISHING AND BEYOND: THE ECONOMICS OF DIGITAL INFORMATION AND INTELLECTUAL PROPERTY (2000), *Bundling and Competition on the Internet,* mimeo (1999).

[53] Rustam Ibragimov, *Optimal Bundling Strategies for Complements and Substitutes with Heavy-Tailed Distributions,* HARVARD INSTITUTE OF ECONOMIC RESEARCH DISCUSSION PAPER #2088 (2005).

[54] Sreya Kolay and Greg Shaffer, *Bundling and Menus of Two-Part Tariffs,* 51 J. IND. ECON. 383 (2003). Their article extends the general literature on use of non-linear pricing and price discrimination as a self selection mechanism. See, e.g., M. Murphy, *Price Discrimination, Market Separation, and the Multi-Part Tariff,* 15 ECON. INQ. 587 (1977). For a recent survey of the literature on optional tariffs and self selection, see John C. Panzar and J. Gregory Sidak, *When Does an Optional Tariff Not Lead to a Pareto*

compared to a strategy that uses menus of two-part tariffs, bundling yields higher profits for the monopolist. The monopolist does better with bundling than with two-part tariffs because bundling, by limiting the quantity of the goods purchased, better constrains the amount of surplus a high-demand consumer can obtain if he chooses the low-demand offer. This allows the seller to offer a bundle that extracts more surplus from the high-demand consumer. While profits increase, the effect of welfare is ambiguous.

Fang and Norman examine optimal mechanisms for the provision of excludable public goods where purchasers valuations of the public goods are private information.[55] They show that these optimal mechanism can involve bundling. Bundling increases the probability that the public goods will be provided in the first place. In addition, it also reduces the extent to which use exclusions must be used. Thus, bundling of excludable public goods may be an efficient way to ensure their provision.[56] Anton and Yao examine the optimally of bundling intellectual property (IP) versus a sequential pricing strategy when some of the IP goods sold by the monopolist are excludable and others are not.[57] They show that with multiple bidders, a sequential strategy where the contractable portion of the IP is sold before the non-contractable portion will dominate a strategy where the contractable and non-contractable portions are sold as a bundle.

Choi examines the use of bundling by a multiproduct monopolist who bundles an established product with a product of uncertain quality.[58] Choi shows how a multiproduct monopolist can leverage a reputation for quality in the established market to overcome information asymmetry problems in the second market with asymmetric information, and can be an effective way to signal the quality of the unknown product. Thus, bundling can enhance efficiency and welfare by lowering information costs. However, Choi shows that, in some cases, the ability to signal quality through bundling may cause the multiproduct monopolist to delay the introduction of the second product. The effect of the delayed introduction of the second product can result in bundling lowering overall welfare.[59]

Improvement? The Ambiguous Effects of Self-Selecting Non-Linear Pricing When Demand is Interdependent or Firms Do Not Maximize Profits, mimeo (2005).

[55] Hanming Fang and Peter Norman, *An Efficiency Rationale for Bundling of Public Goods,* mimeo (2004).

[56] The authors note that their model is consistent with site licensing of copyrighted materials. But *see* Aaron S. Edlin and Daniel L. Rubinfeld, *Exclusion or Efficient Pricing? The Big Deal Bundling of Academic Journals,* 72 ANTITRUST L. J. 119 (2004) (noting the potentially exclusionary effect of offering large bundles of academic journals to libraries).

[57] James J. Anton and Dennis A. Yao, *Markets for Partially Contractable Knowledge: Bootstrapping vs. Bundling,* 3 J. OF THE EUROPEAN ECON. ASSOC. 745 (2005).

[58] Jay P. Choi, *Bundling New Products With Old to Signal Quality, with Application to the Sequencing of New Products,* 21 INT'L. J. INDUS. ORG. 1179 (2003). *See also* Frank Mathewson and Ralph Winter, *Tying as a Response to Demand Uncertainty,* 28 RAND J. ECON. 566 (1997).

[59] Other articles that examine the non strategic pricing issues include Vlad Mares, *Bundling in Low Competition Environments,* mimeo, Washington U. St. Louis (2005), Christopher Avery, *Bundling and Optimal Auctions of Multiple Products,* 67 REV. ECON. STUD. 483 (2000), and Thomas R. Palfrey, *Bundling Decisions by a Multiproduct Monopolist with Incomplete Information,* 51 ECONOMETRICA 463 (1983) (showing the use of bundling and probabilistic bundling as an optimal pricing strategy in an auction setting), M. Armstrong, *Multiproduct Nonlinear Pricing,* 64 ECONOMETRICA 51 (1996)

III. Single Product Monopolist with a Competitive Market for the Other Good in the Bundle.

A. Non Strategic Bundling

This setting has been studied extensively, particularly in the context of examining the validity of the leverage theory. Schmalensee considers the incentive for a single product monopolist to bundle a competitively supplied good in the context of the Adams and Yellen model.[60] This paper is an important bridge between the multiproduct monopolist literature reviewed in Section II and the strategic foreclosure literature. The Schmalensee article shows that a monopolist in Y will bundle for reasons other than to leverage its monopoly power into the X market when X is competitively supplied.

In the case of independent demands the monopolist in product Y does not have an incentive to engage in pure bundling of Y and a competitively supplied product X. To see this suppose that there is a competitive supply of good X, and that $P_X = c_X$. If the monopolist chose to offer only a bundle of X and Y at price P_B, the pattern of sales of the bundle and stand alone product X would be as illustrated in Figure 6. Consumers with reservation values to the southeast of point Z would purchase only the competitively supplied good X. Consumers with reservation values above the $P_B - c_Y$ line and to the right of the line [P_B Z] would choose to purchase the bundle (area B plus the rectangle to the northeast of point Z).

[Insert Figure 6 here]

Now suppose that the monopolist alternatively chose to sell the monopoly good Y at a stand alone price $P_Y = P_B - c_X$. For each unit sold, the per unit profit would be identical to that of the bundle at P_B. However, the monopolist would gain in two ways. First the monopolist would make additional sales to consumers in the shaded area A (made up of those consumers with low values for good X but values of y greater than $P_B - c_X$. Thus, the monopolist would make greater profits by selling the monopoly good as a stand alone product. In addition, stand alone sales of y would eliminate the oversupply of good X in the region labeled B.

[Insert Figure 7 here]

In contrast, mixed bundling can be profitable in such a setting. To see this, consider Figure 7, which shows the pattern of sales under mixed bundling. In order for any sales of the bundle to be made, it must be the case that $P_B < P_X + P_Y$, or equivalently $P_B - P_Y < c_X$, since $P_X = c_X$. Thus, the implied price of the competitively supplied good must be below its cost.[61] This condition also implies that the per unit margin on the

[60] Richard Schmalensee, *Commodity Bundling by Single Product Monopolies*, 25 J. L. & ECON. 67 (1982).
[61] This condition would violate the antitrust test set in Barry Nalebuff, *Exclusionary Bundling*, mimeo, Yale University (2004) discussed *infra* in Part B of this Section.

bundle $P_B - c_X - c_Y$ must be less than the margin on the stand alone sales of the monopoly good $P_Y - c_Y$.

As a result, the bundling monopolist loses money (relative to a strategy where no bundle is offered) on bundled sales where the demander's reservation price is above the horizontal line at P_Y. On the other hand, the monopolist extracts more surplus from those demanders who choose to buy the bundle who have values for the monopoly good below P_Y. Thus, in order for bundling to be profitable, the distribution of customers must consist of a relatively large number of consumers with relatively high reservation values for the competitive good, but relatively low values for the monopoly good. Intuitively, mixed bundling works when the bundle identifies a large number of consumers with negatively correlated reservation values of this type. Net surplus can either increase or decrease based on the particular distribution of reservation values.

It is interesting to note that the quantity of the competitively supplied good X unambiguously increases relative to the non-bundling setting. Part of the increase comes from an oversupply of good X (in area Q, which results in inefficient sales to low valued users). Moreover, while total sales of X increase, unbundled sales of X fall. This, however, does not prove that bundling is being used for strategic purposes, such as leveraging. Note that the monopolist is indifferent, ceteris paribus, between producing units of X himself or purchasing X from the competitive firms for resale. Thus, leveraging or predation is not a motivation for bundling in this setting. Indeed, any disadvantage the monopolist faces in integrating the production of X and Y will lead him to strictly prefer outsourcing the production of X to existing competitive firms.[62]

B. Exclusionary Bundling

A set of recent models have examined the use of mixed bundling in this setting as a way to engage in exclusion of an existing rival.[63] Both examine a setting where a multiproduct monopolist in product Y engages in bundling of Y and X in the presence of a competitive market for X. In contrast to the Schmalensee (1983) article, their analyses are based on homogenous or representative consumers, so that issues of price discrimination do not arise.

Both papers show that a bundling discount can lead to foreclosure of firms that only produce X. Moreover, the exclusion does not require the monopolist to price below cost in order to carry out the exclusion. To see how this works, consider the following example contained in Nalebuff.[64] A monopolist in product Y also sells X, which is supplied competitively at a marginal cost of 10. Suppose a representative individual's demand for Y is given by $Q_Y = 100 - p_Y$, and the demand for X is inelastic at 20. Under these conditions, the monopolist that did not bundle or tie would price Y at 50 and sell 50

[62] See generally, ROGER D. BLAIR AND DAVID L. KASERMAN, ANTITRUST ECONOMICS (Irwin 1985).
[63] These include Nalebuff, *supra* note 61, and Patrick Greenlee, David Reitman, and David S. Sibley, *An Antitrust Analysis of Bundled Loyalty Discounts,* mimeo, U.S. Department of Justice (2004).
[64] Nalebuff, *supra* note 61.

units. *X* is sold at cost (10) in a competitive market. If *Y* is produced at zero marginal costs, total profits are 50*50 = 2500.

Now suppose that the monopolist lowered the price of *Y* to 49 only to those who also purchased their 20 units of *X* at 11. At this price, profits from *Y* fall by 1 to 2499 (49*51).[65] By taking the lower price on *Y*, the representative demander saves 50 (1 on the 50 units he would have purchased at the monopoly price). In addition, he gains the surplus associated with the 51st unit. He pays 20 more for the 20 units of *X*. In total, he is better off by at least 30. The monopolist is also better off. He gives up 1 when he lowers the price of *Y*, but now makes an additional 20 on sales of *X* at the higher price.

Nalebuff would condemn such tying because of its effect on competitors in *X*. In order for other suppliers of *X* to sell to the representative consumer, they must offer the consumer a savings of at least 30, the net benefit from entering the tie. In order to do this, the price of *X* for the stand alone product would have to be between 7 and 8, which would be below cost. Thus, according to Nalebuff, equally efficient competitors would be excluded. This result would even apply to a competitor with lower costs than the monopolist (*e.g.*, a competitor with a marginal cost of production equal to 9). Moreover, this exclusion would be accomplished with an increase in profits to the monopolist. Thus, the type of recoupment requirement that is part of the predatory pricing literature would not apply to this type of exclusionary bundling.

In the case where *X* and *Y* are consumed in fixed proportions, Nalebuff defines exclusionary bundling to have occurred when the incremental price of the *YX* bundle over *Y* alone is less than the bundler's long run average variable costs of *X*. When *Y* and *X* are not consumed in fixed proportions, the competitive price of *X* minus the implied discount on *X* required to retain consumers must be above the monopolists long run average variable costs.[66] In the example above, the implied per unit discount is approximately 5/2, which subtracted from the competitive price of 10 results in an implied price of *X* that is below the monopolist's cost of producing *X*.

However, as Nalebuff notes, in this example, static consumer and total welfare increases. In effect, the tie between *X* and *Y* allows the monopolist to implement a two-part tariff, which reduces the deadweight losses associated with monopoly by lowering the price of *Y*.[67] The overcharge on *X* serves the function of the entry fee. Based on static welfare considerations, this test can commit type I errors. Nalebuff states that the consideration of static welfare is too narrow. Specifically, he claims that the disruption in

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[65] At the monopolist's optimal price, small changes in price have second order effects on profits.
[66] This is the test adopted in *Ortho Diagnostics Systems v. Abbot Labs*, 920 F. Supp. 455 (SDNY 1996). See Greenlee, et al, *supra* note 63. They note that in any case where a bundling monopolist passes the *Ortho* test, such prices cannot be equilibrium prices if the competitor in *X* is equally efficient. And if the competitor is not equally efficient, then cost differences, and not the bundling, may explain his exclusion.
[67] See generally, Walter Y. Oi *A Disneyland Dilemma: Two Part Tariffs for a Mickey Mouse Monopoly,* 85 Q. J. ECON. 77 (1971), Barry Nalebuff, *Bundling as a Way to Leverage Monopoly,* YALE UNIVERSITY WORKING PAPER SERIES ES #36 (2004).

competition in the *X* market would outweigh the benefits of allowing *X* to be used to implement a two part tariff.[68]

On the one hand, it is hard to see why the monopolist does not directly implement a two part tariff through the traditional lump sum fee without having to distort pricing and production decisions in the *X* market.[69] On the other hand, the two part tariff involving *X* does not have to distort decisions in the *X* market. As noted by Schmalensee (1983), the monopolist here is indifferent between producing *X* himself or purchasing units of *X* from his competitors and reselling them at 11. In the case where there exists a more efficient competitor with lower marginal costs, the monopolist would strictly prefer to purchase units of *X* from the more efficient competitor for resale through the bundle.

Greenlee et al. (2004) employ a similar model to examine bundled rebates. One deviation from the Nalebuff example presented above is they explicitly consider a model in which the demand for *X* is not perfectly inelastic.[70] In the absence of bundling, the prices for *Y* and *X* equal P_Y*, the stand alone monopoly price for *Y*, and c_X respectively. The monopolist in *Y* can also offer a bundled rebate with prices $(P_Y - \varepsilon, P_X)$ if the buyer purchases his *X* from the monopolist. If not, the consumer is charged P^s_Y to purchase Y separately.[71]

In all of the cases, this stand alone price is set at a level so as to make stand alone purchases of *Y* unattractive. Grenelee, et al. classify bundled rebates as a form of tying.[72]

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[68] For example, he suggests that foreclosure in the x market may serve to protect the y market. Nalebuff does not explicitly model these dynamic effects. For an explicit model of such effects, see Dennis W. Carlton and Michael Waldman, *The Strategic Use of Tying to Preserve and Create Market Power in Evolving Industries,* 33 RAND J. ECON. 194 (2002), discussed in Section IV, *infra*.

[69] If so, prohibiting the use of bundling for these purposes would not be costly, as the monopolist would find some other mechanism to enforce the two part tariff. However, if the use of *X* is the most efficient way to implement the two-part tariff, then prohibition would entail social costs.

[70] Nalebuff, *supra* note 61, considers a similar effect when he examines the bundling of substitutes.

[71] The bundled rebated eliminates the need to carry out the requirements contract explicitly. Rather, the rebate ε is given to the retailer on the condition that the total purchases of either *X* or *Y* from the *Y* monopolist exceeds a set target level. If this target level is set at the correct level, the retailer will only receive it if he purchases all of his *X* from the *Y* monopolist.

[72] Grenelee, et al., *supra* note 63, suggest that to the extent that bundled rebates can be classified both in form and substance as tying, then much of the attention directed toward bundling by the fallout from the LePages case may be misdirected. 3M's and others' use of bundled rebates can be analyzed as a tie under the antitrust laws. This classification does not imply that bundled rebates should be condemned. See generally, Benjamin Klein & Lester Saft, *The Law and Economics of Franchise Tying Contracts,* 28 J. L. & ECON. 345 (1985). Recent literature on the economics of distribution have shown that efficient distribution contracts may require that manufacturers use direct payments to ensure the provision of efficient promotional or other types of demand increasing investment by retailers. Such direct payments are required in order to prevent retailers from free riding on the promotional investments of a manufacturer by shirking or switching consumers to competing products with higher margins. *See* Benjamin Klein & Kevin M. Murphy, *Vertical Restraints as Contract Enforcement Mechanisms,* 31 J. L. & ECON. 265 (1988), Benjamin Klein & Joshua Wright, *The Economics of Slotting Arrangements,* mimeo George Mason University (2004). This is true even when the payments are not per unit discounts. Bundled rebates, in

For small deviations from the stand alone prices where the bundle price of Y is discounted by ε and the price of X is increased by δ, the bundle will be pareto optimal for the monopolist and the consumer. In this case, the consumer will choose the bundle even if the original stand alone prices, P_Y* and c_X are available in the market. The reasoning is similar to that set out in the discussion of the Nalebuff example. However, as the bundle price of Y falls and the price of X rises, total surplus can fall, as increases in the price of X cause deadweight losses in the X market. Moreover, if the monopolist maximizes profits and extracts all of the possible consumer surplus, consumer surplus must fall by definition relative to the separate pricing equilibrium. The only exception would be if the monopolist was extracting all of the consumer surplus in the separate pricing equilibrium through the use of a two part tariff.

Moreover, in some cases, the bundled rebate can be set such that the non discounted stand alone prices of both X and Y are above their stand alone prices in the absence of bundling.[73] Specifically, it is optimal in such cases for both the price of Y with the discount and the price of X sold in the bundle to be set to their monopoly levels. In this case both consumer surplus and total surplus must fall.

Based on these results, the authors suggest that one examine the standalone price to gauge whether or not bundling reduces consumer welfare. The Greenlee et al. test would sort out consumer welfare reducing bundling by examining to see if the stand alone price P^s_Y is greater than the monopoly price in the non-bundling equilibrium P_Y*. The rule would condemn all cases of pure bundling (with an implicit P_Y* of infinity). As a result it would also condemn some cases where total welfare increased.

Both the Nalebuff and Greenlee et al. papers apply their respective antitrust test to several recent antitrust cases that examined the legality of bundled rebates and other discounts.[74] The Ortho test suggested by Nalebuff focuses on whether or not an equally efficient competitor can be excluded by the bundling, while the Greenlee et al test would apply a stricter standard that would allow exclusionary mixed bundling in cases where consumer welfare increased.[75]

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theory, can fit into this category, as they would punish retailer that diverted sales to the products of other sellers.

[73] Assuming that the stand alone price of Y is priced so that it is unattractive, this will be the case when the consumer surplus of consuming both goods at the monopoly prices is greater than the consumer surplus from consuming X alone at competitive prices.

[74] These cases include *LePages*, *supra* note 8, *SmithKline Corp v. Eli Lily & Co*., 427 F. Supp 1089 (1976), *Ortho*, *supra* note 66.

[75] In *SmithKline*, Greenlee et al., *supra* note 63 argue that the court came up with the correct decision for the wrong reason. Under their analysis, the bundling should have been condemmed because the bundled rebates resulted in stand alone prices for the antibiotics that were greater than or equal to the price that existed prior to use of the rebates. Nalebuff, *supra* note 61 would condemn the bundled rebates for their exclusionary effect. Nalebuff would use the *Ortho* test as a first screen, then consider defenses, such as efficiencies from bundling, or differential costs. The models, however do not explicitly address these types of tradeoffs.

IV. Monopoly in Good Y and Limited Competition in Good X.

Several recent papers have examined the strategic use of bundling in a setting where a monopolist in *Y* faces limited actual or potential competition in *X*. Bundling is this literature is used to reduce the profits of an entrant if he does decide to enter, and thus serves to deter entry. The entry deterrence literature generally examines models where there is an incumbent monopolist facing a limited set of entrants. Incumbency in these models means that (i) there is a monopolist who currently produces both *X* and *Y*; and (ii) entrants must incur some type of fixed cost to enter the market. Under these conditions, if bundling reduces the entrant's expected profits associated with entry relative to the non-bundling equilibrium, bundling can serve to deter entry when doing so lowers expected profits below the fixed costs of entry.[76]

In general, these models show the circumstances in which bundling can result in the deterrence of entry that would have occurred absent bundling.[77] In this section, all of the equilibria examined involve pure bundling. While these models provide a useful counterpoint to the literature that suggested foreclosure was not a viable theory, it is also the case that these models often contain restrictive assumptions, including strict limits on the number of potential entrants. Moreover, in many cases, the welfare consequences of allowing bundling are ambiguous or likely positive.

A. Entry Deterrence and Committed Bundling

Whinston presented a model where pure bundling could deter entry.[78] In the Whinston model, market *Y* is served by a monopolist, while market *X* is served by the monopolist and potentially by a second firm. The products in the *X* market are differentiated. This latter assumption differentiates the Whinston model from the Schmalensee model presented in Section III. In period 1, both firms choose whether to be active in market *X*. If the firm chooses to be active in the *X* market, it incurs a fixed cost *K*, and produces *X* at a constant marginal cost. Thus, there are economies of scale in the *X* market. In period 2, firms set prices. If the second firm has chosen to enter the *X* market, the second firm sets its price for the *X* good. The *Y* monopolist chooses the price of *Y*, and if he has entered the *X* market, can also choose the price of *X* and the price of a bundle of *X* and *Y*. Whinston shows that, in the absence of precommitment to bundle by the monopolist, bundling has no strategic value. The monopolist can do no better than the equilibrium where only the components are offered.

However, this result is altered if the base model is altered to allow the monopolist in period 0 to choose to commit to offering a bundle. Whinston shows that a precommittment by the monopolist to produce only the bundle results in firm 2 earning

[76] For a general discussion of entry deterrence models, see A. Dixit, *The role of Investment in Entry Deterrence,* 90 ECON. J. 95 (1980).
[77] For an applied antitrust analysis of bundling in this context, see Edlin & Rubinfeld, *supra* note 56.
[78] *See* Michael D. Whinston, *Tying, Foreclosure, and Exclusion,* 80 AM. ECON. REV. 837(1990).

less when he enters and competes with the bundle than when he enters and only the components are offered by the *Y* monopolist. Intuitively, committed bundling in the Whinston model commits the monopolist in *Y* to more aggressive pricing should firm 2 enter the *X* market.[79] Because the monopolist only offers the bundle, he must make sales of *X* in order to make a sale of *Y*. Relative to the independent pricing game, the bundling monopolist has an added marginal incentive to reduce price and take sales away from firm 2. As a result, when *X* chooses to enter against a monopolist that has precommitted to bundle, prices in the *X* market, as well as profits firm 2 are lower than in the independent pricing game.

When entry occurs, the monopolist also makes lower profits than in the independent pricing game. The reduction in profits comes from two sources. The first is the lowered prices in the *X* market. In addition, because he only offers the bundle, he makes fewer sales of *Y*. Because of this latter result, the monopolist would not choose to engage in pure bundling if it would not successfully deter entry. This is also the reason that the precommitment is required, as he would choose to abandon bundling any time entry occurred. Knowing this, bundling would be a non-credible threat, and could not deter entry. However, if entry does not occur, the profits of the monopolist may (but do not have to) go up. Moreover, even if entry is deterred, the effect of bundling on welfare is ambiguous.

B. Entry Deterrence without Commitment

Nalebuff examines the use of bundling as an entry barrier that does not require any commitment.[80] The primary result is that pure bundling can be an effective entry deterrent strategy when an incumbent producing *X* and *Y* faces a single entrant that is constrained to producing a single product. That is, the entrant can enter *X* or *Y*, but not both *X* and *Y*. As is the case in the Whinston model, the pure bundling of goods *X* and *Y* results in a smaller residual demand for either of the single goods, and reduces the profitability of single product entry.

In the model, the incumbent posts prices for *X* and *Y* that cannot be changed. Consumers are distributed on the unit square – that is, their valuations of *X* and *Y* are uniformly distributed between 0 and 1. There are no costs of production in the model. The entrant faces a fixed cost *E* to enter either *X* or *Y*. Under the conditions in Nalebuff's model, the monopoly price for each good equals .5. Thus, only consumers that value an individual good at greater than .5 purchase the unbundled goods. If the monopolist posts stand alone prices for *X* and *Y*, there are two possible outcomes: Prices

[79] Jose Carbajo, David de Meza, &Daniel J. Seidmann, *A Strategic Motivation for Commodity Bundling,*, 3 J. IND. ECON. 283 (1990) note a strategic rationale for bundling based on changes in the aggressiveness in pricing. In the case of Cournot competition, they shows that use of bundling can cause a rival firm to bid less aggressively, thus increasing profits. However, the result does not hold with Bertrand competition. *See also* Daniel J. Seidmann, *Bundling as a Facilitating Device: A Reinterpretation of Leverage Theory,* 58 ECONOMETRICA 491 (1991).

[80] Barry Nalebuff, *Bundling as a Barrier to Entry,* 119 Q. J. ECON. 159 (2004)

are set low enough so that single product entry is not profitable (limit pricing); or the incumbent sets monopoly prices, and the entrant enters at the monopoly price.

If the bundle price is 1, all consumers that value the package of *X* and *Y* at more than 1 will choose to buy the bundle. As a result, the residual demand for just *Y* is reduced to consumers who value $Y > .5$ and $X < .5$. Thus, the residual demand at $P_X = .5$ is one half of what it would be absent the bundle. This reduction of profits results in less entry, especially if *E* is large. Note that in the model, bundling can be optimal in the face of entry. Thus, a precommitment to bundling is not necessary in this setting.

[Insert Figure 8 here]

The paper examines entry deterrence independently of welfare. The paper has a price commitment structure, where the incumbent fixes a price that cannot be changed. This generates a potential commitment advantage, but also a second mover advantage for entrants. As a result, entry in this model is often welfare reducing – that is, entry results in the monopoly price (when the entrant takes one market) plus the costs of entry. The alternative outcome absent bundling is to deter entry through limit pricing. Relative to entry, welfare is increased as the limit pricing results in a lower limit price and no entry costs.[81]

Consider the following example. Under the separate pricing with entry outcome, the welfare losses are the monopoly losses plus the cost of entry. Now suppose a bundle results in entry deterrence. The highest price for the bundle is .80, that results in 68% of consumers purchasing both *X* and *Y*. All consumers who previously bought both *X* and *Y* in the separate pricing equilibrium also buy the bundle (Quadrant I in Figure 6). But some of the high value *Y* customers ($v_Y > .5$) now buy *X* in addition to *Y* (Area IIA in Figure 6), while others now buy nothing (Area IIB). At the optimal bundle price of $P_B = .80$, it can be shown that the gain from the additional purchases of *X* outweigh the losses from those who forgo *Y*. This result in symmetric for the lower right quadrant (high value *X* and low value *Y* consumers, in Quadrant IV-A and B). In addition, there are some consumers with moderate values of *X* and *Y* that previously purchased neither good under the separate pricing equilibrium that now purchase the bundle in Quadrant III-A. Indeed, Brennan shows that relative to the no bundling equilibrium with entry, welfare in almost any alternative equilibrium increases, including those where bundling results in marginal entry deterrence.[82]

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[81] The monopolist will engage in limit pricing results as long as $E > 1/8$. At $E = 1/8 + \varepsilon$, the price equals between .14 and .15, and social losses equal .02, and can reach as high as the monopoly social loss (with large *E*). In comparison, with entry, the social losses equal $2*.5*.5/2 = .25 + E$. Thus social losses can go as high as .375 with entry.

[82] Timothy J. Brennan, *Competition as an Entry Barrier? Consumer and Total Welfare Benefits of Bundling,* AEI-BROOKINGS JOINT CENTER FOR REGULATORY STUDIES RELATED PUBLICATION 05-08 (2005). Brennan's analysis sets aside fixed costs. As noted above, consideration of entrant differential fixed costs will strengthen Brennan's results.

While these papers show that bundling can be used for entry deterrence purpose, the normative implications of these entry deterrence models are not clear.[83] The results of entry deterrence models have been shown to be sensitive to the specific assumptions of the model.[84] Moreover, there exist substitutes to bundling as an entry deterrent strategy that would generally not raise antitrust concerns, such as long term contracts, or quantity discounts.[85] Whinston suggests two other reasons that issues of policy be approached with caution. First, the simple models do not consider other motivations for the practice. Moreover, as noted above, the impact on welfare when exclusion does occur is uncertain. This latter effect, coupled with the fact sorting out leverage-based instances of tying from other practical cases would be difficult, would make "specification of a practical legal standard extremely difficult."[86]

V. Limited Competition in *Y*, Competition in *X*

There has been little work on extending the results of the models reviewed in Sections I-IV to the case of oligopoly in the good produced by the monopolist. One exception is Chen, who extends the model to consider bundling in a market where there is a duopoly in the production of *Y* and competition in the production of *X*.[87] Chen assumes that in the absence of bundling, the firms will engage in Bertrand competition in the duopoly market *Y*, and *X* will be produced by other firms in a competitive market. Thus, both products are priced at marginal cost in the absence of bundling.

When a precommitment to bundling is allowed, the firms will use bundling to differentiate their products. Specifically, Chen shows that a strategy where one firm sells a pure bundle while the other firm sells only *Y* is an equilibrium. The single product producer of *Y* attracts those demanders who have a relatively low valuation of *X*, while the producer of the bundle is attractive to those who have relatively high values of both products. Those with low values of *Y* and high values of *X* purchase *X* from the competitive market. In equilibrium, the stand alone price of *Y* is above the marginal cost of *Y*, and the bundle price is greater than the sum of the marginal cost of producing both *X* and *Y*. Thus, the firm selling the stand alone product makes higher profits than the firm selling the bundle, as the bundle producer must always compete with the combination of

[83] See generally, C. C. von Weizsacker, *A Welfare Analysis of Barriers to Entry,* 11 THE BELL J. ECON. 399 (1980), Harold Demsetz, *Barriers to Entry,* 72 AM. ECON. REV. 47 (1982) (discussing welfare based standards for evaluating barriers to entry).
[84] *See, e.g.*, David Malueg and Marius Schwartz, *Preemptive Investment, Toehold Entry, and the Mimicking Principle*, 22 RAND J. ECON. 1 (1991) showing, in a different context, that the entry deterrence results of specific models can be weakened if the assumption of a single entrant is relaxed, or if the model is extended past two periods.
[85] See P. Aghion & Patrick Bolton, *Contracts as a Barrier to Entry*, 77 AM. ECON. REV. 388 (1987), T. Randolph Beard, George S. Ford, &Lawerence J. Spiwak, *Quantity Discount Contracts as a Barrier to Entry,* PHOENIX WORKING PAPER (2004).
[86] Whinston, *supra* note 78.
[87] Yongmin Chen, *Equilibrium Product Bundling,* 70 J. BUS. 85 (1997).

the stand alone *Y* good and the competitively produced *X*.[88] Because prices were assumed to equal marginal cost without bundling, welfare unambiguously decreases as a result of bundling.

VI. Limited Competition in both *Y* and *X*

Recent analyses of bundling with limited competition in both goods have focused on the case where firms are duopolists in both *X* and *Y*. In these duopoly models, the goods *X* and *Y* are assumed to be perfect complements – that is, no consumer consumes a unit of *X* without also consuming a unit of *Y*.

Economides models competition between duopolists in the provision of complementary goods.[89] Consumers demand only the composite good (consuming the individual component products yields no benefit), and they have different preference regarding the four possible combinations, two pure combinations, (X_1,Y_1), (X_2, Y_2), and two hybrid combinations (X_1,Y_2) and (X_2, Y_1).[90] In the model, both firms produce both component products, but each firm must decide in the first period whether or not to offer a discounted bundle in addition to the individual products. Given the decision by the firms to offer the bundle discount or not, the firm set prices in period 2. In the model, mixed bundling is a dominant strategy over non-bundling by firms. However, when the composite goods are not close substitutes, he shows that bundling takes on the characteristics of a prisoner's dilemma, as both firms profits are lower than in the no bundling equilibrium.

In contrast to the Economides results, Anderson and Leruth have a model that shows pure components competition will emerge from duopoly competition.[91] Kopalee, et al. provide a useful reconciliation of these divergent results based on demand conditions.[92]

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[88] There will be multiple equilibria. One in which firm one produces the single product and firm 2 produces the bundle, one where firm 2 produces the single product and firm one produces the bundle, and a mixed strategy. Both firms would prefer to be the single product producer. How the firm solve the coordination problem is not addressed in the paper.

[89] Nicholas Economides, *Mixed Bundling in Duopoly,* NYU STERN SCHOOL OF BUSINESS WORKING PAPER EC 93-29 (1993).

[90] An example of perfect complements would be a computer system that requires both the hardware and an operating system to function.

[91] Simon P. Anderson & Luc Leruth, *Why Firms May Prefer Not to Price Discriminate via Mixed Bundling,* 11 INT'L J. IND. ORG. 49 (1993)

[92] Praveen Kopalle, Aradhna Krishna, & Joao L. Assuncao, *The Role of Market Expansion in Equilibrium Bundling Strategies,* 20 MANAGERIAL & DEC. ECON. 365 (1999). Other related papers include Jeffrey Church & Neil Gandal, *Systems Competition, Vertical Merger, and Foreclosure,* 9 J. ECON. MANAGEMENT. STRATEGY 25 (2000) and Richard J. Gilbert & Michael Riordan, *Product Improvement and Technological Tying in a Winner Take-All Market,* mimeo, University of California, Berkeley (2005) (analyzing compatibility and technological tying).

Nalebuff extends the two good duopoly analysis with complementary products to an multi-good setting.[93] He shows that the prisoners' dilemma characterization disappears as the scope of the bundle increases beyond 2 goods. Rather, the asymmetric equilibria where one firm bundles and the other firm sells the components can be an equilibrium, as the firm selling the components would not benefit from producing a competing bundle, which would result in even lower profits.

Matutes and Regibeau also examine mixed bundling in a duopoly setting where competing two good dupolists choose whether to make their goods compatible with their rivals.[94] In a prior paper, they examined the compatibility choice, but did not allow the duopolists to offer a bundle discount.[95] When bundling is allowed, Matutes and Regibeau show that the competing dupolists have strong incentives to produce compatible components. Similar results were found by Economedies for the n-good case.[96] Thus, in these models, the pure components strategy is preferred to producing incompatible components, which is equivalent to choosing a pure bundling strategy.

The preference for the pure components strategy comes from two effects. First, use of the pure components strategy increases industry demand by increasing the varieties available. Second, firms' price cutting incentives are lower with compatibility. A price cut in good *X* will cause an increase in the demand for *X* and will also increase the demand for the complementary good *Y*. Under a pure bundling strategy, the price cut will be fully internalized, as all of the additional sales of *Y*, *ceteris paribus*, will be made by the firm that cut price. However, in a world of compatibility, some of the additional sales of *Y* will go to the other firm. This tempers the relative incentive to cut price.

When the duopolists are allowed to engage in mixed bundling, the nature of the equilibrium changes. For low consumer reservation values, both firms may choose to engage in mixed bundling given the firms' prior choice to make compatible components. The added incentive to lower the bundle price follows from the price cutting firm's ability to internalize all of the additional sales. As was the case in the Economides paper, the bundling decision under these circumstances has the structure of a prisoners' dilemma game. Intuitively, if one of the firms chooses to bundle while the other does not, the bundling firm will choose to decrease the bundle price and increase the individual prices relative to the pure components equilibrium. Moreover, increasing the individual prices causes the non bundling firm to lower the prices of its components. Thus, the bundling firm is better off, and the non bundling firm is worse off. These incentives cause both to firms to engage in mixed bundling. Under this equilibrium profits fall. Anticipating

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[93] Barry Nalebuff, *Competing Against Bundles,* in PETER HAMMOND & GARETH MYLES, EDS., INCENTIVES, ORGANIZATION, AND PUBLIC ECONOMICS, (Oxford U. Press 2000).
[94] Carmen Matutes & Pierre Regibeau, *Compatibility and Bundling of Complementary Goods in a Duopoly,* 40 J. INDUS. ECON. 37 (1992).
[95] Carmen Matutes & Pierre Regibeau, *Mix and Match Product Compatibility Without Network Externalities,* 19 RAND J. ECON. 221 (1988).
[96] Nicholas Economides, *Desirability of Compatibility in the Absence of Network Externalities,* 79 AM. ECON. REV. 1165 (1989).

these circumstances, the dupolists may choose to produce non-compatible components, as the pure bundling outcome will be preferred to the competition with mixed bundles that will occur if compatibility was chosen.

For moderate values, mixed bundling by one firm and pure components by the other is an equilibrium for a wide range of moderate consumer reservation values. For high or low consumer reservation values the equilibrium will have both firms selling pure components.[97]

Variants of the entry deterrence model in this structural setting have been examined in several articles. Choi & Stefanadis model a setting where *X* and *Y* are perfect complements, so they only have value when consumed together.[98] In their model, successful entry into either market is an increasing function of the level of R&D expenditures. In such a setting, pure bundling makes one-level entry useless. To see the basic result, consider the following simplified example where R&D is either a success, or not.[99] Let $p_X(e_X)$ and $p_Y(e_Y)$ denote the probability of success given expenditures e_X and e_Y, and let π_X and π_Y denote the level of profits when one level entry is achieved in the absence of bundling. Because successful entry requires success in both product markets, the entrant's expected profits are reduced by $(1-p_X)p_Y \pi_Y + p_X(1-p_Y) \pi_X$ for any given level of expenditures e_X and e_Y.

If the probability of entry is exogenous, bundling would not be used in this context. The marginal effect of bundling would be to block entry of innovators who would have chosen to enter with a single product in the absence of bundling. The existence of a lower cost entrant in a single product market would increase the profits of the monopolist, as the monoplist would be able to extract some of the added surplus generated by the existence of a more efficient producer of the complementary good. Given this, bundling would not be used by a monopolist in this case. However, bundling also serves to suppress incentives of potential entrants to invest in R&D generally. As a result, the probability of all types of entry are decreased, including entry into both markets. The Choi and Stefanadis result, like the Whinston results presented in Section IV.A, also relies on precommittment, as the monopolist would want to unbundle in the face of entry.

These same authors present a model that allows multiple sequential entrants.[100] In the basic model, entrants make sequential attempts to enter both the *X* and *Y* markets. In

[97] Choi, *supra* note 6, examines mergers in the context of a duopoly model. The effect of a merger is to allow (or lower the cost of) bundling. The welfare consequences of allowing the merger is identical to the welfare consequences of allowing bundling that are reviewed in this section.
[98] Jay P. Choi & Christodoulos Stefanadis, *Tying, Investment, and the Dynamic Leverage Theory,* 32 RAND J. ECON. 52 (2001).
[99] The more general case would allow two level entry when the entrant's bundle has lower total costs than the incumbent's bundle.
[100] Jay P. Choi & Christodoulos Stefanadis, *Bundling, Entry Deterrence, and Specialist Innovators,* mimeo (2003).

this model, the probability of entry is exogenous, so bundling would not be used to deter entry. However, in the face of multiple entrants, the inability of entrants to enter with single products lowers the probability that consumers will be able to assemble a competing bundle. In the absence of bundling, if viable single product entry can occur in products *X* and *Y* in periods *t* and *t+k* respectively, this will allow consumers to assemble a competing bundle in periods *t+k* and beyond. However, with bundling, single product entry in period *t* will not occur. If entry with *X* does not occur at time *t*, the authors assume that this technology is lost. Thus, if viable single product entry with *Y* occurs in *t+k*, the absence of entry at time *t* results in the absence of a complementary product *X*, and prevents consumers from assembling a competing bundle. Thus, bundling interferes with temporal coordination, and reduces the probability a competing bundle will exist.

Carlton and Waldman also have a model of entry deterrence in which pure bundling interferes with the temporal ability to enter with both products.[101] In their model, an entrant is considering sequential entry into *X* and then into *Y*. The model considers the case where the entrant may enter with a lower cost technology. If the lower cost entrant only enters with *X*, industry profits would rise, and the monopolist would be better off. Under these circumstances, pure bundling would not be used to deter entry. However, Carlton and Waldman show that pure bundling may be used if the entrant may also later enter with a competing *Y* product. By preventing entry into *X*, bundling reduces the present value of the total sequential entry strategy. If this reduction in profits is large enough, the deterrence of entry into *X* may be sufficient to prevent future entry into *Y*. Once again, the Carlton and Waldman result requires that the initial monopolist commits to bundle, as they would choose to cease bundling if entry actually occurred.[102]

Finally, Gans and King use a similar model to examine the use of bundled discounts with unrelated products.[103] In the model, firms can offer bundled discounts that are a fixed amount off the individually priced goods. If the component goods in the bundle are sold by independent firms, the stand alone prices are independently set. In

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[101] Carlton & Waldman, *supra* note 68. *See also* Patrick DeGraba and Rafi Mohammed, *Intertemporal Mixed Bundling and Buying Frenzies,* 30 RAND J. ECON. 697 (1999) (presenting dynamic model of mixed bundling).

[102] Carlton and Waldman have a separate paper that examines the use of tying in the presence of anticipated product upgrades and consumer switching costs. *See* Dennis W. Carlton & Michael Waldman, *Tying, Upgrades, and Switching Costs in Durable-Goods Markets,* mimeo, University of Chicago (2005). The existence of these effects also create dynamic incentives for entry deterrence that are not present in static models While their results shows that tying can be used to deter entry, they suggest that "a very cautions approach" to antitrust liability be taken based on such dynamic models. Dennis W. Carlton & Michael Waldman, *How Economics Can Improve Antitrust Doctrine Towards Tie-In Sales,* 1 COMP. POLICY INT'L 27 (2005).

[103] Joshua S. Gans and Stephen P. King, *Paying for Loyalty: Product Bundling in Oligopoly,* mimeo, University of Melbourne (2004). For an analysis of antitrust and loyalty discounts, *see* Patrick Greenlee & David Reitman, *Distinguishing Competitive and Exclusionary Uses of Loyalty Discounts,* mimeo, U.S. Department of Justice (2005), *Competing with Loyalty Discounts,* mimeo, U.S. Department of Justice (2005), Bruce H. Kobayashi, *The Economics of Loyalty Discounts and Antitrust Law in the United States,* 1 COMP. POLICY INT. 115 (2005).

this setting, bundled discounts increase the profits of the bundling firms and reduce the profits of the non-bundling firms. However, if there is bundle versus bundle competition, profits of the firms are not higher than in the non-bundling equilibrium. Moreover, social welfare falls in the all bundling equilibrium, as some consumers now consume an inferior mix of component goods through the bundle.

VII. Competitive Markets and Bundles

Even though bundling is ubiquitous in competitive markets, the economics literature has paid the least attention to this aspect of the problem. One exception is Craswell, who examined tying in competitive markets as a way to control product quality.[104] Another exception is Evans and Salinger, who examine the choice of bundling in markets where competition results in the market price equal to average cost.[105] Evans and Salinger's analysis attempts to abstract from both the price discrimination and strategic considerations to examine cost based reasons why firms would choose to bundle or tie. In their model, firms can choose to produce the component goods, a bundle of the component goods, or any combination. Both goods and the bundle are produced with constant marginal costs c_i and a recurring fixed cost F_i. Because of the economies of scale in production, all markets are characterized by conditions of natural monopoly, and only one firm produces in equilibrium. Thus, competition in the context of this model means free entry, and the zero profit condition must be enforced via contestability.

By examining a setting in which markets are contestable, Evans and Salinger rule out by assumption strategic motives for bundling based on entry deterrence. This allows them to focus on cost as the primary determinant of bundling. In the model, they allow for two types of costs savings: marginal cost savings ($c_B \leq c_Y + c_X$) and fixed cost savings ($F_B \leq F_Y + F_X$). Evans and Salinger illustrate, through examples, how fixed and per unit cost savings induce bundling or tying. They show that high fixed costs, or moderate fixed costs with limited demand for one or more of the components can generate pure bundling in equilibrium.

In their base example, there are three types of consumers, those who prefer to consume only *X*, those who prefer to consume only *Y*, and those who demand both *X* and *Y*. For simplicity, these demands are assumed to be inelastic. The base case has equivalent numbers of each of three types of consumers, i.e., $q_X = q_Y = q_B = q$. Under these conditions, bundling in such a market will not occur when there are no fixed cost or variable cost savings from bundling. Under the pure components strategy, the price of good i equals $MC + F/2q$, and the implicit price of the bundle = $2MC + F/q$. If we let $q = 100$, and $F = 600$, and $MC = 8$, then the pure components price equals 11. If a firm

[104] Richard Craswell, *Tying Requirements in Competitive Markets: The Consumer Protection Aspects,* 62 BOS. U. L. REV. 661 (1982). *See also,* Gary D. Eppen, Ward A. Hanson, & R. Kipp Martin, *Bundling-New Products, New Markets, Low Risks,* 32 SLOAN MGMT. REV. 7 (1991).

[105] *See* Evans & Salinger, *supra* note 1, David S. Evans and Michael Salinger, *An Empirical Analysis of Bundling and Tying: Over the Counter Pain Relief and Cold Medicines,* CESIFO WORKING PAPER NO. 1297 (2004).

engages in mixed bundling, the separate products are priced at $MC + F/q$ (14 under the numerical assumptions), and the bundle is priced at $2(MC + F/q)$ (at 28). This strategy is dominated by the pure components strategy, as both of the individual goods and the bundle assembled by the consumer will be cheaper than the offerings of the mixed bundle. Intuitively, the mixed bundle requires that the seller incur an additional fixed cost equal to $2F$. Under the pure bundling strategy, the price of the bundle equals $2MC + 2F/3q$ (equal to 20 under the numerical assumptions). The pure bundling strategy will be undercut by single product entrants at $MC + F/q = 14$. Thus, these conditions will not lead to either mixed or pure bundling.

Pure bundling will emerge if fixed costs are high enough. Specifically, if fixed costs are greater than three times the total variable costs of producing a stand alone product ($F > 3MC*q$), then pure bundling will be sustainable. To see this, let $F = 3000$. The pure components strategy will still dominate the mixed bundle. However, the pure bundle is sustainable. The pure bundle will be priced at 36. A single product entrant could charge no lower than 38. Moreover, the pure components price of 23 which requires sales to both the stand alone and bundle customer, would not be strictly preferred by the bundling customers, and thus would not threaten sustainability of the pure bundle.

Fixed cost savings associated with bundling increases the likelihood of pure bundling in such a market, as bundling allows the savings of these fixed costs. Intuitively, when fixed costs are high, the fact that the bundle spreads these costs over a larger base results in lower average total costs. As F increases, the fixed costs savings associated with producing the bundle will outweigh the additional marginal costs of producing the additional bundled goods. To see this, suppose that the recurring fixed cost of producing the bundle equals F rather than $2F$. Under these conditions, the pure bundle will be sustainable when $F > 1.5*MC*q$. With $F = 1200$, the price of the pure bundle equals $2MC + F/3q = 20$, and the price of the mixed bundle equals $2MC + F/q = 28$, and the stand alone prices would equal $MC + F/q = 20$. The pure components price equals 14. The mixed bundle once again would not defeat the pure components strategy, as neither the individual demanders nor the bundle demanders would strictly prefer the offerings in the mixed bundle. However, the pure bundle at 20 would not be under cut by single product entry. Moreover, the pure components strategy would not be able to attract the bundle demanders, and would not be sustainable at 14.

Mixed bundling can be induced by a combination of fixed and marginal cost savings. For example, suppose that the unit costs of producing a stand alone good equals 8, but the unit cost of producing a bundle equals 14. Also, suppose that the fixed costs of producing the bundle equals $F = 600$. The pure components price equals 11, and the pure bundle price equals 16. The mixed bundle prices equal 20 for the bundle, and 14 for the individual components. It is easy to see that the pure bundle at 16 will induce stand alone entry at 14 and is not sustainable. Further, the pure components prices at 11 will induce bundled entry at 20, and are not sustainable. However, the mixed bundle prices are sustainable.

Bundling can also be induced by moderate fixed cost and low demand for the stand alone products. For example, suppose that the base case is changed so that the demand for each stand alone product was only 5 instead of 100. In this case, the pure components price would equal 13.7, the pure bundle price would equal 26.9, and the mixed bundle prices would be 28 for the bundle, and 128 for the stand alone goods. Under these conditions, the pure bundle is sustainable against stand alone entry and the pure components strategy would not induce the defection of the bundle customers. The pure component strategy is also sustainable. However, the sustainability of the pure components strategy can be destroyed by small bundle fixed cost savings.

Evans and Salinger apply this model to several settings. The first is the bundling of acetaminophen (an analgesic that is the active ingredient in Tylenol) and pseudoephedrine hydrochloride (a decongestant, and the active ingredient in Sudafed). Evans and Salinger note that there are 145 and 155 firms that produce products containing the respective compounds. They also note that for the CVS pharmacy private label products, acetaminophen costs 2.99 per 24 tablets, and pseudoephedrine hydrochloride costs 3.49 for 24 tablets. Thus purchasing both separately would cost 6.48. CVS also sells a 24 tablet bundle that contains the same dosage of both ingredients for 3.99. The incremental price for pseudoephedrine hydrochloride in the bundle is 50 cents. A similar price pattern is observed for the branded versions of the separate and bundled products.

The difficult task is to make strong inferences regarding the level of cost savings. In the case of cold remedies, assuming the implausibility of price discrimination or leveraging as an explanation for the observed mixed bundling, cost savings are the likely residual explanation. However, the exact size and nature of these savings are not observable.

VIII. Empirical Examinations of Bundling

Empirical studies of bundling have concentrated on bundling in regulatory contexts. Because of the coarse nature of the regulations, these studies have examined pure bundling. For example, industry level regulations can cause de facto ties by preventing non-vertically integrated sellers from providing downstream services. Haas-Wilson examined the effect of state restrictions on the fitting of contact lenses by opticians via regression analysis.[106] The effect of these restrictions is to prevent opticians from independently fitting consumers with contact lenses, resulting in a de facto tie between the sale of contact lenses and eye examinations. Hass-Wilson found that these state level restrictions increased the price of contact lenses 8%, but had negligible effect of the quality of the services.

[106] Deborah Haas-Wilson, *Tying Requirements in Markets with Many Sellers: The Contact Lens Industry,* 69 REV. ECON. & STAT. 170 (1987).

A second set of regulatory decisions that have allowed a comparison of market outcomes with and without bundling are regulations that require firms that currently sell bundled output to unbundle the package. Examples include empirical examinations of mandatory unbundling in the telecommunications industry. Hausman and Sidak examine mandatory unbundling in the telecommunications industry, and provide a useful review of the regulatory unbundling literature and an empirical examination of the effect of such regulations in five countries.[107] In this setting, mandatory unbundling takes the form of mandated or involuntary access to the facilities of a firm at a regulated price. They focus on examining whether mandatory unbundling achieved the following goals: (1) promotion of competition in the form of lower prices and greater innovation in retail markets, which is assumed not to be feasible absent mandatory unbundling; (2) promotion of future facilities based entry; and (4) promotion of competition in wholesale access markets. Hausman and Sidak did not find any empirical evidence that mandatory unbundling achieved any of the stated goals. They found that retail prices did not fall after mandatory unbundling, not did they find evidence that unbundling increased facilities based entry.

In theory, antitrust actions that resulted in the abandonment or modification of previously used bundling strategies would provide a similar opportunity to study empirically the effects of bundling. Such studies would provide valuable information to courts and policy makers considering the promulgation of antitrust standards for bundling. However, such detailed studies generally have not been done to date.[108]

In addition to the examination of the effects of regulation, several papers have examined the how consumers perceive of bundling discounts. That is, rather than examine the issue of whether or not bundling should be used as a strategic device by the seller, these papers examine how bundled offers should be presented to consumers. These papers examine the pricing of the bundle vis-à-vis individual components, and the question of which products to include in the bundle.[109] Kridel and Taylor examine the optimal pricing problem by estimating the demand for custom calling services (call waiting and call forwarding) that are offered separately and as part of a bundled

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[107] Jerry A. Hausman & J. Gregory Sidak, *Did Mandatory Unbundling Achieve its Purpose? Empirical Evidence from Five Countries,* 1 J. COMP. L. & ECON. 173 (2005).

[108] See generally, Paul A. Pautler and Robert P. O'Quinn, *Recent Empirical Evidence on Mergers and Acquisitions,* 38 ANTITR. BULL. 741 (1993) (survey of the empirical antitrust literature).

[109] These papers include Manjit S. Yadev, *How Buyers Evaluate Product Bundles: A Model of Anchoring and Adjustment,* 21 J. CONS. RES. 342 (1994), Manjit S. Yadev and Kent B. Monroe, *How Buyers Perceive Savings in a Bundle Price: An Examination of a Bundle's Transaction Value,* 30 J. MKT'G RES. 350 (1993), and R. Venkatesh and Vijay Mahajan, *A Probabilistic Approach to Pricing a Bundle of Products or Services,* 30 J. MKT'G RES. 494 (1993), *Products with Branded Components: An Approach for Premium Pricing and Partner Selection,* 16 MKT'G SCI. 146 (1997), Dilip Soman & John T. Gourville, *Transaction Decoupling: How Price Bundling Affects the Decision to Consume,* 38 J. MKT'G RESOURCES 30 (2001), B. A. Harlam, A. Krishna, D. R. Lehmann, & C. Mela, *Impact of Bundle Type, Price Framing, and Familiarity on Purchase Intention for the Bundle,* 33 J. BUS. RES. 57 (1995), Michael D. Johnson, Andreas Herrmann, & Hans H. Bauer, *The Effects of Price Bundling on Consumer Evaluations of Product Offerings,* 16 INT. J. RES. IN MKT'G. 129 (1999).

discount.[110] Given their estimates of demand elasticities, they find that prices are set far from the optimum, and that profit maximizing prices would require increasing the stand alone prices and increasing the bundle discount.

IX. Conclusion.

While this survey has found many recent advances in the economic analysis of bundling, several primary omissions reveal themselves. First, these advances have largely been on the theoretical side. Second, the vast majority of the theoretical analyses of bundling contain restrictive assumptions regarding the degree of competition, the way in which the firms interact. Third, there has been little effort at trying to integrate incentives to bundle based on strategic considerations with cost or efficiency based reasons for bundling. And last, but not least, scant attention has been paid toward generating testable hypotheses and carrying out empirical tests of the theories and their underlying assumptions. In all, a review of the economic literature supports the SG's position with respect to delaying the promulgation of antitrust standards for bundling.

How much patience we will have is another issue. The hope is that academics will be spurred to fill the gaps in our theoretical and especially our empirical knowledge of bundling. However, the resolution of our knowledge gap may not be forthcoming anytime soon. The general criticisms of the bundling literature are neither new nor limited to the economic analysis of bundling. Indeed, similar criticisms have been directed toward the theoretical literature on industrial organization[111] and antitrust generally.[112] In many of these areas, progress has been slow, and little evidence exists that courts in will wait to adopt new antitrust standards.[113] The likely outcome of such a process will be the adoption of antitrust rules that do not distinguish between anticompetitive and procompetitive bundling,[114] and the persistence in differing and inconsistent approaches to the application of the antitrust laws to bundling both domestically and internationally.[115]

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[110] Donald J. Kridel & Lester D. Taylor, *The Demand for Commodity Packages: The Case of Telephone Custom Calling Features,* 75 REV. ECON. & STAT. 362 (1993).

[111] See, e.g., Timothy J. Muris, *Economics and Antitrust*, 5 GEO. MASON L. REV. 303 (1997), Bruce H. Kobayashi, *Game Theory and Antitrust: A Post Mortem*, 5 GEO. MASON L. REV. 411 (1997) (reviewing critiques of the IO literature).

[112] See, e.g., Timothy J. Muris, *The FTC and the Law of Monopolization* 67 ANTITRUST L. J. 693 (2000), (suggesting that history of Section 2 enforcement has seen far too many mistakes); Hovenkamp, *supra* note 10, (noting that notwithstanding a century of litigation, the scope and meaning of exclusionary behavior under the Sherman Act remains poorly defined).

[113] *See, e.g.*, Harold Demsetz, *How Many Cheers for Antitrust's 100 Years?* 30 ECON. INQ. 207 (1992).

[114] See Kobayashi, *supra* note 10.

[115] The area of pricing conduct has been one of the most striking areas of divergence in EU and US antitrust law. While there is a broad consensus that EU law should abandon its in favor of an effects based approach (see e.g., *Selective Price Cuts and Fidelity Rebates,* A Report Prepared for the Office of Fair Trading by RBB Economics, (2005)), it is not clear that the current state of the economic literature will be strong enough to overcome the strong differences in the normative approaches to antitrust law that exist between the U.S. and E.U. *See* James C. Cooper, Luke M. Froeb, Dan O'Brien, & Michael G. Vita, *Vertical Antitrust Policy as a Problem of Inference,* 23 INT. J. INDUS. ORG. 639 (2005).

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Table 1 – Types of Bundling

	X	Y	Bundle (XY)
1. Pure Components	**Available**	**Available**	**Not Available**
2. Mixed Bundling (**MB**)	**Available**	**Available**	**Available**
3. Pure Bundling (**PB**)	**Not Available**	**Not Available**	**Available**
4. Pure Bundling, X available separately. (**PB, X**)	**Available separately**	**Not Available**	**Available**
5. Pure Bundling, Y available separately (**PB, Y**).	**Not Available**	**Available Separately**	**Available**
6. Pure Bundling, X and Y available separately. (**PB, X, Y**)	**Available Separately**	**Available Separately**	**Available**

Table 2 – Degree of Competition in the Two Good Case.

	Monopoly in good x	Limited Competition in x	Competition in good x
Monopoly in good y	II. Cournot (1938, **PB**) Stigler (1964, **PB**) Adams and Yellen (1976, **PB, MB**) Schmalensee (1989, **PB**) Salinger (1995, **PB, E**) MacAfee, et al. (1989, **MB**) Bakos and Brynjolfsson (1999) (**PB**)*	IV. Nalebuff (2004a) (**PB, X**), Whinston (1990) **(PB, X)**,	III. Schmalensee (1982) (**MB, X**), Greenlee, et al., (2004) (**MB, X**), Nalebuff (2004b) (**MB, X**).
Limited competition in y		VI. Economides, Matues and Regibeau (1992) (**MB**, **PC**, duopoly in X and Y), Carlton and Waldman (2002) (**PB, X, Y**), Choi and Stefanadis (2001, 2003) (**PB, X, Y, PC**) Nalebuff (2000) (**MB**, duopoly, multiple goods)	V. Chen (**PB, X, Y,** duopoly in y)
Competition in good y			VII. Evans and Salinger (2005) (**PB, X, Y, E**).

E = Efficiencies from Bundling Allowed
PC = Assumption of Perfect Complements

Figure 1 – No Bundling (Pure Components)

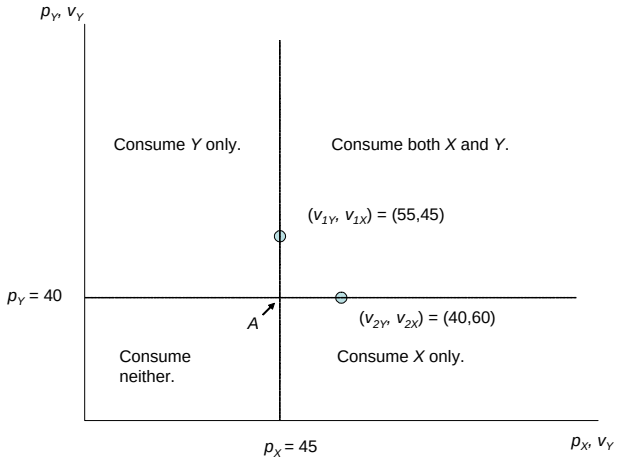

Figure 2 – Pure Bundling

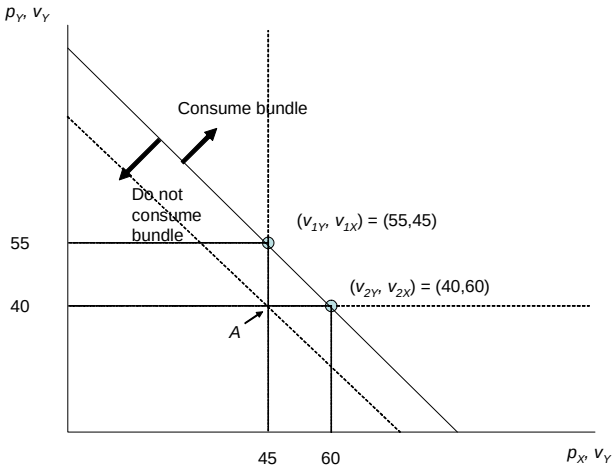

Figure 3 – Pure Bundling with Four Consumers

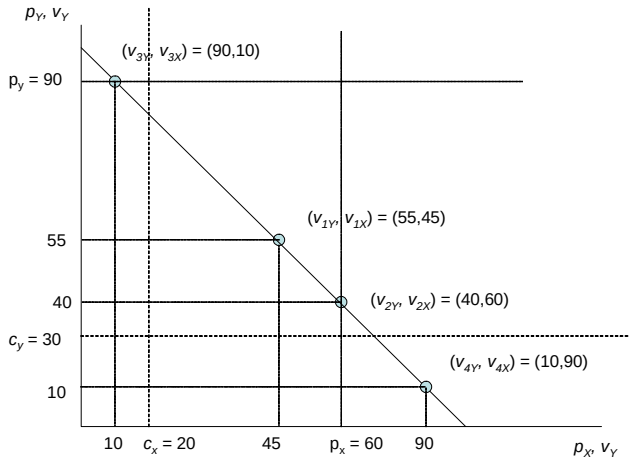

Figure 4 – The Aggregate Components Demand Curve

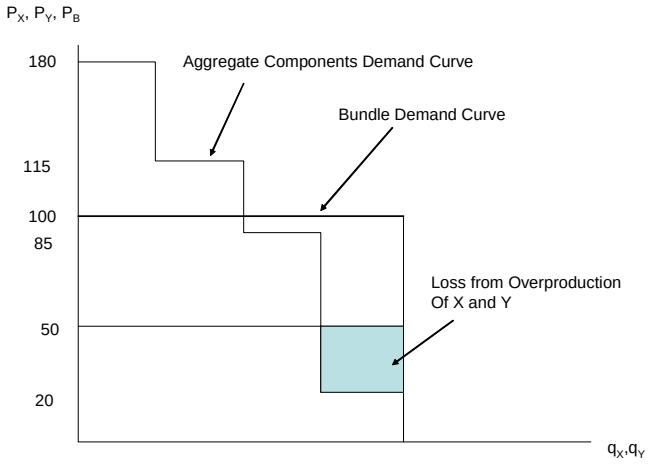

Figure 5 - Mixed Bundling with Four Consumers

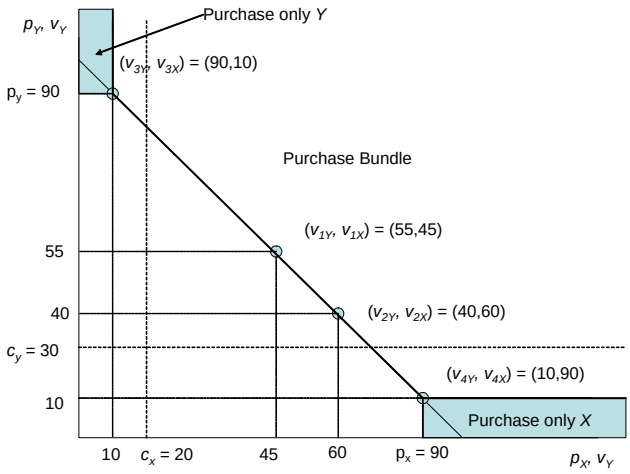

Figure 6 – Pure Bundling by a Y Monopolist with a Competitive X Market.

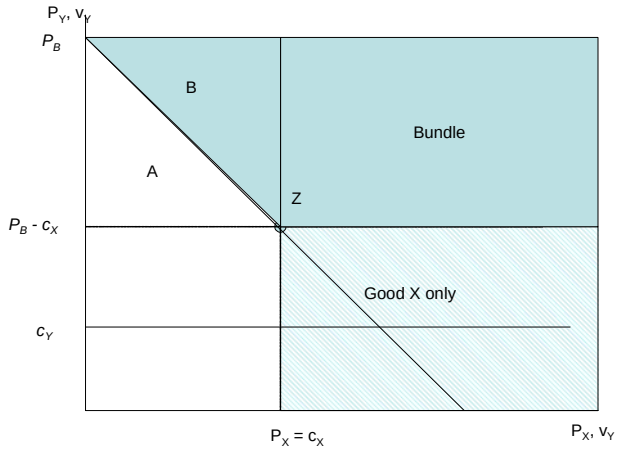

Figure 7 – Mixed Bundling by Y Monopolist with Competitive X Market.

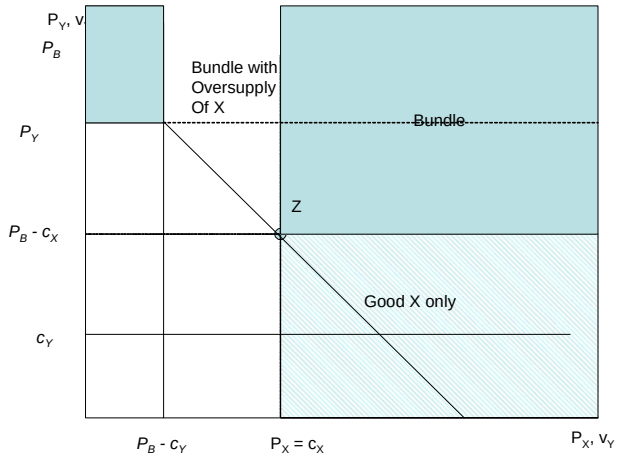

Figure 8 – Pure Bundling and Entry Deterrence