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COMMODITY BUNDLING AND THE BURDEN OF MONOPOLY*

WILLIAM JAMES ADAMS AND JANET L. YELLEN

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I. INTRODUCTION

Firms often sell their goods in packages: sporting and cultural organizations offer season tickets, restaurants provide complete dinners, banks offer checking, safe deposit, and travelers' check services for a single fee, and garment manufacturers sell their retailers clothing grab bags comprised of assorted styles, sizes, and colors. We shall refer to the practice of package selling as commodity bundling. A firm that sells goods only in package form has adopted a *pure* bundling strategy. A firm that sells the same goods separately as well as in packages has adopted a *mixed* bundling strategy.

Commodity bundles sometimes include goods that cannot be sold separately in the market place. For example, an automobile can be interpreted as a package of luxury and transport services. The transport services could be offered without luxury (in the form of a stripped down car), but luxury must be sold in conjunction with motive power. Similarly, aspirin can be sold with or without a well-known brand name, but the brand name cannot be sold alone. In general, firms offering several incarnations of the same product, differing in either real or perceived quality, practice mixed bundling.

Commodity bundling also occurs when firms sell the same physical commodity in different container sizes. For example, toothpaste, detergent, and cereal are sold in small and large packages. In such cases, a bundle consists of multiple units¹ of the same commodity. Offering both sizes constitutes mixed bundling, while offering just the large size constitutes pure bundling.²

Why is commodity bundling such a prevalent marketing strategy? Some observers focus on the cost savings in production, trans-

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1. Whenever a commodity is infinitely divisible, the choice of a "standard unit" is essentially arbitrary.

2. Thus, a telephone company that offers local calling only for a fixed monthly fee is engaged in pure bundling. A telephone company that offers local calling on both a fee for service and a monthly basis is engaged in mixed bundling.

actions, and information associated with package selling.³ Others dwell on the complementarity in consumption of bundle components. We shall demonstrate that commodity bundling can be profitable even when these motivations are absent. In particular, we show that the profitability of commodity bundling can stem from its ability to sort customers into groups with different reservation price characteristics, and hence to extract consumer surplus.⁴ We choose to emphasize this rationale for commodity bundling for several reasons.

First, in the real world firms cannot always resort to conventional forms of price discrimination in order to extract consumer surplus: reservation prices of specific customers are typically unknown; even if they were known, laws like the Robinson-Patman Act might prevent a seller from using them in an overtly discriminatory scheme. Commodity bundling can overcome these two practical problems associated with conventional price discrimination. We demonstrate this in Section II. In some circumstances, bundling is just as profitable as Pigouvian price discrimination of the first degree. In most circumstances, it is more profitable than simple monopoly pricing.⁵

Second, bundling motivated by price discrimination has dis-

3. This is one implication of the transaction cost literature. See, for example, R. Coase, "The Problem of Social Cost," *Journal of Law and Economics*, III (Oct. 1960), 1-44; and H. Demsetz, "The Cost of Transacting," this *Journal*, LXXXII (Feb. 1968), 33-53.

4. This view was first articulated in G. Stigler, "United States v. Loew's Inc.: A Note on Block Booking," in P. Kurland, *The Supreme Court Review: 1963* (Chicago: University of Chicago Press, 1963), 152-57. See also R. Markovits, "Tie-Ins, Reciprocity and Leverage Theory," *Yale Law Journal*, LXXVI (June 1967), 1397-1472. Several recent papers illustrate the relevance of this phenomenon in a variety of institutional and market settings: R. Parks, "The Demand and Supply of Durable Goods and Durability," *American Economic Review*, LXIV (March 1974), 37-55; S. C. Salop, "The Noisy Monopolist: Imperfect Information, Price Dispersion and Price Discrimination," unpublished manuscript, 1973; J. K. Salop and S. C. Salop, "Self-Selection and Turnover in the Labor Market," paper presented to the Econometric Society Meetings, Toronto, 1972; A. M. Spence, *Market Signaling* (Cambridge, Mass.: Harvard University Press, 1974); A. M. Spence, "Time and Communication in Economic and Social Interaction," this *Journal*, LXXXVII (Nov. 1973), 651-60; and J. Stiglitz, "Monopoly and Imperfect Information: the Insurance Market," unpublished manuscript, 1973. Commodity bundling is not the only sophisticated strategy a monopolist can use to enhance profit and complicate welfare judgments. The most similar practices are full-line forcing and all-or-none offers, although conventional price discrimination, the multipart tariff, and product differentiation are all related. See, respectively, M. Burstein, "The Economics of Tie-In Sales," *Review of Economics and Statistics*, XLII (Feb. 1960), 68-73; and R. Markovits, *op. cit.*; R. Baldwin, "Equilibrium in International Trade," this *Journal*, LXII (Nov. 1948), 748-62; E. Clemens, "Price Discrimination and the Multiple Product Firm," *Review of Economic Studies*, XIX (Jan. 1951), 1-11; W. Oi, "A Disneyland Dilemma: Two-Part Tariffs for a Mickey Mouse Monopoly," this *Journal*, LXXXV (Feb. 1971), 77-96; and E. Chamberlin, *The Theory of Monopolistic Competition* (Cambridge, Mass.: Harvard University Press, 1933).

5. Simple monopoly pricing involves setting those prices for each component that maximize profit. In general, the monopolist must take account of any interdependencies among product demand curves in his computation of these prices. This point is developed in M. Bailey, "Price and Output Determination by a Firm Selling Related Products," *American Economic Review*, XLIV (March 1954), 82-93.

tinctive normative consequences. On the one hand, bundling could lead monopolists to oversupply as well as undersupply specific commodities: equilibrium output could fall on *either* side of ideal output. On the other hand, bundling could lead monopolists to sell whatever output is produced to the wrong people, in the sense that potential gains from trade among consumers would exist in equilibrium. Hence the conditions for distributive efficiency as well as those for allocative efficiency might be violated. Neither Pigouvian first-degree price discrimination nor simple monopoly pricing results in either of these problems. These findings are discussed in Section III.

Third, the existence of commodity bundling seriously complicates public appraisal of monopoly, for it impairs the validity of major tools of applied welfare economics, such as consumer-producer surplus analysis and hedonic price indices. Finally, prohibition of bundling in monopolistic markets, without elimination of monopoly, can either increase or decrease the deadweight loss arising in the relevant markets. This reinforces the desirability of a structural, as opposed to conduct, attack on market power. We discuss these implications of commodity bundling in Section IV.

II. THE MODEL: POSITIVE PROPERTIES

Consider a model with the following characteristics. Technology is such that A1 holds.

A1. (Technology) The marginal cost of supplying each good separately (c_1, c_2) is invariant with respect to output, and the marginal cost of supplying the two goods in a bundle is the sum of the component costs ($c_B = c_1 + c_2$). There are no fixed costs.

Tastes are such that for all individuals A2 and A3 hold.

A2. (Indivisibility) The marginal utility of a second unit of either commodity is zero.

A3. (Independence) The reservation price for a package comprised of one unit of each commodity (r_B) is equal to the sum of their separate reservation prices (r_1, r_2).⁶

By assumption, therefore, this model excludes both economies in the bundling process and complementarity in consumption. If bundling is found to be profitable, it cannot be explained by these phenomena.

If the monopolist knows the reservation price of each consumer for each commodity, his profit-maximizing strategy is simply Π -

6. We assume here that any individual would be indifferent between consuming both goods 1 and 2 and a package consisting of these two goods. In other words, a package is identical to the sum of its component parts from the consumer's point of view.

gouvian first-degree price discrimination with respect to each commodity separately. If the monopolist knows only the distribution of reservation prices in the population, however, or if he is legally prevented from engaging in pure price discrimination, then his ideal pricing strategy is more difficult to establish. Three options open to him are as follows.

1. Set the single price on each commodity separately, (p_1^*, p_2^*) , which yields the greatest profits. We call this a pure components strategy, or simple monopoly pricing.

2. Offer the two commodities for sale only in a package comprised of one unit of each at the price p_B^* chosen so as to maximize profits. This is the pure bundling strategy.

3. Combine strategies one and two by offering each commodity separately and a package of both, at a set of prices (p_1^*, p_2^*, p_B^*) , which maximizes overall profits. This is the mixed bundling strategy. Since the value of a bundle to consumers is no greater than the value of its components, mixed bundling is a distinct strategy only if the package is sold at a discount relative to its components.

Each of these strategies is easily represented in diagrammatic form.

The reservation price of each consumer for each commodity can

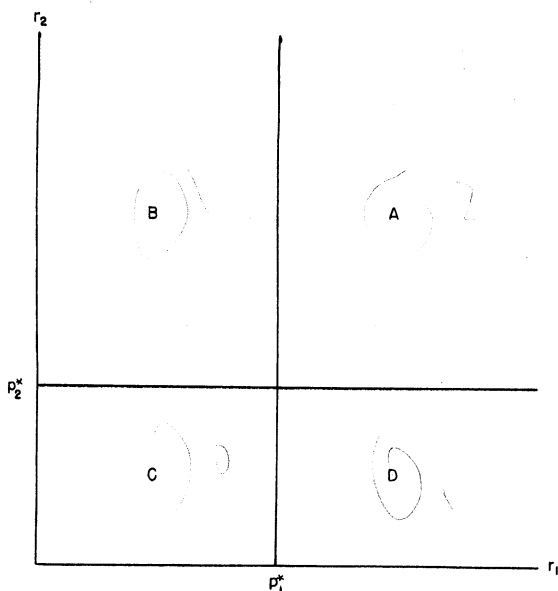


FIGURE I

be represented as a point in Figure I. If the monopolist adopts the pure components strategy, and sets component prices p_1^* and p_2^* (Figure I), the population is sorted into four groups: individuals with reservation prices at least equal to market prices for both commodities (Area A in Figure I), individuals with reservation prices less than market prices for both commodities (Area C), and individuals with reservation price at least equal to market price for one but not the other commodity (Areas B and D). Those in Area A purchase both goods, those in Areas B and D purchase goods 2 and 1, respectively, and individuals in Area C purchase neither good.

If instead the monopolist adopts the pure bundling strategy, the population is sorted into only two groups: those whose reservation price for the bundle ($r_B = r_1 + r_2$) is at least equal to the bundle's market price, and those for whom the opposite is true. In Figure II the

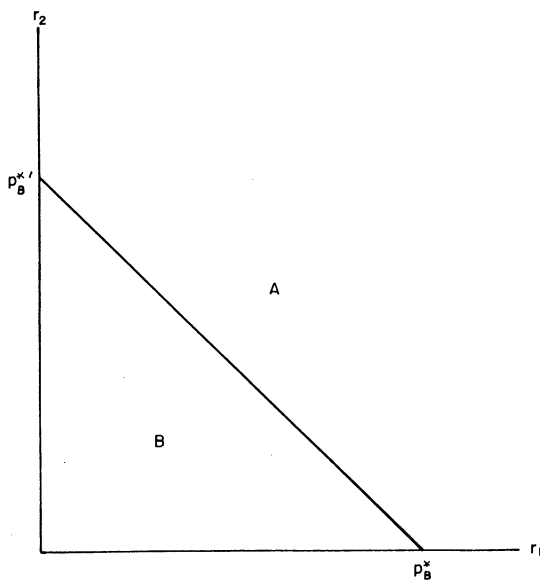


FIGURE II

bundle price appears in reservation price space as a straight line with both intercepts equal to the bundle price p_B^* and hence with a slope of minus one. Those in Area A buy the bundle and hence consume both goods. Those in Area B do not buy the bundle and hence consume neither good.⁷

7. The sorting of consumers depicted in Figure II assumes that resale of components is impossible.

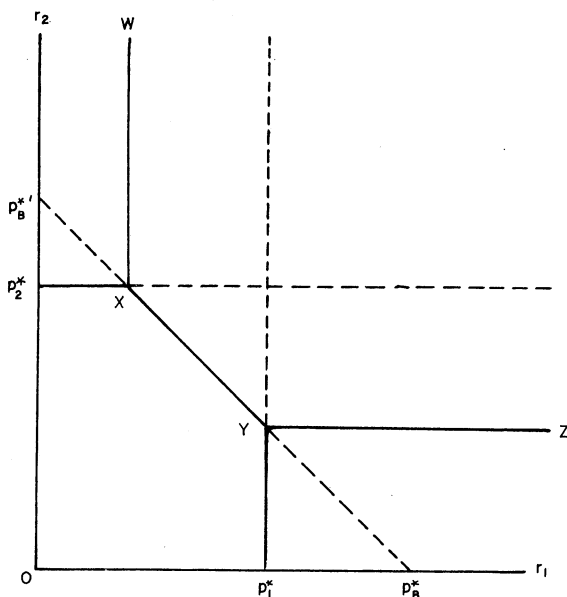


FIGURE III

Finally, if the monopolist adopts the mixed bundling strategy, customers are again sorted into four groups. These appear in Figure III. Individuals in Area $Op_2^*XYp_1^*$ consume nothing. They are characterized by $r_1 \leq p_1^*$, $r_2 \leq p_2^*$, and $r_B \leq p_B^*$. Individuals southeast of p_1^*YZ consume only good 1. They are characterized by $r_1 \geq p_1^*$ and $r_2 \leq p_B^* - p_1^*$. The reason is that $(p_B^* - p_1^*)$ represents the implicit price of good 2 to an individual already prepared to buy good 1.⁸ For similar reasons those northwest of p_2^*XW consume only good 2. They are characterized by $r_2 \geq p_2^*$ and $r_1 \leq (p_B^* - p_1^*)$. The last group comprises those northeast of $WXYZ$, who consume the bundle. They are characterized by $r_1 + r_2 \geq p_B^*$, $r_1 \geq (p_B^* - p_2^*)$, and $r_2 \geq (p_B^* - p_1^*)$. In words, the bundle is consumed by those who not only derive positive consumer surplus from purchase of the bundle but also derive more surplus from the bundle ($r_B - p_B^*$) than they would from purchase of either component separately ($r_i - p_i^*$, $i = 1, 2$).

The profit-maximizing monopolist chooses among these sorting mechanisms by calculating the most remunerative configuration of prices under each strategy and then by comparing the resulting profits. The relative profitability of the three strategies depends on

8. Note that $p_1^*p_B^*$ must equal p_1^*Y , since the slope of $p_B^*p_B^*$ is -1 .

the distribution of consumers in reservation price space and the structure of costs. Each conceivable ranking of the three is in fact possible.⁹ The reason is that each strategy has both strengths and weaknesses vis à vis its rivals.

In order to assess the virtues and defects of each strategy, a benchmark is required. Since pure price discrimination is known to be the most remunerative pricing strategy available to a firm, it provides a benchmark for appraising the profitability of other pricing schemes. In the context of our model pure price discrimination satisfies three conditions:

C1. (Complete Extraction) No individual realizes any consumer surplus on his purchases.

C2. (Exclusion) No individual consumes a good if the cost of that good exceeds his reservation price for it.

C3. (Inclusion) Any individual whose reservation prices for a good exceeds its cost in fact consumes that good.

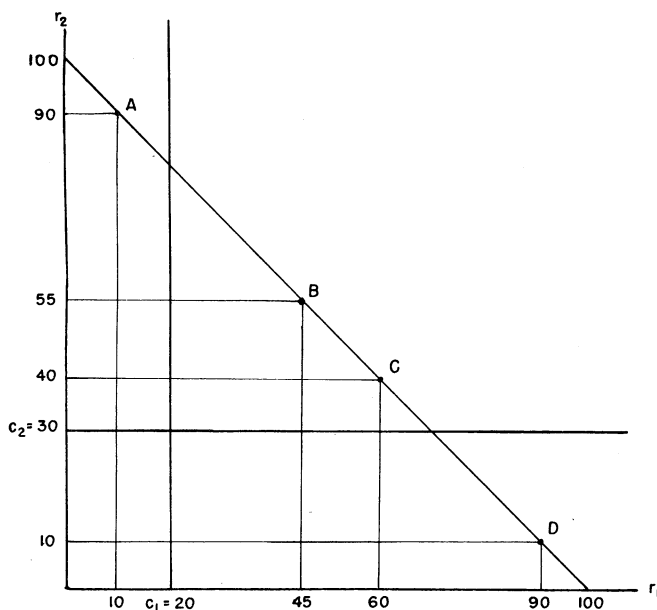
To what extent does simple monopoly pricing, or bundling in some form, also satisfy these conditions?

The pure components strategy never violates Exclusion because within the framework of our model prices in component markets are never set below cost.¹⁰ As we show below, this virtue of simple monopoly pricing is not shared by its bundling rivals. On the other hand, the pure components strategy violates Extraction or Inclusion as long as customers are distributed in reservation price space such that the monopolist faces downward-sloping demand curves in both component markets: the finite elasticity of demand curves implies that monopolists cannot extract all consumer surplus on a particular good without preventing some individuals with valuation in excess of cost from consuming it. This violates Inclusion.

If the bundle demand curve is extremely elastic while the component demand curves are not, pure bundling avoids excessive violation of Inclusion and Extraction. This proposition is illustrated in Figure IV. The four consumers—*A*, *B*, *C*, and *D*—are distributed in reservation price space along a straight line with slope minus one. The value of the bundle is the same to all customers so that the bundle demand curve is perfectly elastic. The relative value of the components differs among customers, however, so that each component demand curve is downward-sloping. If the monopolist knows the

9. An appendix to this effect is available upon request from the authors.

10. This follows from assumption A3. If an individual's reservation price for one good depends on the amount of the other he consumes, the profit-maximizing pure components strategy might involve violation of Exclusion. The loss leader is a classic case of this proposition.



	p_1^*	p_2^*	p_B^*	Profits
Pure Components Strategy	60	90	—	140
Pure Bundling Strategy	—	—	100	200
Mixed Bundling Strategy	90	90	100	230

FIGURE IV

common valuation of the bundle by his customers, he can satisfy the extraction and inclusion requirements simultaneously by charging each customer a price equal to that amount for the bundle.¹¹

The chief defect of pure bundling is its difficulty in complying with Exclusion. The greater the cost of supplying either good, the greater the possibility of supplying some individuals with commodities for which reservation price falls short of cost. In Figure IV, A and D are individuals with $r_i < c_i$ for some commodity. Thus, pure bundling

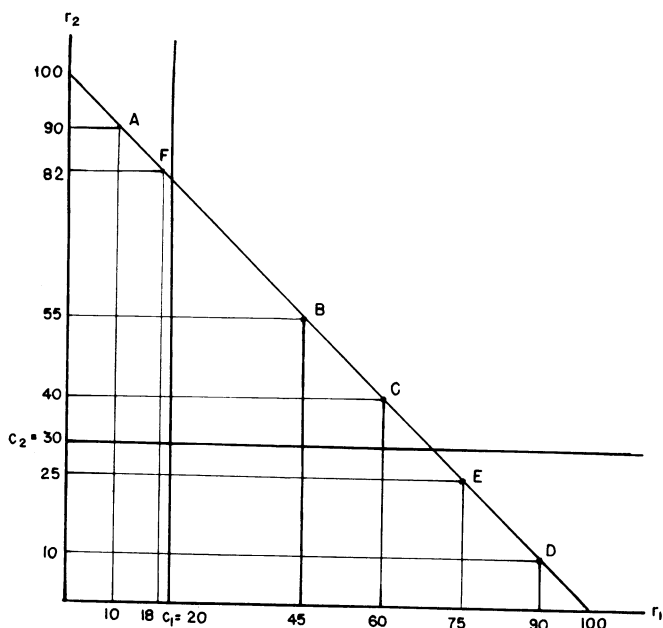
11. The pure bundling strategy is analytically equivalent to an all-or-none offer. In both cases a package of commodities is offered to the consumer on a "take it or leave it" basis.

is preferred to simple monopoly pricing only if the greater profits accruing from more complete extraction or inclusion are not outweighed by the lower profits due to less complete exclusion. The more negligible are costs relative to reservation prices, the less of a problem this poses for pure bundling.

The mixed bundling strategy is more profitable than its pure counterpart whenever Exclusion is violated in the pure bundling equilibrium. The reason is that creation of separate component markets adds two categories into which the monopolist can sort his customers. In Figure IV, for example, he can charge prices $p_1^* = 90$ and $p_2^* = 90$ in the component markets, thereby inducing individuals *A* and *D* to cease consuming the good they value below cost but continue consuming the good they value above cost. In general, *whenever the exclusion requirement is violated in a pure bundling equilibrium, mixed bundling is necessarily preferred to pure bundling.*¹² That mixed bundling satisfies Exclusion more completely than does pure bundling, however, does not mean that mixed bundling avoids the problem altogether. Rarely does a monopolist find it profitable to exclude every individual whose reservation price for a good falls short of its cost. The reason is apparent in Figure V, which is identical to Figure IV except for the presence of consumers *E* and *F*. Mixed bundling is still the most profitable strategy, but Exclusion is unfulfilled in the cases of *E* and *F*. To exclude them from the bundle market proves too costly in terms of consumer surplus foregone on *A* and *D*. Another way of putting this is that the component demand curves are downward-sloping and hence successive price reductions on a given component usually reduce total revenue in that component market. Like pure bundlers, therefore, mixed bundlers face a trade-off between more complete extraction and more complete exclusion. The dilemma is simply less pronounced in the case of mixed bundling.

If customers are distributed in reservation price space such that people with high reservation prices for the package exhibit small variance in their valuations of the components, and vice versa, then mixed bundling has another virtue relative to pure bundling: it fa-

12. The proof of this assertion proceeds as follows. Assume that the monopolist adopts a pure bundling strategy and sets a price of p_B^* . Assume further that there exists some consumer *i* for whom $r_1 + r_2 \geq p_B^*$ and $r_2 < c_2 - \epsilon$, where $\epsilon > 0$. If the monopolist now adopts a mixed bundling strategy, with prices p_B^* and $p_1 = p_B^* - c_2 + \epsilon$, he necessarily earns more profits than under pure bundling: profits are unchanged on individuals for whom $r_1 + r_2 \geq p_B^*$ and $r_2 > p_B^* - p_1$, since they consume the bundle in both cases. Profits are increased, however, on individuals for whom $r_1 + r_2 \geq p_B^*$ and $r_2 < p_B^* - p_1$, since they bring in $p_1 - c_1 = p_B^* - c_B + \epsilon$ apiece instead of just $p_B^* - c_B$. Profits are also increased on individuals for whom $r_1 + r_2 < p_B^*$ and $r_1 \geq p_1$, since they previously consumed nothing but now generate $p_1 - c_1$ in profits apiece. All other individuals consume nothing in both cases.

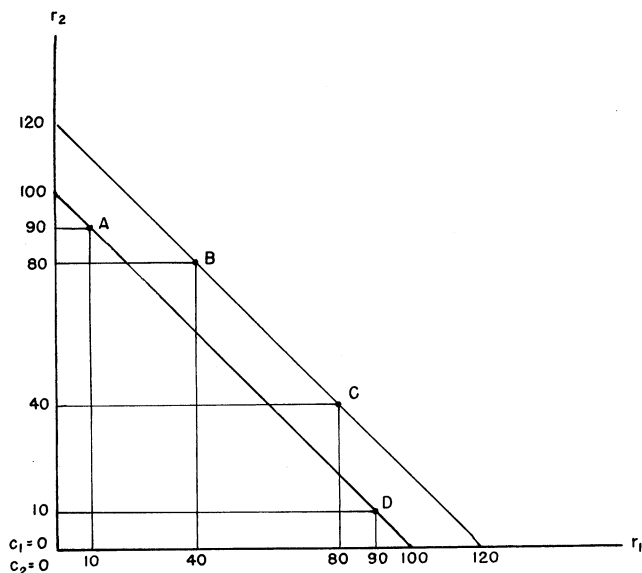


	p_1^*	p_2^*	p_B^*	Profits
Pure Components Strategy	60	82	—	224
Pure Bundling Strategy	—	—	100	300
Mixed Bundling Strategy	90	90	100	330

FIGURE V

cilitates the monopolist's attempts to extract the consumer surplus of individuals with high reservation prices for both goods. The reason is that a mixed bundler can charge a high bundle price and yet extract via separates markets the consumer surplus associated with customers valuing one but not both goods highly. This is illustrated in Figure VI. The bundle is priced to extract all the surplus of *B* and *C*, while the separates markets are used to extract the surplus of *A* and *D*. If the distribution of consumers in reservation price space is the opposite of that assumed here, however, pure bundling could be preferred to its mixed counterpart.¹³

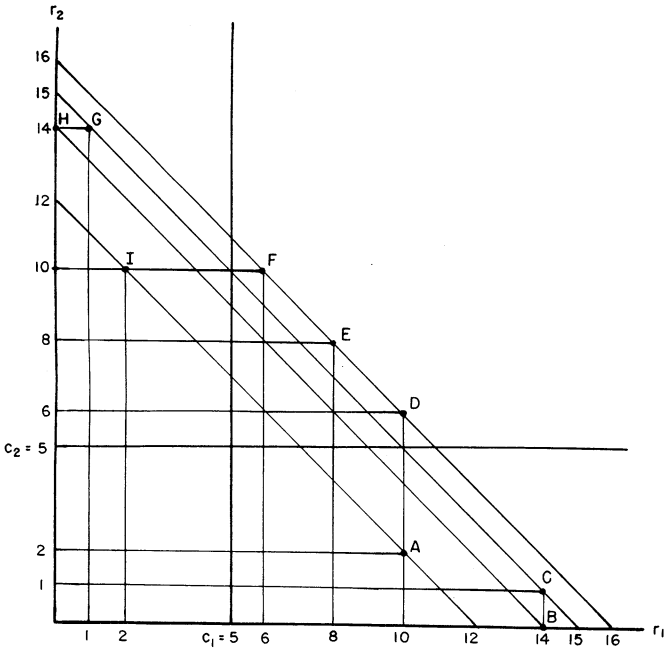
13. For example, if $c_1 = c_2 = 0$ and consumers *A*, *B*, *C*, and *D* have reservation prices equal to (30, 90), (40, 60), (60, 40), and (90, 30), respectively, the pure bundling strategy generates profits of 400, while the mixed bundling strategy yields profits of 340. Hence pure bundling could be preferred to mixed bundling.



	p_1^*	p_2^*	p_B^*	Profits
Pure Components Strategy	80	80	—	320
Pure Bundling Strategy	—	—	100	400
Mixed Bundling Strategy	90	90	120	420

FIGURE VI

Turning to comparison of mixed bundling with simple monopoly pricing, if the correlation coefficient linking an individual's valuation of one good to his valuation of the other good is not strongly positive, we can see that the mixed bundling strategy is better able to satisfy Extraction and Inclusion simultaneously. This is possible in Figure VII. The monopolist adopting a pure components strategy sets $p_1^* = p_2^* = 10$ in this situation, earning 40 in profits. If he then offers a bundle at $p_B = 16$, without changing the component prices, he entices people currently consuming nothing (i.e., E), as well as people currently consuming just one good (i.e., D, F), to purchase the bundle, while retaining other customers (i.e., A, B, C, G, H, I) in the separates markets. More generally, strong negative correlation helps the mo-



	p_1^*	p_2^*	p_B^*	Profits
Pure Components Strategy	10	10	—	40
Pure Bundling Strategy	—	—	14	28
Mixed Bundling Strategy	14	14	16	54

FIGURE VII

nopolist to achieve greater Inclusion by insuring that numerous individuals like *F*, *E*, and *D* exist. In the case at hand, simply adding the bundle at a price of 16 generates profits of 48 rather than 40. Profits are not maximized, however, by leaving component prices at their prebundle level. The bundle option permits the monopolist to raise prices in component markets, in pursuit of more complete extraction, without driving as many customers entirely out of the market. In Figure VII, for example, introduction of a bundle at a price of 16 makes it profitable to raise each component price from 10 to 14. This involves sacrifice of customers at *A* and *I*. Without the bundle,

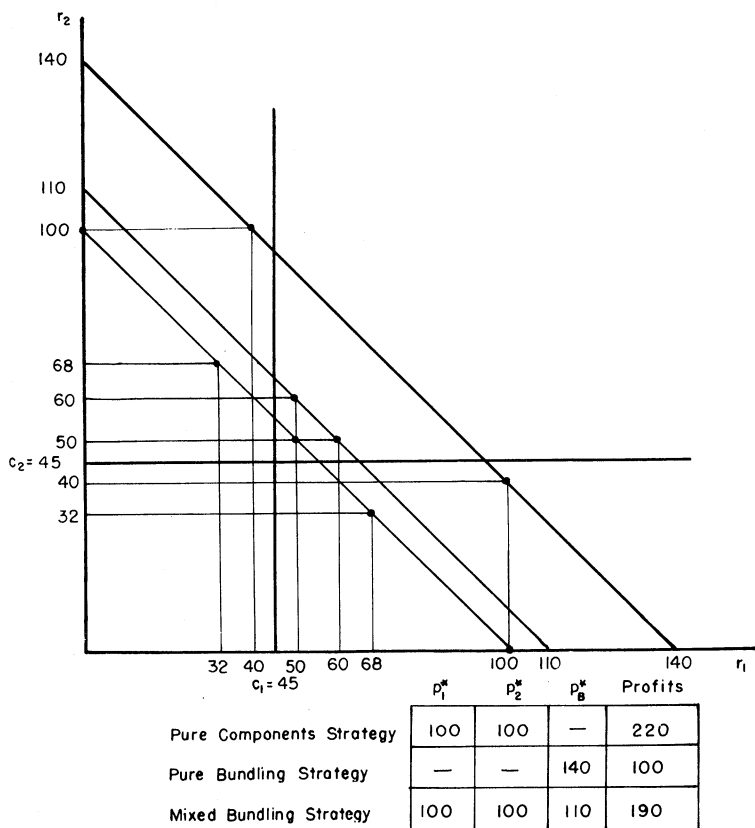


FIGURE VIII

however, D and F would also exit from the market. On balance, introduction of a bundle, when coupled with elevation of component market prices, permits achievement of 54 in profits. These are the highest attainable under any of the three strategies. In effect, negative correlation guarantees the existence of individuals with extreme tastes (e.g., B , C , G , H) who realize substantial consumer surplus in pure components equilibrium.

A major defect of mixed bundling vis à vis simple monopoly pricing is its difficulty in accomplishing Exclusion and Complete Extraction simultaneously. In Figure VIII, for example, if costs are $c_1 = c_2 = 45$, exclusion is such an important desideratum that pure components pricing is more profitable than mixed bundling. If $c_1 = c_2 = 30$, by contrast, so that exclusion is no longer a serious problem,

simple monopoly pricing is less profitable than mixed bundling. This illustrates the general proposition that pure components pricing is a more desirable strategy the greater the cost of violating Exclusion.¹⁴

In sum, each of the three pricing strategies has both advantages and disadvantages in relation to the other two. Whether one generates more profits than another depends on the prevailing level of costs and on the distribution of customers in reservation price space. In numerous experiments with plausible cost structures and continuous distributions of reservation prices, we found some form of bundling to be more profitable than simple monopoly pricing.¹⁵ Thus, commodity bundling can be expected to occur in the real world under more than the highly particular circumstances discussed here.¹⁶

We are now in a position to understand why a restaurant might offer complete dinners as well as an à la carte menu. Some people value an appetizer relatively highly (soup on a cold day), others may value dessert relatively highly (Baked Alaska, unavailable at home), but all might wish to pay roughly the same amount for a complete dinner. The à la carte menu is designed to capture consumer surplus from those gastronomes with extremely high valuations of particular dishes, while the complete dinner is designed to retain those with lower variance in their reservation prices.

With slight changes in interpretation, our model can be used to explain why products like toothpaste are sold in multiple container sizes. The horizontal axis in such cases measures an individual's reservation price for a first unit of the good, while the vertical axis measures his reservation price for an additional unit of the same good, given that he consumes a first unit. These definitions guarantee that

14. It is also possible, although less probable, that taste considerations alone render pure components pricing more profitable than mixed bundling. This is illustrated by the following example. Assume that five consumers—*A*, *B*, *C*, *D*, and *E*—have reservation prices of (80, 80), (75, 75), (45, 45), (75, 5), and (5, 75). Assume that $c_1 = c_2 = 0$. The pure components strategy with $p_1^* = p_2^* = 75$ generates profits of 450. Although a bundle could be offered at a price of 90 in order to induce *C* to enter the market, gains from the inclusion of *C* would be outweighed by the loss of revenue on sales to *A* and *B*. Furthermore, increasing prices in components markets in conjunction with introduction of a bundle would not increase profits either. The point of this example is to suggest that there exist some distributions of tastes consistent with any strategy ranking as long as Exclusion is violated by none of the options.

15. To demonstrate this, we explored the profitability of bundling when individual reservation prices for the two components follow the joint normal distribution. Our experiments covered a wide range of parameters of the taste distribution and a wide range of cost structures. Suffice it to say that, for every characterization of tastes we studied, bundling in some form was preferred to pure components pricing for some cost conditions. Less complete explorations of tastes following the uniform and chi-square distributions were consistent with this result.

16. Using attendance data on first-run movies for various cities, Stigler attempted to show that real world tastes are such that the block booking practice of movie distributors can be explained by a model of this type. See Stigler, *op. cit.*

assumptions A1–A3 can be satisfied.¹⁷ Note, however, that what comprises “one unit” of a good is inherently arbitrary. Moreover, customers must lie below the 45-degree line in reservation price space so as to comply with the law of diminishing marginal rates of substitution. Finally, the monopolist must charge the same price in both separate markets. Whenever mixed bundling occurs in toothpaste-type situations, the monopolist is engaging in price discrimination by offering quantity discounts. Individuals with high reservation prices for the first ounce and low reservation prices for the second ounce have lower price elasticities of demand than do those with more equal valuations of successive units. Offering both one- and two-ounce containers thus induces individuals with inelastic demand to pay a high unit price in the component market, while individuals with elastic demand pay a low unit price in the bundle market.¹⁸

Our model also provides a plausible explanation of why automobile manufacturers add luxury to at least some of their vehicles. If the horizontal axis of reservation price space is defined as valuation of transport services, while the vertical axis is defined as the valuation of added luxury, assumptions A1–A3 can be satisfied.¹⁹ In such situations the monopolist could offer just a basic car, just a luxury car, or both. Since the last strategy is equivalent to mixed bundling, it is usually the most profitable of the three.²⁰ That explains why consumer

17. Note how this incarnation of the model can be used to treat divisible goods, even though they appear to be excluded by assumption A2. In the limiting case of perfect divisibility, bundling is equivalent to imposing nonlinear budget constraints on consumers. The nonlinearity stems from the fact that the average unit price of toothpaste depends on the quantity of toothpaste consumed. The important point here is that bundling can be profitable in a world of divisible commodities for exactly the reasons set forth here.

18. This point is made in Salop, *op. cit.*

19. Note how this incarnation of the model can be used to treat complementarity even though it appears to be excluded by Assumption A3. Two goods are complements in consumption if an individual's reservation price for a unit of one depends on the quantity consumed of the other. By this definition luxury and transport services are complements in our model, since we assume that no individual would pay anything for luxury if he does not consume transport. Hence, by defining the vertical axis as we have, it is possible to analyze complementary goods.

20. In this situation it is rarely in the monopolist's interest to offer only a basic car. The reason is that as long as some consumer values luxury in excess of cost, profits can be increased by offering a luxury, as well as a basic, car. The proof is as follows. Assume that the monopolist offers a basic car at price p_1 . Assume further that there exists an individual with $r_1 \geq p_1^*$ and $r_2 > c_2 + \epsilon$, $\epsilon > 0$. If the monopolist introduces a luxury car with price $p_B = p_1^* + c_2 + \epsilon$, all consumers with $r_1 \geq p_1^*$ and $r_2 \leq p_B - p_1^*$ continue to purchase only good 1. Profits on these sales are unchanged. All consumers with $r_1 \geq p_1^*$ and $r_2 > p_B - p_1^*$ now purchase the bundle instead of the basic car. Profits on these sales rise from $(p_1^* - c_1)$ to $(p_B - c_1 - c_2 = p_1^* - c_1 + \epsilon)$. In addition, individuals with $r_1 < p_1^*$ and $r_1 + r_2 > p_B$ now consume the bundle instead of nothing. Since $p_B > c_B$, greater profits are earned on these individuals. In situations of the car variety pure bundling is likely to be more profitable relative to mixed bundling than in cases of the restaurant type. However, the existence of any consumer in pure bundling equilibrium with $r_2 < c_2$ still suffices to guarantee the superiority of mixed bundling.

goods' manufacturers typically sell their product in both differentiated and undifferentiated form.²¹

In conclusion, we have shown that commodity bundling is more profitable than simple monopoly pricing in a wide variety of circumstances. The reason is that it often permits more complete extraction of consumer surplus than is possible under a pure components strategy. Price discrimination is another technique designed to achieve that result. What are the relative merits of these two schemes? Package selling has two virtues when compared with price discrimination. First, it requires far less information to implement. For example, Pigouvian first-degree price discrimination could be practiced only if the monopolist knows the reservation prices of each individual for each commodity. Needless to say, individuals have a strong incentive to conceal such information whenever possible. Commodity bundling, on the other hand, can be practiced even if the monopolist knows only the joint distribution of reservation prices in the population. Such information is sufficient to calculate the most profitable bundle and component prices. In a bundling context the price structure is such that individuals automatically sort themselves into distinct reservation price groups and thereby reveal truthful information concerning their tastes. In this sense commodity bundling serves as a self-selection device.²²

Second, since each person pays the same price for what he consumes as do all others purchasing the same market basket, price discrimination laws based on price differentials alone are not violated. Unlike pure price discrimination, therefore, commodity bundling leaves its practitioner immune from prosecution.

III. THE MODEL: NORMATIVE PROPERTIES

Two requirements of Pareto optimality in the model of Section II are that commodities be distributed among consumers in such a way that no mutual gains from trade are possible, and that output of

21. In the industrial organization literature it is usually argued that product differentiation is profitable because it raises barriers to new competition. Our results suggest that product differentiation might be profitable even if entry barriers are unaffected. On the market structure explanation see W. Comanor and T. A. Wilson, "Advertising, Market Structure and Performance," *Review of Economics and Statistics*, XLIV (Nov. 1967), 423-40.

One major class of automobile-type situations, sometimes discussed in other contexts, involves bundling of a good and a bad. The bad cannot be disembodied from the package. The bad could be the search costs or waiting time required to purchase a commodity. See, respectively, Salop, *op. cit.*; and Spence, "Time and Communication in Economic and Social Interaction."

22. See Spence, "Time and Communication in Economic and Social Interaction;" and Salop and Salop, *op. cit.*

Consumers located in the area AHp_1^*E , for example, do not consume good 1, while individuals northeast of $FAEp_1^*$ do. And yet, some individuals in the former area (e.g., X) value good 1 more highly than do some individuals in the latter area (e.g., Y). Thus, mutual gains from trade of good 1 for money between X and Y are possible, violating the distributive efficiency criterion. The same reasoning applies to distribution of good 2. Insofar as it leads to distributive inefficiency, commodity bundling shares certain normative properties with (imperfect) price discrimination.²⁴

In cases of the restaurant type commodity bundling also results in allocative inefficiency. Unlike simple monopoly pricing, however, bundling can lead to oversupply as well as undersupply of either or both commodities. This, too, is illustrated in Figure IX. All consumers located east of c_1c_1' should consume good 1. In mixed bundling equilibrium, though, it is individuals northeast of $FAEp_1^*$ who in fact consume good 1. If $FABc_1'$ contains more customers than does $c_1BEp_1^*$, then good 1 is oversupplied. If not, the reverse is true. Economically, a necessary if insufficient condition for oversupply of good 1 is that equilibrium prices bear the relationship $p_B^* - p_2^* < c_1$ so that the shadow price of good 1 when consumed in bundles is less than its opportunity cost. By similar reasoning the necessary and sufficient²⁵ conditions for undersupply of good 1 are $p_1^* > c_1$ and $p_B^* - p_2^* > c_1$. Since the same logic prevails in analyzing good 2, commodity bundling can lead to oversupply of both commodities, undersupply of both commodities, or oversupply of one and undersupply of the other. Figure V illustrates the first possibility, Figures VI and VII illustrate the second, while Figure IX could be used to illustrate the last.²⁶ That monopolists can produce too much as well as too little output implies that the conventional view of monopoly output lacks general validity.

The welfare implications of bundling of the toothpaste variety are identical to those of the restaurant variety: both distributive inefficiency and allocative inefficiency typically occur, and equilibrium output might exceed optimal output. Therefore, no separate treatment of this case is required.

Bundling of the automobile variety, however, does possess distinctive normative characteristics. These can be illustrated in Figure

24. Whenever bundling occurs, the shadow price an individual faces for one commodity depends on his reservation price for the other commodity. Hence shadow prices on particular goods typically differ among consumers. This is what can lead to distributive inefficiency.

25. Sufficient as long as the mixed bundling equilibrium violates Inclusion in any way.

26. In Figure IX good 1 can be either oversupplied or undersupplied, but good 2 must, by construction, be undersupplied.

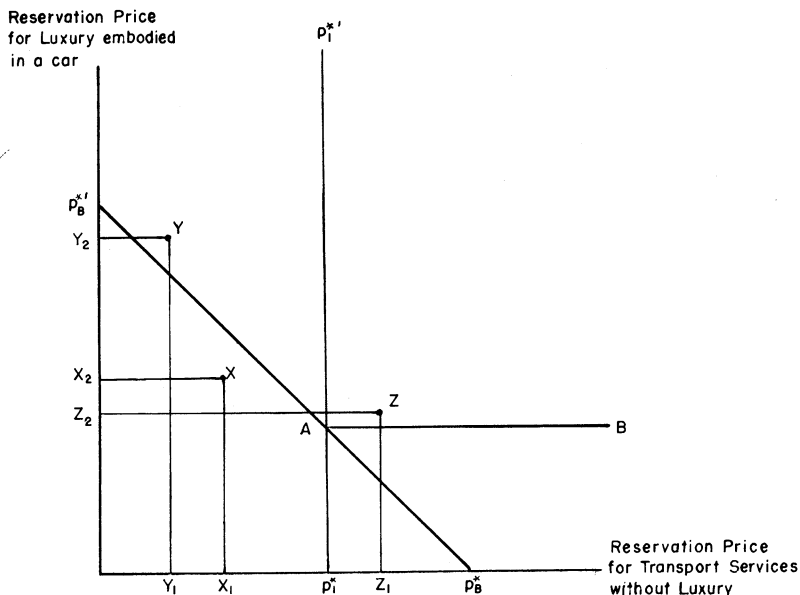


FIGURE X

X. If both the basic car and the luxury car are offered at prices p_1^* and p_B^* , respectively, individuals in the area southeast of p_1^*AB consume the basic car, and individuals northeast of p_1^*AB consume the luxury car. Because luxury is valued only by those who also consume transport services, no mutually beneficial trades among potential customers are possible, even though some who do not consume a commodity value it more highly than others who do. For example, X values transport more highly than does Y , and luxury more highly than does Z . Nevertheless, Y would not sell the transport services of his car to X at a price of Y_1 , even if he could retain the luxury (e.g., in the form of chrome).²⁷ For the same reason, X would be unwilling to pay X_2 for the chrome of Z 's car if that chrome were disembodied from the vehicle. Thus, no distributive inefficiency results from bundling in the car-type situation.

Allocative inefficiency is possible, however, even if some components cannot be disembodied from the bundle. This can be illustrated in Figure XI. In this situation A , B , and C should consume a luxury car, while D , E , and F should consume a basic car. The mo-

27. This follows from our assumption that no individual has a positive reservation price for chrome when disembodied from transport services.

Figure V, for example, mixed bundling is the most profitable strategy. The associated deadweight welfare loss is 7.²⁸ If bundling were prohibited and the monopolist forced to adopt a pure components strategy, the associated welfare loss would be 60 instead. Thus, prohibition of bundling without more might make society worse off. In fact, within the framework of our model, whenever mixed bundling is equivalent to pure price discrimination, it is Pareto optimal. Simple monopoly pricing never is. The possibility that mixed bundling is Pareto optimal is illustrated in Figure IV.

The deadweight loss associated with bundling might also exceed the corresponding loss associated with simple monopoly pricing. This possibility is illustrated in Figure VII. The profit-maximizing strategy for a monopolist is mixed bundling. And yet, the deadweight loss associated with that strategy (i.e., 10) exceeds that associated with the most profitable pure components strategy (i.e., 8). In this case, therefore, inability to bundle on the part of the monopolist would decrease the burden of monopoly.

IV. IMPLICATIONS AND CONCLUSION

In the movie *Five Easy Pieces*, Jack Nicholson enters a diner to purchase some toast and coffee. The waitress informs him that toast alone is not available, even though both bread and toaster are on the premises. Nicholson is forced to order a chicken salad sandwich without chicken, lettuce, or mayonnaise.

Our purpose here has been to explain this and other forms of commodity bundling, such as vacation packages, chrome on cars, and quantity discounts. We have demonstrated that a monopolist's urge to charge customers their reservation prices for each of his products could lead to package selling. We have also demonstrated that bundling is inefficient by Pareto standards: it can lead to oversupply or undersupply of particular goods, and it can lead to the wrong people consuming each good. In this section we present some implications of commodity bundling for public policy analysis.

The first step in social appraisal of monopoly is to ascertain the sources and magnitude of the welfare loss it generates. That is the function of certain tools of applied welfare economics, such as consumer-producer surplus analysis and hedonic price indices. Unfortunately, the reliability of both such tools is seriously jeopardized when monopolists practice commodity bundling.

28. We calculated welfare loss as follows: the total loss is equal to the difference between consumer surplus in pure competition and the sum of consumer surplus and profits in the monopoly equilibrium.

Looking first at consumer-producer surplus analysis, we estimate the burden of monopoly as

$$(1) \quad \Delta W = \int_0^{z^*} \sum_i D_i(z) \frac{\partial x_i}{\partial z} dz,$$

where D_i represents the excess of marginal social benefit over marginal social cost per unit level of activity i , x_i represents the number of units of activity i , and z denotes the extent of monopoly power. In effect, this formula measures the excess of consumer surplus lost over producer surplus gained from simple monopoly, as compared with competitive pricing.

Where monopolists practice commodity bundling, equation (1) has two defects. First, it focuses exclusively on allocative inefficiency, ignoring the distributive inefficiency characteristic of the situation. Second, the formula is inaccurate even in its estimation of allocative inefficiency. To take the simplest and most dramatic example, assume that individuals are uniformly distributed in reservation price space along the line $r_1 + r_2 = 1$, and that both component costs are positive. Suppose also that the monopolist adopts a pure bundling strategy.²⁹ The profit-maximizing price is $P_B^* = 1$, and all individuals consume the package. Resource misallocation exists, since some consumers have reservation prices below cost for one component, while other consumers have reservation prices below cost for the other component. No distributive inefficiency exists. Yet as long as equation (1) is applied at the bundle level, $\partial x_i / \partial z = 0$, so that estimated welfare loss is zero. This follows from the fact that the bundle demand curve is completely inelastic at prices below unity; hence the usual "triangle" measuring the deadweight loss vanishes entirely. In this example the formula not only underestimates welfare loss but fails even to detect its presence.

These defects of the consumer-producer surplus approach have two implications for public policy analysis. First, society may be unaware of the true extent of the burden of monopoly.³⁰ Second, even if society knows the extent of welfare loss, it may fail to pinpoint its source.³¹ This could set governments on the wrong policy track, since

29. Mixed bundling generates more profits in this situation, but its appraisal via equation (1) is more complicated.

30. The Harberger formula provides neither a floor nor a ceiling to the true burden of monopoly; it can be shown that in situations where bundling is profitable, deadweight loss can be overestimated or underestimated by equation (1).

31. Conceptually, the loss associated with allocative inefficiency should be measured as the net gain in producer and consumer surplus that results from increasing (decreasing) component outputs to their optimal levels, given the correct distribution of output among individuals. The loss associated with distributive inefficiency should be measured as the net gain in consumer surplus that results from redistribution of existing output.

distributive inefficiency requires social intervention of a sort different from that designed to eliminate resource misallocation.

Commodity bundling also affects certain conclusions that may be drawn from hedonic price indices. The reason is that practitioners of that art often discuss whether consumers are willing to pay for the quality change they consume. The standard treatment is to suggest that consumers either are willing to pay for improvements they consume, or else are not fully understanding of the costs they bear.³² Bundling analysis suggests a third explanation of why quality might be consumed. Some people value it highly; others do not. The seller finds it profitable to offer quality in a bundle with characteristics consumers uninterested in quality wish to have. As a result, not everyone who buys quality is willing to pay for it. The normative interpretation of quality indices would accordingly seem ambiguous.

Once the sources and extent of welfare loss have been ascertained, the second step in policy analysis is to determine whether public intervention can reduce the loss. If goods sold in the market place cannot be decomposed for separate purchase, for example, government is powerless to stop the evils of bundling.³³ To the extent that package goods can be decomposed, however, it becomes possible to guarantee that shadow prices on all components are the same for all customers. Hence the distributive inefficiency of bundling could be prevented. Moreover, pure components selling could reduce the waste associated with individuals consuming commodities for which they are unwilling to pay cost. Hence at least some of the allocative inefficiency of bundling could also be prevented.

What specifically, then, should governments do? Clearly they must embark on policies that achieve competitive supply of each

32. Consider, for example, the stance adopted in F. Fisher, Z. Griliches, and C. Kaysen, "The Costs of Automobile Model Changes Since 1949," *Journal of Political Economy*, LXX (Oct. 1962), 433-51. In discussing consumer expenditures on automobile model changes, they assert that "the model changes of the last decade seem to have been largely those desired by the consuming public, at least until the last years of the horsepower race. There are thus grounds for believing that car owners (at the time of purchase) thought model changes worth most of the cost. The general presumption of consumer sovereignty thus implies that these model changes *were* worth their cost" (p. 450). But they also aver that "the fact that model change costs for the late 1950's (about \$700 in the purchase price per car, or more than 25 percent, and \$40 per year in gasoline expenses) will probably seem surprisingly high to consumers is an indication that the costs in question were not fully understood by the consuming public" (p. 450).

33. Where no component can be sold separately, bundling is equivalent to the Lancaster formulation of consumer theory. See K. Lancaster, "A New Approach to Consumer Theory," *Journal of Political Economy*, LXXIV (April 1966) 132-57. Apart from the differences in normative interpretation, our model can be distinguished from Lancaster's in the sense that we provide some explanation for the range of products firms choose to offer in the market place. Our model integrates consumer and producer behavior.

decomposable good separately. As some have long, if unpopularly, argued, this might reduce rather than increase the output of firms with market power. The argument that modern industrial societies produce too much product differentiation need not rest on the hypothesis that advertising changes consumer tastes.

In any event public policy must take account of the fact that prohibition of commodity bundling without more may increase the burden of monopoly. This is consistent with the general theorem of second best: when one distortion exists (e.g., monopoly), elimination of other distortions (e.g., bundling) may either enhance or diminish social welfare. The implication is that monopoly itself must be eliminated to achieve high levels of social welfare.

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