Program Competition, Diversity, and Multichannel Bundling in the New Video Industry

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I. INTRODUCTION

In the days when the Federal Communications Commission severely limited the number of local video outlets, the analysis of diversity and viewer welfare in the television industry was focused on channel scarcity. Today new technologies and the movement toward regulatory reform have acted to reduce or remove artificial sources of resource scarcity in broadcasting, and the analysis of competition and policy in the new video industry must address fresh issues. One of these questions is the effect of the competitive process on diversity and economic welfare when it involves competing multichannel broadcasters with both viewer and advertiser-supported programming. This paper is a first step in the analysis of this problem.

Maintainance of a responsive and flexible political process in a pluralistic and democratic society requires the existence of some reasonable (though hard to determine) number of independent media vehicles available for the dissemination of divergent viewpoints. The operative words in the preceding sentence are "reasonable number" and "independent." The concern here is that if control over the means of access to individual decision makers is concentrated in too few hands, political debate will be unduly restricted. In this context diversity refers to diversity of access to media vehicles.[1] In an economy in which transactions are based largely on private property, diversity of access or of "sources" implies either diversity of ownership or governmentally imposed standards for deciding who has access if ownership is not diverse, although these two options are not necessarily mutually exclusive. In any case it is necessary to define access or source diversity with respect to a particular audience—local, regional, or national. While First Amendment values may suggest unlimited source diversity, this may come at a cost both in resources and in content diversity.

Content diversity, as distinguished from access diversity, refers to the variety of programming offered to viewers. Programming is the industry's product and, just as the range of product characteristics must be considered in evaluating the economic performance of any industry, diversity of this type must be considered in evaluating the efficiency with which the industry that supplies programming creates value.

Programming may be a source of two types of value. The first concerns the economic surplus created as a direct consequence of individual consumption—the difference between consumers' valuations of the product and the costs of production and distribution. It is a familiar exercise in welfare economics to determine whether value of this type is maximized by a given industry structure. Because media products are public goods and the technology of distribution is particularly limited, the outcomes may differ radically from what one would observe in nonbroadcast industries with similar structures. The models of viewer choice discussed in this paper offer one means of assessing the efficiency with which the video industry produces the direct consumption benefits associated with its programming.

The second source of value is political. Some argue that the level of content diversity that maximizes direct consumption benefits is still too little. The social benefits of having a citizenry exposed to a variety of political and cultural ideas is ignored in the usual economic welfare calculus. While this perspective undoubtedly has some merit, there is no objective way to quantify those benefits and so we will ignore the social externality aspects of content diversity in the remainder of this paper. Any standard devised to permit welfare evaluations of this type of externality must of necessity embody personal value judgments on the relative merits of various types of programming which we are unwilling to make. In addition, we suspect that a video industry that meets reasonable standards for access diversity and effectively provides programming in response to a wide range of tastes will also perform adequately when the social benefits of content diversity are considered.

In the next two sections we explore the implications of the emerging structure of the new video industry for diversity in the specific senses described above. We argue in section II that a video industry that meets current antitrust standards will also satisfy reasonable criteria for access diversity. Models of programming choice are examined in section III. With their aid we explore the implications of different industry structures for viewer welfare.

II. ACCESS DIVERSITY

Concern with access diversity presumes that for purposes of participation in public debate and political decision-making the power of the individual voice or pen (or word processor) is not sufficient.[2] Individuals must have access to the mass media to participate effectively.

Clearly, as a practical matter, access to the media cannot be unrestricted. The range of differing viewpoints is enormous on most issues of public concern. With finite resources to allocate among all activities, including participation in the political process, it is unreasonable to expect any individual to weigh all opinions on all topics, and it is undesirable that the attempt be made. Thus it is both natural and appropriate that institutions serve as filters or gatekeepers to reduce the number of voices that are actually heard. This also means that gatekeepers may fail by providing either too much or too little diversity. There seems to be general (although by no means unanimous) agreement, however, that the social dangers of too little diversity far outweigh the problems of too much. Still, when commercial gatekeepers must compete in the marketplace, either error can be fatal.

If access diversity is a legitimate policy concern, then the focus of that concern must be on the effectiveness of competition in the industry of gatekeepers. Gatekeepers may be either public or private agents. Western countries have opted for systems of private gatekeepers for print media, presumably from concern that publicly controlled gatekeepers would be too responsive to established political interests. In contrast, broadcast gatekeepers have been publicly owned or regulated. The most important gatekeepers in this country are profit-motivated media enterprises whose financial viability is only indirectly related to their performance in this social or political role. This is the source of the frequently expressed fear that the performance of media firms as gatekeeepers is inadequate and the basis for occassional attempts at corrective intervention such as the fairness doctrine. But the commercial orientation of media firms has advantages in this regard as well. Competitors have economic incentives to seek out and serve unsatisfied demands for social and political as well as other content.

A sufficiency of competing gatekeepers is the usual solution to failure evidenced by any single gatekeeper. The owner of any single outlet may seek (indeed, must seek) to restrain free debate; but the chance of responsible parties being denied media access becomes increasingly remote as the number of independently owned media outlets is increased. Assuming that we are still in a situation where an increase in access diversity is beneficial, it is hard to see how diversity in this sense can help but improve in the emerging video industry. The number of actual and potential sources of programming and gatekeepers has grown substantially with the development of cable and newer distribution technologies and continues to do so. In addition, the development of high quality, relatively inexpensive video recorders has opened up the possibility of direct sales to viewers. This permits the existence and distribution of material which, for a variety of reasons, might not be marketed to mass audiences.

Of course, if the owners of new multichannel distribution systems such as cable, DBS, or MDS control access to these respective systems, then the diversity of content may exceed the diversity of access. However, economies of scale in programming and distribution dictate that most material be widely distributed, and this attentuates the control of the local system owner. In addition, media markets are largely local in character, while viewers are mobile and frequently cross media market boundaries, thus exposing themselves to the products of other gatekeepers. Even within a geographical market, access diversity could decrease given the growth of new technologies only if competing media firms merged or if, as a consequence of competition from new technologies, traditional broadcasters were forced out of the market, to be replaced by a lesser number of multichannel distribution services.

The current Justice Department Merger Guidelines (1982) seems to us to be an adequate safeguard in the case of the first eventuality. While there is no magic number of independent voices that ensures adequate diversity of access, it would be hard to argue for standards stricter than those already applied in evaluating the economic consequences of mergers (Baseman and Owen 1982). A proposed merger attracts attention if the initial Herfindahl index is 1000 and will almost certainly be challenged if the index exceeds 1800, although there are exceptions (see White paper in this book). The minimum number of firms required for an index of 1000 is 10, and 1800 allows for no fewer than 6.

III. CONTENT DIVERSITY AND COMPETITION

The rapid and continuing increase in the number of video offerings is a direct consequence of a revolution in the regulation, technology, and costs of program delivery. Loosening of regulatory restrictions on older technologies, as with MMDS, cable, and LPTV, and cost reducing technological developments, such as DBS and the new video recorder-players, have made feasible the provision of programming in addition to that provided by the traditional broadcasting sources. An extremely complex industry is emerging with competition among and within technologies and between products with different sources of finance (advertising and viewer payments). No existing models of competition in the industry appear to be both sufficiently comprehensive to capture this complexity and be analytically tractable at the same time.

Economic models of program patterns in broadcasting have in the past assumed that all broadcasters used the same technology (or at least had the same costs) and that all were supported in the same way, either by advertisers or by payment from viewers. In the discussion below we explore the implications of relaxing these assumptions. We also explore what may be the most interesting and relevant form of competition in the future—competition among multichannel broadcasters.

A. Welfare Effects of Competition Among Technologies

An increase in the number of alternative sources of content and of gatekeepers and thus of video content diversity is almost unanimously presumed to be beneficial. We tend to agree. Increased content diversity implies a closer matching of video products with consumer tastes, which usually improves consumer welfare. However, a cautionary note must be injected. The emergence and adoption of the new delivery technologies do not necessarily lead to a welfare improvement for everyone, even if available programming alternatives do increase. The means by which an increase in content diversity is brought about are also important.

Imagine there is some program (#1) valued by some consumers, but with too few potential viewers to make the program viable on an advertiser-supported broadcast medium. Those viewers who would prefer this program watch instead some alternative program (#2) that is actually broadcast. The advent of a new technology—say video cassette players—which permits the sale of program #1 directly to consumers increases the welfare of those who now buy the program. But because the audience for program #2 has been reduced, its quality will probably be reduced, and it may even go off the air. Those who prefer program #2 are worse off, and their loss may be as great or greater than the gain to those who prefer program #1. (See appendix 8.1 for an example.) Even if it could be shown that the result of introducing new technologies with effects such as this were always welfare-enhancing in the sense that total surplus increased, there may be significant groups of viewers who are winners or losers. Alfred Kahn (1966) made a similar point concerning the abandonment of passenger rail services when he pointed out that the actual revenues of a railroad fail to reflect an important benefit to consumers: the *option* to use the service.

Programming newly available through cable, video recordings, or DBS has not led so far to the disappearance of particular types of programs from more traditional sources. However, a number of major sporting events—major boxing matches, for example—that would almost certainly have been carried by advertiser-supported broadcasters have recently been available only through pay television.

B. Competition Within a Given Broadcast Technology

Competition among over-the-air broadcasters or among programmers that depend upon and utilize cable channels (e.g., pay-TV networks) takes place within a common technological environment in which each competitor faces the same or a similar cost function. In this section we review the existing literature on such competition, ignoring the competition that exists among different technologies. We also examine some of the implications of competition between pay- and advertiser-supported programming services, a topic not covered in the earlier literature.

1. Competition Among Media with a Single Source of Financing

Programming choice models are of two distinct types: Steiner's model (Steiner 1952) and variants on his approach that were developed later (Rothenberg 1962; Wiles 1963; Beebe 1977) and the Spence-Owen model (Spence and Owen 1977). While the formal structures of the two approaches are quite different, analyses with both have reached similar conclusions. Both the Steiner-type models and the Spence-Owen model show that television markets exhibit various "biases" that depend on their structural characteristics. These biases result from inconsistencies between the set of programs and prices that optimize consumer welfare and those that can be sustained by producers in a competitive equilibrium.

The most important determinants of the performance of a television market besides the number of channels are the distribution of ownership among the channels and whether programs are financed with advertising revenues or direct viewer payments. If channel owners are competitive and advertiser supported, then programming decisions exhibit a strong tendency toward wasteful duplication. This is illustrated most vividly in the Steiner models where programs must belong to one of a number of well-defined types, and programs of a given type are perfect substitutes for each other and thus share the audience for that type. Programmer revenue is primarily a function of audience size because advertisers are paying for exposure to viewers. Thus programmers will offer duplicates of programming types that have large audiences if fractions of these audiences are larger than the audience of a single program for a minority taste audience. Different programs of a given type are perfect substitutes for one another, so the expenditure on duplicate programming produces no increase in viewer welfare. As is shown in Beebe and the third chapter of Owen, Beebe, and Manning (1974), expansion of the number of channels will eventually result in the production of programming for each program type with an audience large enough to generate advertising revenues sufficient to cover the costs of the programming. The problem of wasteful duplication still remains, but there is reason to doubt the validity of the assumption that all programs of a given type are perfect substitutes.

Unnecessary duplication in an advertiser-supported Steiner model does not occur if all channels are controlled by a monopolist. The monopolist will minimize costs by producing only one version of each programming type that is produced. Programming will be provided on additional channels, if available, as long as the increase in total audience size generates ad revenues sufficient to cover the costs of programming and operating the channels. It is this property of monopoly control in combination with the elimination of wasteful duplication that leads Steiner to conclude that with advertiser support the broadcasting industry might perform more efficiently if monopolized than if competitive. This conclusion is valid, however, only if there is no program with less audience appeal that all viewers would watch if the alternative was not viewing at all. Given the existence of a common denominator inferior choice program, a monopolist would program only a single channel with that common denominator program. Depending on the strengths of preferences for first choice over common denominator programming, viewer welfare may well be reduced by more than the savings from reduced programming costs.

Welfare comparisons are difficult within the Steiner framework because viewer preferences are described only in terms of rankings. Actual consumer valuations in terms of willingness to pay play no role in the analysis. For this reason the usual surplus measures cannot be employed to compare the economic welfare implications of various outcomes. What can be said is that viewer welfare cannot decline in either a monopolized or competitive TV market as a result of increased channel availability. (Note, however, that individual consumers can be worse off.) If available channels increase a Steiner monopolist will not respond by providing fewer programs and will provide more programs if capacity restrictions had prevented what would otherwise have been a profitable increase in the number of programs offered. With a sufficient increase in the number of channels it is certain that a competitive industry will offer all types of programming that would attract audiences large enough to cover costs with advertising revenues, though perhaps with excessive duplication. Given that only relative preferences are taken into account in the Steiner framework, the most that can be said about the welfare consequences of increasing channels is that viewer welfare cannot be reduced and will probably increase. With competition there is the possibility that increased viewer welfare will not be sufficient to justify the costs of increased duplicative programming. However, if the value of advertising is at least equal to advertiser payments, then in both cases the marginal program produces value at least equal to its costs if it is not duplicative.

The inability to make welfare comparisons in many cases because of a lack of quantifiable viewer preferences is a serious drawback of Steiner models. It also makes any analysis of pay-television extremely ad hoc. The Spence-Owen model explicitly incorporates viewer demand functions and so avoids these problems.[3] Even so, while the conditions for making welfare comparisons can be described explicitly within the Spence-Owen framework, in most cases actual welfare conclusions require difficult empirical analysis.

Spence and Owen identify the same types of biases for advertiser-supported systems as does the Steiner framework. While no firm produces an exact duplicate of another's programming in a model with continuous variation in product space, a tendency exists for competitive programmers to crowd together in those segments of the market with the most viewers. More differentiation than is optimal occurs in these market segments because producers find it more profitable to cannibalize the surplus of other producers than to establish new products in less densely populated regions of the program space. Relative to the theoretical optimum, the market solution in a competitive, *advertiser*-supported industry is "biased" against programs with small audiences, programs with steep inverse demand functions (high preference intensities), and costly programs (holding net welfare contributions constant).[4] Competitive *pay* programmers often exhibit the same tendency toward excessive cannibalization in heavily populated audience segments.[5] However, these tendencies are greatly reduced relative to an advertiser-supported system because the price mechanism takes account of preference intensity. If the number of channels is allowed to increase indefinitely, the Spence-Owen model predicts that a competitive pay system will probably, although not necessarily, perform more efficiently than a competitive advertiser-supported system.

Spence and Owen do not evaluate the performance of an advertiser-supported monopolist. However, they show that a monopolist of pay services displays some of the same tendencies of a Steiner monopolist. A pay monopolist will be concerned with the internalized costs of cannibalization. For this reason the pay monopolist will tend to offer too little diversity. Some programs for which the increase in viewer plus producer surplus would exceed costs will not be provided because the firm is concerned only with the change in producer surplus.

Steiner models of an advertiser-supported monopolist and the Spence-Owen analysis of a pay monopolist agree in predicting a tendency toward too little diversity. Spence and Owen show that in a pay system the competitive solution is generally preferable to the monopolistic solution if the number of financially viable channels is not constrained by the number of actual channels. They also demonstrate that pay programming is more likely to lead to welfare enhancement than advertiser support under the same conditions. Expanding channel capacities on various broadcast media in recent years may have produced a state in which an artificial constraint on channel availability no longer exists. Moreover, policy has ceased to penalize the development of viewer-supported programming. However, whether at any point the marginal increase in diversity remains beneficial is an empirical question. It is a matter of measuring a new service's contribution to surplus and comparing this with its programming and distribution costs. Surplus measurement is bound to be difficult, especially for advertiser-supported services.[6]

2. *Mixed Systems*

Steiner models and the Spence-Owen model fail to analyze competition in a mixed market of pay and advertiser-supported programming services. Another problem with both models is that they assume that viewers make exclusive choices among programs. This makes sense in the context of the single programming period which these models assume, but in actuality individual viewers have preferences for more than a single channel of programming.

In the models presented in appendix 8.2, we take a step toward the analysis of competition between advertiser-supported and pay-supported broadcasters. If viewers are confined to choosing between one or the other on an exclusive basis, it is straightforward to show that the profitability of pay-TV relative to advertiser-supported TV is greater the more sensitive viewers are to the presence of advertising and the lower the price advertisers are willing to pay per viewer. The profitability of pay relative to advertiser support will be greater the less elastic is consumer demand for pay programs.

Welfare results are somewhat clouded by the traditional difficulties in dealing with advertising. But if one assumes that a dollar paid for advertising is welfare equivalent to a dollar paid by a viewer for pay-TV, then it can be shown that in the competitive equilibrium, choices by broadcasters as to which type of support to utilize will be in themselves consistent with welfare optimization. There remain, of course, "biases" in program selection compared to the global welfare optimum.

Describing (and modeling) competition among pay- and advertiser-supported broadcasters in a world where viewers patronize multiple services is much more difficult. Complications arise from the fact that pay services and advertiser-supported services are concerned with different measures of viewer response. Because they sell exposure to audience members, ad-supported services focus on actual audience size. Pay services, on the other hand, care only about the number of viewers willing to pay for the right to view their programming on an intermittent basis. For any individual program presented by a pay service the actual audience may be much smaller than subscribership.

Central to the demonstration that when viewers are restricted to exclusive choices, broadcasters choose the welfare-maximizing alternative between pay and advertiser support is a proof that under these conditions the audiences (and potential viewership, which in this case are the same) of pay services and advertiser-supported services are equal in size. Therefore direct consumer benefits (consumer surplus) associated with the two sources of support are the same. The simulation exercise reported in appendix 8.2 shows that demand elasticity and viewer sensitivity to advertising play much the same role in determining the relative profitability of pay- and ad-supported programmers when viewers watch the product of several programmers as when their viewing choices are exclusive. However, when viewers patronize multiple services, advertiser-supported services generate much larger potential audiences, and thus greater consumer benefits, than pay services. Because consumer benefits are ignored in the profit calculus, the number of pay services in market equilibrium is likely to exceed the number that maximizes welfare.

An important caveat attends this conclusion. The models developed in appendix 8.2 assume symmetry in the demands for different types of programming. These models do not allow for minority tastes. Because prices can reflect preference intensity, pay services have a much greater incentive to program to minority audiences than do advertiser-supported services. This beneficial tendency of pay programmers must be kept in mind when judging the relative merits of pay- and ad-supported services.

C. Competition Among Multichannel Broadcasters

1. The Economics of Multichannel Bundles

Multichannel service began with cable systems retransmitting distant broadcast signals. The cable industry has since developed more complicated packages of programs, some retransmitted, others produced solely for cable audiences. Regardless of the programming mix, the cable product is a bundled one. The cable subscriber is faced with an all or nothing choice of a group of programs packaged together (commonly referred to as the basic package) and, if he subscribes to these, the further option of subscribing to additional services either singly or in bundles. New multichannel services are just beginning to emerge in the form of DBS and MMDS, but it is already clear that they too are packaged or bundled. However, for reasons that appear to be purely technological, DBS and MMDS programmers currently offer a single bundle of programs with no options for additional services.

Both demand and cost relationships may influence the decision to bundle. For example, a recent econometric study by Owen and Greenhalgh (1983) shows economies with respect to both the number of channels and subscribers; similar relationships appear to hold for other multichannel technologies.[7] Therefore it is possible to offer a multichannel cable bundle at a lower price per channel than a single-channel service. Cost savings from transacting in program bundles relative to selling many programs on an individual basis may also be a powerful incentive to bundling. Economies of scale, whatever the source, however, do not necessarily make a bundle more profitable than services priced individually. Demand conditions must also be considered. In the remainder of this section we develop an analytical framework with which to analyze these demand relationships. We employ this structure to analyze the pricing and bundling strategies of a multichannel monopolist and the probable outcomes of competition among multichannel firms.[8]

Stigler (1963) was the first to suggest that bundling may be a device by which sellers can extract more buyer surplus than would be possible if the bundled goods were sold individually, thus increasing revenue. Adams and Yellen (1976) elaborated on Stigler's work and showed by means of other examples that under various circumstances seller profits may be increased even more by giving buyers the choice of purchasing the bundle or one or more of the bundled products singly. Both Stigler and Adams and Yellen worked with two product examples and assumed the bundled goods were demand independent. Below we add an additional good (program) to illustrate the possibilities of competition among multichannel services.[9]

Stigler's basic insight is easily illustrated with a two good, two consumer example. Consider a two-channel cable system offering programs A and B to viewers 1 and 2. The maximum prices that consumers are willing to pay (reservation prices) are given in table 8.1.[10]

If programs A and B are sold separately, revenue-maximizing prices are $6 and $9 respectively. Total revenue would be $21. By selling the two programs as a bundle, the seller could set a price of $13 for the bundle and receive a total revenue of $26. Revenue increased with bundling because, due to the negative correlation between the reservation prices of viewers 1 and 2 for the two programs, the seller was charging less than 1's reservation price for program A with simple monopoly pricing. Addition of program B enables him to extract more revenue from 1 than his reservation price for program B alone. This more than offsets a reduction of $2 in receipts from viewer 2.

Table 8.1

	Viewer	1	2
Program	A	$10	$6
	B	$ 3	$9

It is easy to show that bundling may make possible the provision of programs that could not generate revenue sufficient to cover cost otherwise. For example, if programs A and B cost $14 and $6 respectively, A would never be produced if the two programs were sold individually, in spite of the fact that it produces value in excess of cost.

Welfare is increasing by bundling in this case. However, it is also true that a *monopolist* selling bundled products is subject to the same inefficiencies as a single-product monopoly—a tendency to produce too little output at too high a price. Unfortunately, employment of the more sophisticated bundling schemes which we discuss momentarily does not necessarily result in a welfare improvement over simple bundling, and simple monopoly bundling does not necessarily increase welfare relative to a monopolist selling the same programs individually.

The inefficiencies associated with simple monopoly bundling are most easily stated with formulas. We will index viewers by capital letters and programs by lower case subscripts. Define RPN_i to be the reservation price of the *N*th viewer for the *i*th program and *RBN* to be the reservation price of the *N*th consumer for the firm's bundle. *RBN* is the sum of the RPN_i over all i in the bundle.

For a given bundle and given group of subscribers, the maximum price for the bundle is the minimum RB among those who become group members. For a group of K subscribers designate the minimum *RB* by *MRBK*. Let F_j be the cost of a program not in the bundle and D_j be the change in the minimum *RB* due to the inclusion of program j. Then for the bundle to be the profit-maximizing bundle, it must be the case that $D_j < F_j$, all j not in the bundle.

Profit maximization also requires that for any potential viewer, M, who is not a subscriber and with *MRBK* the minimum *RB* among K subscribers, $RBM < (MRBK\text{-}RBM)K$.

The latter condition is a restatement of the marginal revenue-marginal cost relation that must be satisfied for profit maximization for a single product firm. A monopolist of a product bundle produces the same type of inefficiency that is associated with single product monop-

Table 8.2

	Viewers	1	2	3	4
Progrrams	A	$10	$6	$ 6	$4
	B	$ 3	$9	$10	$2
	C	$ 7	$3	$ 2	$9

oly, that is, treating the reduction in price on sales to existing customers as a cost of adding a new one.

Adams and Yellen have shown that, depending on the distribution of preferences, more sophisticated bundling schemes may allow for a finer discrimination among buyers. We illustrate this by expanding on the above example. We add one more program and two more viewers with reservation prices distributed as in table 8.2. Priced individually programs A, B, and C would yield maximum revenues of $18, $18, and $14, respectively, for a total of $50. If all three are offered as a bundle, the bundle could be priced at $15 and total revenue would be $60. However, if viewers were given the option of purchasing A, B, and C as a bundle at $18 or C alone at $9, viewers 1, 2, and 3 would purchase the bundle, and 4 would buy just C. Total revenue would be $63.

Is the mixed bundling scheme more efficient than the simple bundling, and is simple bundling more efficient than pricing individually? No unambiguous answer exists in either case, although just as with single product monopoly, a perfectly price discriminating monopolist will produce the socially efficient level of output. The last bundling scheme described with C sold separately from the bundle sacrifices consumer surplus of $6 relative to simple bundling because viewer 4 does not receive programs A or B. On the other hand, if programs cost more than $20 to produce, none would be produced if not for the more sophisticated bundling arrangement.

Refer back to the example based on table 8.1 with costs of $14 and $6 for programs A and B and just two viewers. Program A would not have been produced without bundling. Imagine the existence of a third viewer with a reservation price of $5 for program 1 and $0 for program 2. The monopolist would still prefer simple bundling which would exclude the third viewer. However, both programs could be produced with individual pricing, and total surplus would be higher by $2 ($5 from the new viewer minus $3 due to viewer 1's loss of program B).

2. *Multichannel Competition*

Until recently a discussion of the economies of video bundling could have stopped at this point. Because cable was the only multichannel distribution technology in use for most of the past thirty years, a monopoly bundling model would have been sufficient. However, due to a combination of relaxed regulatory constraints and technological improvements, new multichannel services employing either MDS or DBS distribution technology have recently emerged as potential multichannel competitors to cable.

It is still too early to tell what, if any, economic niches the new services will occupy in the long run. Several services with 4–8 channels of programming employing both technologies have either been started recently or are scheduled to come on line in the near future.[11] Because the first of new multichannel MDS and DBS services plan to carry fewer channels than all but the smallest cable systems, it is widely speculated that the true multichannel competition will be between MDS and DBS services for the right to serve those areas in which the economics are not favorable for cable, primarily areas with low population densities in which the cost of laying cable is high relative to the number of homes passed. If this is the case, the majority of viewers reached by multichannel services will not be much affected by multichannel competition. On the other hand, the emergence of MDS or DBS "wireless cable" (12–18+ channels) is seen by many as a distinct possibility in the future.

Multichannel competition can take at least two possible forms. If competing services offer similar bundles, competition would depress price, possibly as low as average cost, even if only a single firm remained in equilibrium. The extent to which revenue could exceed cost would depend on the costs of entry and exit (Baumol, Panzar and Willig 1982). Multichannel competition may also take the form of multichannel services offering different program packages in the same markets. This becomes more likely the greater the differences in tastes among viewers. Below we explore, again by examples, the character of this type of competition. The extent of multichannel competition is dependent on the structure of demand and on cost conditions. One factor is the extent to which economies of scale with respect to channel capacity extend beyond a single channel. These may reverse before a single distribution system could produce all, or even a significant fraction, of the potentially viable program types. In the absence of economies of scale with respect to channel capacity over some initial range, demand complementarity might provide a multichannel operator with pricing options not available to competitive single channel firms. But eventually increasing costs would still be necessary to ensure the viability of more than one multichannel service.

First we examine competition between two multichannel services when the number of types of programming desired by viewers exceeds the channel capacity of a single service. Assume a market is served by two 2-channel distribution services, one (AC) offering programs A and C, the other (AB) offering programs A and B, with viewer preferences as shown in table 8.2. Assume also that the cost of programming a single channel is \$8, independent of the number of viewers served. If the two services price their bundles cooperatively, joint revenue would be maximized with AC selling to viewers 1 and 4 at a price of \$13 and AB selling to viewers 2 and 3 at a price of \$15. Note that with cooperative pricing and only two services the BC combination would not be offered.

The extent to which price competition may reduce prices is a function of the degree to which viewers perceive the bundles as substitutes and the costs of producing and delivering a channel of programming. From the initial levels of \$13 for AC and \$15 for AB, AB has no incentive to cut price. If AB reduced the price of its bundle to slightly less than \$9 it could pick up viewer 1 because viewer 1 would now realize more surplus from A and B (\$4+) than from A and C (\$4). But AB's revenue would be reduced to less than \$27. The price of AB would have to be cut to \$6 to pick up both 1 and 4. Then revenue would be \$24. AC does have an incentive to cut price. By reducing the price of its bundle to just under \$7 it could pick up viewers 2 and 3 and have revenue of nearly \$28. AB is secure against price competition from AC if it prices its bundle just below \$14.5. AC would then have to set a price of less than \$6.5, and it would earn less than \$26. AB has no incentive to cut price further because the price reduction required to pick up an additional viewer would lower its revenue. In this example price competition between two differentiated services leads to a slight reduction in one of the prices, but both firms still earn substantial profits. If the differences between viewers' reservation prices for the two bundles were less, price competition would lower prices more. However, with this type of differentiation price competition cannot be expected to eliminate all seller profits unless there is the threat of entry by duplicative services. If positive profits attracted entry by firms offering similar packages, equilibrium industry structure would be either two firms, one selling A and C at a price of $8 to viewers 1 and 4, the other selling A and B, each at the same price to 2 and 3, or a single 2-channel service offering either the AB or AC combination to all viewers at a price of $4 per viewer.

The importance of economies of scale with respect to the number of channels is clear if we consider the possibility of simultaneous competition by single-channel firms. If a single-channel service could still deliver programming at a cost of $8 per channel, then three single-channel services, each selling at a price of $2 per viewer would displace any 2-channel competitors. If there were no diseconomies of scale associated with a third channel, a 3-channel service could do the same thing.

Generalizing from this example suggests that the factors affecting the number of multichannel media competitors will include, on the demand side, the overall extent of the video market, the marketing advantages to be gained from bundling channels, and the degree of specialization of tastes among the viewing public. On the supply side, the factors to consider are the structure of costs with respect to number of channels and the extent, if any, of continuing capacity limitations due to spectrum constraints. Our empirical knowledge of these factors is very limited; there is no reason to suppose, for example, that they will not work out to be the same or similar to those in the print media. It should be noted in this connection that the print media consist of a number of technologically similar products. Books, magazines, and newspapers, for example, are produced and delivered in relatively similar ways. But these media coexist in equilibrium because of relatively slight differentiating features that are important to customers. Video delivery technologies may similarly coexist in a competitive environment. It is not inevitable that one or another will win the race to be the dominant technology.

IV. CONCLUSION

The models that we have been exploring in this paper represent only a first step to an understanding of the future of video competition and diversity. We need better models and better data on the cost characteristics of the new media technologies. At the moment we are mostly reliant on guesses and analogies. One useful analogy is the print media. Print media are, in a sense, each made up of several "channels." For example, a newspaper of general circulation or a weekly magazine has several departments or sections. Such channels are related by demand interdependencies or by cost interdependencies, or both. To the extent the print analogues have cost and demand characteristics that are comparable to video technologies, we can expect to see video competition and diversity similar to that in today's print media.

Among the policy issues that arise as one thinks about the possible shapes of future video competition is the problem of media that are constrained to continue to provide single-channel service. It may well be the case, for example, that as cable, MMDS, and DBS penetrate significantly into the marketplace, local broadcasters will be more efficient competitors if they can coordinate their programming and advertising policy. If so, there will come a point where consumers will be better off if the FCC's duopoly rule were eliminated. It is easy to see that this will be a controversial proposal when it is first made and that harm might arise either from too early or from too tardy a relaxation of the regulation.

The other major policy issue, of course, is the necessity for licensing, content regulation, and structural reactions to the presence of transmission bottlenecks, such as a separations policy. The burgeoning new technologies and the withdrawal by the FCC of most of its entry restrictions have created an environment in which there is little if any basis for any form of licensing or content regulation. Moreover, the once widespread view that cable would eventually replace competing local broadcasters with a single local video transmission "bottleneck" looks today increasingly doubtful. In short, it is difficult to see much, if any, consumer benefit in continued FCC regulation of either the new or the old video media.

Appendix 8.1

Demand and cost conditions for two types of programming, 1 and 2, are shown in figure 8.1. Viewers in the community are divided into two groups, A and B, based on their demands for the two types of programming. We assume, as is typical in models of viewer choice, that given a choice of programs or channels each viewer watches only one. (We examine some of the consequences of relaxing this assumption in the simulation study reported in appendix 8.2.) Type A viewers prefer type 2 programming, although most of them are willing to watch type 1 programs if type 2 is not available, or if it is priced too high. Group A's inverse demand function for type 1 programming (in the absence of type 2) is DA1, and its inverse demand function for type 2 programming is DA2. DA1 and DA2 are drawn parallel to simplify the exposition. Members of group A will take type 2 programming as long as its price does not exceed the price of type 1 programming by more than the

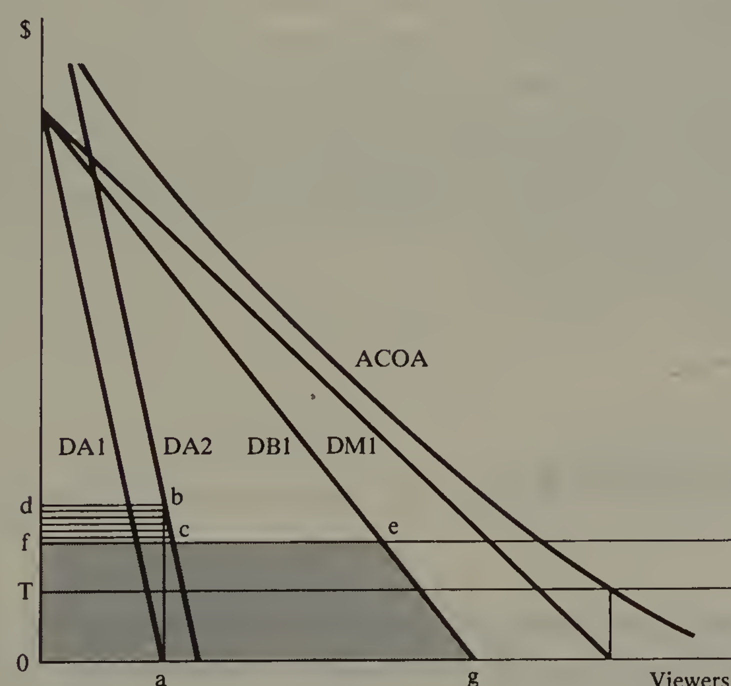

Figure 8.1. Welfare Changes Due to Competition from a New Technology

difference in the heights of the demand curves and will select type 1 otherwise. Group B viewers watch only type 1 programs. Their inverse demand function is DB1. If type 2 programming is not available, the market inverse demand function for type 1 is DM1, the horizontal sum of DA1 and DB1.

Let ACOA be the average cost per viewer for supplying programming via over-the-air broadcasts and assume that advertisers are willing to pay T per audience member. A station broadcasting type 1 programming would just break even if its audience consisted of both groups. Suppose that originally broadcasting was the only means of program distribution, but technical advances in video recordings now make it possible to distribute recorded programs at retail at constant average cost, f. Further, suppose that the supply of video recordings is competitive, b is located vertically above a. Because DA2 and DA1 are parallel, the consumer surplus area under DA2 above db is equal to the consumer surplus area under DA1; f is less than d, so group A viewers will switch to type 2 programming where they receive more surplus.

Advertising revenue from the sale of a group B audience is not sufficient to cover broadcasting costs. Therefore the broadcast services would be dropped, and type 1 programming would be available only through video recordings at price f. In this example it is clear that the benefits of the newly available type 2 programming to group A are more than offset by the reduced surplus of group B. Group A's surplus has increased by the area of trapezoid dbcf, while surplus from group B consumption is reduced by trapezoid fego, which is obviously larger. A similar example could be constructed with the broadcast service supported by viewer payments.

Appendix 8.2

In this appendix we develop two models with competition between pay- and advertiser-supported programmers. Both assume a monopolistically competitive market modeled similarly to that in Spence-

Owen. In the first we maintain the standard assumption of exclusive choices by viewers; in the second we allow for viewers to choose multiple program sources.

For both models we assume a market with n firms producing imperfect substitutes. For $i, j = 1, \ldots, n$ the demand function for the ith firm is given by

$$(1) \quad q_i = V - c\,(bA_i + P_i)^r + f,$$

where:
P_i = the price of the ith program
$f = f(A_1, \ldots A_{i-1}, A_{i+1}, \ldots A_n; P_1, \ldots, P_{i-1}, P_{i+1}, \ldots P_n);$
$\partial f/\partial A_j, \partial f/\partial P_j > 0$
A_i = advertising on the ith program
q_i = the number of viewers on the ith program
T = advertiser payment per viewer per unit time
F_i = cost of programming and distribution for ith channel.
V, b, c and r are positive constants.

Note that we are assuming advertising reduces viewer valuation of a program. If the ith program is ad-supported, $P_i = 0$ and $A_i > 0$. If the ith program is supported by viewer payments, $P_i > 0$ and $A_i = 0$. Profits for the ith firm would be

(2) $PRp_i = P_i q_i - F_i$ if it is a pay service, and
(3) $PRa_i = TA_i q_i - F_i$ if it is ad supported.

We assume firms are Nash competitors in prices and advertising; that is, each firm sets the level of its own price or advertising on the assumption that the advertising or prices of other firms will not change. The system of equations given by (1) has a unique solution if f is quasi-convex in the A_j's and P_j's. Substituting from (1) for q_i in (2) or (3) and differentiating with respect to P_i or A_i as appropriate, we get first order conditions

$$(4) \quad V - (r+1)cP_i^r + f = 0$$

if the ith service is subscriber supported, and

$$(5) \quad V - (r+1)b^r cA_i^r + f = 0$$

if the ith service is advertiser supported. Profit-maximizing values of P_i and A_i are

$P_i^* = [(v+f)/(r+1)c]^{1/r}$, and
$A_i^* = [(v+f)/(r+1)b^r c]^{1/r}$.

Substituting back into (1) we get

$q_i = r(V+f)/(1+r)$

in either case. Alternative profits with pay and advertiser support are
$PRp_i = (r/(1+r))((1+r)c)^{-2/r} (V+f)^{((1+r)/r)}$, and
$PRa_i = T/b\ (r/(1+r))((1+r)c)^{-2/r} (V+f)^{((1+r)/r)}$.

With advertiser support the ith service would be more profitable than with pay support if $T/b > 1$, less profitable if $T/b < 1$, and equally profitable if $T/b = 1$. This relationship is as one would expect. From (1) we see that an increase in A of b units has the same effect on viewer demand as a unit increase in price. So the profitability of pay- relative to ad-supported programming is greater the greater the sensitivity of viewers to advertising relative to their sensitivity to price, and the lower the price of advertising.

Because a profit-maximizing firm has the same value for q_i with either advertiser or pay support, $bA_i^* = P_i^*$.
Designate this value by L^*, and let L' be the value of $bA_i + P_i$ for which $q_i = 0$. Consumer surplus for both pay and ad-supported services is given by

$$CS_i = \int_{L^*}^{L'} q_i(\cdot)dP,$$

where the functional form represented by $q(\cdot)$ is that given by equation (1).

The equivalence of consumer surplus with advertiser and viewer support is easily demonstrated graphically for linear demand functions (r=1). This relationship is evident in figure 8.2. The upper inverse demand function, $D1$, assumes $A_i = 0$. With direct viewer support P_i is set at its revenue-maximizing level, producing the audience size for which $MR1 = 0$. The lower demand function, $D2$, assumes A_i is set at the level which maximizes profits for $P_i = 0$. Because q_i is the same in either case, $D2$ intersects the horizontal axis at the same audience size as $MR1$. $D1$ and $D2$ are parallel; therefore consumer surplus is the same with advertiser or pay support.

Because consumer surplus is the same with either advertiser or pay support, any difference in the welfare benefits associated with the two sources of support is due entirely to differences in producer benefits. As long as a dollar of revenue to a programming service is accorded the same weight regardless of whether it is contributed by subscribers or advertisers, then for the equilibrium configuration of services, firm choices with respect to advertiser support or viewer payments as a source of revenue maximize both profits and welfare.

To bring the model closer to reality we must permit viewers to patronize more than a single programming service. Implicitly this means

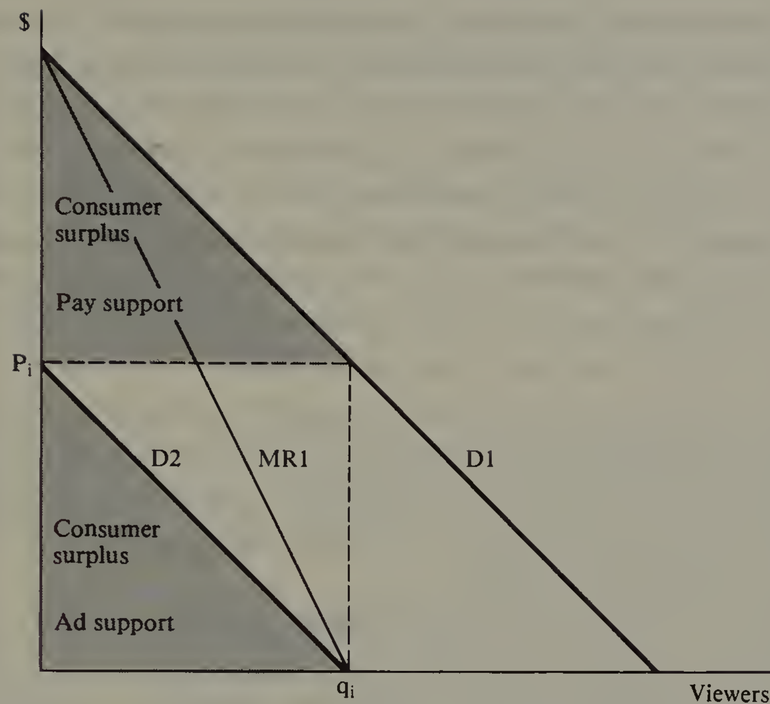

Figure 8.2. Equivalence of Consumer Surplus with Pay and Advertiser Support

extending the time dimension of the model beyond a single programming period. A programming service is now interpreted as a firm programming a single channel for all periods. A service is assumed to strive for a unique identity for its product, but as there are many uncertainties associated with matching video product to viewer tastes, its programming may not always be on the mark. In addition, viewers may themselves desire programming diversity. For both reasons viewers may prefer to have available more services than they can watch at one time. We assume this to be the case. A viewer may have a preferred programmer, but substitutes still have a positive value at the margin.

As we showed above, the formal analysis of competition between pay- and advertiser-supported services is fairly straightforward if viewers make exclusive choices among services. Allowing viewers the option of viewing more than a single service (not simultaneously, of course) brings the analysis much closer to the actual state of competition between services. Unfortunately, the required modifications to the mathematical structure complicate the formal analysis to the point that simulation methods must be employed.

The complications arise from the fact that we can no longer assume that the number of potential viewers and the actual audience for a program are the same at a given time. Divergence between the two measures requires that we develop functional expressions for both. Pay services are concerned with the number of viewers willing to pay for the right to watch their programming on an occasional basis. The size of the actual viewing audience is more important to ad-supported services.

The fact that pay- and ad-supported services are concerned with different magnitudes necessitates that, to keep the problem manageable, we restrict the total number of viewers to be invariant with respect to the number of programming services. If we had to account explicitly for the number of viewers that watch multiple services and the relative frequencies with which they watched each, the problem would be too complex to model. At any rate, this assumption does not seem to be too much at variance with available evidence. Thus we have ad-supported services trying to affect their shares of the viewing audience while pay services worry about subscriber counts.

Much of the structure of the model developed above is still useful for examining the efficiency of competitive outcomes in a more complex environment in which viewers watch the product of more than one programmer. In particular, the demand functions (advertising and price) given by (1) can be reinterpreted as giving the relationship between price and advertising and the number of people who will watch a service at least part of the time instead of the instantaneous viewer count. With this change in interpretation the profit function for a pay service is unchanged as is its first order condition (equation (4)). It is also still valid to employ these relationships to derive and compare measures of surplus since these are still demand functions for the services of TV programmers.

It is the profit expression for an advertiser-supported service (equation (3)) that must be modified. As q_i is now interpreted as the number of viewers potentially in a service's audience, not the instantaneous viewer count, it must be replaced by the service's share of the total audience that is divided among all services. Let N be the total number of TV viewers and assume for convenience that N is invariant with respect to the number and financing of programming services. Define SH_i as the ith service's share of the N viewers. NSH_i is the number of viewers in the ith service's audience. In a market in which viewers watch more than one service, $NSH_i < q_i$, and the profit function for an advertiser-supported service is

(6) $PRa_i = TNA_iSH_i$.

(1′) is the version of (1) used in the simulation. It is linear in both A and P (i.e., $r = 1$). Note that $k = bc$; f is the linear combination of P_j's and A_j's.

(1′) $q_i = V - kA_i - cP_i + g\sum_j P_j + h\sum_j A_j,\ i \neq j;\ g, h > 0.$

With (1′) the first order condition for a pay service (equation (4)) becomes

(4′) $V - 2cP_i + g\sum_j P_j + h\sum_j A_j = 0,\ i \neq j.$

The audience share of an ad-supported service should be an increasing function of the prices of pay services and the levels of advertising of other ad-supported services and a decreasing function of its own advertising. A potentially large number of functional forms could satisfy these conditions, but few are analytically tractable. We chose a measure based on the relative valuations viewers would place on services if competing services were not available. Thus we are comparing viewers' gross valuations of different services, not benefits after netting out the effects of substitute services. Define $S_i(A_i,P_i)$ to be the area under the demand function for values of A_i and P_i if no other programming services are available. Given (1′)

$S_i(0,P_i) = (V^2/c - cP_i^2)/2$, and

$$S_i(A_i,0) = \frac{V^2 - 2kA_i + k^2A_i^2}{2c}$$

the functional form employed for SH_i is

$$SH_i = \frac{S_i}{S_i + \Sigma S_j}, \qquad i \neq j.$$

This expression for SH_i has the properties described as necessary above. This form of SH_i is also intuitively appealing in that programming services receive audiences in proportion to their gross valuations.

Market equilibrium properties were explored with a computer simulation for a market of 20 firms. Results reported in table 8.3 are for a market with 10 ad-supported services and 10 pay services. Because the values of T and N do not influence profit maximizing choices of P and A (although, through their influence on relative profitability they affect the numbers of pay and ad services), their values are arbitrary within this framework and were set equal to 1 for convenience. Each firm

Table 8.3. Market Equilibrium Properties for 20 Television Firms–Simulation Results

	c k g	*c k g*	*c k g*	*c k g*	*c k g*	*c k g*	*c k g*
	1 1 .02	*1 1 .01*	*1 1 .03*	*1 .5 .02*	*1 1.5 .02*	*.5 1 .02*	*1.5 1 .02*
A	.36	.36	.36	.68	.24	.36	.36
P	.66	.57	.77	.79	.64	1.67	.42
$\frac{PRp}{PRa}$	23.08	21.64	23.06	13.64	33.15	40.42	15.88
q_a	.84	.73	.97	1.06	.80	1.01	.82
q_p	.53	.52	.54	.63	.51	.50	.55

A = Amount of advertising.
P = Price of subscriber supported service.
PRp/PRq = Ratio of profits of subscriber supported service to advertiser supported service.
q_a = number of potential viewers for advertiser supported service.
q_p = number of potential viewers for subscriber supported service.
c,k,g = demand function parameters appearing in equations (1) and (1′).

determines the value of its own advertising or price on the assumption that the advertising and prices of its competitors will not change.

The usual symmetry conditions were employed to simplify the analysis. Thus we could solve for a single value of P for all pay services and a single value of A for all ad-supported services. Given the symmetry assumption and equation (4′), the common price, P, charged by pay services is

$$P = \frac{V + 10hA}{2c - 9g}.$$

The complexity of the profit expression for an ad-supported service necessitated employment of a simulation technique to determine profit-maximizing values of A. Profits for an ad-supported firm were calculated using equation (6) for A varying from 0 to values high enough to drive PRa_i to 0. The S_j's that are held constant in the expression for SH_i were calculated for an initially arbitrary value of advertising A_o. The value of A that maximized PRa_i then became the Ao used to calculate new values for P and the S_j's which were employed to determine new values for maximum PRa_i and the associated A. This procedure was repeated until stable values of A and P were achieved.

This simulation exercise was performed for varying values of the model's parameters.[12] Results of the standard comparative statistics exercises performed by varying model parameters were along the lines economic intuition would lead one to expect. Profits of pay services decline relative to the profits of ad-supported services the more price sensitive are viewers (the larger c is). The relative profits of pay programmers increase with increasing sensitivity of viewers to advertising (increasing k).[13]

The magnitudes of greatest policy interest are the values of q_a and q_p, the numbers of potential viewers of advertiser-supported and pay services. For all combinations of model parameters tried q_a is greater than q_p. This result appears to be a consequence of ad-supported programmers compensating for the fact that actual audience is smaller than potential audience by reducing advertising to increase their shares of total viewers.

As we showed with the first model in this appendix, advertiser-supported services and pay services generate equal amounts of consumers' surplus if q_a and q_p are equal; $q_a > q_p$ implies greater consumers' surplus for ad-supported services. If we weight producer profits equally regardless of the revenue source, an advertiser-supported service produces greater total benefits than an equally profitable pay service. Therefore, free competition between the two types of programming services is likely to produce a mix with a larger than optimal proportion of pay services. This property of competition between the two types of services must be weighed against the desirable tendency of pay services to program to minority taste audiences, which ad-supported services tend to ignore.

Notes

The authors would like to thank Peter Greenhalgh for numerous helpful comments and suggestions, and Paul Gottlieb, who did the programming for the simulation exercise reported in appendix 2.

1. For an alternative discussion of the meanings of diversity see Crandall, Noll, and Owen (1983).
2. For a discussion of diversity in the context of First Amendment concerns see Owen (1975, pp. 20–21).
3. The Spence and Owen paper was presented to an audience of professional economists. For this reason the analysis relies heavily on mathematical techniques with which the average noneconomist interested in video diversity is unlikely to be familiar. For an excellent interpretive review of the Spence-Owen article see Lence (1978). The Lence paper was written as an undergraduate project and is available on request through the Department of Economics at Stanford University.
4. "Bias" is used as a way of characterizing the differences between the optimum and the equilibrium sets of offerings.
5. Scherer (1979) provides an excellent graphical analysis of the economics of this type of cannibilization in a market with differentiated products. See also Wildman (1984) for an elaboration on Scherer's diagrams.
6. See Wildman, note 5 above, for a discussion of surplus measures for differentiated products.
7. See Eli Noam's paper in this volume for other evidence of economies of scale.
8. For a different approach to modeling the packaging of cable programming see Besen and Johnson (1982).

9. An excellent condensation of the bundling analysis is presented in the eleventh chapter of Phlips' (1983) book on price discrimination. Phlips argues that because bundling is a form of nonlinear pricing and because for any uniform price greater than marginal cost there exists a nonlinear schedule of prices that produces greater total welfare, economic welfare is greater with bundling than for simple monopoly pricing. We demonstrate below by counterexample that, while welfare may improve with bundling, the reverse is also possible.

10. For advertiser-supported channels the reservation prices would be the values advertisers place on gaining exposure to the particular viewers.

11. For example, USCI launched a 5-channel DBS service in Indianapolis in 1983 and later expanded to Chicago and some East Coast markets.

12. From equation (1′) it is evident that a unit increase in advertising and a C/K increase in P have the same effect on q_i. For the purposes of the simulation this relationship was assumed to hold for the effects of substitutes in the demand function as well. Thus we set $h = gc/k$.

13. It should be remembered that because the values of N and T are arbitrary, only changes in the ratio of profits of ad-supported to pay services, not their absolute values, are of interest.