volumes of production. In a special, limiting case, a *single* enterprise may be able to supply total market demand at least total cost compared to multiple competing suppliers, reflecting the application of a technology of production so technically efficient at large levels of output that only a single supplier is required. Such a firm is called a *natural monopoly*. Often, firms defined as natural monopolies are treated as public utilities and subjected to regulation. Historically, such regulation precludes competitive entry, since, by definition of a natural monopoly, any competitor to the public utility can only produce output at higher average cost and, hence, a higher price to the consumer relative to the prices charged by a regulated natural monopoly firm.[22]

22. The cost structures of firms that supply multichannel video programming to subscribers are likely to be both complex and dynamic over the longer term as new technologies of video programming distribution become more widely available. Analytically, a *multioutput cost function* is a useful tool for understanding the behavior of plant-level costs of production. In particular, such a cost function permits the definition and measurement of *product-specific economies of scale* and *economies of scope*, the cost savings attributable to producing multiple outputs in the same plant using certain shared inputs of production. For a firm that produces a single output, large economies of scale in production may be sufficient to result in a natural monopoly. Most firms, however, produce multiple outputs. The notion of natural monopoly in the case of multiple outputs is necessarily more complicated than the single-output case, although recent theoretical work on the economics of multioutput production have established the cost conditions defining natural monopoly under these circumstances.[23]

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[22] The standard view of single-output natural monopoly implicitly assumes that the natural monopoly firm minimizes the total cost of production for any level of output, notwithstanding the lack of competition that would ordinarily force a competitive firm to behave this way. But without competition to force the natural monopoly firm to minimize the total cost of production, it is both possible and likely that the natural monopoly firm will tolerate *X-inefficiency*, i.e., higher unit cost for any level of output compared to the unit cost of production for a firm that faced competition and consequently minimized its expenditures on the inputs of production. Such X-inefficiency may be expected to persist even if the natural monopoly firm is subject to public utility regulation. Although the idea of X-inefficiency can be traced to Adam Smith, Harvey Leibenstein has advocated its importance in recent years. See Harvey Leibenstein, *Allocative Efficiency vs. X-Efficiency*, 56 AM. ECON. REV. 392-415 (June 1966). A recent collection of articles assessing the state of X-efficiency theory is STUDIES IN ECONOMIC RATIONALITY: X-EFFICIENCY EXAMINED AND EXTOLLED (Klaus Weiermair & Mark Perlman eds. 1990).

[23] The modern theory of multioutput cost functions is fully developed in WILLIAM J. BAUMOL, JOHN C. PANZAR, & ROBERT D. WILLIG, CONTESTABLE MARKETS AND THE THEORY OF INDUSTRY STRUCTURE (1982).

23. Technological change, learning curve effects, and *systems rivalry*[24] between and among competing multichannel video programming distributors may accentuate economies of scale and scope in video programming delivery through time. Such economies do not, however, imply a *natural monopoly market structure* in local video programming distribution markets over the longer term, although such economies may constrain the number of profitable video programming delivery systems in some local markets.[25] Such industry cost conditions are unlikely to represent *policy-relevant barriers to entry*, however, since their realization is likely to be the *result* of systems rivalry rather than an *impediment* to such competition.[26] Some insight concerning the extent of possible economies of scale and scope

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[24] The distribution of multichannel video programming is an example of a *system*, *i.e.*, "collections of two or more components together with an interface that allows the components to work together." Output provided to consumers on networks often implies certain *feedback effects* that may directly affect market structure. A common approach for evaluating feedback effects in network-based markets is studying *market competition between systems* as opposed to competition between products. *See* Michael Katz & Carl Shapiro, *Systems Competition and Network Effects*, 8 J. ECON. PERSP. 93 (1994).

[25] A distinction is drawn between the plant-level technology of production that displays *natural monopoly cost characteristics*, i.e., product-specific economies of scale, economies of scope, or both, and a *natural monopoly market structure*. Many firms, especially firms that tend to be capital-intensive, utilize technologies of production that result in *some* economies of scale or scope in production at observed levels of demand, i.e., reflect natural monopoly cost characteristics. The *extent* of such economies is often insufficient, however, to preclude the entry of rivals that also produce output subject to similar economies of scale and scope. Ordinarily, each entrant differentiates its output from that of its competitors, which, if successful, enhances the consumer's willingness-to-pay for the specific output of the given firm. Thus, even if the incumbent firm could produce total market demand at least total cost, consumers in general do not find the product variety offered by a single firm equivalent to, or even preferred to, the collection of differentiated products and services offered by competing firms. Thus, in most markets, both product-specific economies of scale and economies of scope are never fully realized, since consumers value the benefits of product diversity provided by diverse firms more highly than more homogeneous output produced at lower unit cost and price. By contrast, a natural monopoly market structure will emerge in instances where (1) the technology of production implies product-specific economies of scale, economies of scope, or both that are pervasive and profound; (2) the fixed costs of production are large and almost entirely sunk; and (3) consumers place little or no value on product differentiation. Given these conditions, a monopoly market structure will emerge "naturally" over the longer term, even without government-imposed barriers to entry. Few real-world markets, where entry is free and not constrained by public policy, tend to converge, however, toward natural monopoly as an equilibrium market structure over the longer term.

[26] Policy-relevant entry barriers are discussed in the next section.

is provided by econometric studies of cable system cost functions. Several of these studies are reviewed in the next section.

B. Empirical Studies on Economies of Scale in Cable Television Distribution

24. Rigorous study of the cost structure of local cable systems requires the formulation and estimation of multioutput econometric cost functions. Two empirical studies estimate the cost structure of local cable systems, namely, studies by (1) Owen and Greenhalgh and (2) Noam.[27] Both studies find some evidence of economies of scale, although such economies are not large.[28]

25. Owen and Greenhalgh estimate a fourteen percent cost penalty to overbuilding using data from franchise applications, where output is defined as the number of subscribers.[29] This estimate *overstates* the cost penalty of overbuilding, since total market output is assumed to be constant, i.e., no price competition results from overbuilding. Empirical studies on competition in the cable industry suggest, however, that total market output tends to increase as marginal customers subscribe to basic cable service in response to a reduction in price.[30] When changes in the output of the cable system are measured not only as an increase or decrease in the number of subscribers, but include proportional changes in the amount of institutional (local public, educational, and government) network investment and miles of wire (cable plant), Owen and Greenhalgh's estimates show that the average cost of production is approximately constant with respect to a proportional change in all three measures of output. As noted by the authors and subsequent studies, Owen and Greenhalgh's estimates are troublesome, however, since the franchise application data used in their study are only *estimated* construction and operation expenditures. Such data include the estimates of both efficient and inefficient bidders; could be biased by opportunistic behavior or "gamesmanship;" and ". . . do not clearly reflect the minimum cost based on using best-

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[27] Bruce M. Owen & Peter R. Greenhalgh, *Competitive Policy Considerations in Cable Television Franchising*, 4 CONTEMP. POL'Y ISSUES 69-79 (1986); ELI NOAM, VIDEO MEDIA COMPETITION: REGULATION, ECONOMICS AND TECHNOLOGY (1985).

[28] Given limited data availability, there are few published or publicly-available econometric studies of cost functions for cable firms. Only such econometric studies, however, provide rigorous measures of product-specific economies of scale and economies of scope attributable to multioutput production by a single firm.

[29] In other words, entry of a second cable system forces the incumbent to restrict output (at least initially) and operate at a higher point on its average cost curve, all other things remaining the same. Owen and Greenhalgh estimate the size of this effect as approximately 14% over what cost would have been absent the overbuild competitor.

[30] *See* Beil, Dazzio, Ekelund & Jackson, *supra* note 16.

practice techniques of running a cable system of a given size."[31]

26. In a more sophisticated attempt at measuring scale and scope economies in cable distribution, Noam estimates a series of cost functions using 1981 data for more than 4800 cable systems. His estimates suggest the presence of economies of scale in the production of cable services, but the economies vary according to the definition of output.[32] Product-specific scale elasticity estimates for the outputs defined as "basic subscribers," "pay subscribers," and "homes-passed" are 1.054, 1.074, 1.020, respectively.[33] Product-specific economies of scale are observed for the basic and pay subscriber output measures. The product-specific scale elasticity estimate for the homes-passed measure of output is not statistically different from one, however. These results suggest that economies of scale are observed only in the number of basic and pay subscriptions, and not the physical size of the network, i.e., homes-passed. Taking into account economies-of-scope between the size of the distribution network and the number of subscribers for both basic and pay cable services, Noam's estimates indicate slight economies of scope; the *total scale elasticity* estimate is calculated to be 1.096, implying that a ten-percent decrease (increase) in all outputs in fixed proportion will result in approximately a one-percent increase (decrease) in the cost of production. The scale elasticity estimates from the Noam study (the most sophisticated to date) do not suggest, however, that significant economies of scale -- regardless of the measure of output -- pervade the cable distribution industry.

27. Based on the two econometric cost studies, competitive entry in local multichannel video programming markets may appear to imply some loss in economic benefit

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[31] Owen & Greenhalgh, *supra* note 27, p. 72. A number of studies assert that opportunistic behavior at the franchise stage is significant. *See* Oliver Williamson, *Franchise Bidding for Natural Monopolies -- In General and With Respect to CATV,"* 7 BELL J. ECON. 73-104 (Winter 1976); Robin Prager, *Firm Behavior in Franchise Markets*, 21 RAND J. ECON. 211-225 (Summer 1990).

[32] Data used by Noam consisted of monopoly systems only. The nature of cost under duopolistic competition may be significantly different than under monopoly supply. For example, numerous analysts have suggested the possibility of X-inefficiencies in monopoly markets. *See* NOAM, *supra* note 27; Thomas W. Hazlett, Duopolistic Competition in Cable Television: Implications for Public Policy, 7 YALE J. REG. 65-120 (Winter 1990), at 80; Nelson & Primeaux, *The Effects of Competition on Transmission and Distribution Cost in the Electric Utility Industry*, 64 LAND ECON. 338-46 (1988).

[33] *Product-specific scale elasticity*, ε_s, is defined as the percentage change in output divided by the percentage change in cost, or $\varepsilon_s = [(\%\Delta\text{Output})/(\%\Delta\text{Cost})]$, where values greater than one imply average cost is decreasing as the level of output increases, i.e., economies of scale are present. *Total scale elasticity* measures the change in output as the proportional response of multiple outputs to a proportional increase in the scale of production. Again, values greater than one imply average cost is decreasing as the scale of plant is increased. See W. BAUMOL, J. PANZAR, AND R. WILLIG, *supra* note 23, pp. 73-74.

to consumers, since such entry may prevent the incumbent cable system from fully realizing all the economies of scale and scope inherent in the production of cable services. Such an inference, however, ignores the possible benefits of competitive entry. For example, if *post-entry prices are lower than pre-entry prices*, then cost penalties must be weighed against increases in consumer welfare resulting from lower prices. Therefore, even if economies of scale are present, gains in consumer welfare from *lower* prices may be expected to more than offset the cost penalty of duplicated facilities. As a result, allowing open-entry into local cable markets, where such entry results in lower prices, can increase net social welfare (exclusive of product variety), despite some loss in static economic efficiency resulting from foregone economies of scale.

28. Although local cable distribution networks are probably characterized by slight economies of scale, empirical evidence concerning the favorable price effects of overbuild competition suggest that entry restrictions in local cable markets are likely to be economically-inefficient and detrimental to the welfare of consumers. Given the prospective entry of competitors using different local distribution technologies, such as MMDS, DBS, and LECs, natural monopoly cost characteristics may tend to constrain the number of overbuilders in most local cable markets but need not necessarily constrain the extent of competitive rivalry that should tend to improve consumer welfare over the longer term.

C. Conditions of Entry

29. Barriers to entry and exit are probably the single most important factor influencing market structure. For public policy purposes, however, the concept of barriers to entry should be carefully defined. Bain specified three sources of barriers to entry, namely, (1) the absolute cost advantages of incumbent firms; (2) economies of scale; and (3) the product differentiation advantages of incumbent firms.[34] Stigler proposed a more general definition of barriers to enter, namely, ". . . a cost of producing (at some or every rate of output) which must be borne by a firm which seeks to enter an industry but is not borne by firms already in the industry."[35] Stigler's general definition of a barrier to entry is broadly accepted in many contemporary industrial organization studies. Christian von Weizsäcker proposes a more restricted definition of a barrier to entry that qualifies Stigler's definition, namely, a barrier to entry is ". . . a cost of producing which must be borne by a firm which seeks to enter an industry but is not borne by firms already in the industry and which implies a distortion in the allocation of resources from the social point of view."[36] Weizsäcker's definition of a barrier to entry suggests in effect that the proposed removal of a barrier to entry requires a cost-benefit analysis that identifies all gains in economic efficiency, including relevant externalities, that are derived from the presence of the entry barrier as well as the

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[34] J.W. BAIN, BARRIERS TO NEW COMPETITION (1956).

[35] GEORGE J. STIGLER, THE ORGANIZATION OF INDUSTRY 67 (1968).

[36] C.C. von Weizsäcker, *A Welfare Analysis of Barriers to Entry*, 11 BELL J. ECON 400 (Autumn 1980).

actual or potential losses in economic efficiency resulting from the entry barrier, including all costs implied in eliminating or minimizing its effects.

30. Since some models of market competition establish a direct relationship between the number of firms supplying the market and the quality of market performance, it appears self-evident that any obstacle impeding the free and easy flow of new firms into the market must have a direct and unequivocal adverse effect on market performance.[37] As a result, the elimination of *any* impediment to entry should produce an unambiguous, although possibly small, incremental improvement in market performance and consumer welfare. Following this logic, the "optimal" public policy toward impediments to market entry is, therefore, one of "zero tolerance."

31. Closer examination of a zero tolerance policy toward barriers to entry suggests, however, that such a policy *without important qualifications* is unlikely to be optimal. From a public policy perspective, *not* all impediments, however, are necessarily *barriers to entry* that require some type of government intervention or remediation. For purposes of this *Report*, costs borne by entrants but not incumbents that have adverse affects on consumer welfare are defined as *policy-relevant barriers to entry*.[38] Barriers to entry defined in this way are candidates for regulatory or antitrust scrutiny, where such scrutiny may result in policy recommendations for reducing or eliminating such entry barriers. Such scrutiny should be approached as a cost-benefit analysis that identifies all possible economic efficiencies, if any, that might result from the presence of the barrier to entry; identifies all offsetting economic inefficiencies that might be attributable to the barrier to entry, if any; identifies all relevant positive and negative externalities; and, finally, estimates the economic cost of eliminating the barrier to entry or minimizing its effects.

1. Fixed and Sunk Costs as Barriers to Entry

32. The existence of both scale and scope economies in local cable system networks may represent a limited impediment to unconstrained market entry by potential overbuilders. The essential question is whether such an impediment to entry is also a policy-relevant barrier to entry. Answering this question, however, requires a careful distinction between several types of cost, especially, *fixed costs* and *sunk costs*.

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[37]For a modern economic analysis of some aspects of the relationship between the number of firms and certain indicators of market performance, see MICHAEL L. KATZ & HARVEY S. ROSEN, MICROECONOMICS, 2nd ed. (1994): pp. 489-493.

[38] A similar point of view regarding the definition of barriers to entry is advanced by Baumol, Panzar, and Willig. They argue that ". . . unlike von Weizsäcker's, our definition seeks to specify operationally what types of impediments meet its criteria, [and] we hope to show . . . that our criterion and his overlap in substance. That is, we argue that anything that is an entry barrier by our definition does reduce the sum of consumers' and producers' surplus, while phenomena such as fixed costs and scale economies need not do so." BAUMOL, PANZAR, & WILLIG, *supra* note 23.

33. For a single-output firm, economies of scale are a consequence of enlarging the production capacity of a plant by installing higher-capacity facilities and enlarging, as necessary, the labor force necessary to produce at larger levels of output. At this higher level of output, the *average total cost of production*, i.e., the sum of *total fixed cost* plus *total variable cost*, divided by the higher level of output, is *lower* compared to the average total cost of production for smaller levels of output where the capacity of productive facilities is smaller. In general, total fixed cost ordinarily represents the estimated dollar value of the annual (implied) flow of productive services rendered by capital equipment, such as investment in cable headend and distribution facilities, that do *not* vary with small changes in the level of output.[39]

34. Achieving a lower total average cost by investing in high-capacity production facilities requires a substantial capital investment and is sometimes described as a *capital barrier to entry*. So long as *both* the incumbent and the entrant can acquire the *same* large-scale production facilities at the *same* purchase price, large total fixed costs implied by investment in high-capacity production facilities do not meet the definition of a policy-relevant barrier to entry. Implicit in the conclusion, however, is a crucial assumption that the fixed cost of high-capacity facilities cannot be reduced by reducing the level of production, *but can be eliminated by total cessation of production*. In other words, fixed cost can be eliminated by shutting down production altogether and *redeploying the capital assets* to some other production process within the firm or selling the assets to some other firm. Indeed, the incumbent may be willing to sell the capital assets to an entrant at the current opportunity cost of the assets and abandon production in this particular market.

35. If, however, the high-capacity production assets *cannot* be redeployed to some other profitable use and should the continued production of output in the existing application become unprofitable, then the fixed cost represented by the investment in such capital assets becomes a *sunk cost*. By definition, sunk costs cannot be eliminated even by total cessation of production.[40] Since sunk cost assets cannot be redeployed, *they have no opportunity cost*. As a simple example, investments in railway cars are largely a fixed cost, apart from ordinary wear and tear resulting from usage. If the current usage of a railway car between two points, A and B, becomes unprofitable, then the railroad can easily redeploy the cars to some other route. The fixed cost represented by the investment in roadbed between points A and B obviously *cannot* be redeployed and, therefore, represents a sunk cost.

36. The policy significance of the difference between fixed and sunk costs is

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[39] For a brief review of the capital theory principles that convert the price of a durable asset (a stock) into an annual price of capital services (a flow), see CARLTON & PERLOFF, *supra* note 8, Appendix 3A, pp. 77-78.

[40] *See* BAUMOL, PANZAR, & WILLIG, *supra* note 23.

important.[41] While fixed costs do not ordinarily represent a policy-relevant barrier to entry, sunk costs sometimes do. Sunk costs may have a direct, and sometimes dramatic, effect on the behavior of dominant firms, such as local cable system operators. Much like the railroad track example above, the costs of constructing a cable distribution network may be viewed as sunk, where the coaxial cable plant is analogous to the roadbed investment by railroads.[42] Significant aspects of the cable distribution and video programming industries are characterized by sunk costs. As a result, strategic behavior by incumbent cable systems may be anticipated as a factor directly affecting market structure for local distribution of video programming.

37. If entry into an industry requires large sunk costs, the value of incumbency can be substantial. Incumbent systems may be able to use their incumbency to forestall or deter competitive entry via a number of entry deterring strategies.[43] In general, economic models of entry deterrence stress the inherent advantage in making the "sunk" investments *first*, thereby limiting the opportunities for profitable entry later. For example, suppose that an incumbent cable system has wired an entire franchise area. A potential entrant will realize that any large scale entry into that market will probably force price down, as the output of the entrant is absorbed by the market. Even if the costs of the entrant are as low as those of the incumbent, the post-entry price may fall below average cost, and entry will prove unprofitable.[44] If the prospective entrant's expectations match this scenario, entry is deterred. This entry-deterrent effect depends on the expectations of the entrant about post-entry

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[41] Transaction cost economics places much emphasis on *asset-specificity*, a concept logically equivalent to sunk cost, although the concept is used to explain the choice between private contracting and the internal organization of firms as alternative institutions for effectuating exchange relationships. *See* OLIVER E. WILLIAMSON, THE ECONOMIC INSTITUTIONS OF CAPITALISM (1985). *See also* Oliver E. Williamson, *Transaction Cost Economics*, HANDBOOK OF INDUSTRIAL ORGANIZATION ch. 3 (Richard Schmalensee & Robert D. Willig eds. 1989).

[42] To some extent, sunk costs are a matter of degree, since almost every asset will have some value in the second-hand market. Tirole notes that sunk investments are not an "all-or-nothing" notion; investments are sunk as long as the costs of redeploying the asset exceed the benefits from doing so. JEAN TIROLE, THE THEORY OF INDUSTRIAL ORGANIZATION 1-3 (1988).

[43] Evaluating all theories of entry deterrence where sunk costs are significant is beyond the scope of this *Appendix*. For a general review of entry deterring strategies, *see* Robert Wilson, *Strategic Models of Entry Deterrence*, 1 HANDBOOK OF GAME THEORY WITH ECONOMIC APPLICATIONS (Robert J. Aumann & Sergiu Hart eds. 1992).

[44] Albert Smiley constructs a model which simulates cable overbuilding with engineering demand and cost functions. His simulations show that profitable entry can be deterred if the incumbent wires the entire franchise market. *See* ALBERT SMILEY, *Direct Competition Among Cable Television Systems*, United States Department of Justice, Antitrust Division, EAG Paper #86-9 (1986).

behavior of the incumbent, the degree of economies of scale, and the level and nature of demand.

38. If an incumbent sets price at the monopoly level, then a prospective entrant may perceive entry to be profitable. The incumbent may be able to deter entry, however, by setting *a limit price*, i.e., a price below monopoly price but above average cost. The incumbent, by accepting less than maximum profit in the short run, prevents entry and maximizes profit in the long run.[45] The implications of a limit pricing strategy for consumer welfare are complex. Since a limit price is lower than the monopoly price, it clearly enhances consumer welfare. If the limit price is *above* the duopoly price, then potential welfare is diminished by the entry-deterring effect of the limit price. Thus, consumer welfare is directly affected by the *type* of limit pricing strategy that an incumbent cable system may adopt.[46]

2. *Product Differentiation as a Barrier to Entry*

39. In addition to sunk costs, product differentiation is sometimes viewed as an impediment to entry in local markets for multichannel video programming distribution. Incumbent cable systems may have an advantage over potential entrants arising from consumer preferences for their products. This preference might be the result of advertising, goodwill, reputation, inertia, or other factors. Product differentiation, according to Bain, is a barrier to entry as entrants must entice customers with a lower price and/or incur a greater selling expense per unit than the incumbent(s). Greater selling expenses, incurred *only* by the entrant, make product differentiation a Stiglerian barrier to entry as well.

40. Product differentiation may constitute a barrier to entry if the extent of differentiation is sufficiently "intense," i.e., consumers perceive alternative products as poor substitutes for the differentiated product or service. Intense product differentiation tends to steepen the slope of the demand curve for the differentiated product and increase the margin

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[45] This simplistic view of limit pricing fails to consider, however, the strategic reactions to entry by incumbent firms. In other words, incumbents must decide whether accommodating or opposing entry is more profitable. If the incumbent firm finds it more profitable to accommodate entry, it will reduce its output, making room for the entrant. Bain and Sylos-Labini assume that entrants expect incumbents to maintain output at pre-entry levels. *See* BAIN, *supra* note 34; PAOLO SYLOS-LABINI, OLIGOPOLY AND TECHNICAL PROGRESS (1962).

[46] Leland Johnson provides an example of a limit pricing response by a cable system when it faced competitive entry. The city of Glasgow, Kentucky, decided to build a competitive municipal cable system. Before the first mile of cable was strung, the incumbent cable operator cut its rates by 60%. This response did not discourage the municipality from continuing construction, but did send a signal to the city regarding the future profitability of its system and the competitive stance the incumbent was prepared to take. *See* LELAND JOHNSON, TOWARD COMPETITION IN CABLE TELEVISION 20 (1994).

of price over the marginal cost of production. As a result, advertising and other marketing expenditures that effectively deepen the consumer's *perception* that a product or service or certain of its attributes is unique relative to possible substitutes both preserves price-cost margins and may make it more difficult for an entrant to launch a competitive product or service. An entrant must incur promotional expenditures to overcome the incumbent's existing market dominance. Such expenditures are unrecoverable by the entrant in the event of market exit and may constitute, therefore, a sunk cost impediment to entry.

41. One view of competition in cable television holds that successful entrants must be able to sell an *identical* product, leaving price competition the only option; however, it is possible that competition in local cable markets may be enhanced by greater product differentiation. Avinash Dixit shows that entry is *easier* if two products, the incumbent's and the prospective entrant's, are *more* differentiated, i.e., poorer substitutes.[47] For example, if two goods were not considered substitutes (e.g., peanut butter and cars), then incumbent firms would have no incentive to deter entry. Interestingly, entry is more easily prevented if the incumbent can claim that its product is a good substitute for the prospective entrant's product. If the substitutability of goods enhances impediments to entry, then incumbent cable firms may be able to slow entry by expanding channel capacity, using programming proliferation to make interfirm differentiation more difficult. Thus, incumbent cable firms may increase the quantity and quality of programming in order to lower the profitability of entry, even in niche markets. If entry does occur, product differentiation will allow a firm to exploit monopoly power more effectively by "claiming a special niche for [its] product" that more closely match the diverse preferences of consumers.[48] Thus, if consumers prefer extensive variety in programming choices, entrants may find it more profitable, at least initially, to compete with the incumbent cable system by offering *complementary* rather than competitive programming.

3. *Other Sources of Entry Barriers*

42. Although not fully addressed in this *Report*, other impediments to market entry in local multichannel video programming distribution markets may grow in importance as competition develops. For example, the network nature of video distribution, whether over wire or air, implies the existence of *network effects* and the applicability of the *systems competition* literature.[49] If compatibility between systems becomes an issue, then barriers to

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[47] Dixit notes that the product differentiation in the Bainian sense relates to absolute differences in demand, i.e., the incumbent's level of demand is not sensitive to the entrant's price, which may still be considered a barrier to entry. In Dixit's model, product differentiation is characterized by a finite cross-price elasticity allowing the incumbent's level of demand to change with the output price of the entrant. *See* Avinash Dixit, *A Model of Duopoly Suggesting a Theory of Entry Barriers*, 9 BELL J. ECON. 20-32 (1979).

[48] *Id.*, at 29.

[49] For an overview *see* KATZ & SHAPIRO, supra note 24.

entry may arise. For example, if costly system-specific interfaces are developed, the fact that potential entrants must convince customers to switch interfaces, losing both the financial and human capital investment, may effectively impede entry.[50] These network effects are more likely to be an issue for wireless entry as system-specific receivers must be purchased by the subscriber.

43. In the *1992 Cable Act*, Congress addressed two particular policy-relevant entry barriers, namely, access to video programming and exclusive franchise contract rules. By foreclosing access to a vital input, such as cable programming, incumbent cable firms can erect a potential entry barrier that impedes or deters competitive entry. This foreclosure can occur either through the bargaining power of a large incumbent (an MSO for example), or by the downstream firm vertically integrating into the programming market and refusing to sell its programming to actual or potential rivals. Program access for multichannel video programming distributors using alternative technologies was addressed by the *1992 Cable Act* and enforcement of the rules appears successful. The local franchise process is, perhaps, the most important policy-relevant barrier to competitive entry in local cable markets.[51] Recognizing the potential barrier that franchising poses, Congress, in order to further competition in the cable industry, prohibited the "unreasonable" denial of a competitive franchise in the *1992 Cable Act*. The effectiveness of this prohibition has yet to be determined.

4. Conclusion

44. This discussion suggests that the presence of various types of sunk costs in the cable television industry probably represents policy-relevant barriers to entry in local multichannel video programming markets. As a result, entry-deterring behavior by incumbent cable systems may be anticipated as competition between cable systems and other MVPD firms develops. This *Report* does not propose, however, a policy response to this possible anticompetitive conduct at this time.

D. Sunk Costs and Industry Structure

45. The pervasiveness of sunk costs may have a decisive effect on long term industry structure.[52] Explaining the relationship between sunk costs and industry structure

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[50]The implications of compatibility in systems markets for the development of competition is addressed in the "Symposium on Compatibility," 40 J. INDUS. ECON. (March 1992).

[51] *See* Thomas W. Hazlett, *supra* note 32; Oliver Williamson, *supra* note 41; Richard Posner, *The Appropriate Scope of Regulation in the Cable Television Industry*, 3 BELL J. ECON. 98-129 (1972).

[52] A formal economic analysis of the effects of sunk costs on industry structure is provided by JOHN SUTTON, SUNK COSTS AND MARKET STRUCTURE (1992). The following discussion closely follows Sutton's conceptual approach.

depends on the distinction between *exogenous* and *endogenous sunk costs*. Exogenous sunk costs represent irreversible investments in productive capacity determined in substantial part by the current technology of production. Thus, in the cable industry, the investment in headend and local distribution facilities sufficient to serve a defined service area represents exogenous sunk costs: both the current technology of multichannel video distribution and the service requirements established by franchising authorities are exogenous factors that drive the amount of investment that a cable operator must commit to a particular multichannel video distribution market.[53] More simply, business firms in general and cable operators in particular have very limited discretion in determining the magnitude of exogenous sunk costs.

46. By contrast, endogenous sunk costs represent expenditures on inputs of production that business firms in general and cable operators in particular can vary with substantial discretion in pursuing business objectives. In general, spending on advertising and research and development are prominent examples of endogenous sunk costs. Although the firm can vary the amount of spending on such inputs of production, such spending, once made is necessarily committed to a particular purpose or business objective and cannot be costlessly redirected to some other purpose. In the cable television industry, spending on video programming is a conspicuous example of a major endogenous sunk cost: spending committed to one type of programming cannot be costlessly redeployed to another type of programming.[54]

47. The analytical significance of the distinction between exogenous and endogenous sunk costs in the cable industry is apparent if the evolution of industry structure is viewed as a *two-stage game*.[55] In the first stage of the game, a cable operator invests in a local distribution network of sufficient scale to serve subscribers in the franchised service area. These fixed *setup costs* incurred in this first stage of the game represent exogenous sunk costs.

48. The second stage of the game analyzes the nature of price competition that occurs *after* the sunk setup costs are incurred.[56] Prices for video programming services set at

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[53] From the perspective of the franchising authority, such costs are clearly endogenous. It is the perspective of the firm as a potential market entrant, however, that is critical in understanding the effects of sunk costs on market structure.

[54] Long-term contractual relationships with program packagers or suppliers rather than "spot market" transactions impart a sunk cost quality to such expenditures.

[55] Although the following discussion is derived from Sutton's game-theoretic model, only an intuitive interpretation of the formal analytics is provided.

[56] Although most local multichannel video distribution markets are presently supplied by a single cable system, this monopoly industry structure is not necessarily inevitable over the longer term, especially if policy-relevant barriers to entry are removed. Thus, price competition to varying degrees should be expected in local multichannel video distribution

the second stage of the game depend only *indirectly* on the exogenous sunk costs required to enter the market, however.[57] More specifically, setup costs influence the entry decision of potential competitors. If the exogenous sunk costs implied by market entry are not perceived as unreasonably large, then more firms will enter the market for local multichannel video programming, leading to greater price competition in the second stage of the game.

49. From this conceptual viewpoint, entry decisions of firms into local markets for multichannel video programming will be influenced by the *interplay* between the levels of setup costs in the first stage of the game and the intensity of price competition that firms face at the second stage.[58] If price competition is intense at the second stage of the game, then post-entry profits will be *lower*, all other things remaining the same, and the *fewer* will be the number of firms choosing to enter the market for local video programming. Thus, long term market structure will reflect a tension between the level of exogenous sunk costs that must be committed to enter the market -- and that must be recovered to justify entry ex-post -- and the intensity of price competition that occurs in the second stage of the game. In general, more entrants will tend to increase the intensity of price competition. Lower prices resulting from such competition will make entry less attractive, however, to still other potential entrants.[59]

50. Implicit in the foregoing analysis of exogenous sunk costs and price competition is the assumption that each entrant in the local market for multichannel video programming offers similar, or virtually homogenous, programming to its subscribers. If, however, different firms offer their subscribers substantially-differentiated programming compared to that offered by competitors, then long-term market structure may differ from that of the homogenous product case. Spending on programming is an endogenous sunk cost that a cable operator can vary to deepen the extent of product differentiation relative to the programming offered to subscribers by competitors. Other things remaining the same, increases in endogenous sunk costs may be expected to enhance the subscribers' willingness to pay for the video programming package offered by the cable operator and, thereby, weaken the extent of price competition in stage two of the game. Therefore, unlike the case of homogenous programming offered by competing cable operators, market structure may still remain relatively concentrated, notwithstanding the relatively higher level of post-entry

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markets over the longer turn, as the limited experience with cable overbuilds tends to show.

[57] *See* SUTTON, *supra* note 52, at 29.

[58] *Id.*

[59] *Id.* This relationship between the extent of market entry and the extent of price competition depends critically on the *form* of price competition that actually develops. Three possibilities are commonly cited, namely, (1) Cournot competition; (2) Bertrand competition; and (3) joint profit maximization. For further discussion, see SUTTON, *supra* note 52, chps 2 & 3. Experience in local multichannel video markets where overbuilders compete directly with incumbent cable systems appears roughly consistent with Bertrand competition.

profits that persist given the weakened level of price competition.[60]

51. This discussion illustrates in a highly simplified way how both exogenous and endogenous sunk costs may have a decisive effect on the evolution of local market structure for multichannel video programming distribution over the longer term. This analysis identifies possible trade-offs between the number of actual competitors in any local cable market and the intensity of price competition that might prevail. Implicit in the analysis is the possible influence that large market areas served by any given cable operator may have in reducing market concentration; more firms may be willing to commit to the exogenous sunk costs required to enter the market if the universe of potential subscribers is larger. As a result, the possible entry-deterring effects of vigorous price competition in the stage two game would be mitigated to some extent. Such market structure implications should help guide both the nature of inquiry and policy analysis in future reports.

III.
METHODOLOGICAL ISSUES

52. The assessment of the extent of competition in the market for the delivery of multichannel video programming may be approached from alternative perspectives. In general, the few comments received on methodology recommended that a legal and economic approach should inform the Commission's analysis and urged the Commission to take a relatively broad view of competition in this and future reports. For example, WCA would like the Commission to seek data that will permit a competitive analysis broader than the "wired" market.[61] TCI urges the Commission to adopt a dynamic approach to analyzing competition in the delivered video programming market.[62] Similarly, Time Warner states that the Commission should take a broad approach in its methodology which would consider virtually all information and entertainment media in its analysis.[63] Finally, Home Box Office ("HBO") submitted a paper by Professor Paul L. Joskow which examined various methodologies the Commission could and should adopt in studying "competition".[64] HBO and Professor Joskow urge the Commission to use "comparative institutional analysis" as a means of assessing competition, which would broadly apply the tools of modern industrial

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[60] *Id.* at 27.

[61] WCA Comments at 26-27.

[62] TCI Comments at 2-6; *see also* NCTA Reply Comments at 2.

[63] Time Warner Comments at 4-9.

[64] Paul L. Joskow, Economic Methodologies for Evaluating Competition and Performance in Video Programming and Distribution Markets (Exhibit A to HBO Reply Comments).

organization economics to this industry.[65]

53. As proposed in the Notice of Inquiry in this proceeding, a prominent methodological approach developed in the field of modern industrial organization economics is the *structure-conduct-performance (SCP) paradigm.*[66] The SCP methodological framework facilitates the systematic study of the extent of competition from a variety of viewpoints, and is broad enough to accommodate a number of more specialized approaches toward the study of competition. In a general way, the organization of this *Report* is consistent with the SCP paradigm. The Commission, however, is not adopting a specific methodology for assessing the extent of competition in markets for multichannel video programming distribution at this time. Future reports, however, may address such methodological issues at greater length and propose a general methodology that is consistent with the purposes of such studies on competition in video programming distribution markets.

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[65] *Id.* at 2-9. Comparative institutional analysis would be beneficial, Professor Joskow argues, because it would evaluate markets in the context of their basic economic characteristics; would focus on long-run consumer welfare; would be able to consider the effect of regulation on market performance; and would be flexible enough to balance "imperfections of regulation against imperfections of unregulated . . . markets." *Id.* at 9.

[66] *See* F.M. SCHERER and DAVID ROSS, INDUSTRIAL MARKET STRUCTURE & ECONOMIC PERFORMANCE ch. 1 (3rd ed. 1990); CARLTON & PERLOFF, *supra* note 8, at chs. 1 & 9; TIROLE *supra* note 42.

APPENDIX I

1. This appendix describes the q ratio calculations that appear in Section V of the main text. The q ratio, defined as the ratio of the market value of a firm to its replacement cost, is a measure of market power. The Commission discussed its properties in the *1990 Cable Report*.[1] This appendix addresses the "nuts and bolts" details of the calculations. The broad procedures used follow those used by Professor Paul MacAvoy in a 1990 submission to the Commission.[2]

2. MacAvoy used two separate techniques for calculating market value. He calculated "public" market values for a sample of "pure" cable companies (*i.e.*, companies whose sole business activity was cable television delivery). The public market value is the sum of a firm's liabilities and the value of its outstanding stock (price multiplied by number of outstanding shares). This figure may then be divided by the number of subscribers that the firm serves. Table I-1 shows 1993 public market value calculations for the four firms that the Commission identified as pure cable companies. Two of them, Adelphia and TCA, were also in the MacAvoy sample. (The other three firms in the MacAvoy sample are American TV and Communications, Falcon Cable Systems Co., and Galaxy Cablevision.)

3. The second market value concept is "private" market value. This is the subscriber-weighted average of per subscriber selling prices of cable companies during a relevant period. Table I-3 contains two such estimates, one based on twenty-four 1993 transactions and one based on six announced 1994 transactions. In each case, only cash transactions are included in the calculation, because it is difficult to determine an equivalent cash value for transactions with other components.

4. MacAvoy also employed two techniques for calculating replacement costs. The first is based solely on financial data for pure cable companies and consists of an estimate of adjusted book value of tangible assets. For each pure cable company, tangible assets are divided into net plant and other tangible assets. Net plant (*i.e.*, depreciated book value of plant) is adjusted for inflation and added to other tangible assets, and the sum is divided by the relevant number of subscribers. The inflation adjustment is based on a rough estimate of the average age of plant. The average age of plant is taken to be the difference between gross and net plant divided by current annual depreciation. That average age is multiplied by an annual inflation rate (assumed herein to be four percent) to get the percentage by which net plant must be increased to adjust it for inflation.

5. The second replacement cost method uses current construction cost estimates to derive a net plant figure. This procedure entails adjusting current construction cost per

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[1] *1990 Cable Report* ¶¶ 54-59, App. E, 5 FCC Rcd at 4997-99, 5071-82.

[2] *See* Paul W. MacAvoy, *Tobin's q and the Cable Industry's Market Power*, Comments of the United States Telephone Association in Appendix 5, *1990 Cable Report*, 5 FCC Rcd 4962 (1990) (MM Docket No. 89-600).

subscriber for depreciation to obtain net plant per subscriber. Adding this net plant figure to other tangible assets per subscriber (from the sample of four pure cable companies) yields an estimate of replacement cost per subscriber. The average ratio of net to gross plant for all cable companies in the data source (the Paul Kagan Cable Financial Databook) is used to adjust current construction costs. Table I-2 exhibits these calculations for four construction cost estimates.

6. The estimates of construction costs generally have three components. They are: (1) headend and cable plant; (2) converter box; and (3) "drop and install." This last item is the cost connecting a subscriber to the cable that passes his or her home. One of the headend and cable plant estimates comes from a paper by David Reed.[3] Reed's estimate of $962 is based on an assumed 40% cable penetration rate of homes passed. The actual penetration rate in 1993 was 63%.[4] Adjusting for this yields an estimated headend and cable plant cost of $611 per subscriber. Reed estimates the cost of a converter box at $125 and of drop and install as $50. These latter figures are also used in conjunction with the alternative cable plant and headend estimates.

7. MacAvoy's series of construction cost estimates contains one figure that excludes the drop and install component. The exclusion could be justified on the grounds that at least some cable subscribers pay a separate fee for installation rather than paying for it indirectly via the monthly service charge. To preserve some consistency with the MacAvoy procedure, the current series of construction costs contains one estimate, based on Reed's figures, that excludes drop and install. Accordingly, the "Reed 1" figure in table I-2 is 736=611+125 and the "Reed 2" figure is 786=611+125+50.

8. The other two entries in Table I-2 are labelled "MacAvoy 1" and "MacAvoy 2." They track two of MacAvoy's construction cost estimation procedures. The present calculations are based on data from a different source than MacAvoy used, but the technique is the same. MacAvoy 1 starts with estimates of new build construction costs for 1993 of $646 million and new homes passed of 1.8 million. These figures, along with the 1993 penetration rate of 63% yield an estimated cable plant construction cost of $569.66. Adding to this the converter box and drop and install figures yields $744.66. The MacAvoy 2 estimate begins with the same new build construction cost estimate and with an estimate of 54,900 miles of new plant construction for 1993. Applying an assumed 90 homes per mile and the 63% penetration rate yields an estimate of $207.53. Inclusive of converter box and drop and install, the MacAvoy 2 construction cost estimate is $382.53.

9. Table I-3 contains a series of q ratio calculations, which are also reproduced in the main text of this report. By way of comparison with MacAvoy's earlier work, it is

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[3] David P. Reed, *The Prospects for Competition in the Subscriber Loop: The Fiber-to-the-Neighborhood Approach* (presented at the Twenty-First Annual Telecommunications Policy Research Conference (September 1993).

[4] Paul Kagan Associates, Inc., MARKETING NEW MEDIA, Dec. 20, 1993, at 4.

interesting to note that his public market value per subscriber figure of $1698 is lower than the $2326 figure for the current sample of pure cable firms. By contrast, MacAvoy's private market value estimate of $2311 per subscriber is significantly higher than the $1759-$1831 range for 1993 and early 1994. With respect to replacement cost, MacAvoy's median estimate based on construction cost data was $372.50, while the current figure is $444.99. The calculations herein are thus similar to those of MacAvoy, but not precisely comparable. The current sample of pure cable firms differs from that used by MacAvoy, and the construction estimates come from different sources.

TABLE I-1
Replacement Data for Four Pure Cable Companies

	ADELPHIA	MERCOM	MULTIMEDIA	TCA Average	Weighted Average
Balance Sheet Date	March 1993	Year-End	Year-End	October 1993	
Equity (mil)	287.231	9.960	1,274.442	702.838	
Liabilities (mil)	1,818.207	29.109	768.20	162.814	
Market Value (Total Equity + Liabilities) (mil)	2,105.438	39.069	2,042.732	865.652	
Subscribers Per System	1,244,000	37,757	417,333	473,000	
Market Value per System	$1,692.47	$1,034.75	$4,894.73	$1,830.13	$2,326.28
Net Plant (mil)	398.859	17.946	240.762	106.411	
Adjusted Net Plant (mil)	449.469	22.305	290.520	125.311	
Other Tangible Assets (mil)	111.135	1.310	163.056	7.259	
Replacement Cost (mil)	560.604	23.615	453.576	132.570	
Replacement Cost Per Subscriber	$450.65	$625.45	$1,086.84	$280.27	$538.81
Other Tangible Assets Divided by Subscribers	$89.34	$34.69	$390.71	$15.35	$44.46
Q Value	3.7556	1.6543	4.5036	6.5298	4.4669

Sources: Paul Kagan Assocs., Inc., CABLE TV FINANCIAL DATABOOK, 58, 70,72, 74 (1994). Subscriber information supplied by MERCOM, Inc. CABLE TV INVESTOR, June 7, 1997, at 4.

TABLE I-2
Replacement Cost Per Sub
Based on
Construction Cost Estimates

	Gross Plant Per Sub[5]	Net Plant Divided by Gross Plant[6]	Estimates Net Plant	Other Tangible Assets[7]	Replacement Costs
Reed 1	736	.541	398.18	44.46	442.64
Reed 2	786	.541	425.23	44.46	469.69
MacAvoy 1	744.66	.541	402.86	44.46	447.33
MacAvoy 2	382.53	.541	206.95	44.46	251.41

[5] See text.

[6] PAUL KAGAN ASSOCS., INC., CABLE TV FINANCIAL DATABOOK 72 (1994).

[7] From Appendix I, Table 1.

TABLE I-3
q RATIOS

Public Market Value Divided by Adjusted Book Value (Four Firms)[8]	4.47
Public Market Value Divided by Adjusted Book Value (Two Firms Common to Current and MacAvoy Sample)[9]	4.52
Public Market Value Divided by Median Replacement Costs (Four Firms)[10]	5.23
Private Market Value (1993 Transactions) Divided by Median Replacement Cost[11]	4.11
Private Market Value (Some 1994 Transactions) Divided by Median Replacement Cost[12]	3.95

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[8] From Table 1.

[9] From Table 1, weighted average of Adelphia and TCA q ratios.

[10] From Tables 1 and 2; mediam replacement cost per subscriber, $444.99.

[11] Median replacement cost per subscriber of $444.99 from Table 2. Private Market Value of $1831.10 per subscriber based on 24 cash transactions reported in PAUL KAGAN ASSOC. INC., CABLE TV FINANCIAL DATABOOK 138 (1994).

[12] Median replacement cost per subscriber of $444.99 from Table 2. Private Market Value of $1759.49 based on six cash transactions reported in Cable World, June 27, 1994, at 1, 36.