Cable, Cities and Copyrights

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in association with
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ABSTRACT

The Federal Communications Commission has enacted final rules for cable television systems in the 100 largest television markets, restricting cable service to a greater degree than previously proposed. Most systems will be limited to importing only two distant television signals. Furthermore, they are required to "black-out" imported programs that duplicate a local station's showings at any time up to a year before or after they are locally broadcast.

Left unresolved is the issue of payment of royalties to copyright owners for the programs carried by cable. This paper examines the profitability of major market cable systems subject to the final FCC rules with particular attention to the effects of several copyright fee proposals, including one incorporated in pending legislation. It uses an earlier model constructed to evaluate the 1970 FCC proposals for cable, with substantial modifications to include both the effects of the new rules and recent research findings on cable demand and cost parameters.

The results indicate that, except where atypical conditions prevail, cable systems will be unprofitable in central urban areas having good broadcast reception but marginally profitable on the edges of the larger cities. In these latter cases rates of return are not far above the estimated cost of capital. However, copyright fees of the magnitude that have been proposed are likely to deter cable construction in many of these areas, since rates of return are sensitive to the additional costs and, because demand is price-elastic, higher prices could not increase revenues.
ACKNOWLEDGEMENTS

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I. INTRODUCTION

Final rules of the Federal Communications Commission governing cable television service in the 100 largest television markets went into effect March 31, 1972. The FCC acted after six years of formal proceedings; during that period development of cable service in major cities had been blocked by interim regulations that effectively prohibited the importation of distant television signals. The final rules permit limited importation, varying with the size of the market and the locally-receivable signals. At the same time the rules provide broad "exclusivity" protection to local stations for their programs, requiring cable systems to delete programs under contract to local stations from the imported signals.

The FCC's cable rules have evolved considerably from the 1970 proposals\(^1\) and from Chairman Burch's "letter of intent" to the chairman of the Senate Subcommittee on Commerce.\(^2\) The final rules are the outcome of a "compromise agreement"\(^3\) among the broadcasting, cable, and copyright interests that was promoted by the President's Office of Telecommunications Policy (OTP). The compromise placed additional restrictions on cable through exclusivity provisions for copyrighted programs shown by local stations as well as through an agreement by all parties to support legislation that would impose copyright liability for importation of distant signals.

**Signals Allowed**

The rules now in effect for the major cities may be summarized as follows:

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\(^1\)[12]. An economic analysis of the FCC package appears in [7].

\(^2\)Printed in [5].

\(^3\)In publishing the formal text of the agreement, the FCC preferred the term "consensus." [13], p. 3258.
(1) A cable system must carry
   a) All stations licensed within 35 miles of the system.
   b) All stations that are "significantly viewed" in the
cable system's community.4

(2) Cable systems may import distant signals to reach minimum
service levels, as follows:
   a) In markets 1-50
      • Minimum service: 3 networks and 3 independents.
      • Programs on imported signals are subject to both
        1 year preclearance and life-of-contract protection.5
   b) In markets 51-100
      • Minimum service: 3 networks and 2 independents.
      • Programs on imported signals are protected for a
        2-year maximum when under contract to a local station.
   c) In markets 101+
      • Minimum service: 3 networks and 1 independent.
      • There are no exclusivity limitations.

(3) Cable system in markets 1-100 may import up to two distant
commercial signals after subtracting any signals imported to
meet the minimum service standard.

(4) Foreign-language stations may be imported without limit.
Non-commercial stations are also unlimited, unless there
is local or state objection from educational broadcasters.

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4 Network signals are significantly viewed if they have a 3 percent
viewing share and 25 percent net weekly circulation; independent signals
must have a 2 percent viewing share and 5 percent net weekly circulation.
Viewing share indicates roughly the intensity of viewer interest, and net
weekly circulation the technical availability of a signal in the community.
According to [23, p. 181] 16 of the 37 UHF independents will fail to meet
the viewing test in their own county.

5 The exclusivity provisions are discussed in greater detail below.
In the final rules, the FCC has dropped its earlier proposals for a 5 percent tax on cable revenues to support public broadcasting and the scheme to have operators substitute the commercials of local stations for those appearing on imported signals. As previously proposed, the rules contain requirements for 20 channels of capacity in the top 100 markets, a potential for reverse (nonvideo) communication from the home to the cable center, and FCC fees of 30 cents per subscriber. Technical standards are specified, and an annual performance test must be completed.

The new rules significantly increase the requirements for locally programmed channels. For each broadcast channel, the system must have available a nonbroadcast channel. Specifically mandated are three "access" channels for public, educational, and governmental uses. The latter two are to be provided free on a five-year experimental basis; the public access channel must make the first five minutes of time and equipment free to all comers on a nondiscriminatory basis. The system must have one or more channels available for leasing, and must expand them when demand increases. Finally, the FCC suggests that 3 percent to 5 percent of gross revenues are appropriate levels for local franchise fees, and indicates that higher fees require a showing of cause to the Commission.

Omitted from the rules are any requirements that cable systems pay compensation to copyright owners for the programs carried. The FCC has preferred to leave this issue to the courts and the Congress, and a section of the OTP compromise agreement commits the parties to support legislation setting liability and fees. Thus, apart from copyright fees, the parameters that will affect cable development in the major cities are now determined.

Simulation Model

In this paper we assess the profitability of cable television in the major markets under the final FCC rules, with particular attention to the effect of several alternative copyright fee schedules that have been proposed. Our research extends the computer simulation model and
detailed cost and revenue data developed by Comanor and Mitchell\textsuperscript{6} in their study of the impact of the rules proposed in July 1970.

The Comanor-Mitchell model of a cable television system consists of detailed capital and operating cost items specified as functions of system size (the number of subscribers), number and types of signals carried, housing density, type of system construction, and penetration (percentage of potential homes that subscribe). Penetration, or demand, is a function of the price of cable service, family income, and the increase in number and types of television signals provided by the cable system relative to those available off-the-air. Revenue is derived from the system's size, penetration, and price of service, with a small allowance for advertising revenues that may be earned on a local origination channel programmed by the cable system.

The Comanor-Mitchell cost functions were constructed from audited accounting statements, equipment price lists, and pro forma estimates supplied by a small sample of system operators. In the original model, the penetration equation was estimated by least squares from a random sample of operating systems. For this paper, however, estimates of penetration are taken from R. E. Park's more recent econometric study,\textsuperscript{7} as discussed below.

For any given set of market and system characteristics (e.g., number of signals, housing density, system size, etc.), the model simulates the first 15 years of operation of the specified system and calculates the internal rate of return on total capital on the assumption that the system will be rebuilt periodically and generate revenues indefinitely.

In this paper we considerably modify and expand the original model to include the following:

- The March 1972 FCC rules,
- More accurate and detailed predictions of penetration in major markets.
- The effect of the exclusivity provisions on penetration.

\textsuperscript{6}[7].
\textsuperscript{7}[25].
-5-

- A comprehensive set of cable system parameters encompassing market type, available signals, system location, and subscriber and construction characteristics.
- Four alternative copyright fees schedules (including no fees).

In outline, the analysis of cable profitability focuses on a number of market and system characteristics that can be identified as typical or representative of a cable system if it were to be constructed under current rules. By varying the characteristics (e.g., system size, or lineup of local signals, or housing density) over a comprehensive set of possibilities, the outlook for cable in nearly all parts of the major markets can be assessed. In this analysis, costs and prices have been measured in 1970 values; costs, revenues, and rates of return are consequently in "real" terms. Except for rules changes since July 1970, cost figures are based on Conmanor and Mitchell's detailed report.

Our analysis includes revenues from subscribers, determined by penetration rates dependent on local and distant signals carried, and a realistic amount from advertising on a local origination channel. No revenues or costs have been attributed to the development of leased channels.

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8 All systems considered in this study are newly constructed. The effect of potential copyright fees on existing systems in comparable market circumstances would be somewhat different only in the short run. For several years, these already-built systems would experience reduced profitability and the systems' owners would earn lower returns than they had anticipated. At the same time, revenues would still exceed operating costs, so that the original systems would not actually go out of business. But subsequently, when the systems required rebuilding, the copyright fees could make reconstruction unprofitable, since nearly the same investment considerations apply either to rebuilding an existing system or to constructing the same type of system in a similar but unwired community.
II. THE COPYRIGHT ISSUE

Broadcast stations pay copyright royalties to producers of the programs they transmit. Cable systems pay similar fees for movies and other material shown on their local origination channels, and they must also purchase rights to the programming carried on pay or leased channels. But cable systems currently obtain the bulk of their video material—the local and distant broadcast signals—without a payment to either the stations or the copyright holders of their programs.

The legal status of broadcast signals carried by cable has been based on the *Fortnightly* decisions, in which the Supreme Court held that a cable system acts as a large antenna for the subscriber and does not "perform" the programming material carried over its wires. Consequently, copyright owners have been unable to extract royalties from the cable systems carrying their programs. *Fortnightly* was brought against a system that carried only locally receivable signals and left unresolved the status of signals imported by microwave (or eventually satellite) from distant locations.

In *CBS v. TelePrompTer*, a lower court again held that no liability attached to a cable operator for carrying broadcast signals. However, the decision was reversed by the Court of Appeals. At this writing, that action is under appeal to the Supreme Court, and for the moment the appellate court ruling is in abeyance.

To assess the economic effects of cable carriage of broadcast signals, we consider first the market for programming in the absence of cable. Broadcast stations earn revenues from selling air time for commercial messages, with advertising rates proportional to the audience for the program on which the commercial appears. The size of the audience a program

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10 Liability does attach if the cable system tapes the broadcast program and retransmits it at a later time. [27], p. 29.


will receive is determined by its attractiveness relative to that of programs on competing stations and in part by the appeal of programs "adjacent" in time to it on the same station. Networks and independent syndicators compete for the supply of programming created by program producers.\textsuperscript{13} If now, a cable system that carries all the local signals is constructed in that community, subscribers have the same menu of signals as before.\textsuperscript{14} We may assume that the aggregate audience of the local stations is not diminished by this arrangement, and that advertisers have no reason to pay lower time rates merely because some viewers of their commercials see them over the cable.

When the same system imports independent stations from another community, the audience of the imported stations is enlarged. While total viewing by cable subscribers may well increase because of the greater number and types of program alternatives, viewing of local stations usually declines as well.\textsuperscript{15} The first question is to what extent the imported stations' advertising rates will increase to reflect their larger audiences.\textsuperscript{16} At present, advertisers on independent stations typically purchase audience "by the market," buying time from one local station in each market they wish to reach. Thus advertisers now ascribe little value to additional viewers outside the station's customary viewing area. But this is not likely to be the long-run pattern. Cable systems will attempt to import the independents with the strongest lineup of programs, subject to the microwave costs of doing so. As cable importation develops, the major independents will enjoy substantial increases in their audiences and come to be, in effect, regional or national stations.\textsuperscript{17} In this form

\textsuperscript{13}See, e.g. [3], [10], [23].

\textsuperscript{14}For such a system to attract any subscribers, it would either have to improve reception quality or be no more costly than home antennas.

\textsuperscript{15}See [15], [23], [24].

\textsuperscript{16}Since audience data are routinely collected by county for every station, cable viewing does get attributed to distant stations.

\textsuperscript{17}The three largest independents are currently carried on cable systems with total audiences of 1.1 million, 600,000 and 480,000 respectively. 

\textit{Broadcasting}, July 2, 1973, p. 46. See also [23], p. 170.
they will compete for regional and national advertising with the existing networks, and rates will reflect their total audience. Advertising revenues of the local network affiliates will decrease while independents will gain revenues. The change will give independents an improved position in bidding for programming.

Determining the final effects on the distribution and amounts of payments to program suppliers and the supply of programs produced would require a full-scale analysis that we shall not attempt here. Without copyright liability, the long-run development is likely to be a few strong national independent stations whose major audiences are on cable. This configuration has some of the features of a fourth broadcast network, but a different division of revenues. Revenues for such a "network" arise from both advertising sales and cable subscriptions. All advertising income flows to the stations which contract for the programming; all subscriptions are retained by the cable operator. In contrast, regular network affiliated stations carry the network programs and receive a share of the national advertising revenues as well as the revenues of locally sold spot messages they insert into the network programs.

The most likely effect is that there would be some redistribution of compensation from those program owners now supplying the networks to the suppliers of the major independents. New resources might be attracted to the television programming industry. This is particularly likely if cable systems pay copyright fees. But whether the aggregate payments to program owners would increase or decrease without cable copyright liability is an open question. To the extent that networks currently exercise monopsony power in purchasing programming, the rise of a cable network composed of independent stations would reduce the existing networks' power and require them to pay higher rates to suppliers.

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18 The efficiency of this market arrangement in satisfying viewer tastes merits separate analysis.
19 See [14] and [23], Appendix B.
In its final cable television rules, the FCC has enacted broad exclusivity protection for copyright holders, yet it also clearly anticipates copyright legislation. In ruling on the cases before them, the courts have indicated that congressional action is needed. The OTP compromise commits the interested parties to support legislation that establishes, by statute, cable's access to broadcast signals and sets royalty fees for their use. And in response to these concerns, the chairman of the Senate Subcommittee on Patents, Trademarks, and Copyrights has introduced a bill that would revise the Copyright Law in that manner.

The McClellan bill would affect all cable systems that import distant signals. They would be granted a compulsory license to carry the programming of the imported signals and would make royalty payments on a quarterly basis into a copyright fund. The Register of Copyrights would then disburse the payments to owners of the programming copyrights who may agree among themselves on the division. Disputes are to be adjudicated by a royalty tribunal.

In the following analysis we consider four alternative fee schedules for payment by cable systems to copyright owners. Schedule 1 is the baseline case of zero fees. Schedules 2 and 3 levy successively larger fees as the system's revenue grows. Schedule 3 (incorporated in the McClellan bill) begins at 1 percent of subscriber revenues and rises to 5 percent of revenues exceeding $640,000 annually; Schedule 2 is exactly half of Schedule 3. For Schedule 4, we consider a flat fee of 16.5 percent of subscriber revenues, as proposed by copyright owners during negotiations that followed the OTP compromise agreement. Details of these fees are set forth below and in Figure 1.

<table>
<thead>
<tr>
<th>Copyright Fee Schedule No. (Percent)</th>
<th>Annual Subscriber Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>0</td>
<td>1.5</td>
</tr>
<tr>
<td>0</td>
<td>2.0</td>
</tr>
<tr>
<td>0</td>
<td>2.5</td>
</tr>
</tbody>
</table>

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20. S. 1361, 93rd Congress.
Fig. 1—Alternative copyright fee schedules
In comparing systems in different market circumstances and with alternative fee schedules, we keep unchanged the subscriber price as well as the system size and other attributes of cable service. Cable television systems have some of the attributes of a "natural monopoly" because of their high fixed-low variable cost structure. But in practice, the behavior of cable systems is increasingly limited by local and federal regulation and by competition among firms for franchises. Both of these forces sharply restrict the ability of cable firms to adjust price or output at will.

Monthly subscriber rates have remained virtually constant in current prices over several years as a result of these forces plus the threat of more extensive regulatory action if firm behavior is perceived as excessive. In 1970, Seiden\textsuperscript{22} found most recently franchised systems charging between $5.00 and $7.00 per month. Comanor and Mitchell reported a mean price of $5.00 per month in their sample of \textit{Television Factbook} systems.\textsuperscript{23} Park in 1972 observed an average annual price of $63.\textsuperscript{24} The assumption that moderate cost increases, including new copyright fees, cannot be passed on by price increases is consistent with recent market experience.

Assuming no price response by cable firms if a 16.5 percent fee were imposed requires further discussion. Operating firms would doubtless make strong representations to local authorities about the need for higher prices, and bids for new franchises would quote higher rates. But granting for the moment that regulators allowed part or all of the surcharge to be translated into higher subscriber rates, how would cable profits be affected? The answer depends primarily on the price elasticity of demand.\textsuperscript{25}

Park's study of penetration estimates a nearly unitary elasticity,\textsuperscript{26} and independent estimates from a linear probability model, applied to individual household data, imply a price elasticity of -0.97 to -1.09.\textsuperscript{27}

\textsuperscript{22}[28].
\textsuperscript{23}[9].
\textsuperscript{24}[25].
\textsuperscript{25}For a discussion of the effect of demand elasticity on maximum rates permitted by a regulatory authority, see [9].
\textsuperscript{26}[25], p. 145.
\textsuperscript{27}[6].
These findings are broadly consistent with the availability of good substitutes for cable television service in urban markets. Households in areas with a diversity of over-the-air signals, with generally clear reception, and with a variety of entertainment alternatives, can be expected to decline service rapidly as the monthly price rises.

How, then, would cable systems' profits be affected by a 16.5 percent copyright payment and a concomitant rise in subscriber rates? Revenues would be approximately unchanged, while operating costs would increase sharply by the amount of the copyright payments. Some reductions in other incremental costs would occur by not serving the subscribers who do not purchase service at the higher price. For typical systems, these are the rather small costs of installing additional drop lines, additional maintenance and billing expenses, and higher taxes and dues related to numbers of subscribers. The net effect of allowing higher subscriber rates in conjunction with 16.5 percent copyright fee payments would be to reduce rates of return to nearly the same levels as would be achieved by holding subscriber rates unchanged with the same 16.5 percent copyright fees; and penetration would be lower, providing a narrower base for future leased-channel services.

The discussion in the preceding several paragraphs assumed a degree of upward price adjustment that has not been observed. In the remainder of this study we adhere to a fixed monthly price of $5.00$^{28} for maximum cable broadcast service allowed by the FCC rules. An analysis of the profitability of systems under the alternative assumption of higher rates and consequently reduced penetration would yield approximately the same findings.

$^{28}$ Plus $1.00 for second television sets in 20 percent of the households. No revenue from installation charges is included, as these fees are seldom if ever actually collected. See [6] and [8].

$^{29}$ Since we are considering all prices and costs in 1970 terms, increases in the monthly subscription rate at aabout the rate of increase of consumer prices generally will not contradict our observation that real subscription rates cannot be adjusted.
III. MAJOR PARAMETERS

Market Characteristics

In examining the probable effect of various provisions for payment of copyright fees, we consider separately the characteristics of typical cable systems in four types of markets: the top 50 markets, markets ranked 51-100, markets above 100, and areas located outside television markets. The FCC rules permit different signal carriage in each situation, and impose differential requirements affecting system costs. In addition, the density of housing, the prevalence of underground utilities, and the level of family income also vary by market size. A summary of these major market characteristics is set forth in Table I.

As R. E. Park's econometric findings\(^\text{30}\) demonstrate, the location within the market is also of fundamental importance to determining penetration levels. For this study we therefore subdivide each of the markets 1-50, 51-100, and 100+ into typical "middle market" and "edge market" systems. Middle-market locations are close to off-the-air signals, while edge-market systems are approximately halfway between the transmitter and the B-contour limit of the local signals.\(^\text{31}\) (The fourth category, an "outside" market system, is necessarily at or beyond the location of a typical edge-market system.) Thus the typical systems analyzed fall into one of seven boxes in the following matrix:

<table>
<thead>
<tr>
<th>Market Type</th>
<th>Location</th>
<th>Middle</th>
<th>Edge</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>51-100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>101+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outside</td>
<td></td>
<td>------</td>
<td></td>
</tr>
</tbody>
</table>

\(^{30}\)\(^\text{[25]}\).

\(^{31}\) Central city areas with reception impeded by tall buildings will have high density but also high penetration rates. B contours are calculated from FCC engineering formulas and are intended to enclose areas
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>1-50</th>
<th>51-100</th>
<th>101+</th>
<th>Outside</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local signals typically available</td>
<td>3 networks, or 3 networks + 1 independent</td>
<td>3 networks (some UHF)</td>
<td>2-3 networks (some UHF)</td>
<td>1-2 networks (some UHF)</td>
</tr>
<tr>
<td>Imported signals allowed</td>
<td>2 in all cases; 2-3 independents typical</td>
<td>2 in all cases; 2 independents typical</td>
<td>maximum of 1 independent plus any missing networks</td>
<td>no restrictions</td>
</tr>
<tr>
<td>Exclusivity protection</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Capacity requirements</td>
<td>20 channels 2-way capability</td>
<td>20 channels 2-way capability</td>
<td>12 channels 2-way capability</td>
<td>12 channels 2-way capability</td>
</tr>
<tr>
<td>Local origination</td>
<td>standard; minimum below 10,000 subscribers</td>
<td>standard; minimum below 10,000 subscribers</td>
<td>standard; minimum below 10,000 subscribers</td>
<td>minimum</td>
</tr>
<tr>
<td>Density (houses per mile)</td>
<td>150-200</td>
<td>125-150</td>
<td>100</td>
<td>80</td>
</tr>
<tr>
<td>Underground</td>
<td>10-20%</td>
<td>5-10%</td>
<td>5%</td>
<td>0%</td>
</tr>
<tr>
<td>Family income (projected to 1975)</td>
<td>$11,400-$12,200</td>
<td>$10,000-$11,400</td>
<td>$10,000</td>
<td>$9,000</td>
</tr>
</tbody>
</table>

Table 1

MAJOR CHARACTERISTICS OF TELEVISION MARKETS
Within each box indicating a specific market type/system location, we further consider the two or three most likely lineups of available local signals. While we have not reported every combination that can occur, the cases tabulated represent the major signal patterns to be encountered, and they cover a degree of variation sufficient to include most other possibilities.  

Cable Penetration

Of the many parameters affecting the financial prospects of cable systems, penetration (the percentage of homes passed by the cable that choose to subscribe) is generally the most important. Given that the cable distribution system is already constructed, the marginal cost required to wire an additional home is quite low.

The determinants of cable penetration in fringe reception areas have been investigated statistically by Comanor and Mitchell; Park; and Noll, Peck and McGowan. All three studies use randomly drawn samples of data published by the trade press. While these data introduce some errors of observation, their greatest limitation is that they are drawn almost entirely from systems located in communities with technical reception difficulties, fewer than three network signals, or both.

In contrast, the television environment in the major markets is quite different from this experience. All of the 100 largest markets have three-network service, and 82 of them have all VHF coverage. Thirty-six of the top 50 markets have one or more local independent signals, and three of the markets receive independents from a nearby market that meet the "viewing test." In markets of 51-100, seven markets have local independents and six markets receive neighboring independents well enough to meet the viewing test. Equally important,

having satisfactory picture quality 90 percent of the time for 50 percent of the receiving locations.

32 See Appendix Table A1 for characteristics of signals available in markets 1-50 and 51-100.
33 See [8], [25], and [23], Appendix A. Data are taken from [31], [32].
34 [22], Appendix.
most communities in the top 100 markets have sufficiently high quality signals that they can be received by "rabbit ears" or a non-rotating rooftop antenna. For these reasons, the studies mentioned are of limited value in projecting the cable experience in major cities, as their authors have recognized.\(^{35}\)

One possible alternative source of projections might be surveys of knowledgeable operators. Unfortunately, this approach has thus far been insufficiently detailed to insure that in their replies the respondents assume the same future state of the world will prevail. In a recent survey\(^{36}\) of seven large cable firms, which together own 147 separate systems, the questionnaire asked for unconditional forecasts of the number of subscribers, the number of potential subscribers, and capitalization per home at five-year intervals to 1992. No instructions are provided, for example, regarding what regulatory changes should be anticipated, what nonbroadcast services can be assumed, or what will happen to the general price level. Under these conditions it is perhaps not surprising that predictions of cable penetration in 1982 ranged from 31 percent to 70 percent. More disturbing is that the same respondents, when asked what the actual industry-wide capitalization per home passed was at the time of the survey, gave answers varying from $60 to $150!\(^{37}\)

The one possibility of using existing cable experience is to control carefully factors that will differ most in the large urban areas. In a paper published in this Journal in 1972, Park carries out the necessary analysis.\(^{37}\) In doing so, he improves on the earlier studies in three major ways:

First, all 63 sample cable systems had at least three good reception quality signals available off-the-air. Systems located in hilly areas or that otherwise had impaired reception were eliminated from the preliminary sample.

Second, all data were verified with system operators by telephone interview, insuring greater accuracy than available from only published sources.

\(^{35}\)\cite{7}, p. 166; \cite{25}, p. 131; \cite{23}, p. 290, 292.

\(^{36}\)Reported in \cite{1}.

\(^{37}\)\cite{25}.
Third, measures of signal quality were incorporated directly into the analysis. Distance of the cable system from each transmitter was measured, and UHF signals were introduced with a separate parameter to account for more rapid signal attenuation with distance and the absence of UHF tuners in some households.\textsuperscript{38}

The complete penetration equation is estimated by nonlinear least squares and establishes the effects of the following variables:

- Number of off-the-air VHF signals, by distance from transmitter, with separate categories for networks, duplicate networks, independent, educational, and foreign signals.
- Number of off-the-air UHF signals, by the same categories, by distance from transmitter, with measurement of UHF set penetration.
- Number of cable signals, by the same categories.
- Color set penetration.
- Annual subscriber price.
- Annual family income.

Park's study also finds that demand grows to its final penetration level quite rapidly, with subscriptions reaching their equilibrium level about 18 months after a new section of the cable system has first been opened for service. Monthly time series observations of several systems\textsuperscript{39} support this finding. In contrast, the growth curves estimated from published data all evidence a slower maturation process.\textsuperscript{40} The explanation is that systems with highest penetration were built first, so that in those studies, because quality of reception is not introduced explicitly, the age variable measures the effect of differing reception conditions. The fact that systems are often constructed in several stages has at most a minor effect on penetration estimates. Only when a system is observed less than 18 months after the opening of a new stage of construction will incomplete penetration be observed, and then only for a fraction of the entire system.

\textsuperscript{38}Attempts to test Park's predictions from systems randomly sampled from the Television Factbook are invalid, as it is impossible to control for signal quality from published data alone.

\textsuperscript{39}Reported in [6].

\textsuperscript{40}See [7], [23], [27].
Therefore, for this study we have adopted Park's estimated curve and assumed that complete penetration is reached in 18 months. Figure 2 compares this growth path with that estimated by Comanor-Mitchell.

In the simulations reported below, we project penetration rates using the average figure calculated from Park's equation for each of the major signal characteristics of urban markets. These projected rates can be considered representative of the central experience of systems built in major market communities chosen at random. There is, nevertheless, considerable variation across individual communities in the factors determining penetration. Consequently, we also report results for systems using penetration rates 33 percent greater than predicted to prevail under average conditions. Such rates fall in the upper 10-percent confidence interval of Park's equation and are necessarily atypical of the major market environment.

Since investors and operators will seek to build the most profitable systems first, for several years the experience of new systems in the major markets can be expected to resemble that predicted for the most favorable conditions. Even under the quite restrictive 1972 FCC rules and the copyright fee schedule proposed in the McClellan bill, some particularly attractive communities will indeed be wired. But as higher costs or more restrictive signals conditions are imposed, the areas that would otherwise be profitable investments may be rapidly eliminated. Is this the outlook for urban systems as a result of the 1972 Rules, or would it be engendered by significant copyright payments? We shall attempt to answer these questions by reporting the return to investment in systems with average penetration.

Nonbroadcast Services

Except possibly for a small amount of "local origination" programming produced by individual cable systems, cable television has sold itself by

\[41\] [25], pp. 154-156.
Fig. 2—Rate of subscriber growth over time
providing more and better-quality broadcast television signals. The technologically more innovative uses of cable's broadband capacity are yet unborn or in extreme infancy. Future video services may eventually include subscription channels or programs for first-run movies, sports that are either not carried on broadcast channels or are locally blacked out, and instructional courses for both the general public and for specialized trade and professional audiences. In addition, the two-way capability of the cable makes possible remote reading of utility meters, detection of fire and burglar alarms and, at a more advanced level, a variety of real-time interactions between home viewers and program originators.

Increased gross cable revenues from these services are quite likely in the long run. But to date only "pay cable" has been introduced. By the summer of 1973 it was barely under way in 8 systems, with 35,000 homes subscribing. What little experience has been reported indicates that where it has been offered, 10 percent to 30 percent of existing cable homes have signed up for pay channel access to new movies. To date there is almost no evidence as to whether pay channel services increase penetration rates, aside from one report indicating about 1 percentage point increases for two intermediate-sized systems, and pay channels have not yet been introduced in areas where penetration from broadcast signals would be in the range predicted for urban markets.

Prototype business arrangements between system operators, pay channel managers, and program producers take several forms. At one extreme, the three roles may be combined in a single conglomerate firm such as TelePrompTer or Warner Communications. In other instances, the three principal business functions may be performed by independent entities, with the pay cable manager installing and servicing the required terminals and signing up and billing subscribers, but leasing channels from the cable system and purchasing programming from film producers. Various mixed arrangements are also being tried.

42[20].
Whether new services will make an important contribution to net revenue for cable operators is debatable. The FCC requirement that leased channels be available at non-discriminatory rates provides for entry and considerable potential competition from pay-channel and other nonbroadcast services supplied by other firms.\textsuperscript{45} Under these conditions, higher profits for cable operators will accrue only from whatever additional basic service subscriptions may be induced.

In the analysis below we exclude both the additional revenues and costs that would be generated by nonbroadcast services. Only if (1) new services induce important increases in penetration, or (2) cable operators are permitted to earn monopoly returns on such services will rates of return be underestimated.

\textbf{Exclusivity Restrictions}

The new FCC rules require cable operators to "black-out" numerous classes of programs on imported signals when a local station also shows these programs. These provisions are far broader than the previously announced "simultaneous nonduplication" stricture requiring the cable system to delete from its imported signals any programs that a local station is simultaneously broadcasting. Because the rules also required all local stations to be available on the cable, that provision had no effect on the number of programs available to the viewer.

The new exclusivity rules prohibit cable importation of independent stations' programs to a far greater degree, and because they apply to nonsimultaneous showing, they restrict viewer alternatives. Two sets of exclusivity rules were propounded. In the top 50 markets, cable is automatically prohibited from importing a newly created syndicated program for one year from the date that program is sold anywhere in the country. (The program need not be sold to a station in the cable system's market for this "preclearance" provision to be effective.) Thereafter, cable systems are subject to whatever restrictions are included in a local station's contract with the program supplier. Such agreements can prevent

\textsuperscript{45}[23], p. 194.
importation of a program even though no local station has purchased rights to show it.\textsuperscript{46}

The exclusivity provisions for markets 51-100 are less sweeping. There is no preclearance protection for local stations, and contractual exclusivity arrangements are limited to one to two years, depending on the type of program.

For our purposes, the primary effect of these rules is to reduce the attractiveness of distant signals to subscribers and thus reduce cable penetration. Aside from providing for one channel-switching device for each imported signal, we have not allowed any additional costs of performing the blacking-out function itself, keeping records, etc.

At this writing, evidence on the magnitude of the exclusivity effect is limited to a preliminary study by R. E. Park.\textsuperscript{47} From detailed program listings for four stations--two networks and two independents--plus partial listings for ten other stations, Park synthesizes the expected proportion of a broadcast week that a distant signal would be blacked out. A portion of his findings are reproduced in Table 2.

Park's results indicate, for example, that in those top 50 markets in which local service provides three networks and one independent, the cable system importing two additional independents will be required to black out programs about 39 percent of the time. If it imports a third independent (on a stand-by basis, since the rules allow only two distant signals\textsuperscript{48} at any moment on the cable) and "fills in the blanks" where possible, it can reduce the blacked-out time to about 24 percent. Importing a fourth independent further reduces this to 15 percent, etc. The boxed-in figures represent the expected effect when no standby signals are imported.

The impact of the exclusivity rules on subscriber penetration is likely to be proportionately greater than the reduction in viewing hours. Programs receiving protection will be predominately those with large

\textsuperscript{46}[2].

\textsuperscript{47}[26].

\textsuperscript{48}In a small number of top 50 market communities, there is no local or significantly viewed independent signal. In these areas a third independent may be imported. It must be a UHF station within 200 miles. If none is available, then it must be either a UHF station located anywhere or a VHF station within 200 miles.
Table 2—Percentage of time distant signal channels are blacked-out

<table>
<thead>
<tr>
<th>Local Signals</th>
<th>Number of Distant Signals Allowed</th>
<th>Number of Distant Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Markets 1–50</td>
<td>2</td>
<td>51</td>
</tr>
<tr>
<td>3 network + 2 independent</td>
<td></td>
<td>39</td>
</tr>
<tr>
<td>3 network + 1 independent</td>
<td></td>
<td>52</td>
</tr>
<tr>
<td>3 network</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Markets 51–100</td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

Source: [26], Table 2, p. 5
audiences, many of whom would value an earlier or alternative viewing date or hour that cable could otherwise provide. Nevertheless, lacking data to make a more refined estimate of this effect, we assume that exclusivity protection is equivalent in its impact on penetration to a proportionate reduction in the number of full-time distant independents carried on the cable, using the appropriate boxed figures from Table 2.

Will it be profitable for a cable system to import standby independent signals? The marginal costs of importing will rise as the cable system must go further to find each additional independent. Concurrently, the proportion of time that can be filled in with each extra signal is declining. The exclusivity rules thus place the cable firm in a situation of sharply diminishing returns as regards additional penetration from distant signals. Generally, the answer will be "no." Exceptions may occur when the standby independent has particularly attractive programming, or when importation costs depend less on distance, as could occur with satellite transmission.

Regarding importation costs, we have assumed for all systems in this study that distant signals are delivered by cable system-owned microwave links of 50-100 miles per channel imported. For several market environments the mean distances to the first and second closest independents (in the top 25 markets) are tabulated in the appendix. For several types of markets these averages range from 91 to 208 miles to the closest signal, and 125 to 325 miles for the next closest. Thus the microwave cost estimates used here must be considered generally low, although they may be closer approximations for markets with several closely spaced systems that pool their microwave facilities.

Density and Underground Construction

Density, the number of homes per cable mile, can vary considerably from one potential franchise area to another. The Comanor and Mitchell sample reported an average density of 95 per mile inside major markets, and 79 outside. More recently available data for a number of municipalities in the Dayton, Ohio, and Boston, Massachusetts, areas are

\[49\] p. 177.
tabulated in the appendix. For systems in the study we have assumed somewhat higher densities than Comanor-Mitchell consider, ranging from 80 homes per mile outside of television markets up to 200 homes per mile in the central areas of markets 1-50.

In practice, of course, both higher and lower densities will be encountered. But the tendency to a substantially higher figure for any important number of similar systems is unlikely in view of the FCC's emphasis that it will not authorize carriage of broadcast signals by systems that do not serve all parts of the community.  

When part of the cable system must be placed underground, rather than strung from existing utility poles, construction costs increase substantially. Furthermore, the cost per mile varies greatly according to the material that must be trenched and the protection the cable must receive. In some instances existing utility ditches have excess capacity and most digging can be avoided by paying utility companies to install the cable and for space rented.

We have allowed for 5 to 20 percent of the cable system to be placed underground in the major markets. In doing so, we have assumed that municipal authorities will require the same standards of construction they now apply to their telephone and electric utilities. The range adopted here is consistent with the data reported in the appendix.

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50 Federal Register, p. 3276, §180.
51 See [8], Appendix 2.
IV. RESULTS

Measuring Cable Profitability

To summarize the profitability of the typical cable systems of this study, we will calculate the (pretax) internal rate of return on total capital invested in each system. The rate of return required to induce investment in a system will depend on the proportion of total capital that can be obtained through debt instruments, the borrowing rate, and the minimum return demanded by equity investors. One method of measuring the required return would be to compute the cost of equity capital to the cable television industry according to the capital asset pricing approach.\(^{52}\) To be correct, such a calculation must construct a portfolio of cable firms that are members of the same equivalent-risk class, take into account differences in firm leverage,\(^ {53}\) and be adjusted for regression bias\(^ {54}\) and expected inflation rates. When combined with a long-run estimate of the debt/equity ratio for such firms, a cost of total capital may be developed.

Another approach, and the one adopted here, is to rely on the recent experience of cable firms in obtaining new financing. A detailed 1971 investment survey\(^ {55}\) of the cable industry reports that mature companies with demonstrated earnings have obtained bank credit lines and revolving credit arrangements at 0.5 percent to 1 percent over the prime rate, with long-term debt at 3 percent to 5 percent above prime. Sources of long-term financing are reported looking for a 15 percent return on combined debt-equity instruments. At a more recent industry discussion of financing for cable systems,\(^ {56}\) a major intermediary reported arranging equity financing at around 14 percent.

\(^{52}\)[29].
\(^{53}\)[17].
\(^{54}\)[4].
\(^{55}\)[11].
\(^{56}\)Broadcasting, June 25, 1973, p. 34.
Consumer prices increased at an annual rate of nearly 4 percent during 1970-1972, accelerating to an 8-percent rate in the first half of 1973. Presuming that capital markets were reflecting an expected 4- to 5-percent rate of inflation, a 15-percent rate of return on total capital corresponds to a 10- to 11-percent cost of capital for cable systems in real terms.

For this study, we have held both revenues and costs at 1970 price levels over the full life of the cable system. Financial measures are therefore in real terms, and are appropriately compared to the cost of capital net of changes in the general price level. We assume that the full cable system is constructed in the initial year of operation. Alternatively, one could allow for a series of construction stages with correspondingly staggered demand curves for each stage. Because only a small portion of the cable system capital is completely "fixed," the calculated rate of return would be nearly the same.

Example

We are now prepared to analyze the financial results for typical systems in the several market situations discussed earlier. The detailed cost and revenue schedules built into the Comanor-Mitchell computer program have been modified to include the changes in FCC rules, penetration, and costs discussed above and in the appendix. Using these data and parameters for the specific system, the computer simulates the complete revenue and cost experience to be expected.

As an example, consider a representative system of 25,000 subscribers located near the middle of one of the 50 largest markets,

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57 The Comanor-Mitchell specification provides for some wage increases during the initial years of employment to reflect low entering wages and increasing job productivity [8, pp. 202-203]. Weinberg's very detailed cost study of cable system components is in close agreement with the system costs used here [33].

58 See, e.g. [18].

59 Largely the tower and head-end equipment.
as reported in the first line of Table 3. Density is assumed to be 200 homes per mile, and family income $12,200. Since this is a central urban location, 20 percent of the cable miles are underground. Annual subscriber rates are $62.40, corresponding to $5.00 per month plus a small additional amount for second sets. We assume that systems of this size will operate with "standard" local origination equipment and derive modest revenues from selling advertising on the cablecasting channel, estimated at $2.20 per subscriber annually.

The table shows that 3 VHF networks plus one viewing-test network are available off-the-air. Also, there is one UHF independent and one VHF educational station. In addition to these broadcast signals, the cable system imports two independents and one educational station. We assume these signals are imported by microwave, averaging 3 "hops" of 35 miles each per channel.

Within two years the system is assumed to reach maturity, apart from further growth due to enlargement of its franchise area. Penetration is predicted to be 28.1 percent if the distant signals are fully available, but 27.2 percent as a result of exclusivity protection on the independent channels.

In the remainder of the table we assess the effect on profitability of each of the four copyright fee schedules. If fixed capital equipment is replaced about every 15 years, this system will earn a 10.3-percent real rate of return on total invested capital, absent any copyright fees. Alternatively, the proposed statutory schedule (number 3) reduces the rate of return to 8.8-percent, and the flat 16.5-percent fee lowers returns sharply to 4.1-percent. Assuming a 10-year lifetime for equipment would reduce these returns by about 3 percentage points.

The effect of rising real incomes has been introduced by projecting final penetration based on mean real family income in 1975 for each type of market. Income figures were derived by assuming a 2-percent real rate of increase from 1970 data.
<table>
<thead>
<tr>
<th>Local</th>
<th>Viewing Test</th>
<th>Imported by Cable</th>
<th>Family Income</th>
<th>Penetration</th>
</tr>
</thead>
</table>
| Markets 1-50  
Density = 200, underground = 20% | 1. INV,11U,1EV | INV | 21,1E | $12,200 | 27.2% |
| 2. INV,1EU | - | 31,1E | 11,400 | 24.7 |
| 3. INV,11V,11U,1EV | - | 11,1E | 12,200 | 21.9 |
| Markets 51-100  
Density = 150, underground = 10% | 4. INV,1EU | - | 21,1E | $11,400 | 24.0% |
| 5. 2NV,1NU | - | 21,1E | 10,200 | 30.7 |
| 6. 1NV,2NU | - | 21,1E | 10,000 | 35.3 |
| Markets 101+  
Density = 125, underground = 5% | 7. INV,2NU | - | 11,1E | $10,000 | 29.6% |
| 8. 2NU | - | 1N,11,1E | 10,000 | 55.4 |

| LARGE SYSTEMS | | INTERMEDIATE SYSTEMS | |
|---------------|---------------|---------------|
| Internal Rate of Return | (15 Year Life) | Internal Rate of Return | (15 Year Life) |
| Copyright Fee | Schedule No. | Copyright Fee | Schedule No. |
| 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| Size = 25,000 | | Size = 10,000 | |
| 10.3% | 9.6% | 8.8% | 4.1% | 5.6% | 5.1% | 4.7% |
| 8.8 | 8.1 | 7.4 | 2.6 | 4.3 | 3.8 | 3.4 |
| 6.7 | 6.0 | 5.3 | 0.5 | 2.6 | 2.2 | 1.7 |
| Size = 25,000 | | Size = 10,000 | |
| 4.9% | 4.2% | 3.5% | * | 0.2% | 0.1% | * |
| 8.0 | 7.3 | 6.6 | 1.8 | 3.6 | 3.1 | 2.6 |
| 10.4 | 9.7 | 9.0 | 4.0 | 5.9 | 5.5 | 5.0 |
| Size = 15,000 | | Size = 7500a |
| 9.7% | 9.0% | 8.4% | 2.0% | 6.5% | 6.1% | 5.7% |
| 24.0 | 23.1 | 22.3 | 15.0 | 19.9 | 19.4 | 18.9 |
| 19.9 | 19.4 | 18.9 | 11.1 |

*aIn these tables, N means network, I means independent, E means educational; V means VHF, U means UHF
bMinimal origination facilities and no advertising revenues
*Negative rate of return
### Table 4
CABLE PROSPECTS IN EDGE MARKETS

<table>
<thead>
<tr>
<th>SIGNALS&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Internal Rate of Return (15 Year Life)</th>
<th>INTERMEDIATE SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Copyright Fee</td>
<td>Schedule No.</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Local</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Markets 1-50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density = 150, underground = 10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. 3NV,1IU,1EV</td>
<td>INV</td>
<td>21,1E</td>
</tr>
<tr>
<td>2. 3NV,1EU</td>
<td>-</td>
<td>31,1E</td>
</tr>
<tr>
<td>3. 3NV,1IV,1IU,1EU</td>
<td>-</td>
<td>11,1E</td>
</tr>
<tr>
<td>Markets 51-100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density = 125, underground = 5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. 3NV,1EU</td>
<td>-</td>
<td>21,1E</td>
</tr>
<tr>
<td>5. 2NV,1NU</td>
<td>-</td>
<td>21,1E</td>
</tr>
<tr>
<td>6. 1NV,2NU</td>
<td>INV</td>
<td>21,1E</td>
</tr>
<tr>
<td>Markets 101+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density = 100, underground = 5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. 1NV,2NU</td>
<td>-</td>
<td>11,1E</td>
</tr>
<tr>
<td>8. 2NU</td>
<td>-</td>
<td>1N,11,1E</td>
</tr>
<tr>
<td>Outside Markets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density = 80, underground = 0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. 2NV</td>
<td>-</td>
<td>1N,9E,1E</td>
</tr>
<tr>
<td>10. 2NU</td>
<td>-</td>
<td>1N,9E,1E</td>
</tr>
</tbody>
</table>

<sup>a</sup>In these tables, N means network, I means independent, E means educational; V means VHF, U means UHF

<sup>b</sup>Minimal origination facilities and no advertising revenues

<sup>*</sup>Negative rate of return
| SIGNALS<sup>a</sup> | Local Viewing Test | Imported by Cable | Family Income | Penetration | Copyright Fee | Schedule No. (15 Year Life) | Penetration | Copyright Fee | Schedule No. (15 Year Life) |
|-----------------|-------------------|------------------|--------------|-------------|--------------|----------------|----------------|--------------|----------------|----------------|
|                 | Markets 1-50 Size = 10,000 |                 |              |             |              |                |                |              |             |                |                |
| 1. 3N,1IU,1EV   | INV               | 2I,1E           | $12,200      | 36.3%       | 10.8%        | 10.3% 9.9% 3.7% | 50.5%         | 13.3%        | 12.8% 12.3% 5.7% |
| 2. 3N,1EU       | -                 | 3I,1E           | 11,400       | 32.9        | 8.1          | 7.6 7.2 0.7    | 49.5          | 13.1         | 12.6 12.1 5.5  |
| 3. 3N,11V,11U   | -                 | 1I,1E           | 12,200       | 29.2        | 6.5          | 6.1 5.6 *     | 45.9          | 11.9         | 11.4 10.9 4.4  |
|                 | Markets 51-100 Size = 10,000 |                 |              |             |              |                |                |              |             |                |                |
| 4. 3N,1EU       | -                 | 2I,1E           | $11,400      | 32.0%       | 5.3%         | 4.8% 4.4% *   | 48.4%         | 9.7%         | 9.2% 8.6% 1.6% |
| 5. 2N,1NU       | -                 | 2I,1E           | 10,200       | 40.9        | 7.6          | 7.1 6.6 *     | 51.2          | 11.1         | 10.5 10.0 2.9  |
| 6. 1N,2NU       | -                 | 2I,1E           | 10,000       | 47.1        | 11.4         | 10.9 10.5 4.2 | 59.9          | 15.0         | 14.4 13.9 7.0  |
|                 | Markets 101+ Size = 7500<sup>b</sup> |                 |              |             |              |                |                |              |             |                |                |
| 7. 1N,2NU       | -                 | 1I,1E           | $10,000      | 49.5%       | 17.7%        | 17.2% 16.8% 9.2% | 55.3%         | 16.1%        | 15.6% 15.2% 7.8% |
| 8. 2NU          | -                 | 1N,1I,1E        | 10,000       | 73.9        | 25.5         | 25.0 24.4 15.7 | 87.4          | 25.0         | 24.4 23.9 15.2 |
|                 | Outside Markets Size = 7500<sup>b</sup> |                 |              |             |              |                |                |              |             |                |                |
| 9. 2NU          | -                 | 1N,3I,1E        | $ 9,000      | 66.9%       | 15.8%        | 15.4% 14.9% 7.3% | 66.9%         | 15.8%        | 15.4% 14.9% 7.3% |
| 10. 2NU         | -                 | 1N,3I,1E        | 9,000        | 87.3        | 20.7         | 20.2 19.7 11.3 | 87.3          | 20.7         | 20.2 19.7 11.3 |

<sup>a</sup>In these tables, N means network, I means independent, E means educational; V means VHF, U means UHF

<sup>b</sup>Minimal origination facilities and no advertising revenues
In the analysis below we report rates of returns based only on 15-year lifetimes. Fifteen years represents a compromise between somewhat longer physical lifetimes for some parts of the cable plant and rather shorter economic lifetimes of currently operating systems experiencing technological obsolescence. The rate of recent innovation in electronics suggests that cable systems will continue to undergo major changes.

**Detailed Results**

The financial prospects for cable under the final FCC rules and the effect of alternative copyright fee schedules are contained in Tables 3, 4, and 5. While we shall briefly review the major findings, the reader should consult the tabulations for particulars.

Table 3 reports the expected experience in *middle markets* of large- and intermediate-sized systems. Line 1 of the table has been discussed in detail in the example above. Lines 2 and 3 are for similarly situated communities with somewhat different sets of local signals. Penetration ranges from 22 to 27 percent and rates of return from 6.7 to 10.3 percent for large systems when there are no copyright fees. Despite somewhat higher penetration rates, systems in the second 50 middle markets earn generally lower returns, principally because of reduced density, while in the lowest ranked markets there is great variation, with profitable 55-percent penetration systems when one network is missing from the local signals.

Intermediate-sized systems in middle markets are decidedly below the 10-percent rate of return needed to attract investment funds. Except where quite large systems of 25,000 or more subscribers can be built, central city areas of the major markets are not bright prospects for cable under present rules, even without copyright payments.

The prospects for large systems at the *edge* of major markets, 61 Table 4, are brighter. In the top 50 markets, penetration is in the

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61 Roughly 35 miles or more from the city center.
34- to 38-percent range, with rates of return between 11.4 and 13.3 percent. In the second 50 markets, penetration ranges up to 45 percent, with rates of return from 10.0 to 14.6 percent. In the smallest markets and also the fringe (outside) areas, we find more heterogeneous results, with quite profitable CATV possibilities where fewer than three networks are available.

The corresponding intermediate-sized edge systems are again unprofitable in all three network cases. While large systems should be feasible in the major metropolitan areas, as of February 1973 only 25 systems had more than 20,000 subscribers, and the largest had less than 60,000. Some fraction of these economies of scale can be achieved when a series of smaller systems is under common ownership, thereby realizing savings from efficient use of management and technical personnel and from sharing local programming and signal importation expenses.

The results presented in Tables 3 and 4 are based on market, economic, and construction factors typifying the most common situations that will be encountered in middle and edge locations of each of the four types of markets. Of course, within each category there will be a degree of variation, clustered around the typical situations we report. Some communities will have higher incomes, others will require extensive undergrounding, still others will require elaborate local origination facilities, etc.

To measure the sensitivity of our findings for typical systems to such variations, we have rerun all of the intermediate-sized systems assuming that penetration is one-third greater than would be expected, on average, for each set of market characteristics. A variety of unmeasured factors can cause actual penetration to vary above or below the average value predicted by the penetration equation. In increasing

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the average value by one-third, we have, in effect, selected only the
10 percent of the cases in which penetration is most favorable; nine
out of 10 communities having the same signal lineups, income, etc., will
have lower penetration.

Turning to the results in Table 5, we find that such unusually
high penetration is sufficient to produce at least one profitable
system in each type of market, at least if copyright fees are absent.
We conclude that 7,500-10,000 subscriber systems can expect to earn
a going rate of return in the top 100 markets only when local circums-
stances are unusually favorable.

We turn finally to the financial prospects for cable when copy-
right fees are required. The predominant effect of Schedule 3, the
statutory fees proposed in the McClellan bill, is to reduce the rate
of return on total capital 1.5 percentage points for profitable and
near-profitable systems, and by somewhat less for systems well below
the 10-percent-return level. Thus, in the example system (the first
line of Table 3), the rate of return falls from 10.3 to 8.8 percent.

A one-point change in the real rate of return on total capital
has a considerably larger effect on equity holders. If one-half to
two-thirds of the cable system is financed by 6-percent 63 debt instru-
ments, this leverage converts a 10-percent return on total capital to
a return on equity of up to 14 or 18 percent. In consequence, a de-
cline to a 9-percent return on total capital can reduce the return on
equity by 2 to 3 percentage points, depending on the capital structure
of the system. Changes of this magnitude are more than sufficient to
postpone or eliminate construction of cable systems that otherwise
appear marginally profitable.

The preponderance of evidence in Tables 3-5 is that large systems
at the edges of the top 100 markets will earn a 10- to 14-percent rate
of return before copyright payments, large systems in middle markets

63 In an inflationary period, borrowing costs would be higher by
approximately the expected rate of inflation.
are not likely to exceed 10 percent, and intermediate and smaller-sized systems will be marginally profitable only where special factors operate. Copyright fees, at the level of Schedule 3, would significantly slow the growth rate of cable in the major markets, particularly in middle areas with good quality signals and in edge market communities of intermediate size.

Copyright fee Schedule 2 is exactly one-half the rate of Schedule 3. As expected, it has approximately half the effect of Schedule 3 in reducing the rate of return for all systems.

Schedule 4 is the flat 16.5-percent copyright fee. Its effect on rates of return is devastating. Of all variations studied in the top 100 markets, only systems extrapolated to a 50,000 subscriber level at the edge of markets 51-100 reach a 10-percent rate of return. Fee payments of this magnitude would effectively halt cable growth in the large cities.
V. CONCLUSION

The outlook for early development of cable television service in the major cities is at best mixed. As compared with the rules discussed two years ago, the final FCC rules more tightly restrict the number and choice of broadcast signals a system can provide to its subscribers and include exclusivity provisions that require deleting some portion of those programs.

Our analysis of the important variations in potential market and cable system characteristics in these urban areas demonstrates that only the largest systems, or multiply-owned systems of slightly smaller scale, will be viable in the central city areas where off-the-air reception quality is high, and then only under favorable construction and penetration conditions. At the edges of these markets, returns will be sufficient to attract investment in the largest (25,000 subscriber) systems, but systems of 10,000-15,000 will be profitable only under especially favorable circumstances.

In an investment environment that allows most urban households to be profitably wired for cable television service only when atypically propitious cost and demand factors occur, requiring more than quite limited copyright payments will significantly retard or halt cable expansion in the urban markets. The proposed statutory fee schedule in the McClellan bill (up to 5 percent of subscriber revenue) would generally lower rates of return on total capital 1.5 percentage points for systems in the profitable range; and in an important proportion of cases, its leveraged effect on equity investors would be sufficient to create unprofitable systems.

As expected, a fee schedule of one-half that proposed reduces rates of return on total capital somewhat more than one-half a percentage point. Fees of this magnitude would restrict cable construction primarily in market circumstances in which returns are already limited for other reasons. In contrast, a flat 16.5-percent copyright payment would

\[ See [7]. \]
create a decidedly unprofitable investment climate for cable television throughout the top 100 markets, far outweighing the limited prospects opened up by the 1972 FCC rules.
Modified Costs and Revenues

Several cost items in the Comanor-Mitchell study have been modified for this study, either to take account of the FCC rules as finally adopted or as a result of the availability of more recent information. A brief summary of those costs which were modified for all systems investigated in this report is presented below:

1. Local Franchise Tax. 5% of gross revenues annually.

2. FCC Fee. $35 initial fee plus $0.30 per subscriber annually.

3. Channel switchers. One switcher included in capital equipment costs for each imported signal.

4. Pole rent. All results reported here include pole rent of $250 per aerial mile in top 100 markets, $175 in other markets.

5. Local origination. We assume the Comanor-Mitchell standard systems, with capital costs of $38,000 and annual operating expenses of $4300, and for smaller systems a minimum system, with capital costs of $11,000 and operating expenses of $2500 per year for live origination. All systems are assumed to provide a time-and-weather channel.

6. Public service channels. The final FCC rules require CATV systems to provide 3 non-broadcast channels for non-commercial public, educational, and government access respectively. The public access channel is to be provided without charge, while the other two channels will be free for five years. The costs of meeting these provisions are taken to be an additional 75% of the capital costs assumed for local origination, plus $4875 per year for part-time technician salaries.

7. The previously proposed 5% "public dividend" tax for support of non-commercial broadcasting has been eliminated.

8. Rate of subscriber growth over time. Two recent studies using unpublished data indicate a more rapid rate of growth than was assumed in an earlier version of this paper. We have revised those calculations and based the figures reported here on the assumption that the cable system reaches final penetration after 18 months. Revenues and operating costs are discounted at the end of each 12-month period following system construction, so that net revenues are discounted from the mid-point of the first "year" in which penetration reaches its final level, and similarly thereafter.

65[25], [6].
66[22].
As in the Comanor-Mitchell paper, internal rates of return are calculated for a firm of infinite life. We assume that the firm reaches an equilibrium of revenues and costs after 18 months and that the lifetime of the system's physical assets is 15 years. Thereafter, the plant is rebuilt periodically, while subscriber penetration is held constant at the mature level. The rate of return is generally robust with respect to exact assumptions about conditions in later generations. Another solution to this terminal value problem is to assign the firm a value at the end of its first generation, based on operating characteristics such as revenues, subscribers, etc. For an example of this method see [18].
The Penetration Equation

Technical details of the penetration equation are summarized below. For further discussion see [25].

\[
\log \left( \frac{\text{Pen}}{1 - \text{Pen}} \right) = -8.159 + 3.098 \log X_N + 0.290 \log X_D \\
+ 0.212 \log X_I + 0.298 \log X_E - 0.540 \log X_F \\
- 1.473 \log P + 1.398 \log Y + 0.523 \log C
\]

where

\[
X_I = \frac{1 + W_i}{1 + 0.731 U \sum (1 - d_i^{1.6})^{1/1.6} U_i + \sum (1 - d_i^{1.6})^{1/1.6} V_i}
\]

i = N = network
D = duplicating network
I = independent
E = educational
F = foreign

W_i = number of cable signals of type i
U_i = number of B-contour off-air UHF signals of type i
V_i = number of B-contour off-air VHF signals of type i
Pen = penetration = subscribers/households passed by cable
P = annual price
Y = median family income
C = color set penetration
U = UHF set penetration
In order to use Park's estimated equation to predict penetration for the typical systems investigated here, in all of the simulations reported we assign representative values to the variables as follows:

\[ P = \$62.40, \text{ corresponding to the } \$5 \text{ per month plus } \$1 \text{ per month for } 20\% \text{ of subscribers as a charge for second set.} \]

\[ C = 50\%. \text{ The effect of varying color set penetration is not estimated with sufficient precision to incorporate variations in color set ownership across different types of markets.} \]

\[ U = \begin{align*} &80\% \quad \text{if 0 local network UHF signals} \\ &90\% \quad \text{if 1 local network UHF signals} \\ &95\% \quad \text{if 2 local network UHF signals} \\ &99\% \quad \text{if 3 local network UHF signals} \end{align*} \]

\[ F = 0. \text{ Foreign stations are not included among the signals carried by study systems.} \]

In simulating cable systems for this study, we consider systems located in the central area of a television market, where off-the-air signal quality is generally high, and outlying areas of the same market, where quality is diminished. In the penetration equation the distance variable \( d \) is a measure of the reduction in quality. A \( d \) value of 0 corresponds to a viewer in the center of the market, while a value of 1 represents a viewer at the B-contour of the off-the-air signal.

For the systems in this study we have used the following values for VHF stations:

In **middle market** systems:
- \( d = 0 \) for local stations
- \( d = 1 \) for viewing-test stations

In **edge markets**:
- \( d = 0.5 \) for local stations
- \( d = 0.75 \) for viewing-test stations

The prospects for cable under the 10% most favorable penetration conditions are calculated using 133% of the penetration implied by Park's equation above. This corresponds approximately to the penetration value at the upper 10% confidence limit.  

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67[25], p. 145  
68Ibid, pp. 145-146.
Table A1

Average Characteristics of Signals Available in Top 100 Markets
By Type of Local Network Signals

Markets 1-50

<table>
<thead>
<tr>
<th>Line</th>
<th>Number of Markets</th>
<th>Local Network Signals</th>
<th>Independent V</th>
<th>U</th>
<th>Educational V</th>
<th>U</th>
<th>Viewing Test Net.</th>
<th>Ind.</th>
<th>Distance to Closest Top 100 Independents 1st.</th>
<th>2nd.</th>
<th>Family Income (1975)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>34</td>
<td>3 NV</td>
<td>0.6</td>
<td>1.4</td>
<td>0.6</td>
<td>0.6</td>
<td>0.1</td>
<td>0.0</td>
<td>208</td>
<td></td>
<td>325 $12,229</td>
</tr>
<tr>
<td>(2)</td>
<td>11</td>
<td>3 NV</td>
<td>0</td>
<td>0</td>
<td>0.4</td>
<td>0.5</td>
<td>0.3</td>
<td>0.2</td>
<td>184</td>
<td></td>
<td>252 11,416</td>
</tr>
</tbody>
</table>

Markets 51-100

<table>
<thead>
<tr>
<th>Line</th>
<th>Number of Markets</th>
<th>Local Network Signals</th>
<th>Independent V</th>
<th>U</th>
<th>Educational V</th>
<th>U</th>
<th>Viewing Test Net.</th>
<th>Ind.</th>
<th>Distance to Closest Top 100 Independents 1st.</th>
<th>2nd.</th>
<th>Family Income (1975)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3)</td>
<td>21</td>
<td>3 NV</td>
<td>0</td>
<td>0</td>
<td>0.4</td>
<td>0.4</td>
<td>0</td>
<td>0</td>
<td>198</td>
<td></td>
<td>325 $11,371</td>
</tr>
<tr>
<td>(4)</td>
<td>7</td>
<td>2 NV, 1NU</td>
<td>0</td>
<td>0</td>
<td>0.1</td>
<td>0.4</td>
<td>1.1</td>
<td>0.1</td>
<td>163</td>
<td></td>
<td>252 10,217</td>
</tr>
<tr>
<td>(5)</td>
<td>5</td>
<td>1 NV, 2NU</td>
<td>0</td>
<td>0</td>
<td>0.2</td>
<td>0.2</td>
<td>0</td>
<td>0</td>
<td>91</td>
<td></td>
<td>125 11,713</td>
</tr>
<tr>
<td>(6)</td>
<td>6</td>
<td>3 NU</td>
<td>0</td>
<td>0.2</td>
<td>0</td>
<td>0.3</td>
<td>0.2</td>
<td>0.2</td>
<td>114</td>
<td></td>
<td>174 11,611</td>
</tr>
</tbody>
</table>

Source: [22], appendix, computed from [31], pp. 51a-56a.
Table A2
Households, Population and Density in Dayton, Ohio (Market No. 41)

A. Dayton Urban Area

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dayton</td>
<td>243,601</td>
<td>85,401</td>
<td>149</td>
</tr>
<tr>
<td>Kettering</td>
<td>69,599</td>
<td>22,809</td>
<td>110</td>
</tr>
<tr>
<td>Fairborn</td>
<td>32,267</td>
<td>10,156</td>
<td>107</td>
</tr>
<tr>
<td>Miamisburg</td>
<td>14,797</td>
<td>4,839</td>
<td>71</td>
</tr>
<tr>
<td>Vandalia</td>
<td>10,796</td>
<td>3,335</td>
<td>96</td>
</tr>
<tr>
<td>West Carrollton</td>
<td>10,748</td>
<td>3,476</td>
<td>87</td>
</tr>
<tr>
<td>Centerville</td>
<td>10,333</td>
<td>2,984</td>
<td>66</td>
</tr>
<tr>
<td>Oakland</td>
<td>10,095</td>
<td>3,795</td>
<td>90</td>
</tr>
<tr>
<td>Four Communities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 10,000</td>
<td>23,364</td>
<td>7,683</td>
<td>---</td>
</tr>
<tr>
<td>persons</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>425,620</td>
<td>144,487</td>
<td>119</td>
</tr>
</tbody>
</table>

B. Dayton Urbanized Area (excluding urban area above)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>583,000</td>
<td>192,000</td>
<td>110</td>
</tr>
</tbody>
</table>

Source: [18].
Table A3

Population, Households, Density and Underground for Electric Utilities in Boston, Massachusetts (Market No. 6)

<table>
<thead>
<tr>
<th>City</th>
<th>Population</th>
<th>Homes</th>
<th>Density</th>
<th>Underground</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston</td>
<td>613,140</td>
<td>224,825</td>
<td>340</td>
<td>51%</td>
</tr>
<tr>
<td>Brookline</td>
<td>58,090</td>
<td>18,954</td>
<td>234</td>
<td>40.5%</td>
</tr>
<tr>
<td>Chelsea</td>
<td>30,122</td>
<td>8,154</td>
<td>210</td>
<td>17%</td>
</tr>
<tr>
<td>Somerville</td>
<td>87,047</td>
<td>28,323</td>
<td>328</td>
<td>21.6%</td>
</tr>
</tbody>
</table>

Source: [16].

BIBLIOGRAPHY


