EXCESS CAPACITY IN INTERNATIONAL TELECOMMUNICATIONS: POOR TRAFFIC FORECASTING OR WHAT?

Leland L. Johnson

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Under international cooperative arrangements, governments and private firms have been remarkably successful in building worldwide systems of communications satellites and undersea cables. At the same time, serious policy debates have been triggered by the prospects of competitive entry by firms seeking to offer satellite and cable services in an arena traditionally dominated by monopoly. Substantial excess capacity exists, at least across the Atlantic and Pacific Oceans, and this problem may become more serious with the completion of currently planned investments by existing common carriers and prospective new entrants. Competition may well encourage new services and lower prices to some groups whereas others, not able to take advantage of the offerings, could be harmed. Many questions, therefore, arise about (a) the extent to which competition should be allowed, (b) how the established carriers should be permitted to respond to competition, (c) in the United States, how carriers should be regulated by the Federal Communications Commission, and (d) the likely consequences for the United States and other countries of increasingly competitive international markets.

Under a three-year grant from the John and Mary R. Markle Foundation, The RAND Corporation is addressing issues of international telecommunications as part of a broader research program dealing with the use and regulation of information technologies. This study presents preliminary findings about one area of concern in the international arena—current and prospective excess capacity. In preparation are study drafts dealing with competitive pricing, regulatory policy, and other issues. They will be combined into final reports during 1987 and 1988.
SUMMARY

Excess capacity is a persistent problem, at least in the Atlantic and Pacific Ocean basins. One study shows that in nearly all years during the period 1970-1985, fewer than 50 percent of satellite circuits were used. Cable use was somewhat higher--typically 60 to 70 percent--but combined use generally remained below 50 percent.

This excess is particularly notable since it is over and above reserves needed to meet daily or other periodic peak traffic loads. Carriers generally activate enough full-time circuits to accommodate peak loads. As traffic grows over time, they activate more circuits to keep blockage rates below specified levels. The capacity of concern here is that in excess of such used circuits.

To be sure, some excess capacity is desirable to protect against failure of existing facilities, slippages in construction schedules of new facilities, and other contingencies. Thus, it cannot be satisfactorily estimated as a single quantity. Even so, the problem is sufficiently great that INTELSAT has identified 100 or more satellite transponders that it deems to exceed its international requirements. In response, it is seeking to sell or lease them for domestic use at much lower prices than it has charged its member carriers in the past.

The problem of excess capacity may grow because large additional international facilities are under construction, and because new market entrants are planning to invest in cable and satellite systems for services that, at least in part, compete with those of the established carriers. The fiber optic TAT-8 cable, planned for use across the North Atlantic in 1988, by itself will have a capacity not far below total North Atlantic traffic forecast for 1990.

Why do common carriers and others invest in such a seemingly wasteful manner? This study explores three possible explanations: (a) overoptimistic traffic forecasts, (b) market structure and regulatory policy, and (c) inefficient pricing of circuits.
The international telecommunications market exhibits a striking bias, at least in recent years, toward overestimating traffic growth. For example, the number of INTELSAT's activated circuits at the end of 1980 fell 9 percent below the forecast made in the preceding year, and traffic at the end of 1983 fell nearly 20 percent below the forecast made in 1982. Actual traffic at the end of 1985 was 15 percent below the level forecast in June 1984.

How does one explain such poor forecasting results? Three factors may be at work: (a) Forecasts are not just "best guesses" of future traffic but include contingency allowances to accommodate additional possible traffic, (b) bias results from the bilateral nature of traffic forecasting, and (c) erroneous projections are made of past experience.

Biases caused by the bilateral nature of forecasting are particularly troublesome. INTELSAT's forecasts are based on data presented at an "Annual Global Traffic Meeting." Each pair of countries is called upon to agree between themselves about the level of satellite traffic expected between them. These figures are then added to obtain regional and global totals.

However, bilateral forecasts fail to take into account network relationships among countries. To illustrate, consider two countries, A and B, that add a "contingency" allowance in their forecast to help ensure that enough capacity will be available in case traffic growth is greater than expected or in case particular transmission links are disrupted. However, countries collectively are likely to add an excessive contingency allowance if they fail to take into account the contingency included elsewhere in the network, since contingencies against which countries seek protection are not likely to occur simultaneously.

Problems of bias are exacerbated because of the way costs are shared within INTELSAT. The costs of expanding facilities in response to the inflated traffic estimates between countries A and B are not borne entirely by A and B but are shared with all other participants in proportion to their actual use of the global system. Thus, some of these costs are borne by countries that do not even communicate by satellite with A or B.
Although such inflated forecasts are taken into account in investment decisions, a question remains as to whether the upward bias in forecasts is only the symptom rather the cause of excess capacity. Do incentives to overinvest exist, so that carriers tend to bias their forecasts upward to help justify investments they want to make?

Under certain assumptions, a carrier may wish to overexpand its rate base: Carriers regulated on the basis of their rate of return on investment have an incentive to inflate their rate bases to obtain greater profits. If the rate of return allowed by the regulatory agency exceeds the firm’s cost of capital, and if certain other conditions hold, the firm will seek to expand its rate base beyond a socially optimal level.

But another constraint affects the outcome. Concerned about a possible AT&T bias toward cable because of rate base regulation and AT&T’s manufacturing interests in cable, the Federal Communications Commission (FCC) imposes circuit loading restrictions that force AT&T to use a greater number of satellite circuits in proportion to cable circuits than it might otherwise choose. The precise formula for circuit loading has varied over time, but it has kept AT&T’s use of cable and satellite over the Atlantic in an approximate 50/50 balance.

Rate-of-return regulation of AT&T and Comsat, combined with the FCC’s circuit loading constraints, could lead to the situation where AT&T overinvests in cable and Comsat overinvests in satellites, knowing that AT&T will be forced to use satellites for about one-half of its circuit requirements regardless of Comsat’s costs. Thus, excess capacity becomes a chronic problem. Overoptimistic traffic forecasts help to ensure FCC approval of new facilities.

But this explanation leaves open the behavior of government-owned foreign PTTs (“postal, telegraph, and telephone” entities) who, as signatories to INTELSAT and as co-owners of cable, must agree with Comsat and AT&T before either satellite or cable facilities can be built. It also leaves open the role of other U.S. international carriers who do not face rate-of-return or circuit loading constraints.
Many foreign PTTs may have weak incentives to minimize costs for given levels of international service because (a) they operate as monopolies, (b) the service is quite profitable, and (c) even if costs are not minimized, unit costs fall over time because of technological advance and rapid market growth. Since the PTT is a protected monopoly, its failure to minimize costs would not attract competitive entry that might threaten the firm and the jobs of its managers. Since profits are large, failure to minimize costs may still leave a comfortable margin to forestall complaints by customers or other government bureaus. If costs fall over time because of extraneous factors, there would be even less reason for complaint. The organization can show an impressive record of rate and cost reductions, expanded new services, and so forth, while still operating quite inefficiently.

Thus, a PTT might be willing to invest in excess capacity, or at least not be seriously disturbed if an excess arises as a result of slower-than-expected traffic growth. The excess would provide even greater protection against adverse contingencies, and the cost of the excess would not strain the organization's resources or prove embarrassing for its managers.

Other U.S. international carriers may have little choice about proposed expansion. They have limited influence over satellite communications because AT&T accounts for about 80 percent of Comsat's space segment revenues. They must take Comsat's charges for satellite circuits essentially as given. They also have little influence on the construction of cable. With or without their participation, AT&T and foreign PTTs could pursue their own investments.

Finally, pricing practices may encourage inefficient market entry, exacerbating the problem of excess capacity. Key elements include (a) INTELSAT's costs for the space segment, (b) the costs that Comsat adds to the price of circuits sold to other U.S. carriers, (c) the costs that these carriers add for connecting their customers, and (d) the costs that foreign PTTs add for their connections required for end-to-end service. Because of the way these various elements are priced (including INTELSAT's policy of global rate averaging), new entrants may be able to cover their costs even if their costs are higher than those of existing carriers.
In short, in light of the scattered and far from complete evidence, this study reaches the following conclusions:

- **INTELSAT clearly served a critically important role in its early years by successfully establishing a global satellite network; but its pricing and investment policies are becoming increasingly inappropriate in a world where attractive separate satellite systems and fiber optic cables are emerging.**

- **INTELSAT's global cost sharing arrangements encourage countries to overestimate their individual facility needs, for they are billed for costs only in proportion to their actual use of INTELSAT facilities.**

- **Global average cost pricing encourages new, possibly uneconomic, entry on heavily used routes, not only despite excess INTELSAT capacity but, paradoxically, because of it.**

- **Excess capacity arises not simply because of chronically overoptimistic traffic forecasts, but because of the incentives of some carriers to expand facilities beyond economic levels. Because these forecasts are inflated to help justify these facilities, the forecasts are more of a symptom than a cause of excess capacity.**

- **The FCC's circuit loading constraints on AT&T, essentially guaranteeing Comsat a portion of AT&T's traffic, encourages Comsat to behave inefficiently because excess costs can be passed on to AT&T.**

- **Rate-of-return regulation of Comsat encourages its oversubscription to INTELSAT ownership and possibly other forms of rate base expansion, which imposes additional costs on its customers.**

All of these tentative findings will be the subject of future RAND studies.
CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREFACE</td>
<td>iii</td>
</tr>
<tr>
<td>SUMMARY</td>
<td>v</td>
</tr>
<tr>
<td>Section</td>
<td></td>
</tr>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>II. NATURE OF THE PROBLEM</td>
<td>6</td>
</tr>
<tr>
<td>III. OVEROPTIMISTIC TRAFFIC FORECASTS</td>
<td>12</td>
</tr>
<tr>
<td>Targets for Forecasting</td>
<td>14</td>
</tr>
<tr>
<td>Bilateral Forecasting</td>
<td>17</td>
</tr>
<tr>
<td>Projections Based on Past Experience</td>
<td>19</td>
</tr>
<tr>
<td>Effects of Forecasts on Facilities Planning</td>
<td>22</td>
</tr>
<tr>
<td>IV. MARKET STRUCTURE AND GOVERNMENT REGULATION</td>
<td>24</td>
</tr>
<tr>
<td>Expansion of Rate Base</td>
<td>24</td>
</tr>
<tr>
<td>Incentives of Foreign PTTs</td>
<td>33</td>
</tr>
<tr>
<td>Incentives of Other U.S. International Carriers</td>
<td>36</td>
</tr>
<tr>
<td>V. INEFFICIENT PRICING</td>
<td>38</td>
</tr>
<tr>
<td>VI. CONCLUSIONS</td>
<td>41</td>
</tr>
</tbody>
</table>
1. INTRODUCTION

The development of intercontinental telecommunications links is an impressive success story. These facilities, consisting of undersea cables and communications satellites, have embodied rapid technological advances and sharply declining circuit costs. Consequently, many new services have been developed, and the annual rate of traffic growth has frequently exceeded 20 percent.

The first commercial communications satellite was launched in 1965, under the auspices of the International Telecommunications Satellite Organization (INTELSAT). By early 1986, INTELSAT had a global network of 16 far more advanced satellites (covering the Atlantic, Pacific, and Indian Ocean regions) with about 1750 pathways supplying telephone, data, and television services to more than 160 countries and territories. INTELSAT's charge to its members (paid in U.S. dollars) for use of a satellite telephone circuit in 1985 was only 15 percent of the charge in 1965 and, in the face of general inflation, far less in real terms.

INTELSAT is a nonprofit cooperative of 112 member states (as of October 1986) who invest in the global system in rough proportion to their use. By the end of 1985, total net investment in the space segment exceeded $1.6 billion. (Satellite earth stations are separately owned and operated by users.)

The Communications Satellite Corporation (Comsat) is a private for-profit firm established in accordance with the Communications Satellite Act of 1962 as the U.S. representative to INTELSAT. In this capacity, Comsat is responsible for advocating U.S. interests and for making its share of capital contributions to INTELSAT.

INTELSAT is organized into four units:

- The Assembly of Parties, composed of all member states, usually meets once every two years to consider general policy and long-term objectives. The United States is represented by the State Department.
- 2 -

• The Meeting of Signatories, composed of member governments or their designated telecommunications entities (of which Comsat is one), usually meets annually to consider financial, technical, and operational aspects of the system.

• The Board of Governors, consisting of 20 or more signatories or representatives of groups of signatories, depending on investment shares, usually meets quarterly to make decisions about such details as design, procurement, and operation.

• The Executive Organ, headed by the Director General responsible to the Board of Governors, consists of a staff that manages the system's day-to-day operation.

In addition to satellites, more than 200 undersea telephone cables have been installed worldwide.¹ For example, over the years ten cables have been laid across the North Atlantic, each with progressively higher capacity and lower circuit costs. An eleventh cable (TAT-8), planned for operation in 1988, will incorporate fiber optic technology to afford a greater capacity than all existing North Atlantic cables combined.

Generally, cables are owned jointly by the "postal, telegraph, and telephone" entities (PTTs) of countries that heavily use the particular cable in question, with arrangements for access by nonowning PTTs. For cables connecting the United States with other countries, AT&T and other U.S. international carriers share ownership with foreign PTTs. Although foreign PTTs (but not U.S. carriers) also participate in INTELSAT as signatories or members of the Board of Governors, INTELSAT itself is not involved in cable investment or operation.

Except for separate regional and transborder systems, and the Soviet INTERSPUTNIK system, INTELSAT holds a monopoly in providing international satellite links. Moreover, all U.S. carriers, including AT&T, must deal with Comsat to gain access to INTELSAT circuits. In other words, Comsat is the monopoly supplier to U.S. users. Access at the foreign end is generally under the monopoly of PTTs.

Aside from U.S. carriers, most owners and operators of cable facilities are government owned and operated PTTs that have a monopoly on telecommunication services in their own countries. No one can provide telecommunication links—via either cables or satellites—to or from these countries without the permission of these entities.

In 1985 AT&T accounted for more than 90 percent of U.S. international telephone traffic. A few carriers, such as MCI International and US Sprint, offer telephone service in competition with AT&T but their international market shares are currently small, in part at least because of difficulties in negotiating operating agreements with foreign PTTs. In addition, U.S. "record" carriers supply telex, data, and other nonvoice services.

This structure of the industry has triggered many concerns at the Federal Communications Commission (FCC) and elsewhere that, despite the successes noted above, the international telecommunications system does not operate efficiently. Although excess capacity is not easily identified as a single quantity, since contingency reserves are needed, concern has been widely expressed that substantial excess capacity exists, especially in use of satellites. Even so, large new investment projects are under way. INTELSAT is seeking to sell or lease its idle transponders for domestic uses at reduced prices that some assert are unfairly low and predatory. Concerned that AT&T may be biased in favor of cable, the FCC imposes on AT&T "circuit loading" constraints requiring it, in effect, to procure about one-half of its Transatlantic circuit needs from Comsat, regardless of Comsat's costs. The FCC subjects Comsat and AT&T to traditional rate-of-return regulation, whereas other U.S. carriers have been largely deregulated.

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2 The most notable exceptions are the United Kingdom and Japan, whose telecommunications markets are being restructured to permit competitive entry. For useful case studies of telecommunications developments in the United States, Canada, United Kingdom, Federal Republic of Germany, France, Finland, and Japan, see R. R. Bruce, J. P. Cunard, and M. D. Director, From Telecommunications to Electronic Services, Butterworth, Boston, MA, 1986.

Hoping to improve the efficiency with which the international system operates by making it more competitive, the FCC has recently granted landing rights to two privately owned fiber optic cable systems planned for installation across the North Atlantic, and it has conditionally authorized the applications of a half-dozen private international satellite systems to operate outside INTELSAT.

Although these systems face numerous hurdles before they can be constructed and operated, their conditional approval by the FCC has triggered heated debate. Some observers extol the virtues that competitive entry will confer. Others are concerned that the problem of excess capacity will become even worse. Others assert that the viability of INTELSAT will be seriously threatened. Yet others point out that average-cost pricing—such as INTELSAT’s global cost averaging in setting its rates for satellite use—encourages inefficient market entry: Newcomers, free to select only relatively profitable routes, may be able to survive even if their costs are higher than those of INTELSAT or of other existing carriers. Finally, we are reminded that, in any event, neither the FCC nor the U.S. carriers can unilaterally decide the nature of international market structure. In all cases, agreements must be reached with foreign governments or foreign PTTs.

The following questions highlight major aspects of this debate:

1. Why does large excess capacity exist, and why are existing carriers and prospective market entrants nevertheless willing to invest in new facilities?
2. How should Comsat be regulated in its role of monopoly supplier of international satellite circuits to U.S. users?
3. Should U.S. carriers be permitted to deal directly with INTELSAT and, if so, what should be the future role of Comsat?
4. Should the FCC’s circuit loading constraints on AT&T be modified or abolished?
5. How should INTELSAT price its services in light of existing excess capacity and in response to potential competition from new cable facilities and separate satellite systems?
6. What are the likely consequences of this potential competition for INTELSAT's users?

7. How is the role of foreign PTTs likely to evolve in promoting or blocking a more competitive international market structure?

The purpose of this study is to focus on the first of these areas. Subsequent RAND studies will address the others. Together, they are concerned with questions of how incentives might be strengthened to promote efficiency in the construction and use of international cable and satellite facilities.
II. NATURE OF THE PROBLEM

In both the Atlantic and Pacific Ocean basins, excess capacity is a persistent problem. One study shows that in nearly all years during the period 1970-1985, fewer than 50 percent of satellite circuits were used. Cable use was somewhat higher--typically 60 to 70 percent--but combined use generally remained below 50 percent. The study concludes that "from the viewpoint of providing service at the least cost, all the trans-Atlantic and trans-Pacific cables constructed between 1970 and 1984 appear to have been unnecessary." These include three Atlantic cables (TAT-5, TAT-6, TAT-7) and two Pacific cables (HAW-3 and TPC-2) with a combined investment cost of $1.15 billion in 1984 dollars.

This excess is particularly notable since it is over and above reserves needed to meet daily or other periodic peak traffic loads. Carriers generally activate enough full-time circuits to accommodate peak loads. As traffic grows over time, they activate more circuits to keep blockage rates below specified levels. The capacity of concern here is that in excess of such used circuits.

To be sure, the above figures should be interpreted with caution. Some excess capacity is desirable for several reasons:

- Excess capacity is needed to help prevent traffic disruption caused by greater than expected traffic loads or by failure of existing facilities.
- Some facilities may fill more quickly than others and may need to be expanded or replaced even though excess capacity exists in the overall system. For example, bottlenecks may occur because satellite and cable circuits are not perfect.

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2Ibid., p. 50.
3Ibid., p. 47-D.
substitutes.\footnote{Each technology has advantages over the other. Until fiber optics cable is introduced, it is economic to transmit video only over satellite. Satellite circuits require fewer repeaters than cable, helping to increase quality of transmission. On the other hand, cable is less vulnerable to eavesdropping and it is not subject to the propagation delay inherent in transmitting 22,500 miles to and from a satellite. However, technological fixes have reduced the problem of time delay. For a brief discussion see E. Pthenakis, Manual of Satellite Communications, McGraw-Hill, New York, 1984, pp. 23-25.} Both route diversity and media diversity (cable and satellite) are used to cope with such problems.

- Contingencies must be allowed for time slippage in introduction of new facilities because of development problems, for example, or accidents--the launch failure of an INTELSAT V-A satellite in May 1986 being a case in point.
- Improvements in circuit quality embodied in new facilities may justify their construction in the face of excess capacity in older facilities. The service improvements afforded by fiber optic cable over earlier analog cables is a leading example.
- It is economic, in some cases, to incur the costs of excess capacity in the satellite space segment because doing so reduces the incremental earth station costs that would otherwise be incurred as traffic grows.\footnote{For an explanation of this point see W. Hinchman, The Economics of International Satellite Communications, Summary Report, Vol. 1, INTELSAT, Washington, D.C., May 18, 1984, p. 6.}

In spite of these reasons, the problem is sufficiently great that INTELSAT has identified 100 or more satellite transponders that it deems to exceed its international requirements. It is seeking to sell or lease them for domestic use at much lower prices than it has charged its member carriers in the past. Indeed, the FCC and others are concerned that these prices are too low to cover cost--a subject to be treated in a subsequent RAND study.

The problem of excess capacity may grow because large additional international facilities are under construction, and because new market entrants are planning to invest in cable and satellite systems for services that, at least in part, compete with those of the established carriers.
Estimation of potential excess capacity is complicated not only because of uncertainties about future traffic levels but because of uncertainties about the capacities of specific cable and satellite facilities. For example, the number of voice circuits can be increased by adding circuit multiplication equipment to earth stations and to cables. One technique—time assignment speech interpolation (TASI)—has for years been applied to cable circuits to double their capacity. Others are in various developmental and experimental stages. Moreover, the capacity of a satellite depends on how it is used. One that connects only a few earth stations can handle more circuits than one that connects dozens of stations scattered, say, around an ocean basin.

With these caveats in mind, we make lower bound estimates of the potential problem by making conservative assumptions about the capabilities of existing and planned facilities. Table 1 illustrates this approach with data on capacities and projected traffic across the North Atlantic. The excess capacity of 45,000 circuits accounts for more than 50 percent of the total—with this excess estimated on the following conservative assumptions.

- The figure for existing cables of 9,000 circuits does not include the use of TASI.
- One INTELSAT V-A and three INTELSAT VI's are shown, drawn from the two V-As and four INTELSAT VI's scheduled for launch by the end of 1990. The remaining satellites are assumed either to be launched in a stretched-out time schedule, to be lost as a result of accident, or to be placed over other ocean basins.
- The capacities for the satellites shown do not include circuit multiplication possibilities using new technologies. For example, one study shows the "operational capacity" of an INTELSAT VI as high as 55,000 circuits, contrasted with 30,000 circuits assumed in note "d" of Table 1.7

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6Recent space launch accidents have increased the uncertainty about future launch dates. The above schedule is drawn from INTELSAT, Launch Vehicle Status Report for INTELSAT V and VI, BG-66-17E, Washington, D.C., February 9, 1986.

7J. Cummins, R. Lemus, J. Reyna, and J. Crispin, Satellites Versus
Table 1

FACILITIES' CAPACITY AND TRAFFIC PROJECTED IN 1986 FOR NORTH ATLANTIC IN 1990

<table>
<thead>
<tr>
<th>Facility</th>
<th>Estimated Capacity (Voice-Grade Circuits)</th>
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<tbody>
<tr>
<td>Existing cables</td>
<td>9,000&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>TAT-8 cable</td>
<td>35,000&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>One INTELSAT V-A</td>
<td>6,000&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Three INTELSAT VIs</td>
<td>36,000&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Total Capacity</td>
<td>86,000</td>
</tr>
<tr>
<td>Estimated traffic</td>
<td>41,000&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>Excess Capacity</td>
<td>45,000&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup>Rounded figure from data on TAT-5, TAT-6, and TAT-7, reported in Kererl and McNally, op. cit., p. 47-D.

<sup>b</sup>Based on maximum capacity of 37,800 if capacity were devoted solely to voice services. FCC, Memorandum Opinion, Order, and Authorization, 98 FCC 2d 440, 445 (1984).

<sup>c</sup>Based on "capacity average" of 15,000 circuits for an INTELSAT V-A satellite from INTELSAT Report 1985-1986, Washington, D.C., p. 17. A figure of 40 percent of 15,000 is used because North Atlantic traffic accounts for about 40 percent of INTELSAT total traffic in the Atlantic Ocean basin.

<sup>d</sup>Same methodology and source as in note "c", with the "capacity average" of each INTELSAT VI given as 30,000.

<sup>e</sup>Rounded figure from estimates of U.S. traffic of 37,299 circuits and Canadian Traffic of 3,814 circuits across the North Atlantic taken, respectively, from Table 3 below and from Teleglobe Paper to the Sixth NACWG Meeting, Quebec City, Canada, May 28-30, 1986, p. 1.

<sup>f</sup>Does not include television traffic. However, the television channel capacity of INTELSAT satellites is also excluded.
- 10 -

• All existing satellites over the Atlantic basin are assumed either to have exhausted their useful lives or to have been transferred to other ocean regions.
• The projected traffic of 41,000 circuits for 1990 may be an overestimate, as discussed below.

Moreover, Table 1 does not include other cable and satellite systems that may be in use by the end of 1990. A leading example is the private PTAT-1 fiber optic cable proposed by Tel-Optik Limited (and approved by the FCC) for operation in 1989 between the United States and the United Kingdom. The prospective capacity of this cable is the equivalent of 62,500 voice circuits if circuit multiplication is used—a capacity far exceeding total traffic projected over the North Atlantic in 1990.8

The situation is similar in the Pacific. The FCC has approved construction of the HAW-4/TPC-3 cable to be completed in 1988.9 It is to have a capacity of about 40,000 circuits—more than six times INTELSAT circuit use in the Pacific in 1985. In addition, an application to the FCC has been filed by Pacific Telecom Cable, Inc., for a private fiber optic cable between the state of Washington and Japan, with completion planned in 1989.10

To be sure, the cost of international satellite and cable facilities represents only a small part of the price paid by end users—perhaps 10 percent or so according to some interviewees. Thus, the burden of excess capacity, one might argue, has only a small effect on retail telecommunications rates. But this argument ignores the fact that, with the millions of telephone calls and other services provided each year, the cost of international facilities in total dollars is not trivial. The current net investment in INTELSAT's worldwide space

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15FCC file I-S-C-L-86-002.
segment alone is about $1.6 billion, as noted above, with many more
millions invested by international carriers in earth stations. The cost
of a single INTELSAT VI satellite, including launch, insurance, and
other support items, is estimated in one study at $232 million.\textsuperscript{11}
INTELSAT has five such satellites on order. The TAT-8 and the
HAW-4/TPC-3 cables are estimated to cost about $362 million and $633
million, respectively.\textsuperscript{12} Clearly, the ways in which such facilities are
planned and used have serious consequences for society.

Why do common carriers and others invest in such a seemingly
wasteful manner? We will explore three possible explanations: (a)
overoptimistic traffic forecasts, (b) market structure and regulatory
policy, and (c) inefficient pricing of circuits.

\textsuperscript{11}Cummins et al., op. cit.
\textsuperscript{12}Memorandum Opinion, Order, and Authorization, 98 FCC 2d 440, 447
(1984); Memorandum Opinion, Order, and Authorization, FCC file no.
III. OVEROPTIMISTIC TRAFFIC FORECASTS

At best, forecasting is a hazardous art, given the multitude of uncertainties and unknowns involved in attempts to gaze into the future.¹ But the experience in international telecommunications merits special attention because of a striking bias, at least in recent years, toward overestimating traffic growth.

Table 2 illustrates the extent to which INTELSAT overestimated its future traffic during the period 1980-1983. For example, the number of INTELSAT's activated circuits at the end of 1980 fell 9.2 percent below the forecast made in the preceding year, 1979, whereas traffic at the end of 1983 fell 19.8 percent below the forecast made in 1982. For 1985, actual traffic amounted to 80,670 half-circuits--15 percent below the level of 95,070 half-circuits forecast in June 1984.²

Table 2
SHORTFALL OF ACTUAL TRAFFIC BELOW FORECAST MADE IN PRECEDING YEAR

<table>
<thead>
<tr>
<th>End of Year</th>
<th>Shortfall (%)</th>
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<tbody>
<tr>
<td>1980</td>
<td>9.2</td>
</tr>
<tr>
<td>1981</td>
<td>15.1</td>
</tr>
<tr>
<td>1982</td>
<td>17.4</td>
</tr>
<tr>
<td>1983</td>
<td>19.8</td>
</tr>
</tbody>
</table>

NOTE: Traffic levels are for full-time voice-grade circuits.

¹For an excellent account of why forecasts can fall wide of the mark, despite the use of highly sophisticated analytic techniques, see B. M. Mitchell, R. E. Park, and F. Labrune, Projecting the Demand for Electricity: A Survey and Forecast, The RAND Corporation, R-3312-PSSP, February 1986. Although the discussion is couched in terms of the demand for electricity, it is relevant to telecommunications and other markets as well.

²INTELSAT Report 1985-1986, op. cit., pp. 12 and 24. Transmission of a circuit from (to) an earth station to (from) the satellite is a "half-circuit." Hence, two half-circuits (or a full circuit) are required for an end-to-end connection. Unless otherwise indicated, all references in this study are to full circuits.
Moreover, one would expect errors of progressively shorter-term forecasts to decline. But this is not the case for INTELSAT, at least for some recent years. To illustrate, Fig. 1 shows the trend in forecasting traffic for 1983, whose actual traffic volume at the end of the year was slightly above 65,000 half-circuits, shown by the horizontal line. Even at mid-year 1983, the forecast for the year-end level exceeded actual traffic by about 13 percent (75,000 half-circuits versus 65,000 half-circuits). The forecast of 70,000 half-circuits that had been made four years earlier turned out to be closer to the mark!

![Graph showing trends in INTELSAT traffic forecasts](image)

**Fig. 1—Trends in INTELSAT traffic forecasts**

Figure 2 shows that only for 1985 do forecasts consistently improve with the passage of time, and even for 1985 the forecast made at mid-year (88,684 half-circuits) exceeded by 10 percent the actual traffic level (80,824 half-circuits) recorded at year end. For all the years, except for 1984 and 1985, the forecasts made four years in advance were closer to the actual traffic levels than were any of the later-term forecasts. And the years 1981 to 1984 show the same "bow wave" pattern as in Fig. 1--worse intermediate-term forecasts than the four-year forecasts but with forecasts showing improvement at some point as they become progressively shorter-term.

How does one explain such curious results? Three factors may be at work: (a) targets toward which forecasts are made, (b) bias caused by the bilateral nature of traffic forecasting, and (c) erroneous projections of past experience.

TARGETS FOR FORECASTING

The forecasts reported in this study are typical of those encountered elsewhere--point estimates of future traffic levels. But what these point estimates seek to estimate is unclear. A future traffic level is a random variable with a probability distribution. That is, many future traffic levels are possible at various probabilities of occurrence. The most appropriate point estimate depends on how the forecast is to be used. For example, if one uses traffic forecasts to estimate future revenues, a "best guess" point estimate would be targeted at the mean of the probability distribution. The actual level would sometimes be above and sometimes below the forecast, with errors tending to cancel out.

But in other cases, a forecast might be needed to determine future capacity requirements. To illustrate, suppose that the benefit of preventing a telephone call from being blocked is ten times the cost of having available sufficient additional capacity to prevent the blockage. Suppose, further, that decisions about how much capacity to maintain are made on the basis of traffic forecasts. In this situation, the optimal response is to target the forecast at the 90 percent level of the probability distribution--that is, to estimate future traffic at a level
Fig. 2—Trends in INTELSAT satellite traffic forecasts for year shown

SOURCE: INTELSAT (1984), op. cit., p. 15 and correspondence with INTELSAT staff.
such that the probability of actual traffic exceeding that level is only
10 percent. In this way, the expected benefit of avoiding a blocked
call is made equal to the cost of the capacity required to prevent the
blockage. Nine times out of ten, on average, the capacity will not to
be needed. However, since the cost of that capacity (per time period)
is one-tenth of the cost saved by preventing the call from being
blocked, the cost of maintaining that capacity over ten time periods is,
on average, equal to the cost of preventing the blockage that otherwise
would be expected to occur.

But this means that nine times out of ten, on average, the forecast
level is expected to be above the actual level—exhibiting an upward
bias of the sort discussed above. The bias arises because, rather than
reflecting one's best guess about the actual traffic level, the forecast
reflects an added "contingency" so that investment decisions based on
that forecast take into account the cost of capacity relative to the
costs of preventing traffic blockages.

With technological progress, the cost of adding a unit of capacity
is falling relative to the benefit of preventing traffic blockages. Per
circuit costs for both cables and satellites have fallen drastically, as
noted in Sec. I. But the value to a consumer of avoiding blockages may
have changed little. If so, there may be a progressively greater
tendency to forecast traffic levels that exceed actual ones.

The difficulty with this approach, however, is that it can easily
mislead people. They may interpret the figures as best guesses about
future traffic levels used, for example, to estimate future revenue
requirements and the reasonableness of particular tariffs. In fact, the
forecasts may be slanted to help with investment decisions aimed at
achieving optimal levels of capacity.

It is important, then, for forecasters to be explicit about the use
to which their answers are to be put, and to explain how they get their
results. In this way, regulators and the public would understand the
goals that forecasters seek, and the basis for investment decisions
could more easily be subject to outside scrutiny than is the case when
contingencies are buried without explanation in inflated forecasts.
However, if this misleading approach to forecasting were the only cause of the upward bias in forecasting, the situation would perhaps be tolerable. For the approach could encourage an optimal level of capacity, including amounts that would be unused much of the time.

Unfortunately, other factors also encourage inflated forecasts—and these do not encourage optimal capacity levels. It is to these that we now turn.

**BILATERAL FORECASTING**

INTELSAT's forecasts are based on data presented at an "Annual Global Traffic Meeting." Each pair of countries is called upon to agree on the level of satellite traffic expected between them. These figures are then added to obtain regional and global totals.\(^3\)

However, bilateral forecasts may fail to take into account network relationships among countries. To illustrate, consider two countries A and B. For at least two reasons they may add a "contingency" allowance in their forecast: (a) to help ensure that enough capacity will be available in case traffic growth is greater than expected, and (b) to help ensure that enough redundancy exists so that traffic can be accommodated if particular transmission links are disrupted.

The difficulty is that countries collectively are likely to add an excessive contingency allowance, if each pair fails to take into account the amount of contingency included elsewhere in the network. The reason is that contingencies against which countries seek to protect themselves are not likely to occur simultaneously.

Consider the first contingency above. If unexpected traffic growth occurs between countries A and B, they may be able to accommodate the increase by rerouting traffic through country C. Unless A and B jointly take into account their contingency allowances with all other countries through which rerouting might take place, they are likely to

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\(^3\)The most recent publicly available figures are contained in a voluminous document, *INTELSAT Data Base from INTELSAT 1985 Global Traffic Meeting*. This, together with other sources, provides a rich body of disaggregated country-by-country data that could be used to evaluate the determinants of both traffic level and traffic forecasts.
through which rerouting might take place, they are likely to overestimate the allowance needed to handle traffic between themselves.

With respect to the second contingency, overestimates are even more difficult to avoid. For the appropriate allowance needed between A and B may depend on the contingencies included between other pairs of countries. For example, suppose a cable break disrupts traffic between A and B. Service might be maintained by using spare satellite circuits that might eventually be used between E and F. Conceivably, even if A and B include no contingency allowance in their forecast, they could be protected by the allowances made by other pairs.⁴

These problems of bias are exacerbated because of the way costs are shared within INTELSAT. The costs of expanding facilities in response to the inflated traffic estimates between countries A and B are not borne entirely by A and B but are shared with all other participants in the global system. Thus, some of these costs may be borne by countries that do not even communicate by satellite with A or B. The INTELSAT investment share of each participant is about equal to its share of global use. If A’s share is less than expected, either other countries bear a larger share of the investment costs or A earns about a 14 percent return on its excess investment.⁵ INTELSAT exacts no explicit penalty against a country for poor forecasts, nor does it pay a reward for good ones.⁶

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⁴An obvious possibility for mitigating the upward bias stemming from bilateral agreements is for INTELSAT itself to adjust downward its aggregate forecasts. Since 1984, INTELSAT staff have been doing this for forecasts extending beyond two years.

⁵INTELSAT imposes a "space utilization charge" set to generate revenues sufficient to provide a target return on investment of 14 percent. Countries whose relative use is less than their ownership shares earn that return on their excess investment. Conversely, countries whose use exceeds their investment share pay the utilization charge, which includes a return to other countries for their excess investment. Thus, nonmember countries that use the system, such as the Soviet Union, compensate member countries for their investment through use charges.

⁶In 1984, an INTELSAT staff analysis recommended that countries be rewarded for good forecasts, but the recommendation has not been adopted (INTELSAT (1984), op. cit., p. 20).
PROJECTIONS BASED ON PAST EXPERIENCE

Second, a bias may arise because of the tendency to extrapolate into the future the results of the past. International traffic has increased rapidly, with annual growth rates typically exceeding 20 percent. But one must be wary of projecting such growth rates far into the future. As simple calculations would show, such compounded growth rates would allow so much traffic that everyone on earth could talk with everyone else on earth--simultaneously! This is an elementary point, of course, but it is surprising how easily people can be seduced by the magic of compound growth into making wild predictions.

The problem posed by projecting on the basis of past experience is illustrated in Table 3. It shows the trend of forecasts made collectively by U.S. international carriers of their traffic (both satellite and cable) across the North Atlantic. As in the earlier INTELSAT data, Table 3 shows a bias toward overestimation. The June 1980 forecast of 23,461 circuits for 1985 turned out to be 37 percent too high. Progressively shorter-term forecasts did become more accurate for 1985, in contrast to the bow wave pattern in INTELSAT forecasts shown in Figs. 1 and 2. But note that, although the U.S. international carriers have adjusted downward their forecasts for 1990 and 1995, they continue to assume nearly the same high rate of growth. The June 1980 forecast shows an average annual growth rate of 16 percent between 1985 and 1995. Although the later March 1986 forecast includes large downward adjustments, it shows a growth rate nearly as high—15 percent between 1985 and 1995.

These recent forecasts are troubling because the rate of traffic growth has dropped. Figure 3 shows the reduction in the growth rate for INTELSAT's global traffic since 1981. In the Atlantic Ocean region, satellite traffic growth fell to below 10 percent in 1983, 1984, and 1985.\textsuperscript{7} For satellite and cable traffic together in the Atlantic Ocean region, growth rates for 1983 and 1984 were 10 and 12 percent respectively, compared with earlier rates in excess of 20 percent.\textsuperscript{8}

\textsuperscript{7}INTELSAT Report 1985-1986, op. cit., p. 24. These figures include North Atlantic and all other routes in the Atlantic region.
Table 3
TRAFFIC FORECAST, UNITED STATES AND CEPT COUNTRIES
(Equivalent voice circuits)

<table>
<thead>
<tr>
<th>Date of Forecast</th>
<th>1985</th>
<th>1990</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 1986</td>
<td>17,173 (actual)</td>
<td>37,299</td>
<td>70,582</td>
</tr>
<tr>
<td>November 1984</td>
<td>18,092</td>
<td>37,161</td>
<td>81,888</td>
</tr>
<tr>
<td>September 1983</td>
<td>19,516</td>
<td>45,190</td>
<td>97,841</td>
</tr>
<tr>
<td>April 1982</td>
<td>21,002</td>
<td>46,030</td>
<td>99,664</td>
</tr>
<tr>
<td>October 1981</td>
<td>23,170</td>
<td>49,486</td>
<td>102,101</td>
</tr>
<tr>
<td>June 1980</td>
<td>23,461</td>
<td>50,152</td>
<td>104,510</td>
</tr>
</tbody>
</table>

SOURCE: Contribution of the United States, North Atlantic Consultative Working Group, Quebec City, Canada, May 28-30, 1986; Table 6-1.

aCEPT is the Conférence Européen des Administrations des Postes et des Télécommunications, an association of the PTTs in 26 European nations.

Despite these reductions, the U.S. carriers continue to project a growth rate of 15 percent--casting doubt on the reliability of the figures of 37,299 and 70,582 estimated respectively for 1990 and 1995.

Moreover, the excess capacity estimate of 41,000 circuits in Table 1 is based on the forecast of 37,299 circuits from Table 3. But the growth rates in Table 3 and Fig. 3 suggest that the 1990 forecast may be too high. If so, excess capacity would be even greater than that shown in Table 1.

The remaining curiosity is the bow wave pattern in Figs. 1 and 2. Why have INTELSAT's short-term forecasts been wider of the mark than longer-term forecasts? According to one interviewee, participants tend to play "catch-up" in adjusting (or not adjusting) their forecasts to reflect current experience. Rather than reducing their forecasts in

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*Kwasal and McNally, op. cit., p. 47-A.
response to shortfalls experienced in the current period, they tend to believe in the forecasts made earlier for future years. Thus, a shortfall in the current period is interpreted as meaning that traffic will grow even faster to reach earlier projected levels.
Such thinking is consistent with the notion that the future will be like the past. As noted above, Fig. 1 shows a forecasting error of 13 percent based on the estimate in mid-year 1983 for the end of year 1983. From mid-1983, traffic would have had to grow by 26 percent annually to reach the level forecast by the end of the year. Such a high estimated growth rate would have been plausible only if one had believed that the days of the 1970s, shown in Fig. 3, would quickly return.

EFFECTS OF FORECASTS ON FACILITIES PLANNING

Are traffic estimates, with such a poor track record, taken seriously in investment decisions? Apparently, the answer is Yes. One report notes that INTELSAT's decision in December 1980 to procure three INTELSAT V-A satellites for delivery in 1984 was predicated on the belief "that the forecast requirements would be realized in that time frame and that additional capacity would be needed." Only a few months later, in March 1981, INTELSAT's Board of Governors issued a request for proposal for the INTELSAT VI series "to meet requirements in 1986 and beyond." The report goes on to note that

If the decision to procure the first three V-A satellites had been postponed until after January 1981 when the 1980 actuals showed a significant shortfall, it is not unreasonable to consider the possibility that different satellite procurement programs might have been undertaken. In the case of INTELSAT VI, it is even possible this information might have had a major impact on the decisionmaking process.  

Moreover, information shown in Table 3 was used in the FCC's deliberations about whether to authorize construction of the TAT-8 fiber optic cable for operation in 1988. At the time of its decision, it had in hand the forecast of September 1983 showing 45,190 circuits in 1990. Taking these and other forecasts into account, the FCC staff

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10 Ibid.
estimated that demand would exceed total capacity without TAT-8 in 1992. The FCC decided, however, to approve the 1988 operational date to help protect against risks that INTELSAT VI's satellite program might be delayed and to accelerate availability of the benefits of TAT-8's digital technology (in contrast to the analog technology of existing cables). Had the U.S. carriers' forecasts been closer to those made in March 1986 (shown in Table 3 as being 17 percent lower for 1990 and 28 percent lower in 1995 than the forecasts made in September 1983), perhaps the FCC would have put greater pressure on the carriers to delay TAT-8.
IV. MARKET STRUCTURE AND GOVERNMENT REGULATION

Although such forecasts as those discussed in the preceding section are taken into account in investment decisions, a question remains as to whether the upward bias in forecasts is only the symptom rather than the cause of excess capacity. Do incentives to overinvest exist, so that carriers tend to bias their forecasts upward to help justify investments they want to make?

In response, let us explore several possible reasons why carriers might have an incentive to overinvest.

EXPANSION OF RATE BASE

Under certain assumptions, carriers regulated on the basis of their rate of return on investment have an incentive to inflate their rate bases to obtain greater profits. If the rate of return allowed by the regulatory agency exceeds the firm's cost of capital, and if certain other conditions hold, the firm will seek to expand its rate base beyond a socially optimal level.

Many analysts have sought to determine whether regulated firms, such as AT&T and Comsat, in fact operate under these conditions.\(^1\) If they do, one could speculate that (a) AT&T has an incentive to invest in cables in excess of traffic requirements as a way to expand its rate base and, hence, its profits, and similarly (b) Comsat has an incentive to encourage expansion of INTELSAT, and hence, its investment in INTELSAT.

However, Comsat is in a special position. As an owner of INTELSAT, it is primarily a wholesaler of satellite circuits to AT&T and other U.S. international carriers who "retail" the circuits to end users. About 80 percent of Comsat's revenues through INTELSAT are generated by provision of circuits to AT&T.\(^2\) Thus, the behavior of AT&T can greatly

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\(^1\)See, for example, the discussion in Kwerel and McNally, op. cit., pp. 16-18, 61-65.

affect Comsat's fortunes. If AT&T has a bias toward cable as a way to expand its rate base, Comsat would be under pressure to minimize its per circuit satellite costs and, hence, its rates to AT&T. In this case, excess capacity might be expected to show up in cable, reflecting AT&T's bias, but not in satellites, since Comsat is so heavily dependent on AT&T.

But another constraint affects the outcome: Concerned about a possible AT&T bias toward cable because of rate base regulation and AT&T's manufacturing interests in cable, the FCC imposes circuit loading restrictions that force AT&T to use a greater number of satellite circuits in proportion to cable circuits than it might choose, in cooperation with its correspondent foreign PTTs. The precise formula for circuit loading has varied over time; but it has kept AT&T's use of cable and satellite over the Atlantic in an approximate 50/50 balance. In 1985, the FCC adopted a revised formula giving AT&T somewhat greater leeway to use relatively more cable circuits during the period 1986-1988. For example, if AT&T's forecast for 1987 of its traffic with European countries of 19,540 circuits is borne out, AT&T will be permitted to carry 52.0 percent on cable, in comparison with 47.3 percent under the "balanced loading" formula used previously. Before the end of 1988, the FCC plans to review the situation to determine whether to continue with the new formula, or to apply another one, or to abolish loading constraints altogether.

Rate-of-return regulation of AT&T and Comsat, combined with the FCC's circuit loading constraints, could lead to the following situation: AT&T overinvests in cable, and Comsat overinvests in satellites knowing that AT&T will be forced to use satellites for about one-half of its circuit requirements regardless of Comsat's costs. Thus,

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2The FCC noted in its most recent report and order on circuit loading, "We indicated our particular concern that AT&T's preference for cables, as a cable equipment manufacturer and rate base regulated carrier, could lead that carrier to employ cable facilities even if satellite facilities were more costs effective." 50 Fed. Reg. 34813, 34814 (August 28, 1985).
4Ibid., p. 34826.
excess capacity becomes a chronic problem. Overoptimistic traffic forecasts help to ensure FCC approval of new facilities.

Although this might appear to be a tidy explanation of excess capacity, it leaves several key questions unanswered: What independent evidence do we have about whether a bias induced by rate-of-return regulation exists? How does one explain the behavior of government-owned foreign PTTs who, as signatories to INTELSAT and as co-owners of cable, must agree with Comsat and AT&T before either satellite or cable facilities can be built? What is the role of other U.S. international carriers who do not face rate-of-return or circuit loading constraints? We will address first the evidence about bias, and then we will treat questions of foreign PTTs and other U.S. carriers.

Many empirical studies have been undertaken (mostly in the electric utility industry) to determine whether rate-of-return regulation leads to overinvestment.\(^6\) Conclusions have been drawn in both directions, but the results are generally ambiguous or questionable. No studies in the telecommunications field have shown convincing evidence about whether a bias exists. The root difficulty lies in devising a satisfactory empirical test to identify and measure the bias, if it exists, in light of the multitude of factors that simultaneously affect decisionmaking.

To illustrate this problem, we could seek to determine whether AT&T has a bias toward cable by comparing its behavior with that of other U.S. international carriers who are not subject to rate-of-return or circuit loading constraints. Table 4 shows recent data on circuit use by four U.S. carriers. ITT World Communications (ITTWC), RCA Global Communications (RCAGW), and MCI International (MCII) were essentially deregulated in 1985, after the FCC's decision that they do not hold dominant market positions.\(^7\) Even before the FCC's decision, the


\(^7\)FCC, Report and Order, 102 FCC 2d 812 (1985).
evidence suggests that the rate-of-return constraint was not binding on
these carriers, at least in recent years. According to ITTWC, the rate
of return for these three carriers during the first half of 1983 ranged
between 6.3 and 9.0 percent, whereas ITTWC's own rate of return declined
from 14.5 percent in 1980 to 10.4 percent in 1981 and to 10.2 percent in
1982. Moreover, since 1979 only AT&T has been subject to circuit
loading constraints.

Under these circumstances, the data in Table 4 can be interpreted
in one of four ways:

1. *Neither AT&T nor Comsat has a bias.* Those carriers not subject
to rate base or circuit loading constraints use a larger
proportion of cable to satisfy their requirements than does
AT&T. Without a circuit loading constraint, AT&T would also

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<th><strong>Table 4</strong></th>
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<tr>
<td><strong>USE OF CABLE AND SATELLITE FACILITIES, U.S. TO WESTERN EUROPE</strong></td>
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<tr>
<td><strong>(Equivalent voice circuits)</strong></td>
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<tr>
<td><strong>Carrier</strong></td>
</tr>
<tr>
<td>RCA (Global Communications) (September 1985)</td>
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<tr>
<td>ITT World Communications (June 1985)</td>
</tr>
<tr>
<td>MCI International (September 1985)</td>
</tr>
<tr>
<td>AT&amp;T (January 1986)</td>
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</table>

SOURCE: Monthly circuit status reports filed by carriers with
the FCC. Calculations based on service to 16 countries: Austria,
Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg,
Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and United
Kingdom.

*100 FCC 2d 177, 201 (1985). In comparison, AT&T's allowed rate of
return exceeds 12 percent.*
use more cable, not because of a bias toward cable but for the same reasons that unregulated carriers rely more heavily on cable. These reasons could include lower costs to the carriers for cable circuits than for satellite circuits or service advantages of cable over satellite in some applications.

2. **Comsat has a bias; AT&T has no bias.** Under its rate of return constraint, Comsat may have an incentive to expand its rate base while passing these costs on to AT&T and other U.S. carriers in higher rates. Since these other carriers are not subject to the loading constraint, these higher rates (which must be charged to both AT&T and other carriers on a nondiscriminatory basis) would encourage them to rely relatively heavily on cable circuits.\(^9\) The circuit loading constraint forces AT&T to carry a large portion of its Transatlantic traffic on satellites regardless of Comsat's rates. Although Comsat loses some of the other carriers' traffic to cable because of its inflated rates, it more than makes up the loss by charging high rates to its captive and large customer--AT&T.

3. **Comsat has no bias; AT&T has a bias.** Even if Comsat has no bias and makes every effort to minimize its rates to AT&T and other carriers, these other carriers may chose a relatively high percentage of cable circuits as a reflection of service advantages and relative costs. Even if AT&T has inflated cable costs because of its bias, the other carriers may still prefer a relatively large percentage of cable circuits. AT&T would use more cable too in the absence of the circuit loading constraint.

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\(^9\)Over a wide relative price range, carriers generally prefer a mix of satellite and cable facilities, rather than relying on only one, to help protect against outages and to offer their customers services, some of which can be best delivered by cable and others by satellite. As noted above, cable and satellite circuits are close, but not perfect, substitutes.
4. *Both AT&T and Comsat have a bias.* Both satellite and cable costs could be excessive, with their relative costs perhaps being about the same as if no bias existed. Other carriers rely heavily on cable for the reasons already discussed. Again, the circuit loading constraint keeps AT&T from using as much cable as it would like.

Table 4, then, does not show unambiguously whether a bias exists for either AT&T or Comsat. But it is helpful in exploring the alternative outcomes and in showing how a bias by either carrier might affect the preferences between the satellite and cable circuits by other carriers.

**Other Evidence Relating to Comsat**

Is there any other evidence relevant to the issue of bias? With respect to Comsat, two phenomena are worth noting, although again they do not provide unambiguous evidence of bias.

_Oversubscription to INTELSAT._ Comsat has a long-standing policy of oversubscribing to INTELSAT circuits. That is, its INTELSAT ownership share is greater than its utilization share—typically by a few percentage points.\(^{10}\) Thus, under INTELSAT ownership and utilization procedures as discussed previously, Comsat earns about 14 percent (before tax) on its excess investment.\(^{11}\) In comparison, its FCC-authorized after-tax rate of return is set in the range of 11.48 to 12.48 percent.\(^{12}\) After adding taxes to the (approximate) 14 percent

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\(^{10}\)For example, in 1983 Comsat's ownership share was a little over 24 percent; its usage share was only 21 percent. 97 FCC 2d 296, 312 (1984). This excess of about 3 percent generated a revenue to Comsat of $17.5 million. Comsat, Form 10-K, Securities and Exchange Commission, 1984, p. 6.

\(^{11}\)The actual return has generally been higher than INTELSAT's target rate of 14 percent. The return fell from 17.7 percent in 1980 to 13.5 percent in 1985, after remaining above 14 percent during the 1970s. INTELSAT, Intelsat Releases CY 1985 Financial Results, Washington, D.C., (release 86-14) March 11, 1985, Appendix A.

\(^{12}\)Communications Satellite Corporation, 68 FCC 2d 941 950 (1978).
return on this excess investment, as part of its "revenue requirement" to be recovered from its customers, Comsat stands to gain financially if its actual after-tax cost of capital is less than the FCC-authorized return.\textsuperscript{13} The ostensible reasons for Comsat's policy of oversubscription are that (a) it helps other countries who, hard pressed for investment funds, prefer to invest less than their use share (in effect, they prefer to lease rather than to buy), and (b) oversubscription by some members of INTELSAT is required to offset the use, with no investment, by nonmembers such as the Soviet Union.

However, an unregulated firm seeking to maximize its profits would be willing to invest at a before-tax return of 14 percent only if this return were no less than its before-tax cost of capital. One source estimates Comsat's before-tax allowable return at about 24.6 percent (based on a 12.5 percent post-tax allowable return and a 49.3 percent tax rate)\textsuperscript{14}--substantially higher than the return on INTELSAT investment. Thus, although foreign PTTs--not subject to tax--would be willing to invest at 14 percent if their opportunity cost of capital were no greater than 14 percent, Comsat may be willing to do so only as a consequence of rate-of-return regulation that provides an incentive to inflate its rate base.

Of course, other factors, not explored in this preliminary study, may also help to explain Comsat's actions. Although the willingness of Comsat to invest at a return less than its before-tax cost of capital is suggestive of a rate base bias, additional analysis is needed before more definitive conclusions can be drawn.

\textit{Comparisons with domestic satellite carriers.} Evidence of rate base inflation may also be found by comparing Comsat's tariffs with those of domestic satellite carriers that, facing stiff competition from terrestrial links as well as from other satellite carriers, do not face

\textsuperscript{13}All this assumes that Comsat is continuously constrained to earn no more than its authorized return. In fact, Comsat has frequently earned a return in excess of the authorized level. See \textit{Communications Satellite Corporation}, 56 FCC 2d 1101, and \textit{Comsat Study} 77 FCC 2d 564.

FCC-imposed constraints on their rate of return. Inflation of the rate base would be expected to show up in relatively high tariffs.

Table 5 shows a comparison between Comsat's current tariff and one estimated in 1979 by FCC staff for domestic satellite carriers. Comsat's tariff is indeed higher--by more than a factor of three--even though the more recent figures for Comsat reflect more advanced satellite technology than that available to domestic carriers in 1979.\textsuperscript{15} This comparison suggests a bias toward rate base expansion as well as the effects that rate-of-return regulation may have on incentives to control costs more generally. As long as the regulated firm can pass on its expenses (as well as the allowed return on investment) to users, it has less incentive to exercise strong cost control than otherwise.

Table 5

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<tr>
<th>SATELLITE TARIFF COMPARISONS</th>
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<tr>
<td>Tariff\textsuperscript{a}</td>
</tr>
<tr>
<td>Space segment</td>
</tr>
<tr>
<td>Earth segment</td>
</tr>
</tbody>
</table>

SOURCE: Comsat Study, 77 FCC 2d 564, 797 (1980), and Comsat tariffs as of October 1, 1986.

\textsuperscript{a}Tariff for voice grade, full-time, half-circuit, per month.
\textsuperscript{b}Tariff is insensitive to distance.
\textsuperscript{c}Average of tariffs filed by RCA and Western Union for domestic satellite service. Because tariffs are sensitive to distance, the FCC calculated weighted averages per route per tariff. To reflect discounts to large volume users, the FCC computed an average discount and deducted it from these tariff calculations.
\textsuperscript{d}Comsat monthly voice-grade circuit charge.

\textsuperscript{15}In 1979, Comsat's tariff was $1340 in comparison with $1070 shown in Table 5.
Again, however, clear-cut conclusions cannot be drawn from this preliminary study, because other factors may also be at work. For example, the current monthly INTELSAT use charge of $390 reflects the additional costs imposed by INTELSAT's excess capacity and borne by all INTELSAT users. If domestic satellite carriers are not burdened with such excess capacity, their per circuit costs are lower. Figures on overall domestic satellite loadings are not readily available. However, the American Satellite Company reports that, after one year of use, its ASC-1 satellite has a loading of over 80 percent--well in excess of loadings typical of international service.16

Moreover, differences in the design and cost structures of domestic and international satellite systems must be taken into account. The frequently made statement that satellite circuit costs are insensitive to distance is only approximately correct. If only a portion of the world visible to the satellite must be covered--such as the United States--the satellite's electrical energy can be concentrated in narrowly focused beams covering the desired area, to permit smaller and lower cost earth stations. In contrast, transoceanic communications among many scattered points requires more uniform coverage of the entire visible earth, with consequent increase in earth station requirements. Thus, a portion of the costs shown for Comsat may reflect necessary differences in earth station costs rather than inefficiencies.

Yet another possibility is that satellite systems have scale economies that are more fully exploited by domestic systems. If domestic systems carry more traffic than does Comsat, their per circuit costs may be lower than Comsat's as a consequence of these economies.

Other Evidence Relating to AT&T

Many have expressed concern that AT&T is biased toward cable not only because of rate-of-return regulation but because an unregulated AT&T subsidiary is engaged in the manufacture of cable. Indeed, it is concern about this possible bias, in addition to possible distortions caused by rate-of-return regulation, that has lead the FCC to impose

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16*Telecommunications Reports, October 6, 1986, p. 38.
circuit loading constraints on AT&T. Arguably, AT&T can circumvent rate-of-return regulation if it is able to transfer costs from its regulated activities to its unregulated subsidiary. That is, if the subsidiary sells cable to AT&T at an inflated price, these costs can be passed on to "monopoly" rate payers, while the subsidiary enjoys extraordinary profits.

As others have noted, however, transfer prices are limited because AT&T is generally required to bid against other firms for contracts to manufacture cables for international use. Notably, in bidding for construction of the TAT-8 cable, AT&T's proposal for constructing the entire cable was 7.2 percent lower than the joint construction effort that was subsequently approved. According to the FCC, "the co-owners accepted the higher cost from multiple bidders in order to accommodate certain countries' demands for participation by their domestic industries and to stimulate competition in cable construction." This experience does not support the notion that transfer prices are used to circumvent rate-of-return regulation.

INCENTIVES OF FOREIGN PTTs

Neither Comsat nor AT&T can decide unilaterally how much international satellite or cable capacity is to be built. In every case they must work with foreign partners. Comsat is one of more than 100 signatories to INTELSAT, albeit the largest member with an ownership share of about 25 percent. Decisions about new investments are made by INTELSAT's Board of Governors whose 27 members represent 91 of the 100

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17. See the discussion in Kwerel and McNally, op. cit., p. 18.
18. 98 FCC 2d, op. cit., pp. 442-443. Under the final proposal, U.S. companies will construct a portion of the TAT-8 system accounting for approximately 75 percent of the total system cost.
19. A question arises, however, about whether foreign PTTs are biased toward cable since, in some cases, cable is manufactured in their countries. On a priori grounds there is no strong reason to believe that, on balance, a bias exists, because these countries also are involved in manufacturing hardware for satellite systems. Many U.S. and foreign firms construct earth stations. Although all INTELSAT satellites to date have been procured from U.S. firms, they include a growing import content.
signatories. Each governor represents a signatory or a group of signatories "with the greatest investment shares," with each governor "voting on substantive issues in proportion to the investment shares he represents."  

AT&T jointly owns undersea cables with U.S. and foreign partners. In the case of TAT-8 "50 percent of the cable will be owned by, and 50 percent of the costs allocated to the 'Western parties'....The other 50 percent of the cable and its costs will be allocated to the Eastern parties." As a "Western party" AT&T's ownership share is nearly 37 percent, with seven other U.S. carriers (including those listed in Table 4) and Canada's Teleglobe holding the remainder. The Eastern parties include the PTTs of 20 European countries.  

Thus, even if Comsat and AT&T were biased in favor of overinvestment, they could satisfy their objectives only with the cooperation of other parties. Why would foreign PTTs be willing to cooperate in constructing excess capacity? In most cases, they are government-owned and are not subject to rate-of-return regulation. Moreover, foreign telecommunications entities have generally not been known for heavy overinvestments in their domestic markets. On the contrary, complaints have been voiced in many countries about long delays in installation of new telephones and poor service. Such problems are especially severe in less developed countries that are hard pressed for investment funds in all directions, of which telecommunications is only one.  

In response, consider the following three hypotheses:  

1. Foreign PTTs generally have greater freedom of action in the international arena than they do domestically. Many are forced to

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22. 98 FCC 2d, op. cit., p. 446.  
23. Ibid., p. 441.  
maintain rates below market clearing levels (hence the queues for telephones) to benefit domestic residential and business users. Moreover, they must compete with other state enterprises for investment funds, where the criteria for allocations depend on national priorities that reflect many considerations in addition to marketplace signals (such as the length of queues). The international market, however, depends heavily on multinational firms, "wealthy" domestic enterprises (such as in the tourist trade), and high-income individuals. Many PTTs are free to set higher, market-clearing rates in the international arena, and, indeed, are encouraged to do so to "tax" these user groups for the sake of subsidizing domestic activities such as the postal service.

2. Because international service is quite profitable, and with the net revenues devoted to "worthy" domestic purposes, these PTTs can more easily raise investment funds for this market than they can for domestic services.\^25

3. The PTTs may have weak incentives to minimize costs for given levels of international service because (a) they operate as monopolies, (b) the service is quite profitable, and (c) even if costs are not minimized, unit costs fall over time because of exogenous technological advance and rapid market growth. Whether managers single-mindedly seek to minimize costs for a given output depends on numerous factors. If the organization is a protected monopoly, its failure to minimize costs would not attract competitive entry that might threaten the firm and the jobs of its managers. If profits are large, failure to minimize costs may still leave a comfortable margin to forestall complaints by customers or other government bureaus. If costs fall over time because of extraneous factors, there would be even less reason for complaint. The organization can show an impressive record of rate and cost

\^25Although it is generally agreed that international service is quite profitable, little hard evidence is available. AT&T's reported rate of return on its international message telephone service (IMTS) was 15 percent, 23 percent, and 36 percent for the years 1977, 1978, and 1979, respectively—the last years for which such data were collected. The FCC further notes that "available aggregated data indicate that AT&T's rate of return for IMTS since 1979 has exceeded its overall authorized rate of return." 100 FCC 2d 177, 827 (1985).
reductions, expanded new services, and so forth, while still operating quite inefficiently.

If the preceding characterization is valid, a PTT might be willing to invest in excess capacity (or at least not be seriously disturbed if an excess arises as a result of less-than-expected traffic growth). The excess would provide even greater protection against adverse contingencies, and the cost of the excess would not strain the organization's resources or prove embarrassing for its managers.

The tendency to overinvest would be strengthened if other major parties had a positive incentive to overinvest, stemming from the bias caused by rate base regulation discussed above. For example, if Comsat or AT&T do have incentives to overinvest, they would likely find more willing foreign partners than would be true if the above hypotheses were without foundation.

**INCENTIVES OF OTHER U.S. INTERNATIONAL CARRIERS**

The preceding leaves open the role of the other U.S. carriers. They do not enjoy monopoly positions, nor are they known to make large profits. Facing competition among themselves and from AT&T, they surely do not fit within the above hypotheses. As co-owners of cable facilities and as users of satellite circuits, why are they willing to invest in excess capacity?

The answer may be that they have little choice. With respect to satellites they have limited influence because AT&T accounts for about 80 percent of Comsat's space segment revenues. They must take Comsat's lease charges for satellite circuits essentially as given. They also have rather little influence on the construction of cable. With or without their participation, AT&T and foreign PTTs could pursue their own investments.

Other U.S. carriers can choose not to participate but rather to obtain circuits from AT&T in accordance with the FCC's policies for access to cable circuits by nonowners.\(^2\) In accordance with current FCC policy (with respect to the existing TAT-7 cable), they can acquire rights similar to those of ownership through the purchase of IRUs

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\(^2\)With respect to TAT-8, see 98 FCC 2d, op. cit., pp. 453-457.
(indefeasible rights of user). They need procure only the number of circuits they want at "net book cost." Thus, they do not necessarily bear the costs of excess capacity.

For TAT-8 the FCC will retain jurisdiction over the access rights of nonusers, although whether access will continue at net book cost is unclear because of objections by owners that IRU holders do not bear their full cost. However, even if IRU holders are required to bear a greater cost burden in the future, this burden would be shared by all such holders, so that none would be placed at a competitive disadvantage relative to the others.

\[^{27}\text{Under this approach they pay for their share of operating and maintenance costs, "while an IRU guarantees the owner the right to use a circuit for the life of the facility but gives him no voice in the day-to-day management of the facility" (Kwerel and McNally, op. cit., p. 65).}\]

\[^{28}\text{Net book cost of a circuit is computed by dividing the depreciated value of the facility by its circuit capacity.}\]
V. INEFFICIENT PRICING

The way that international services are priced may attract entry by new competitive firms or expansion of capacity by existing carriers, in the presence of substantial excess capacity. To explore this possibility, consider the following cost elements:

1. **INTELSAT's costs.** As noted above, INTELSAT covers its costs through space segment utilization charges. These charges vary depending on the service application (voice, video, data), the technology employed (e.g., frequency division multiple access or time division multiple access), different usage patterns (full-time, part-time, occasional), different earth station types and sizes, and other factors. A key consideration, however, is that the space segment utilization charge is the same for all users for each type of utilization. For example, the monthly utilization charge is $390 for a full-time voice-grade half-circuit, working through a "Standard A" earth station with frequency division multiple access. The charge for two half-circuits, required to link two such earth stations, is therefore $780. This use charge is uniform for all such circuits whether used, say, between New York and London or between Nairobi and Buenos Aires.

2. **Comsat's costs.** As noted previously, all U.S. retail carriers must procure their circuits through Comsat--the monopoly wholesaler to U.S. carriers. Comsat adds its administrative and operating costs, taxes, and other items to the $390 INTELSAT rate, and resells the half-circuit for $610. Again, this is an average cost rate offered on a nondiscriminatory basis to all U.S. carriers.

3. **Earth station costs.** The cost of the earth station must be added to the cost of the space segment. This is done by whichever carrier handles the circuit, for an earth station it owns either singly or in partnership with other carriers. Under an FCC decision in 1984,

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As will be discussed in future RAND studies, the FCC has considered proposals for direct access by U.S. carriers to INTELSAT but it recently decided against them. FCC, Report and Order 97 FCC 2d 296 (1985).
Comsat is no longer permitted to offer earth station services "wholesale." Rather, these services must be handled through a separate unregulated subsidiary that competes with other U.S. carriers.\footnote{Report and Order, 100 FCC 2d 250, 289 (1984).}

Previously, Comsat offered a "bundled" space segment-earth station at a monthly rate in 1985 of $1060 for a half-circuit.

4. **U.S. landline costs.** To provide service to end users, the retail carriers must add landline costs from the earth station to the customer's premises. These costs are embedded in tariffs for international service on an average-cost basis. That is, the tariff element that covers the circuit connection from an earth station to a customer's premises located on a high-density domestic route is the same as that to a customer's premises located the same distance from the earth station on a low-density route.

5. **Foreign carrier costs.** In addition to the half-circuit treated above, the other half-circuit must be included to provide end-to-end service. This involves another $390 INTELSAT charge plus the costs incurred by foreign carriers for earth stations and landline extensions.

In contrast to INTELSAT, consider a firm proposing to build a satellite system for service primarily between the United States and Western Europe. It can design satellites with spot beams to illuminate these relatively small areas and can work with smaller and less costly earth stations than those generally used by INTELSAT. By locating these stations at or near customer premises, it can reduce or eliminate landline extension costs—in addition to bypassing INTELSAT and Comsat.\footnote{To be sure, there is a major hurdle—perhaps the greatest of all—in getting agreement from foreign PTTs to offer the service. Agreement may be particularly difficult if bypass of the PTTs domestic network is involved. The point cannot be overemphasized that neither the U.S. government nor U.S. carriers can unilaterally decide the character of the international market structure. Issues relating to foreign PTTs will be treated in future RAND studies.}

Moreover, the new entrant has the advantage of serving only high-density routes of its choice, where its circuit costs are relatively low, whereas the INTELSAT use charge reflects a global cost average. Ironically, the very fact that INTELSAT has excess capacity, by requiring a higher INTELSAT use charge than otherwise, may help to
induce competitive entry unless INTELSAT adopts more flexible pricing in response.4

A basic concern is whether the new entrant's costs are, in fact, lower than those of INTELSAT. Average-cost pricing by INTELSAT, Comsat, and carriers offering landline extensions may push their rates on high-density routes substantially above costs over those routes—a disparity between rates and costs that works to the competitor's advantage. The new entrant's cost may be below the rates but above the costs of the existing carriers.

The situation is similar for organizations proposing new cable systems. Whether prospective entry is by a group of common carriers (as with TAT-8) or by a group proposing private noncommon carrier service (as with PTAT-1), a key comparison is the cost per used circuit vs. the use charges of INTELSAT, the add-on by Comsat, and the cost savings in earth stations and cost differentials in landline extensions. Again, the existence of excess capacity in INTELSAT may encourage rather than discourage entry.

The obvious problems here lie in distortions between INTELSAT's prices and costs, along with distortions elsewhere in the system. The issue of appropriate pricing, in light of excess capacity and prospective competitive entry, will be the subject of a future RAND study.5

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4In the economics literature, excess capacity in the hands of the incumbent firm is generally viewed as a deterrent to entry because the firm, if threatened, can reduce its price to make entry unprofitable. But if the firm is constrained to price at average cost, as in the case of INTELSAT, excess capacity attracts rather than discourages entry.
5See also the discussion in Kwerel and Pitsch, op. cit., pp. 6-7.
VI. CONCLUSIONS

The preceding discussion suggests that chronic excess capacity arises from a combination of factors, whose individual contributions are impossible to quantify. These include (a) upward bias in forecasting errors, (b) the incentives of carriers to overinvest, influenced either by rate-of-return regulation or the tendency to underestimate the social cost of excess capacity, and (c) pricing policies that attract new market entrants even in the face of existing large excess capacity.

With respect to forecasting, difficulties in anticipating and adjusting to recent declines in the rate of traffic growth surely contribute. Current forecasts continue to include rates of growth higher than those experienced in recent years. The problem is intensified when forecasters play the game of catch-up; believing that historical high rates of growth will soon return, they fail to adjust for current shortfalls. This has caused near-term forecasts to be even less accurate than longer-term ones.

However, overoptimistic forecasts are more a symptom than the cause of excess capacity. Carriers may have incentives either to introduce upward biases in their own forecasts or to uncritically accept the overly optimistic estimates of others, to justify investments they want to make. Rate-of-return regulation of AT&T and Comsat may induce them to seek uneconomic expansion of their rate bases, although no clear-cut evidence has been found in this study to show whether, in fact, they behave in this way. However, the circuit loading constraints on AT&T, essentially guaranteeing Comsat a share of AT&T's overseas market, is a factor that, in theory at least, introduces additional incentive to overinvest in satellites and, more generally, to exercise less cost control.

Apart from rate-of-return considerations, foreign carriers as well as AT&T and Comsat may perceive the costs of excess capacity to be lower than is the cost to society. With monopoly power in highly profitable markets, the additional costs would not erode market shares or cause other government bureaus to complain. Perceived as small, these
additional costs may be regarded by carriers as outweighed by whatever benefits accrue from excess capacity.

Finally, pricing practices may encourage inefficient market entry, exacerbating the problem of excess capacity. Key elements include (a) INTELSAT's costs for the space segment, (b) the costs that Comsat adds to the price of circuits sold to other U.S. carriers, (c) the costs that these carriers add for connecting their customers, and (d) the costs that foreign PTTs add for the other half-circuit required for end-to-end service. Because of the way these various elements are priced (including INTELSAT's policy of global rate averaging), new entrants may be able to cover their costs even if their costs are higher than those of the existing carriers.

In short, in light of the scattered and incomplete evidence, this study suggests the following conclusions:

- INTELSAT clearly served a critically important role in its early years by successfully establishing a global satellite network; but its pricing and investment policies are becoming increasingly inappropriate in a world where attractive separate satellite systems and fiber optic cables are emerging.
- INTELSAT's global cost sharing arrangements encourage countries to overestimate their individual facility needs, for they are billed for costs only in proportion to their actual use of INTELSAT facilities.
- Global average cost pricing encourages new, possibly uneconomic, entry on heavily used routes, not only despite excess INTELSAT capacity but, paradoxically, because of it.
- Excess capacity arises not simply because of chronically overoptimistic traffic forecasts but because of the incentives of some carriers to expand facilities beyond economic levels. Because these forecasts are inflated to help justify these facilities, the forecasts are more a symptom than a cause of excess capacity.
- The FCC's circuit loading constraints on AT&T, essentially guaranteeing Comsat a portion of AT&T's traffic, encourages Comsat to behave inefficiently because excess costs can be passed on to AT&T.