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# DEFINING AND COSTING POTS: A COMMON CARRIER APPROACH USING THE JOINT PRODUCTS METHOD

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## EXECUTIVE SUMMARY

This work attempts to define Plain Old Telephone Service (POTS) using sound economic and regulatory principles. It describes a method to define POTS using a common carrier approach. It incorporates the common carrier approach that suggests defining POTS by services. It also describes the traditional costing and pricing methods used in telephony and describes a method new to telephony to cost and price POTS: the joint products method first discussed by the English economist Alfred Marshall. Although it has received attention in the economics literature, this method has not been applied to the regulated telecommunications industry.

Chapter I introduces the issue. It discusses how the confluence of events has changed the focus of telecommunications policy makers from universal service at just and reasonable rates to efficiency, competition, and technological advancement. This change has exerted pressure upon established social, political, and economic concepts used to regulate the telephone industry. The change also is forcing policy makers to better define services that are monopoly and services that are competitive. This bifurcation also is forcing policy makers to better define the concept of plain old telephone service. Defining POTS is only half the battle, however. Economic regulation entails setting rates. This raises the specter of costing and pricing issues related to POTS regardless of the definition. These issues are complex, particularly in telephony with its economies of scale and joint and common costs.

Chapter II reviews some specific approaches to defining POTS by the Federal Communications Commission, state regulatory commissions, telephone companies, academics, and other interested parties. These definitions range from simple dial tone to a fully integrated broadband network. At stake for residential and small business users are the types of services and the prices at which they will be available. At stake for all users is the quality of the public switched network and its costs, the rate of technological development, and the degree of economic and social integration of our society.

Chapter III discusses innovation and the rate of technological change, particularly as they relate to market structure and monopoly power. It examines the hypothesis that competitive markets are more efficient and provide greater technological growth than other market structures. Major conclusions are derived in this chapter that will be used later in discussing the definition of POTS. First, little relationship exists between innovation, productivity, and market structure both on a theoretical basis and as evidenced by empirical analysis. Second, economic efficiency does not necessarily correspond with the lowest cost provision of service. Firms in competitive markets may not be able to take full advantage of economies of scale and scope. Consequently, they may not be the lowest cost providers of service. Third, telephone utilities may use new technology when it is not cost effective to gain a strategic advantage.

Chapter IV undertakes the difficult task of defining POTS. The definition emphasizes infrastructure, social and economic integration, and the avoidance of information haves and have nots. The definition is based upon the concept that monopoly or POTS are common carrier functions and provides as an example of a POTS definition a service-based category definition. A method and criteria are provided to change the services included in the definition. The general criteria to change the POTS concept are that the addition or deletion of a service is necessary for an individual, family, firm, or other entity to be a fully functioning member of society and the economy.

Chapter V presents the most prominent costing and pricing methods to be applied to POTS. The strengths and weaknesses of fully distributed cost methods, marginal cost methods, including long-run incremental costs, and stand-alone cost methods are discussed, and the joint products method is presented. An example of the joint products method is formulated using data readily available to telephone utilities. The joint products method is the preferred method for costing and pricing POTS because it apportions all costs so the utility will not under- or overearn, it is based upon marginal cost, and is relatively inexpensive to compute.

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## FOREWORD

Plain old telephone service (POTS) is an important yet elusive concept for regulators and telephone service providers. This report seeks to define POTS in terms of the services to be included in POTS and develops a cost allocation mechanism based on the use of the joint products concept. Taken together, the definition and the cost allocation mechanism should improve the understanding of regulatory policy makers of the strengths and weaknesses of the POTS concept.

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# CHAPTER I

## THE POTS STORY: AN OVERVIEW

The telephone and a modern communications system are such an integral part of our industrialized society that their presence is taken for granted. Few inventions have had a greater effect upon our economic and social fabric.

This chapter explores the development of telephony, its importance in our economic and social structure, and changes in telecommunications policy over the last half century. These changes have led to the need for a more precise definition of POTS, and perhaps to the need for better costing and pricing methods.

The telephone's ring, perhaps more than any other sound in our daily lives, evokes a response. We stop what we are doing to answer it. Its ring may evoke anticipation, hope, fear, relief, anxiety, or joy. The telephone has helped shape our cities and nation. It has changed the rate of scientific and technological development. It has changed the way we produce goods, the rate at which we produce them, and the income we receive from our productive activities. It has saved lives and made the skyscraper possible. It has broken up multigenerational households and provided the American people with the mobility to respond to economic incentives.[1]

### The Selling of the Telephone

When Bell announced his invention to the world, it was not recognized as a revolutionary technology. In fact, his greatest feat may not have been the invention of the telephone as much as the selling of the telephone.

In the 1870s, telegraph was king with sets being placed in homes in virtually every major city. It gave access to police and fire stations and provided for social and business interaction. Major breakthroughs for the telephone did not come until the 1890s when Pennsylvania required that miners have a means of communicating

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[1] John Brooks, *Telephone*, (New York, NY: Harper & Row, Publishers), 1975, 8.

from mine interiors to the surface. Also during this time, business executives discovered the telephone could allow them to take vacations and still be available for instant communications with their office or clients.[2]

Until then, the telephone was considered a toy--a marvelous toy, but of no practical use. When Bell offered the telephone patent to Western Union for $100,000, the telegraph company turned down his offer, saying it could think of no obvious use for the invention. What's more, the expense of converting from telegraph to telephone would have been too great.

Bell also offered his invention to the British Post Office Department which ran the British telegraph system. It also rejected his invention.[3]

By the 1920s, uses were found for Bell's marvelous toy. It was regulated by the Interstate Commerce Commission (ICC) and Theodore Vail's concept of universal service was adopted by policy makers. Universal service was codified in the Telecommunications Act of 1934[4] and was a primary concern of policy makers until the 1970s when the Federal Communications Commission intensified its competitive policies.

The pace of technological change was not a major concern of policy makers in telecommunications although the telecommunications industry consistently was a leader in technological advancement.[5] By the 1980s many industry observers and participants

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[2] Sidney Aronson, "Bell's Electrical Toy," in *The Social Impact of the Telephone*, ed. Ithiel DeSola Pool, (Cambridge, MA: The MIT Press), 1978, 17-30.

[3] Ithiel Pool DeSola, *The Social Impact of the Telephone*, (Cambridge, MA: The MIT Press), 1978, 15.

[4] The term universal service was not used in the Act itself. The concept is derived from specific language in the Act, "to make available, so far as possible, to all people of the United States a rapid, efficient, Nationwide, and worldwide wire and radio communication service with adequate facilities at reasonable charges."

[5] On a broader scale, policy makers outside telecommunications were concerned about technological advancement. In the 1930s Congress established the National Technical Economic Committee to investigate the economic and technical causes of the depression. In the 1960s, "stagflation" became an issue. The overall concern about technological advancement did not spill over into telecommunications, probably because of the success of the Bell system and its technological leadership.

considered Vail's goal of universal service at reasonable rates accomplished. POTS was a vague term, and fully distributed costing methods generally were the norm.

The success of the Bell system and the confluence of three other events conspired to change the focus of telecommunications policy makers from universal service to efficiency and technological advancement.

The first of these major events was the demise of the relative economic power of the United States.

The United States emerged from World War II as the only industrialized nation with its economy intact. The result was massive domination of the world economy. It was a dominance that was bound to end.

Economic dominance by the United States had as much to do with historical events as with our economic structure and policies. However, the now diminished dominance of the United States (although it remains the world's preeminent economy) has raised concerns about the nation's ability to compete in world markets and has raised concerns about productivity and technological advancement.[6] Because of the importance of the telecommunications infrastructure to competitiveness in the information age and this country's traditional technological leadership in telecommunications, the general concerns about competitiveness by policy makers have been translated into specific concerns about the rate of technological innovation in telecommunications.

The second event which conspired to change the policy maker's traditional focus is the ideology of competition.

Largely fueled by postwar economic success, the ideology of competition moved from a prominent force in economic thought to virtually the only force in economic and political policy during the 1970s and 1980s. A major feature of the ideology of competition is technological advancement. The Federal Communications Commission adopted technological advancement as a cornerstone of its procompetitive policies.[7] A

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[6] David Halberstam, *The Next Century*, (New York, NY: William Marrow and Company, Inc.), 1991.

[7] Federal Communications Commission, *In the Matter of Policy and Rules Concerning Rates for Dominant Carriers*, CC Docket No. 87-313, Oct. 4, 1990, 13-16.

number of states that have adopted procompetitive policies have acted partially on the basis of technological advancement (this relationship is discussed in greater detail in Chapter III).

The third trend is the type of technology now being deployed in the telecommunications industry: digital switches and fiber optics. These are high-fixed-cost, high-capacity technologies unburdened by current network uses. In fact, current uses of the network may not even make these technologies economically attractive. Once the productive capacity represented by these technologies is in place, the fixed costs are sunk. The resulting marginal costs are relatively low for existing and most new services. The extra capacity and low marginal cost for new services provide clear economic incentives for telephone utilities to search for new sources of revenues. Utilities need new technologies and new services to create uses for the extra capacity.[8] Consequently, greater emphasis is being placed on product innovation by telephone utilities.

Changing Regulatory Concepts

Changes in public policy reflect the changes in these concerns. As mentioned, public policy changed from being dominated by concerns over universal service to including strong components of technological advancement and international competitiveness. This change, coupled with actual changes in telephone technology, are exerting pressure upon established social, political, and economic concepts used to regulate telephony. The definition and consensus of basic ideas such as universal service and plain old telephone service (POTS) have never been absolutely clear and free of controversy. Today's new environment is blurring further their definition and destroying what consensus previously existed.

Tied to specific concerns about competitiveness are concerns about the effect that costing and pricing methods have upon competitiveness and efficiency.

Along with blurring the definition of universal service and POTS has come a blurring of regulatory purpose. The doctrine of regulated monopoly was applied

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[8] Bruce L. Egan, "Telecommunications Strategy in an Age of Risk," *Public Utilities Fortnightly*, 125, no. 9 (April 26, 1990), 22-23.

almost exclusively in telephony until the 1970s. The doctrine of regulated monopoly established certain public policy goals (including universal service at reasonable rates) and conferred certain obligations and benefits upon telephone utilities.[9] The FCC began moving away from strictly adhering to the doctrine of regulated monopoly in the 1970s when it began to allow entry into various telecommunications markets. The FCC also saw limited competition as a method of exerting regulatory control over AT&T.[10] However, the idea of limited competition as a regulatory tool was abandoned during the Reagan era, replaced by the idea that competition should be the only tool to regulate the telephone industry.[11]

The resulting divestiture of AT&T also played a role in blurring regulatory purpose. Although divestiture did not mandate deregulation, it provided a framework from which deregulation could move forward. Judge Harold Greene had no doubt about the correctness of deregulation, feeling that competition would give the country the most advanced, best, and cheapest telephone network.[12] He agreed with Walter Hinchman, former Chief of the FCC's Common Carrier Bureau, that the FCC was incapable of regulating AT&T.[13]

The Justice Department, the FCC, the courts, AT&T, and the general philosophy espoused by the Reagan administration all pressed for deregulation. Standing in the way was the U.S. Congress. Confronted with the specter of higher local telephone rates and the fear of companies that would face a deregulated but

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[9] For a discussion of public policy goals and the obligations and benefits of public utilities see James C. Bonbright, *Principles of Public Utility Rates*, (New York, NY: Columbia University Press), 1969; and Alfred E. Kahn, *The Economics of Regulation: Principles and Institutions,* (Cambridge, MA: The MIT Press), 1989.

[10] Steve Coll, *The Deal of the Century: The Break Up of AT&T*, (New York, NY: Atheneum), 1986, 46.

[11] Dennis R. Patrick, "On the Road to Telephone Deregulation," *Public Utilities Fortnightly*, 114. no. 12 (December 6, 1984), 19.

[12] Ibid., 253.

[13] Ibid., 365.

downsized AT&T, the Congress prevented deregulation of the telephone industry, perhaps as much by not taking action as by taking any positive action.[14]

The regulatory policy result was a general distrust and relaxed reliance upon traditional rate of return regulation, without replacing it with another form of regulation.

Into this milieu came a new breed of regulator and policy maker. Louise McCarren, former Chairwoman of the Vermont Public Service Board, exemplified this new breed. She was bright, energetic, and concerned believing in the efficiency goal and Adam Smith's "invisible hand." Commissioner McCarren and the Vermont legislature adopted social contract regulation in Vermont--a form of regulation that provided neither full regulation nor full competition.[15]

The issue of the type of regulation or the move to deregulation was neither liberal nor conservative with liberals and conservatives lining up on both sides of the issue. Many emerging policy makers, such as Commissioner McCarren, rejected traditional regulation in this new age of telecommunications. The FCC, unable to pursue a policy of deregulation, turned to price cap regulation, which it finally adopted in 1989. States are searching for pricing and costing methods that are efficient and do not place undue burden upon the local exchange ratepayer.

Lack of Consensus

Within a few years after divestiture many states altered their regulation of telephony. Virginia deregulated intrastate interLATA service, Nebraska deregulated all telephone service, Florida is refraining from regulating intrastate interLATA service on a experimental basis, and Colorado has deregulated some telephone services. Some states, such as Colorado and Washington, have bifurcated telephone services into monopoly services and competitive services with a different regulatory approach to each. A large number of states have adopted some form of incentive

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[14] Ibid., 347-356.

[15] For a discussion of social contract regulation in telecommunications see Douglas N. Jones, *A Perspective on Social Contract and Telecommunications Regulation*, (Columbus, OH: National Regulatory Research Institute), 1987.

regulation.[16] The point here is that as of divestiture there was no consensus about the form that telephone regulation should take or whether telephone utilities should be regulated at all.

The weakening regulatory resolve and confusion over regulatory policy occurred simultaneously with the shift from a policy emphasis on universal service and reasonable rates to a policy emphasis on technological advancement and international competitiveness.

With these changes a new definition of universal service is being called for as well as new ways of costing and pricing. The terms of this new definition are not set, however. For example, the California Intelligent Network Task Force stated that regulators should redefine universal service to include access to the intelligent network including a "transparent gateway" to databases and other information services, protocol conversion, and simultaneous voice and data services.

On the other hand, some commissioners hold a much more restricted concept of POTS. For example, Commissioner Gail G. Schwartz of the New York PSC views POTS primarily as dial tone with access to very limited services.[17] She views the rest of the public switched network as open to competition. The reason? To unleash technology driven by competition.

POTS is indeed a basic building block of the public switched telephone network. But it is a building block that has never been clearly defined. As a result, even greater controversy exists today about the definition of POTS. This lack of a clear definition and consensus on the meaning of POTS and the objectives of the telephone network can't help but hamper the work of regulators. More importantly, it may hamper the satisfactory provision of basic service to subscribers.

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[16] For more detailed information about telephone regulation in the various states see Amy K. Levins and Brenda Ewers, *Report on Telecommunications Alternative Regulation Plans by State*, Missouri Office of Public Counsel, May 1991; and Alan D. Mathios and Robert P. Rogers, *The Impact of State Price and Entry Regulation on Intrastate Long Distance Telephone Rates*, Federal Trade Commission, November 1988.

[17] Gail G. Schwartz, "A New Deal for Telecommunications," *Public Utilities Fortnightly*, 118, no. 11 (Nov 27, 1986), 13-14.

Will Future Needs Be Meet?

To date the regulated telecommunications carriers themselves have not reached a consensus about POTS. If a policy vacuum exists, these carriers will determine the nature of POTS. The regulated telecommunications carriers are privately owned and may be more inclined to increase private rather than social benefits. The regulator's job is to achieve a balance between public and private goals. Absent a clear definition of POTS and associated regulatory concepts, regulators cannot achieve this balance. Also, regulated telecommunications carriers will not know what regulators expect of them. The result may be that the future network will not meet the needs of average residential and business customers.

The discussion here does not include the full range of telecommunications services but only those service to be deemed as POTS. As such, the services should be well established and the demand or need for them well documented. The question is which well-established services should be included in POTS? The task should not fall to regulators alone, but should include consumers, telephone utilities and other interested parties. The final decisions, however, will fall upon regulators.

## CHAPTER II

## THE STATE OF POTS

The term POTS has been used by policy makers and others more often in a generic and abstract sense than as a precise technical term. Universal service (and by affiliation POTS) has been viewed loosely as access to the public switched network for voice transmission at reasonable prices. The proliferation of new services, brought about primarily by technological advances in electronics and computers, has pushed regulators and others to examine the concept of basic service. Put another way, an attempt now is being made to define POTS.

### A Broader Policy Debate

As new services proliferated in the 1970s and early 1980s, regulators became concerned about the proportion of research funds and investment directed toward the public switched network. The concern was that telephone utilities were directing dollars toward large businesses and potentially competitive markets at the expense of residential and small business customers. Many worried that the emphasis on large business and potentially competitive markets would increase costs to the POTS user without a concomitant increase in the quantity and quality of POTS services.

Although the emphasis was on the large user, residential and small business customers benefitted from the proliferation of telecommunications services. Touch-tone, for example, has brought a wide array of services to the residential and small business customer. In addition, many small businesses and residential customers use their telephone lines for computer services and facsimile transmission.

Because the interest in modernization and infrastructure is driven by the factors discussed in Chapter I, and since modernization largely is responsive to the needs of the large, sophisticated, or specialized telecommunications users, the policy debate has broadened from universal service at a reasonable price to the need for a more concise definition of POTS and quality-of-service issues. The reason for the change is

the bifurcation of telephony into basic regulated services and enhanced nonregulated services. The split requires a more precise definition of POTS or regulated services.

The debate is more than just prattle. Policy makers recognize that the telephone system is a necessary part of our social, political, and economic infrastructure. The telecommunications services required to maintain this integration is changing in a world becoming more technologically advanced and information rich. Without due consideration of these issues, advanced telecommunications services may be denied those who need them. The world could be divided into information haves and have nots.

The FCC was not the first agency to grapple with the POTS definition problem, but when the FCC speaks people pay attention. The FCC's entrance into the POTS arena came through its various computer inquiries. The issue confronting the FCC was how to minimize regulating data processing services while preventing firms with communications bottlenecks from using their market power to stifle competition.

The First Computer Inquiry (Computer I), completed in 1973, divided services into regulated communications and unregulated data processing.[18]

Rapid advances in computer and communications technology quickly rendered Computer I obsolete. In 1976, the FCC launched its Second Computer Inquiry (Computer II). Computer II divided services into basic services, and enhanced services and data processing. Basic services were defined as "pure transmission capability over a communication path that is virtually transparent in terms of its interaction with customer-supplied information."[19] Enhanced services were defined as those that "combine basic service with computer processing applications that act on the format, content, code protocol or similar aspects of the subscribers' transmitted information, or provide the subscriber additional, different, or restructured information, or involves subscriber interaction with stored information."[20]

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[18] Henry D. Levine, "The User's Stake in CEI and ONA," *Telematics*, 3, no. 11 (November 1986): 3.

[19] Ibid.

[20] Ibid.

Computer I and II were attempts by the FCC to define utility services that should be regulated and nonutility service where regulation could be forborne. They were a genuine effort by the FCC to address the melding of communications and computers. As mentioned, the FCC also believed it was unable to regulate the company and viewed Computer I and II as a means to bring AT&T within manageable bounds.

The FCC's Move Toward Deregulation

The FCC quickly became dissatisfied with Computer II. Shortly after its completion in 1981, the FCC moved from a policy position that competition could be used as a regulatory tool to one supporting deregulation. Computer III then was launched. Its purpose was to develop regulatory tools that would permit dominant carriers to provide basic services and enhanced services through one company without cross-subsidization of competitive services by basic services and without jeopardizing competition in the enhanced services market.[21] The original Computer III order required the unbundling of basic service elements (BSE). Local operating companies were required to offer to any and all takers the local exchange telephone network's underlying components of basic service on an unbundled basis. State regulation was relegated to nonenhanced use of a BSE.

However, the FCC was forced to scale down its Computer III order after *Louisiana Public Service Commission v. FCC*. Partially because of this ruling, the FCC may wield considerable influence but it will not play a direct role in defining POTS which primarily is an intrastate issue.[22]

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[21] Levine, "The User's Stake," 4.

[22] Gretchen Dumas, "Open Network Architecture: Equal Access for Enhanced Services," *Telematics*, 4, no. 7 (July 1987): 5. The *Louisiana Public Service Commission vs the FCC* decision reaffirmed the dual jurisdiction between federal and state regulation. The FCC had attempted to preempt the state on depreciation methods. The FCC was not allowed to determine the method of depreciation for intrastate ratemaking purposes.

State Strategies

State regulators, particularly as a result of the FCC's actions, are beginning to recognize the necessity of defining POTS in a changing telecommunications environment. For example, Warren Wendling, Supervising Telecommunications Engineer at the Colorado Public Utilities Commission, stated in testimony that his Commission needed to consider the evolving nature of basic service.[23] He stated that basic service should include:

- Universal service (no unserved customers);
- One-party service available on request without construction charges;
- Transmission quality of a high enough grade to transport low-speed data (2400 bps) and facsimile (fax) transmission as well as voice;
- Touch-tone;
- Digital or stored program control central offices providing access to advanced services;
- Digital interoffice facilities;
- A local calling area encompassing the user's community of interest;
- Access to the network services through an open network architecture.

All this should be provided at fair, just, and reasonable cost-based rates set through a legal process that guarantees access to interested parties.

Mr. Wendling's testimony is just the beginning of a dialogue. Colorado, like many other states, has not developed a specific definition or policy pertaining to POTS. Embedded in Colorado statutes is a concept of universal service and a list of services that are considered basic exchange to be regulated under the doctrine of regulated monopoly.[24]

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[23] Warren L. Wendling, testimony before the Colorado Public Utilities Commission in Docket No. 90A-655T, 14.

[24] See Section 40-15-101 *et seq.*, Colorado Revised Statutes.

Many states are in a position similar to Colorado. Florida, in Docket No. 860984-TP dated November 20, 1987, adopted a definition for universal service used first in the Communications Act of 1934. Florida has not begun an investigation into the definition of POTS, but is concerned about the issue. Idaho, like Colorado, depends for its POTS definition upon a new telecommunications act referred to as the Telecommunications Act of 1988. The Act defines basic exchange service as the provision of access lines to residential and small business customers with the associated transmission of two-way interactive switched voice communication within a local exchange area. The Act is concerned about universal service and incorporates a universal service fund.[25]

Wisconsin also operates under statutes that similarly define basic exchange service. Other than stating that the Commission finds that universal service includes access and a reasonable amount of usage, Wisconsin has not directly addressed the issue.

The New York Department of Public Service staff has pursued the definition of basic service and likes a description of basic service provided to it by ALLTEL.[26]

> In our opinion, we believe that one must...ascertain what is involved in providing...(basic services) from the outset. The customer must request service. An account must be established. A number must be assigned. A connection to the customer premise must be made to the local distribution plant. This loop will terminate at the central office. The central office must be equipped with trunks to send and receive calls from the outside world. Now that facilities are in place, the customer requires certain services. Foremost is the ability to receive and transmit calls. In today's environment it is necessary to be able to outpulse in Dual Tone Multi Frequency (DTMF). Therefore, Touch-tone is a (basic) service. The customer also expects the facilities to operate correctly, therefore testing and repair is required. The telco expects to be paid, therefore recording and billing and collecting must be provided for. The customer also expects his number to be published in a white directory.

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[25] Idaho Code, s62-601 et seq.

[26] New York Department of Public Service, Communications Division, memo to the Commission, March 1990, 5-6.

The New York Department of Public Service submitted to the Commission an outline of what it considered basic service.[27]

1. Network Services
   a. Loop
      (1) Link
         - Terminating equipment at customer premises
         - Connection (line) between customer premises and serving central office
      (2) Port
         - Terminating equipment at central office
   b. Usage
      (1) Primary local calling area (Band-A-type calls)
      (2) Extended calling areas (other local/intra-LATA toll calls, and inter-LATA carrier access
   c. Installation of basic service
   d. Complementary Services (e.g., Touch-tone)

2. Public Service Adjuncts
   a. Emergency calling systems
   b. Statewide Relay
   c. Directory Assistance
   d. Operator services associated with local calling

3. Customer Services
   a. Business Office
   b. Repair
   c. Billing and Collection

Still few states have launched a specific POTS investigation. In fact, most states view POTS as any and all elements included in their basic local exchange service charges. The major short-term changes are the inclusion of Touch-tone in basic rates and the adjustment (enlarging) of local exchange calling areas.

The Bifurcation Dilemma

The impetus for changing POTS or specifically addressing the definition of POTS arises from the concept that part of telephony is a monopoly business and part of it is a competitive business. This bifurcation is the same dilemma that the FCC

[27] Ibid., Appendix 1.

confronted in Computer I and Computer II. At the time of Computers I and II, the FCC looked upon competition as an aid to regulation. Today the FCC and many states look upon competition as a goal in itself.

These regulatory bodies suggest certain services are monopoly services that should be regulated under the doctrine of regulated monopoly. They further suggest that certain other services are not monopoly services and should be more lightly regulated or deregulated. Relative to POTS or regulated services, states expect more rapid technological growth from the more competitive services as well as more cost-effective service and better quality service. To make the regulatory split, states need to determine what constitutes monopoly services (POTS) and what constitutes competitive services.

On the federal level, in Computer III the FCC confronted a major contradiction in its policy position. It was committed to deregulation but recognized the possibility of economies of scale and scope in telephony. Economies of scale and scope imply a natural monopoly, which further implies the absence of a competitive market. In effect, the adoption of nonstructural or accounting safeguards was an attempt by the FCC to have its cake and eat it, too. It wanted to take advantage of any economies of scale and scope in telephony and at the same time allow entry and competition in these markets. State regulatory commissions will face the same contradiction the FCC did in making the split between monopoly and competitive services.

Although the FCC has been a leader in bifurcating telephony into monopoly and competitive markets, by itself the federal agency could not have imposed its concepts upon state regulators. State regulatory commissioners and staff must first have had a predilection toward competitive ideology. Or, more precisely, a sufficient mass of commissioners and staff must have had this predilection. The FCC also received help from a multiplicity of sources who espoused the virtues of competition or a new vision of telecommunications in the information age.

Telecom 2000

The National Telecommunications and Information Administration (NTIA) gave the FCC a major boost with its *Telecom 2000.*[28] Some of the major conclusions of the report are:

- A vast array of new telecommunications and information services will become available by the year 2000, many of which will be used by most people in day-to-day life;
- Government-imposed legislative, regulatory, and judicial barriers continue to limit competition and innovation in local telephone service, cable television service, and Bell operating company information services;
- Present regulatory pricing policies delay modernization of the country's telecommunications infrastructure, jeopardize the affordability of basic service, deny customers access to new and innovative services, and potentially compromise the competitiveness of U.S.-based firms as well; and
- In a fully competitive environment, new services could lead to the formation of an electronic national or even international "neighborhood" which bridges geographic, economic, and social barriers.

The report emphasizes the importance of telecommunications in the information age and the value of the competitive market in spurring innovation and ensuring American competitiveness in world markets.[29]

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[28] National Telecommunications and Information Administration, *NTIA Telecom 2000: Charting The Course for A New Century,* (Washington, DC: U.S. Department of Commerce), October 1988, 11-12.

[29] Interestingly, Alfred C. Sikes, then the Director of NTIA, when introducing the report in 1988 often referred to Minitel as an ideal to which we should aspire. Minitel is offered by the French telephone system which is government owned and is a heavily subsidized system.

Edwin B. Parker takes a different tack than NTIA. He states:[30]

> A primary goal of state regulatory commissions should be to arrange for affordable universal access to single party Touch-tone telephone service at quality levels suitable for data and facsimile transmission as well as voice. This should be the new 'universal service' standard.

Parker's vision of POTS (his universal service standard) can be provided over narrowband and does not require universal broadband fiber. The standard can be met by radio as well as wireline technology. Parker's vision of the future of telephone service is more expansive than his universal service standard. He envisions affordable universal information access for all residential and business customers which includes broadband services.

The Intelligent Network Task Force

Pacific Bell is among the leaders in an attempt to redefine POTS. To that end it convened The Intelligent Network Task Force. The purpose of the task force was to evaluate issues raised by the "intelligent network" and the impact of the network on society.

The task force concluded that universal service should be redefined to include access to the intelligent network. The intelligent network is defined as a telecommunications system that offers the following to all residential and business customers:[31]

- A transparent gateway to databases and other information services provided from a variety of sources;
- Network protocol conversion between unlike computer systems;
- Assured privacy for communications and transactions handled via the network;

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[30] Edwin B. Parker, *State Telecommunications Policy Recommendations*, prepared under grant from the Ford Foundation and the Aspen Institute, 1991, 4.

[31] *Pacific Bell's Response to the Intelligent Network Task Force Report*, 22-23.

- Simultaneous voice and data services;
- Store-and-forward services such as voice mail, software delivery, some forms of videotex and audiotex, and advanced 976 services;
- Transmission and routing for such home-oriented services as household security, health care monitoring, and remote environmental control;
- Provision for network access by disabled persons and those not fluent in English;
- Automatic language translation as technology advances.

Since the task force considered the old definition of universal service inappropriate, it redefined universal service as access for virtually all citizens to:[32]

1. The Intelligent Network;

2. A package of specific network applications services deemed by law or regulation to be essential in everyday life, and thus included in the regulated rate base.

The makeup of this set of services will evolve over time, but the task force anticipates that it will include:

- Touch-tone service, which is a prerequisite to many Intelligent Network services:
- Conventional phone service, including long-distance access, access to 911, 411, and so on;
- Access to publicly supported information services (including data bases and public library services);
- Access to information services integral to public education;
- The network's provisions for serving customers not fluent in English; and
- Network facilities for persons with disabilities.

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[32] Ibid., 23.

Whither the Little Guy?

As discussed earlier, current interest in modernization and infrastructure is largely driven by worries about U.S. competitiveness in world markets.[33] The interest is in response primarily to the needs of the large, sophisticated, or specialized telecommunications user. Modernization of the telephone system also is driven by the belief that the company that is first to blanket an area with fiber optics will not only have a competitive advantage but will have an effective monopoly for the next thirty years.[34] At issue, however, is the place of residential and small business customers in this milieu. Many see residential and small business customers of the future as interactive cable television services users who will then migrate to other services available from the feature-rich public switched network.

To the extent that the discussion includes broadband services (and it must if telephone companies are to obtain a strategic advantage), the cost of providing this infrastructure is likely to be enormous.[35] A 50 percent penetration of these services may take twenty years or more. In the intervening time, the POTS customer may pick up many of the joint costs of such a network.

The use and needs of the POTS customer should be the standard against which to judge the modernization, costing, pricing, and design of the public switched network. This requires a clear definition and consensus of the basic concept of POTS. A definition that adopts video dial tone as a reasonable POTS standard will look different than one that adopts Mr. Wendling's standard or one that adopts a standard of dial tone. Each would meet different objectives and each has costing and pricing implications.

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[33] See Robert G. Harris, "Telecommunications as a Strategic Industry," speech delivered to the New York University Club, December 15, 1988.

[34] Egan, "Telecommunications Strategy," 23.

[35] For an estimate of these costs see Julia A. Miezejeski, et al, *An Analysis of a Portion of the Cost of Converting a Local Telephone Utility Network into a Network Capable of Delivering Broadband and Cable Television Services to All Subscribers*, (Columbus, OH: The National Regulatory Research Institute), October 18, 1990.

To date POTS has been used more in a generic sense and has not been well defined. Policy makers and others now are attempting to define POTS more rigorously. The primary impetus in the push to define POTS is the bifurcation of telephony into regulated monopoly services and unregulated (or more loosely regulated) competitive services. At stake for residential and small business users are the types of services that will be available and the prices at which those services will be available. At stake for all users is the quality of the public switched network and its costs, the rate of technological development, and the economic and social integration of our society.

## CHAPTER III

## INVENTION, INNOVATION, AND TECHNOLOGICAL CHANGE

In this chapter innovation and technological change are discussed, particularly as they relate to market structure and monopoly power. The FCC, supported and encouraged by others, has encouraged deregulation and a move toward competitive markets. The impetus for the FCC's action is the belief that competitive markets are more efficient and provide greater technological growth than other market structures, especially regulated markets. A reasonable POTS policy must address these issues raised by the FCC and be influenced by the facts. To the extent that regulation inhibits technological progress and efficiency, policy makers presumably would want to reduce regulatory interference. In this instance, POTS may be more narrowly defined and other policies such as lifeline rates substituted for regulation. However, if regulation does not significantly interfere with technological progress and efficiency, policy makers should not be concerned in this context about the breadth of regulation in defining POTS.

Myth, however, may be more important than reality. Nowhere does reality seem to be more shrouded in myth than in the discussion of technological change in telephony.

Regulators long have been interested in promoting technological change. Over the past two decades, however, there has been greater concern about who receives the benefits of technological change and who pays the cost.[36] More recently, regulators have been concerned about the role that technological change plays in United States economic competitiveness. The concerns of regulators are warranted. Productivity growth is important to our economic well being, enhancing our standard of living, the quality of our lives, and our competitiveness in world markets.

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[36] See Raymond W. Lawton, *Telecommunications Modernization: Issues and Approaches for Regulators*, (Columbus, OH: The National Regulatory Research Institute), January 1988.

The Bigger Picture

Economists and others have developed an extensive literature on the subject of invention, innovation, and technological change. This chapter provides a general review of that literature, both inside and outside telephony. The review particularly will provide a perspective on the relationship between technological change and market structure and changes in productivity in relationship to market structure and regulation.

Invention is the act of recognizing and solving some technical problem through research and development. It is basic research, the investigation of phenomena to gain knowledge for its own sake. The act of invention is very uncertain. If the research is directed, it may achieve its goal, it may achieve another goal (invention of something that was not intended), or it may achieve no outcome.

Even though the outcome of the invention stage is less certain, it tends to be less expensive relative to other stages. It remains quite important, however, because it is the building block on which innovation and technological change are made.[37]

The development or innovation stage takes a rudimentary idea and transforms it into a product ready for commercial utilization. It is applied research and the translation of technical and scientific knowledge into concrete new products and processes. It consumes, in general, several times the funds spent on basic research.

The two final stages discussed by economists are the entrepreneurial stage and the diffusion stage. The entrepreneurial stage is bringing the product to market. It involves raising funds for the venture and developing an organization to provide the service or product. The diffusion stage spreads the new product or process to other firms throughout the economy.

Historically, telephony is unique in that all of these functions were largely borne by the same firm, AT&T. In most cases, these functions are performed by different entities.

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[37] F. M. Scherer, *Industrial Market Structure and Economic Performance*, (Chicago: Rand McNally and Company), 1970, 350.

Demand-Pull

An argument put forth by those advocating deregulation or regulatory reform is that in the information age, people are clamoring for new telecommunications products and services. A deregulated industry or one burdened by less regulation will have the incentive to meet these demands. These advocates are implicitly adopting a demand-pull view of innovation.

Demand-pull innovations are motivated by market considerations, with less of their impetus coming from scientific personnel. Invention under the demand-pull concept is a response to profit opportunities. For example, transistors were developed by AT&T in response to a need for smaller and more efficient switches.[38]

Empirical studies verify the existence of these demand-pull innovations but do not verify them as one of the most important determinants of innovation.[39] In fact, as an explanation of the innovative process, the demand-pull theory is almost tautological. The reason is that inventions that do not have a demand component to them are not brought to the marketplace, a long process indeed. Funds will not be expended in the entrepreneurial stage unless someone thinks that a profit can be made which entails some demand for the product.

Demand or need for a product may exist long before the product is brought to market. Lack of scientific or technical knowledge may prohibit bringing an innovation to fruition to the point where profits can be made. This appears to be the case, for example, in the elusive search for inexpensive alternatives to fossil fuels. Thus, scientific knowledge is a necessary but not sufficient condition to bring an innovation to market. This brings us to technology-push innovations.

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[38] Morton I. Kamien, *Market Structure and Innovation*, (Cambridge: Cambridge University Press), 1982, 35.

[39] Rod Coombs, et. al., *Economics and Technological Change*, (Totowa, NJ: Rowman and Littlefield, Publishers), 1987, 101.

Technology-Push

Technology-push innovations are those induced primarily by advances in knowledge. Ideas spawn basic research that creates new products. Bell's invention and development of the telephone is an example of a technology-push innovation. At the time of its invention, no one saw the need for the telephone, but the technology and scientific knowledge had advanced to the point that the telephone could become a reality.

Although debate has raged between proponents of demand-pull and technology-push hypotheses, they may be viewed as complementary rather than competing explanations of innovation. Virtually every invention can be traced to some advance in basic scientific knowledge, and virtually every invention brought to the marketplace arrives with the idea of making a profit (meeting a perceived demand). Nonetheless, the debate has contributed to our fundamental understanding about the innovation process. It also has shown that innovation is a complex process that depends upon a number of factors, two of the most important of which are scientific knowledge and demand.[40] Technological progress in terms of introducing new products or installing more cost effective means of production, cannot be made without sufficient demand or adequate scientific knowledge.

Induced Innovation

The English economist, John R. Hicks, formulated a theory of innovation from another perspective.[41] He said:

> A change in the relative prices of the factors of production is itself a spur to invention, and to invention of a particular kind - directed to economizing the use of a factor which has become relatively expensive.

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[40] Ibid., 102.

[41] John R. Hicks, *The Theory of Wages*, (London: MacMillan), 1932.

Hick's formulation became know as the theory of induced innovation. Microeconomic research in this area has shown some propensity to devote research and development to saving the most expensive factor.

However, the relationship is not a strong one. Innovation is always limited by scientific and technological knowledge. As the frontiers of science and technology are reached, the cost of R&D activities increases. In allocating its research funds a firm will consider three factors:

- The relative contribution to reducing production costs of different research projects;
- The cost or intrinsic difficulty of the project itself, and
- The extent to which a particular research project can be pushed toward its scientific and technological frontier.

Thus, changes in factor costs do not have easily predictable effects on the direction of technological change.[42]

The Schumpeterian Hypothesis

Since the early 1980s federal telecommunications policy has had as an operating principle that competitive markets are preferable to regulated markets. Included in this policy is the belief that competitive markets will foster greater technological change than monopolistic ones, particularly regulated monopoly markets.

The FCC's contention is a testable hypothesis. One way to state the hypothesis is that technological innovation is greater in competitive markets than other market structures. A more general statement might be, "Does any particular market structure result in a greater rate of technological development than other market structure?"

It turns out that economists have tested these hypotheses, particularly a Schumpeterian hypothesis, which is worth discussing since it is the opposite of the FCC's hypothesis.

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[42] Ibid., 108.

Schumpeterian theory states that monopoly power is conducive to innovation and technological growth. It is conducive for two reasons. First, innovation can create or sustain monopolies. Once a monopoly is created, the firm can earn extraordinary (monopoly) profits. Thus, firms with monopoly power are more inclined to innovate because they can reap the rewards from innovation.[43]

Second, firms realizing monopoly profits are better able to finance innovative activities. They can attract capital easier and a failed project will not lead to economic ruin.[44] Because of this, and the fact that firms must innovate to retain a monopoly position, firms with monopoly power have a large incentive to innovate.

Who is correct, the FCC or Schumpeter? Based on empirical studies performed by a wide variety of economists, neither is entirely correct. Let me quote from F. M. Scherer who has surveyed the extensive literature:[45]

> A little bit of monopoly power, in the form of structural concentration, is conducive to invention and innovation, particularly when advances in the relevant knowledge base occur slowly. But very high concentration has a favorable effect only in rare cases, and more often it is apt to retard progress by restricting the number of independent sources of initiative ... Schumpeter was right in asserting that perfect competition has no title to being established as the model of dynamic efficiency.

Scherer goes on to say that what is needed is a subtle blend of competition and monopoly.

Two economists specializing in innovation processes, Morton Kamien and Nancy Schwartz, after reviewing the extensive literature examining the relationship between market structure and innovation, essentially came to the same conclusion as Scherer. They conclude that little correlation exists between market power (or the

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[43] The more competitive the market the faster the rewards for innovation dissipate. In a highly competitive market, the rewards will disappear quickly. Thus, there is little incentive for innovation.

[44] Competitive firms ride the razors edge between staying in business and failure. A minor mistake can push a firm in a competitive market into bankruptcy.

[45] Scherer, *Industrial Market Structure*, 377-378.

lack thereof) and innovation. They believe that some support exists for the hypothesis that a market structure somewhere between monopoly and perfect competition would promote the highest rate of innovative activity.[46]

Coombs and others also rule out the relationship between market structure and innovation. They believe that technological opportunity is the primary cause of differences in patterns of innovation. They think that differences in technological opportunity may lead to oligopoly but market structure is not important to technological opportunity.[47]

Coombs' point that technological opportunity may lead to oligopoly should be emphasized. Technological change can affect market structure by altering the optimal scale of production. If this scale decreases, then more firms can serve the same market, thereby increasing competition. If the optimal scale of production increases, fewer firms can serve the same market, thereby discouraging competition.

The telecommunications industry tends to exhibit economies of scale and high fixed costs relative to variable costs (at least in the local exchange markets). For technological change to alter market structure to make it more competitive, the technological change must reduce dramatically the existing economies of scale. To reduce the existing scale economies, the new technologies must be capital-saving. That is, they must reduce the level of fixed costs to variable costs. The industry seems to be moving in the opposite direction from this with the change to digital switches and fiber optics.[48] If the technological change is such that fixed costs remain high relative to variable, as seems to be the case, a competitive market cannot arise nor can a stable market arise without collusion.

Changes in productivity are more important than changes in technology. Technological change is interesting only to the extent that it increases productivity. Technological change that does not increase productivity is neither interesting nor of

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[46] Kamien, *Market and Innovation*, 104.

[47] Coombs, *Economics and Technological Change*, 113.

[48] See Miezejeski, *An Analysis;* and David Gabel, and Mark Kennet, *Estimating the Cost Structure of the Local Telephone Exchange Network*, (Columbus, OH: The National Regulatory Research Institute), October 1991.

great value. The primary indicator of efficiency is productivity not technological change, although technological change is an important ingredient in productivity.

Stifled Productivity

A reading of the FCC's price cap docket, for example, or a myriad of other publications, can lead to the conclusion that productivity in telecommunications has been stifled because it has been a regulated monopoly. The data show quite the contrary.

Between 1948 and 1985, telecommunications showed a higher rate of growth in productivity than any other industry. These data are a little misleading because the greatest increase in productivity growth occurred between 1948 and 1965 where it far outstripped all other industries (except electric utilities) with a 5.6 percent annual growth in productivity. The industry remained at the head of the productivity class until 1979 with increases that averaged 3.4 percent between 1965 and 1973 and 2.4 percent between 1973 and 1979. After 1979, productivity growth declined and averaged 1.3 percent a year. The industry moved from the head of the productivity class to the middle.[49]

The industry follows a general decline in productivity growth in the United States as a whole, but its rate of decline has been even greater, starting from a higher perch and falling faster. The decline also mirrors the FCC's procompetitive policy. In the days when the FCC practiced the doctrine of regulated monopoly, the industry exhibited the highest rates of productivity growth (1948-1965). The industry exhibited high rates of productivity growth and remained among the most productive during the time when the FCC relaxed the doctrine of regulated monopoly but had not yet moved to its procompetitive policy (1966-1979). After the FCC introduced its procompetitive policy, productivity growth declined even further and the industry ranking relative to other industries fell precipitously (1980-1985).

Correlation is not necessarily causation. The decline in productivity cannot be laid entirely on the doorstep of the FCC's procompetitive policy. Such a strong

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[49] Martin Neil Baily and Alok K. Chakrabarti, *Innovation and the Productivity Crisis,* (Washington, D.C.: The Brookings Institute), 1988, 6.

correlation, however, should give one pause to consider what contribution the FCC's procompetitive policy may have made to the industry's productivity decline.

Research by Ishaq Nadiri and Mark Schankerman point out two other interesting events that are occurring in the industry. The first is that between 1947 and 1976 the rate of technological change increased.[50] All other things being equal, an increase in the rate of technological change should result in an increase in productivity. Assuming that the rate of technological change continued to increase through the 1980s (a somewhat heroic assumption but one consistent with federal policy), the expectation is that productivity also should increase, counter to the reported data.

There may be several explanations for this seeming paradox. One may be a decrease in managerial talent and ability. The available stock of managers may not be able to organize new technology efficiently with other resources. A decrease in managerial talent and ability may play a role, but remains only one of a number of factors.

Demand Curve Shifts

The research by Nadiri and Schankerman points to another possible cause for this productivity slump. Their research indicates that shifts in the demand curve are the major source of productivity growth over the period they studied.[51] The reason that shifts in the demand curve can contribute to productivity growth is economies of scale, which imply downward sloping cost curves. When demand shifts outward increasing output, the unit cost of output decreases. The decrease in unit cost will translate into productivity increases.

The potential for major productivity gains through economies of scale may have been exhausted as we entered the 1980s. This hypothesis is compatible with federal

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[50] M. Ishaq Nadiri, and Mark A. Schankerman, "Production, Technological Change, and the Rate of Growth of Total Factor Productivity in the U.S. Bell System," in Thomas G. Cowing and Rodney E. Stevenson (eds.), *Productivity Measurement in Regulated Industries*, (New York, NY: Academic Press), 1981, 245.

[51] Ibid.

competitive policy. With a larger number of firms in the market, the market size of each is reduced. As a result of a larger number of firms serving the market, each of the firms may not be able to serve a sufficient number of customers to take full advantage of potential economies of scale. This is one of the problems that Computer III attempted to address.

Innovation and Market Strategy

A final reason for productivity declines in the industry may be that telephone companies are trying to position themselves for the future by deploying digital switches and fiber optics. Many think that the firm first to deploy digital switches and fiber optic cable will be in a position to monopolize its territory or at least be the dominant firm. Unfortunately, fiber and digital equipment is less efficient (more costly for a given level of output) than older technologies in many applications.[52] In an effort to position themselves for the future, monopolists are not employing the most cost-effective technologies. Hence, a decrease in productivity growth rates.

The type of technology--high fixed cost, low variable cost--being deployed should not be a surprise. The fact that telephone companies have invested R & D in this type of technology also should not be a surprise. If telephone companies can find uses for the investments (increase in demand and usage), productivity gains as well as gains in market power will be forthcoming. A clear economic incentive exists to bias R & D toward investment that will increase scale economies.

Given the history of innovation, technological change, and productivity growth in telecommunications, it is difficult to argue that regulation has stifled technological change and productivity.

Elizabeth Bailey argues that timing is important in innovation. Firms must be able to reap the benefits of innovation rather than quickly pass price reductions onto the consumer (shades of the Schumpeterian argument). The more competitive the environment, the faster profits are eliminated as economies are passed on to consumers. In a regulated environment, commissions determine the length of time

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[52] See Gabel and Kennet, *Estimating the Cost Structure;* and Miezejeski, *An Analysis.*

benefits (profits) are retained by the firm before prices are decreased. The result is that regulated firms have substantial incentives to invest in R & D and place a high emphasis on innovation.[53] Data on productivity growth in the telecommunications industry and the electric power industry appear to support this hypothesis.

Efficiency

A final issue that should be discussed before leaving the topics of innovation, technological change, and market power, is the economist's notion of efficiency. Most people think of operating at least cost when they think of efficiency; not so the economist. Market efficiency to the economist means the equivalence of price and marginal cost. The greater the distance between price and marginal cost, the less efficient; the closer price is to marginal cost, the more efficient.

The genesis of this concept is in the perfectly competitive model where price equals marginal cost. Such a market structure by definition is efficient and any other market structure by definition is inefficient since price deviates from marginal cost in all markets except perfectly competitive ones.

The rub is that perfectly competitive markets may not be the same as least-cost market structure. The reason is economies of scale. Perfectly competitive markets require a large number of firms. None may be large enough to take advantage of least-cost, large-scale production technologies. Thus, a monopoly or oligopoly market that can take advantage of economies of scale through large-scale production techniques may be the least-cost provider(s). Even though they may not be the most efficient provider(s) in economic terms, they may be the lowest-cost provider.[54]

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[53] Elizabeth E. Bailey, "Innovation and Regulation," *Journal of Public Economics*, 3 (August 1974): 185.

[54] In a dynamic sense, competitive markets may not lead to the lowest cost production over time. The reason goes back to the earlier discussion about innovation. Perfectly competitive markets are not as innovative and do not produce as much technological change as other market structures. Over time other market structures will result in lower production cost but will not be considered economically efficient.

Several conclusions will be of use later when discussing the definition of POTS. First, little relationship exists between innovation, productivity, and market structure both on a theoretical basis and as evidenced by empirical analysis. In fact, telephony regulation acquits itself well on grounds of technological change and productivity increases. A policy that turns away from regulation on the basis of an inverse relationship between technological change and regulation would be not be supported by historical evidence.

Second, economic efficiency does not necessarily correspond with the lowest-cost provision of service. Economies of scale and scope may exist, but firms in a competitive market will not be able to take advantage of these economies. Consequently, they will not be the least-cost providers of service.

Third, telephone utilities may employ new technology when it is not cost effective to gain a strategic advantage. The new technologies will make a plethora of new services available whether or not demand for them exists.

These concepts will be employed in the next chapter when the POTS concept is defined and in Chapter V where POTS costing and pricing are discussed.

## CHAPTER IV

## THE ONCE AND FUTURE DEFINITION OF POTS

The definition of POTS will depend upon the values, visions, and priorities of society at large. Competing views will make any definition of POTS controversial and the debate tinged with emotion. That marvelous toy, the telephone, continues to dazzle, but now it is firmly entrenched in our social and economic structure. Nevertheless, what policy directions policy makers should take with respect to POTS are unclear.

The possibilities are numerous, ranging from a narrow definition of POTS as dial tone to a broad definition that includes broad band, as in Pacific Bell's *Intelligent Network Task Force Report.* The alternatives also include regulatory possibilities from complete deregulation to the FCC's Computer I, II, and III concepts, to full rate base, rate-of-return regulation.

The ideas presented here will be based upon the discussion in Chapters I through III, and will emphasize infrastructure, social, and economic integration and avoidance of information haves and have nots. POTS should allow individuals, families, and small firms to be fully functioning, integrated members of society and the economy.

### Competition Is Good...But

The need to define POTS more precisely is based upon the belief that competitive markets are not always the best option. Otherwise, policy makers would not be as concerned because all services would fall under the doctrine of regulated monopoly. The doctrine of regulated monopoly requires a single provider of all services within a certificated territory. Since all services are regulated in the same manner, the definitions and boundaries of the services are not as crucial.

Competition, however, is a strong economic driver. Economists extol the virtues of the competitive market for good reason. Under certain conditions, exactly

the right products are produced at the lowest possible prices. This occurs because of three general properties of competitive markets. First, the cost of producing the last unit of output just equals the price paid by consumers. Second, the price is equal to the average total cost for representative firms. This allows investors to receive a return just sufficient to induce them to maintain investment at the level required to produce the quantity consumers will buy at the market price. Third, each firm is producing its output at the point of minimum cost based upon the technology employed. Firms which do not operate at this minimum cost will be driven from the market because the market forces resources to be employed at their maximum efficiency.

Even so, market failures occur frequently. Market failures are phenomena or conditions that prevent attaining the virtues of the competitive market discussed above. Where market failures occur that are not patchable,[55] alternatives to a free-functioning competitive market must be used. Natural monopoly or natural oligopoly are examples of nonpatchable market failures and seem to be the norm in telephony. An efficient, well-functioning industry may require partial regulation to prevent information haves and have nots, to prevent price discrimination, to obtain rapid technological advances and increases in productivity, and to obtain the widest dissemination of new technology discussed in Chapters I-III.

The Common Carrier Concept

We saw in Chapter III that little theoretical or empirical support exists for the contention that competitive markets are most efficient (least cost) or provide the most rapid technological or productivity advances. In fact, until the 1980s the telecommunications industry was a leader in technological advancement and productivity growth. We should consider recapturing the policies that brought such

[55] Patchable market failures are those that can be fixed so that the virtues of a competitive market can be obtained. This may entail removing government regulations, publishing certain types of information, enforcing antitrust statutes, and so forth. Nonpatchable market failures are so persistent and pernicious that the virtues of a competitive market cannot be obtained without strong and persistent interference in the market.

success to the telecommunications industry. A major cornerstone of that policy was that the regulated utility was a common carrier.

The FCC in its various computer dockets implicitly recognized the common carrier function of telephone utilities. A major thrust of those dockets was to determine what the common carrier function of the utility was and what it was not. That which the FCC implicitly determined was common carriage was to be regulated and that which it implicitly deemed not to be a common carrier function was not to be regulated--a perfectly reasonable scheme. Not all telephone company operations should be considered common carriage. But, all that we deem as POTS should be considered common carriage and under fairly traditional regulation.

POTS Defined

The place to begin defining POTS is where we are today, although that is a mosaic. In Chapter II, we looked at what several states had done and found only a few states have addressed the issue directly, but several more see a need to define POTS. Some common elements are present in the states that have addressed the issue. We can try to capture some of that commonality. However, we should remember that each state has its own economic, demographic, and social characteristics. This in turn, can lead to a somewhat differing definition of POTS in the various states, a situation that is as it should be.

POTS can be defined by facilities, services, functions, and perhaps a few other ways. The definition presented below basically focuses on services, and should not be considered sacrosanct but viewed more as a guideline or example. Ideally, each state should conduct its own investigation to tailor POTS to its own needs. One itemized listing of POTS could include the following:

- Access to local exchange service;
- Access to interexchange carriers;
- Ability to receive local and long-distance calls;
- Access to emergency services;

- Universal service to include a lifeline rate for low-income customers;
- A local calling area sufficiently large to encompass the user's community of interest;
- A standard of one-party service available without construction charges;
- Touch-tone;
- Transmission quality to transport low-speed data (2400 bps) facsimile (fax) transmission as well as voice;
- Access to advanced services provided in digital or stored program control central offices;
- Access to information services and 800 services;
- Local directory assistance;
- Directory listing and residential and business directory;
- Local operator services;
- Customer service including billing;
- Installation and set up of POTS.

The Definition Can Change

The world is not static so definitions cannot be static either. Once a definition is set, a process to change it also must be established.

The process and the criteria for change should be preset. An expansion of the definition of POTS should follow the general concepts used to define it originally. The criteria should be based upon the concept that the addition or deletion is necessary for an individual, family or firm, or other entity to be a fully functioning member of society and the economy. Some of the criteria should be:

- Is it essential for network access?
- Is the service necessary for economic and social integration?
- Is it a bottleneck facility with few competitive alternatives?

- Are elements of economies of scale and scope present or is the service tied to other such services?

A high level of penetration should be expected of a service, perhaps 80 percent or greater, to be included in the definition of POTS. Obviously, some exceptions need to be made to this generalization. E911 won't have 80 percent use nor will access to gateway services. These, however, may be included on the basis of economic and social integration.

Also, the change should not affect universal service or cause a substantial increase in rates.

Rate Increases to Accommodate New Technologies

Some will argue that rates should be increased to accommodate new technologies and new services. The argument should be met with skepticism for a variety of reasons. In the first place, investment usually should be made only when it causes a decrease in real cost and real prices.[56] In Chapter III, we learned that real costs and real prices generally have declined in telephony since World War II while the quality and quantity of services have increased.

Obtaining lower real costs and prices while increasing the quality and quantity of services has meant modernizing the public switched network. Dr. Raymond Lawton defines modernization as replacing present technology with more efficient technology. He states that the decision rule for modernization is that the net future revenue stream of the newer technology exceeds that of the older technology.[57] Since overall cost can be expected to decline in telephony and since new technologies most likely will provide a wider array of services, a further constraint needs to be placed on the analysis. The constraint is that new technologies do not cause the price of POTS to increase.

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[56] Real costs and real prices are those adjusted for inflation.

[57] Lawton, *Telecommunications Modernization*, 125-126.

The reason for the constraint is that the new services may not generate sufficient revenues to cause the net future stream of revenues to increase without raising POTS prices. Since POTS could be offered with the existing technology at a lower price than with the new technology, POTS customers should not have to pay for new technologies that offer new services they don't use.

Other reasons exist to be skeptical of the argument to allow increasing real costs and prices to accommodate new technology. They pertain to technical economic conditions in telephony. The industry exhibits economies of scale and scope and also exhibits a high rate of technological change that should push real costs down further. It is a declining-cost industry where real prices and real costs can be expected to continue to decline.

Some argue that fiber to the home and to the curb will provide new and unusual services that will make the nation more competitive, although it may increase costs and prices. They argue further that these new and unusual services should be included in POTS. The argument has several disadvantages.

The major excuse for fiber optics is to provide broadband services. That primarily means video transmission. If the broadband services cannot provide sufficient revenues to cover any additional expenses without raising real costs and prices for other services, particularly POTS, standard modernization principles would say the investment should not be made.

The major danger of taking such a position is to be called a Luddite, a pejorative term that in this case would be misapplied. A better and more accurate term would be "smart business." Here is why.

Higher costs even with a broader array of services do not necessarily make the nation more competitive. In general, economists argue that lower costs and lower prices with a broader array of services will make the nation more competitive and improve the national welfare. Most new services do not require new investment.

The French Minitel system often is touted as the example for the United States telecommunications industry to follow. Minitel uses dumb terminals and its services are provided over copper wire. The basic telephone infrastructure is in place in the United States to provide Minitel-type services. Two things are lacking, however:

consumer demand and the will by telephone companies to provide Minitel gateway-type services.

Confusion of Monopoly and Competitive Functions

Telephone companies appear to consider it necessary to provide content and transmission of information services. A major result of this approach is to confuse the essentially monopoly function of transmission services with the essentially competitive function of information services. The confusion would give a distinct competitive advantage to the local exchange carriers in the provision of information services. This insistence on duality, it is argued, so far has inhibited the growth of the information services industry.

Separating Monopoly and Competitive Functions

The common carriage approach used here would keep transmission and information services separate. It would allow the local exchange companies to develop the economically viable investment needed to provide transmission and access to information service providers. It also would allow a competitive information services industry to develop.

The major efficiency advantages of such a system are obvious in the Minitel system and in Prodigy and CompuServe, all of which are offered over copper wire. They do not push the technological envelope.

It is instructive to remember here that Prodigy and CompuServe are provided over existing loop and often through less than up-to-date central offices. Prodigy and CompuServe-type services particularly point to the wisdom of the common carrier approach. Both services need to get to customers, and make money only when customers buy them, and when customers use their services through the public switched network.

Companies like Prodigy and CompuServe will figure out how to get to their customers through the local exchange network. Since penetration levels are important to these types of firms, they will figure out how to most effectively and efficiently use the existing network. In other words, effective and efficient use of the network does not

need to be within the sole purview of the local exchange carrier, and it does not require the latest most expensive technology.[58]

Maintaining Universal Service

Some will argue that changes in POTS will not affect universal service, even though costs, and thereby price, may increase. Such arguments should be received with skepticism.

Here's why. The demand for basic exchange service tends to be inelastic. Elasticity of demand is a measure of the sensitivity of consumer response to a change in price. An inelastic demand means that consumers are not very sensitive to price changes and that an increase in price will not change very much the amount that people consume.[59] One of the reasons that demand curves tend to be inelastic is that there are few good substitutes for the product, namely local exchange service.

The argument that universal service will not be affected (much) by an increase in price puts us in this position: a firm with substantial monopoly power in a declining-cost industry increases the price of a product (that is necessary for both social and economic integration of individuals and businesses) for which there are few reasonable substitutes. It is a difficult argument to put forth in a society striving for greater efficiencies, even one that has minimal concerns about equity.

The argument is even more peculiar. The reason pertains to the nature of demand for telephone service. Telephone penetration rates are highly correlated with income. The higher the level of income the greater the probability that a household will have a phone. Conversely, the lower the household income, the less likely it is to have a phone. Telephone penetration rates of middle-to-upper-level-income households is in excess of 96 percent. Even a large price increase is not likely to

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[58] Moreover, electronic equipment that dramatically compresses signals is coming into the market that will make existing investment more effective and efficient. These and other unforeseen technological changes may be more flexible and cost effective than fiber to the home and fiber to the curb.

[59] To be more precise the percentage change in price is greater than the percentage change in the quantity purchased.

decrease penetration levels within this group. A price increase simply will result in a redistribution of income from middle-and-upper-income households to telephone companies.

Low-income households exhibit penetration levels in the range of the mid 1970s. Universal service is not a reality in this group. A price increase will decrease these already low-penetration rates. Therefore, low-income households, for whom universal service is not yet a reality, will take the brunt of any price increase, making universal service even less of a reality for them.

Predicting New Technologies and Services

A major advantage of the common carrier approach is that regulators do not need to predict accurately new services and technologies. A vision of POTS (such as those by Pacific Bell in Intelligent Network Task Force and by Robert G. Harris) that views POTS as a digital broadband network able to provide new, unusual, and yet-to-be-invented services over a digital integrated local exchange company requires the deployment of certain technologies and a good idea of the nature of future services.

Predicting the deployment of new services and the technologies necessary to provide the new services is risky business. Technology takes strange turns and twists that seem to defy long-run prediction. Recall that Alexander Graham Bell's selling of the telephone was almost as great a feat as his invention of the telephone. No one wanted the telephone. Western Union could have picked up the patent for a fraction of its future value but saw no real use for Bell's toy. Their decision looks foolish today, but would any of us have done any better without the perfect vision of hindsight?

Return to 1963. Stanley Damkroger states that three million students in 7,500 schools across the country and thousands more in colleges and universities will receive part of their daily instruction via television. Closed-circuit television will enable numerous programs to be sent simultaneously from an originating studio directly to classrooms. Damkroger predicted that every major school, college, and university would have a closed-circuit television system and one-third of primary and secondary

students' education would be through closed-circuit television. All this would happen by 1971.[60] It didn't.

The picture phone was another new technology that was going to change the telecommunications world. It would eliminate business travel. Instead of flying or driving to a meeting, a video conference could be substituted. In 1965, Peter Nanzel, an AT&T vice-president, predicted that a TV screen would be at every telephone. Another AT&T executive in 1969 stated that growth in picture phone service was expected to parallel that of the telephone itself. These businessmen and others were very confident of the picture phone's place in the communications market.[61] Again, the predictions did not come to pass.

The literature is filled with the promise of new services that never came to fruition as well as those that proved unusually successful. The point is not whether there will be successful and unsuccessful new services. There will be both. The point is how regulation handles the introduction of new services, the risk of introducing new services, and their inclusion in POTS.

Regulators should avoid being placed in a position where they need to predict the types of future services to be offered. It is risky business and one in which failure is almost guaranteed. It is very difficult in the first place to know what products will or will not be successful before the fact. Who would have predicted the success of the pet rock or the failure of the Sony Beta video system or the fall of the Union of Soviet Socialists Republics?

Success at picking new products requires spreading risks. The new product market is akin to investing in the over-the-counter stock market. If you are limited to one company or a small group of companies, your probability of success is

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[60] Stanley F. Damkroger, "Educational Television and the Telephone Companies," *Public Utilities Fortnightly,* 72, no. 3 (August 1, 1963), 19-20.

[61] See Peter A. Nanzel, "The Changing Concept of Communications," *Public Utilities Fortnightly*, 76, no. 9 (October 28, 1965), 29 and William M. Ellinghaus, "New Services in Communications," *Public Utilities Fortnightly*, 84, no. 10 (November, 1969), 24.

quite low. To be successful and achieve big gains, you need to spread your risk over a larger number of companies.

The problem that regulators face is that once they lock into a set of future services, they cannot spread their risk. If those services require substantial investment, they are really stuck. This sort of scenario is, of course, a good ploy on the part of telephone utilities because it shifts the risk from the stockholder to the ratepayer. Regulators and ratepayers in essence become the risk-bearing partners. Failure simply means higher rates to customers, but not correspondingly lower returns for shareholders.

Regulators also are not in a particularly good position to evaluate the efficacy of new products, whether in terms of revenue and cost potential or technological feasibility. Making such evaluations often takes large sums of money that regulatory commissions typically do not have. Therefore, information about potential revenues, costs, and technological feasibility will come from the regulated utilities. These types of studies are difficult under the best of circumstances. And, since the utility has an incentive to put the safest picture forward, it will not be the best of circumstances for regulators.

Regulators will not be immersed in the details of developing a project. They will not know intimately the strengths and weaknesses of a project. A myriad of small items such as the inclusion or exclusion of a word, or the positioning of a word or a question can change the results of a survey. Policy makers are not likely to be privy to such information.

Policy makers need not be Luddites. When it comes to POTS, they simply need to remember the counsel, "To modernize means to replace present technology with a more efficient technology."[62] This issue will be discussed in greater detail along with costing and pricing of POTS.

For now, remember that vendors will want access to customers through the public switched network, and will develop technologies that will take advantage of the existing network. Remember also Mr. Damkroger's closed-circuit television, which

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[62] Lawton, *Telecommunications Modernization*, 225.

sounds an awful lot like today's distance learning that was to be offered via 1960s' technology. The same thing can be said of the picture phone and video conferencing. New technologies in spectrum compression and other advances are making the existing network more efficient.[63] Policy makers should strive for the appropriate rate of technological change, not the maximum rate of technological change--a rate of technological change that is cost effective and efficient. The rate should not leap ahead of the ability of customers and vendors to take advantage of the new technology.

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[63] Maryland Public Service Commission Staff, *Building a More Competitive Telecommunications Infrastructure*, Case No. 8388, November 7, 1991.

## CHAPTER V

## THE COST OF SERVICE

Whose ox is gored is one of the prime questions in the ongoing debate on the definition of POTS. No matter what the definition of POTS, whether it is dial tone or fully integrated digital services via fiber optics, some scheme must be devised to recover the cost of service.

Since the early 1960s, the telephone industry has struggled with pricing and costing concepts to apply to basic service as well as to new and unusual services. The discussion is often technical but underlying the technical arguments are fundamental principles, values, and visions of society. To a large extent, costing and pricing principles employed in telephony reflect the values and visions of the larger political and social body. Thus, an understanding of costing and pricing principles that have been applied and that are available will help policy makers define, cost, and price POTS.

The methods discussed here are fully distributed cost (FDC), marginal cost (MC) to include incremental cost, stand-alone cost, and joint products. The options generally presented in telephone rate cases consist of FDC and a variant of marginal cost, long-run incremental cost (LRIC). FDC methods are the most widely used by state regulatory bodies. The stand-alone method was first presented in the early 1980s, but has not yet gained widespread acceptance. The joint products method, while discussed extensively in economics literature, has not previously been applied in telephony, and is introduced here.

Until fairly recently, cost-of-service studies were not used in telephony. Prior to the early 1960s, the FCC relied upon informal procedures--termed continuing surveillance--as the principal method to establish rate structure. Continuing

surveillance amounted to informal negotiations between the FCC and the regulated utility in lieu of a rate investigation, hearing, and prescription.[64]

The FCC became concerned about cost allocation methods after the landmark *Above 890* case oriented the FCC toward the introduction of competition and greater reliance on the market place. As a result of the new competitive orientation, the FCC became interested in detecting predatory pricing or cross-subsidization. Cost-of-service studies became important and necessary tools in implementing the FCC's procompetitive policy.

The first cost-of-service study was ordered in 1962, was completed in 1965, and became known as the "Seven-Way Cost Study." The study divided AT&T's interstate investment, revenues, expenses, and net earnings among seven categories of service--message telephone service, wide-area telephone service, teletypewriter exchange service, private-line telephone service, TELPAK, private-line telegraph service, and all others.[65]

Fully Distributed Cost

The issues pertaining to cost-study methods were discussed at length in FCC Docket 18128. The arguments have changed little since then. The primary choice continues to be between fully distributed cost methods and marginal-cost methods, although stand-alone cost methods have received some attention recently and a new choice, the joint products method, is presented later in this chapter. The FCC chose to rely on FDC methods but recognized that each method has its strengths and weaknesses. Of course, the strength and weakness of each is determined in part by regulatory goals and objectives.

FDC methods account for all costs on the books and records of the firm, including current operating expenses such as wages, salaries, maintenance, advertising, research, depreciation, operating expenses, and return on investment. In other words,

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[64] Federal Communications Commission, *In the Matter of American Telephone and Telegraph Company, Long Lines Department, Revisions of Tariff FCC No. 260 Private Line Services, Series 5000 (TELPAK)*, Docket 18128, October 1, 1976, 32.

[65] Ibid., 8.

all fixed and variable costs are included. If calculated for various levels of output FDC methods would describe the total cost curve for a utility. If divided by those levels of output, it would describe the average cost curve for a single product utility. This is an important conceptual feature as we shall see later.

The major advantage of FDC methods is that they account for all costs on the books and records of the firm. In principle, FDC methods can establish rates which meet the revenue requirement of the utility to cover both fixed and variable costs.

So why is there a controversy over cost methods? If utilities were single product firms, the controversy over cost methods would greatly decrease. Utilities, however, are multiproduct firms, and telephone utilities, in addition to being multiproduct firms, tend to exhibit economies of scale with as much as 50 percent of their costs as joint and common costs.

The method of joint and common cost apportionment is crucial in the use of FDC methods. Since joint and common costs make up such a large percentage of total costs, their apportionment determines whose ox is gored when rates are established. Yet, no generally preferred method of apportioning these costs exists.

The term "arbitrary" often is used in conjunction with the apportionment of joint and common costs, and cost-based prices are sensitive to the method of apportionment. Widely different rates may be obtained, a result that leaves many regulators nervous. The fact that 50 percent of a telephone utility's costs (and consequently prices) are subject to judgement calls and policy orientation is seen as a major weakness by many policy makers.

Three other major weaknesses generally are discussed by critics of FDC methods. First, joint and common costs often are apportioned on the basis of usage-sensitive factors. Since these costs do not change with usage, they should not be apportioned by usage-sensitive factors. Second, FDC methods do not allocate resources efficiently because prices are not equal to marginal cost. Finally, demand or market considerations are absent, or at best a secondary consideration.[66]

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[66] See Alfred E. Kahn, *The Economics of Regulation: Principles and Institutions*, (Cambridge, MA: The MIT Press), 1989, 150-158.

In Defense of FDC Methods

FDC methods have gained wide acceptance in part because their weaknesses are not as substantial as they may seem at first. For example, the argument that the allocation of joint and common costs is arbitrary has a kernel of truth but is much overblown. The field of cost accounting addresses the assignment or allocation of costs, uses a variety of methods to allocate costs that can be termed as joint or common, and provides some principles for such allocations. Joint and common costs usually are attached to services indirectly by means of a factor that can be directly related to the service. This factor serves as a bridge between the joint and common costs and the service. Ideally, the factor chosen as the basis for the allocation will be related logically to both the joint and common costs and the service. It is within this framework that the class of allocation methods are chosen. Cost accounting texts discuss a variety of ways to accomplish this task. Simply because FDC methods allow for choices, judgements and decisions in allocation factors do not mean that the factors are arbitrary, particularly when an established body of thought exists on the subject that is widely used throughout the business community.

A weakness of FDC methods that economists emphasize is that price is not equal to marginal cost and, consequently, is not economically efficient. Unfortunately, price will equal marginal cost in only one instance--the perfectly competitive model. As we all know, the perfectly competitive model is a theoretical construct with no corollary in the economy of the real world of business. The concept of marginal cost is useful in making informed decisions, but nowhere is price set equal to marginal cost. A profit-maximizing firm will equate marginal cost with marginal revenue to determine its profit-maximizing level of output. Price will always be set above marginal cost (except in the perfectly competitive model).

In an imperfect world where the economy in general cannot set prices equal to marginal cost (and as a practical matter prices cannot be set equal to marginal cost in telephony) absolute efficiency is an irrelevant argument. Setting price equal to average cost will come closer to economic efficiency than prices in most industries. As a theoretical matter, FDC methods do little violence to efficiency in an otherwise imperfect world. FDC methods often are criticized because they employ usage-

sensitive means to allocate joint and common costs. Since joint and common costs do not change with usage, economists consider their allocation by usage-sensitive means to be inefficient.

The allegation that FDC methods allocate joint and common cost on a usage-sensitive basis actually pertains only to specific FDC applications. FDC methods can recover joint and common costs through a fixed allocator.

Finally, the fact that FDC methods do not take demand factors into consideration can be fixed. If a regulatory body had sufficient faith in a set of demand studies, a repression adjustment could be made. A repression adjustment makes changes in newly established rates to take into account the elasticity of demand.

Marginal Cost

Detractors of FDC methods tend to advocate the use of marginal cost as the basis for pricing in telephony. Marginal cost is defined as the change in total cost resulting from a one-unit change in the level of output. According to microeconomic theory, setting price equal to marginal cost will result in an optimal allocation of productive resources. If price is set equal to marginal cost the appropriate amount of society's resources--neither little nor too much--will be used to satisfy consumers' wants and needs. Marginal-cost pricing methods place primary emphasis on this important function of prices.

Most economists will advise policy makers to set price equal to marginal cost. The reason pertains to allocative efficiency stated in the preceding paragraph. Their recommendation should not be adopted wholesale but neither should it be taken trivially.

The most important criticism of marginal-cost pricing in telephony is a practical one. Marginal cost tends to be below average cost for most services. Therefore, if price is equal to marginal cost the utility will sell each unit of service for less than it costs to provide the service. A loss will ensue. If the utility were a public enterprise, the loss could be made up with a lump sum tax--an efficient solution.

Regulated telephone companies typically are not public enterprises, however legislatures generally are loath to transfer public tax revenues to private for-profit businesses. Consequently, price must deviate from marginal cost for some or all services.[67] How this is done and the degree of deviation are, of course, the source of endless argument. Some advocate the inverse elasticity rule where the deviation from marginal cost is proportional to the inverse of the price elasticity of demand for each service. Others advocate residual pricing, which views the end-user as cost causer and is a prominent technique among telephone utilities. Responsibility for the shortfall is placed on basic exchange rates for residential and small business customers. Residential pricing also places all joint and common costs upon the basic exchange or POTS ratepayer, including most of the cost and risk of technological change.

Detractors of marginal-cost pricing say that prices are not equal to marginal cost and consequently, are not economically efficient anyway. In the end, marginal-cost pricing does not remove the judgmental task of adjusting some prices to cover joint and common costs.

Even though economists have advocated marginal-cost pricing in telephony for more than twenty-five years, it has made few inroads into public utility pricing. The primary reasons are the practical ones discussed above, not the theoretical ones. Two major hurdles must be overcome before marginal-cost pricing is instituted in telephony. First, if all prices were set at marginal cost, the firm would quickly go broke since marginal cost for all major telephone services is below average cost. Second, almost all methods of revenue reconciliation lead to price discrimination which puts the small customer at a disadvantage relative to the large customer.

A theoretical argument against the use of marginal cost is this: except in one circumstance, profit-maximizing firms in an unregulated market do not set price equal

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[67] Ramsey pricing or its special case, the inverse elasticity rule, is the preferred method to adjust prices among classes of services or products to enable a utility to earn its revenue requirement when marginal cost pricing is used. The use of the inverse elasticity rule has drawbacks from a regulatory perspective since it places the greatest burden on those classes of consumers who have the fewest options and the greatest need. For a description of Ramsey pricing see William J. Baumol, and David F. Bradford, "Optimal Departures from Marginal Cost Pricing," *The American Economic Review*, LX, no. 3 (June, 1970): 265-283.

to marginal cost but use marginal cost as a decision variable to maximize profits. The one circumstance where firms set price equal to marginal cost is in perfectly competitive markets, which probably don't exist. In all other markets, price is set above marginal cost. The degree to which price exceeds marginal cost is one method by which economists measure monopoly power. In the real world of finance, investors and managers are concerned about whether price is equal to or exceeds average costs. Marginal cost may be the decision variable but average cost is the performance variable. The relation of price to average cost determines the rate of profit.

We live in an imperfect world where markets are not perfectly competitive. Given this imperfection, price as a general rule deviates from marginal cost whether in the telephone industry or elsewhere. Regulators who set price equal to average cost most likely will move price closer to marginal cost in telephony than in most industries. The so-called efficiency losses caused by setting price equal to average cost instead of marginal cost will be minor. This is particularly true when considering that price must deviate from marginal cost anyway if the utility is to stay in business over the long term.

Long-Run Incremental Cost

No discussion of telephony cost methods would be adequate without mentioning long-run incremental cost (LRIC). LRIC is an operational adaptation of the economic concept of long-run marginal cost. Incremental costs are used instead of short-run or long-run marginal costs because as a general proposition marginal costs are not observable. A one-unit change in output for a large firm will change total cost by such a small amount that an accounting system cannot observe it.

Investments by firms also tend to be lumpy. Telephone companies, for instance purchase switching equipment in increments of 5,000 or 10,000-line capacities. Smaller increments are not available. LRIC can handle this lumpy investment that causes problems for other marginal cost methods.[68]

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[68] For a more complete discussion of this issue see Harold Hotelling, "The General Welfare in Relation to Problems of Taxation and of Railway and Utility Rates," *Econometrica*, July 1938, 242-269.

However, LRIC generally has not been accepted by regulatory bodies. There are a myriad of reasons for the lack of acceptance.

LRIC assumes that the future can be known with a high degree of certainty, which is, to say the least, an heroic assumption. The use of LRIC for current pricing decisions requires that the future be known with certainty.[69] The services which are to be offered must be known. Long-run projections of a number of economic and noneconomic events such as population, household formation, personal income, labor force participation, wage rates, technological development, interest rates, domestic and international business activity, inflation, and unemployment must be known. In addition, methods to estimate these variables must be agreed upon. To state that accurate long-run projections of these and other events is possible is indeed an act of heroism.

Neither Heros Nor Villains

Most policy makers are neither heros nor villains. Economists and others who may make projections and projections may be necessary to intelligently plan and implement functions of business and government, but economists generally claim no more than an ability to recognize trends and relative relationships. Few, if any, claim an ability to establish an actual set of accurate long-run prices.

Also, let's assume for the moment that telecommunications costs for various services can be known ten years into the future. The question then must be asked whether or not it is appropriate to impose future costs or revenues upon current income statements or balance sheets.

Moreover, there is no necessary relationship between long-run and short-run variables. A price based upon LRIC may be above or below short-run incremental costs or fully distributed costs. Prices based upon long-run incremental cost may allow the firm to earn excessive monopoly profits based upon current books and

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[69] Perfect knowledge of the future may be avoided by creating an optimal system such as Gabel and Kennet did in *Estimating The Cost Structure of the Local Telephone Exchange Network.* It still will present the problem of underearnings, and the problem of allocation of joint and common cost still will be present.

records. It may allow the firm to price predatorially, or the firm may not be able to cover even short-run marginal cost based upon current books and records. This can be a particularly vexing problem in a declining cost industry.[70]

LRIC does not escape the problem of allocations. Even in the long run, multiple products can be produced from the same plant. Although all costs are variable, some method must be devised to allocate or assign joint costs and common costs.

The Stand-Alone Cost Method

One other telephony method is the stand-alone cost method developed by Gabel, Melody, Warnek and Mihuc.[71] The method was derived from one used by the Tennessee Valley Authority to allocate the joint cost of water projects which served multiple purposes such as power production, recreation, navigation and flood control. The concept is elementary: constructing a dam that serves multiple purposes is less expensive than separate dams for each purpose. Glaesar also invokes a principle that he terms "alternative cost avoidance" which is a measure of each activity's participation in common expenditures or investments. The method allocates the economies of scale or scope based on the cost savings each service realizes from joint production.[72]

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[70] To confuse matters further, LRIC, as used by the former Bell operating companies, is not actually a long-run cost study. It can be viewed more as a replacement cost study. It uses a mix of current and embedded technology. The choice of the mix appears to be arbitrary and seems to vary from service to service.

[71] Richard Gabel, et. al., "The Allocation of Local Exchange Plant Investment to the Common Exchange and Toll Services on the Basis of Equalized Relative Cost Benefits," prepared for the Kansas Corporation Commission, May 23, 1983.

[72] Martin G. Glaeser, "Those Joint TVA Costs," *Public Utilities Fortnightly* (August 31, 1939). For a game-theoretic approach see Gerald R. Faulhaber, "Gross-Subsidization: Pricing in Public Enterprise," *American Economic Review*, 65 1975: 966-977; Michael L. Goetz, "Cost Allocation Techniques and Pricing Alternatives: Crossing the Great Divide," in *Perspectives on the Telephone Industry: The Challenge for the Future,* (New York: Harper & Row Publishers), 1989.

Although the stand-alone cost concept is straightforward, its execution is not when applied to telephony. The method requires a knowledge of systems and system costs that do not exist. In other words, a hypothetical system must be engineered and its costs estimated. For example, a long-distance system would need to be reconstructed without the existing local exchange system. Lisa Chalstrom, a telecommunications economist for the Iowa Utilities Board, also points out that the stand-alone approach should be used only to allocate costs among major service categories such as local, long distance, and private-line services.[73]

And the Winner Is...

None of these methods is simultaneously theoretically satisfying and practically applicable. As a consequence, the regulatory community has chosen the least abrasive avenue, much as the FCC did in Docket 18128 when it said[74]

> It is recognized that although not ideal, these two methods (FDC method 1 and 7) can provide a valuable guide for determining the justness and reasonableness of present and past return levels and relationships at issue herein. The results of analysis of return on investment in accordance with FDC methods 1 and 7 provide a 'zone of reasonableness' which enables us to evaluate the lawfulness of Bell's return levels. Although not necessarily perfect, these methodologies together are sufficient to identify cross-subsidization and provide carrier accountability.

An alternative cost allocation method discussed by Alfred Marshall in *Principles of Economics* is available.[75] It has not been widely applied in the regulated utilities arena, particularly in telecommunications.

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[73] Lisa Chalstrom, "Cost Allocations for Regulated Telephone Companies," *Third Annual Western Conference of the Advanced Workshop in Regulation and Public Utility Economics*, July 1990.

[74] FCC, *In the Matter of American Telephone and Telegraph Company*, Docket 18128, 89.

[75] Alfred Marshall, *Principles of Economics*, 8th Ed., (London: MacMillan), 1927. For other applications of the concept see: Alfred E. Kahn, *The Economics of Regulation*, vol. I, (New York, NY: John Wiley and Sons, Inc.), 79-86; Mary Jean Bowman, and George Leland Bach, *Economic Analysis and Public Policy*, (New York: Prentice-Hall), 1943.

The Problem of NTS Costs

As mentioned, the bulk of telecommunications costs are fixed and are often referred to as nontraffic-sensitive (NTS) costs. NTS costs are a major problem with FDC methods since they must be allocated by some method. As stated earlier, no agreed-upon reasonable, rational, or logical method is available to allocate these costs. While this statement generally is correct when applied to FDC methods, it is not universally correct.

Besides being fixed costs, NTS costs also include joint and common costs, which are not the same even though they are inexorably conjoined in telephony and are treated the same.

Common costs are synonymous with overhead costs, which are incurred in the provision of two or more services that do not change as the output of either or both services changes. The classic example is the cost of the Chief Executive Officer's desk.

Economists and others have no particular generally accepted method to allocate common costs. Allocation may not be arbitrary and capricious but never is it exact and sure.

Joint cost, however, can be allocated reasonably and rationally using the joint-products method discussed by Marshall. Joint costs arise from joint production, which occurs when two or more goods are produced from the same investment. It differs from common costs in that the investment is used directly in the production process. The classic example is the production of mutton and wool from sheep as discussed by Alfred Marshall.[76] Marshall defined joint products as things that cannot easily be produced separately but are joined in a common origin. By producing wool, mutton also is produced. So long as each product has a market value, each will be produced, but only according to the strength of its demand.

Marshall used the example of imported Australian wool as driving down the price of wool in England. The importation of foreign wool caused English sheep growers to develop heavier sheep with better meat at an early age at the expense of

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[76] Marshall, *Principles of Economics*, 388-390.

some deterioration of their wool. The business person needed to know the costs attributable to these joint products to ascertain the amount of each to produce. Marshall advised that:[77]

> when it is possible to modify the proportions of these products, we can ascertain what part of the whole expense of the process of production would be saved, by so modifying these proportions as slightly affecting the amounts of the others. That part of the expense is the expense of production of the marginal element of that product; it is the supply price of which we are in search.

Marshall provides a rational basis to establish cost and price under conditions where joint products are made in variable proportions. A less ghoulish but nonetheless illustrative example of costing and pricing using the joint products method is local exchange service and long-distance service produced from the local loop. A conceptual analysis of the joint products method using local exchange and long distance telephone service begins with the idea that the price of customer access (local loop) is not the relevant consideration. The demand and the price (cost) of each of the components of customer access, local calls, and toll calls are the relevant factors. Thus, if we begin with separate demands from local and toll calls, we can sum the two demand curves to obtain the demand for access. Moreover, for any given quantity of access there exists a marginal price for local calls and a marginal price for toll calls that consumers are willing and able to pay, which add up to total demand for access.

Price is determined by the interplay of supply and demand with the caveats that the firm must recover its total cost of production and that a product will not be produced unless it earns a price equal to or above its marginal cost. It is clear in this analysis that joint products are related in terms of demand as well as costs.

Figure 1 shows a simple diagrammatical presentation of the joint products concept using local calls and toll calls. The demand for local calls and toll calls is given as D/Local Calls and D/Toll Calls, respectively. The marginal cost of local calls land toll calls is MC/Local Calls and MC/Toll Calls, respectively. A price equal

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[77] Ibid., 390.

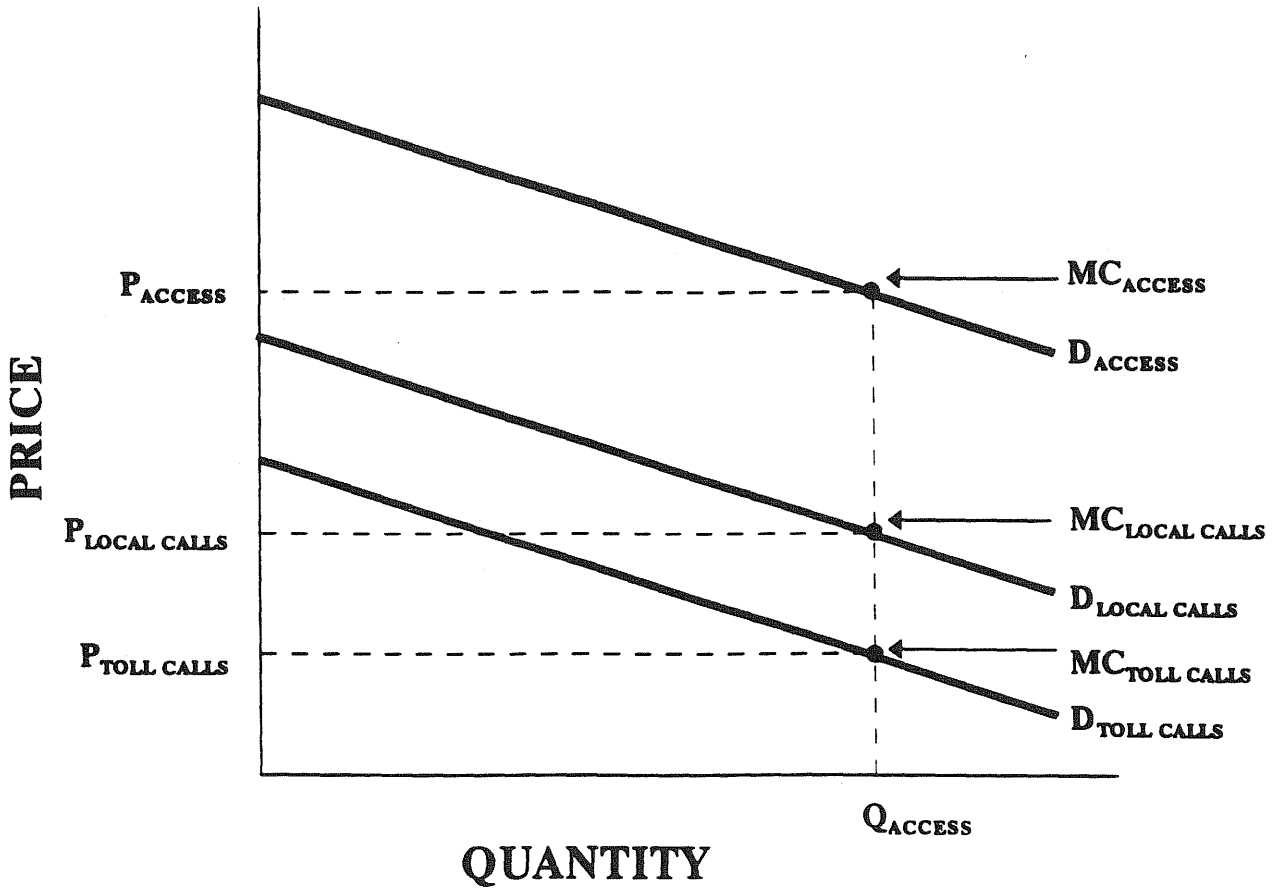


Figure 1. Joint Production

to the marginal cost of local calls and the marginal cost of toll calls will not yield sufficient revenues to cover the total cost of the firm. Consequently, the price for both local calls and toll calls must include sufficient revenues to cover their joint cost (customer access). This is accomplished by proportionally adding the cost of customer access to the marginal cost of each service, local calls, and toll calls. This allows the firm to recover its total cost of production, thereby allowing it to continue in business, based upon the marginal cost of each of its joint products.[78]

Real World Solutions

The move from a conceptual framework to practical application is fraught with difficulty. The world we live in is not as clean as our theoretical world. First, cost-of-service studies usually set a revenue requirement for each service. They do not set a per-unit price based on a per-unit cost as defined by theory. Second, accounting and engineering data are not kept in a form that will allow the necessary calculations of marginal cost for each of the numerous categories of service.[79]

Given these difficulties, principle must be balanced with practicality. The theory of joint products cannot be precisely applied to the telecommunications access market if the traditional service-by-service revenue requirement is used. However, a reasonable approximation can be made with some modest assumptions[80]

A typical cost study as performed by a former Bell operating company will be used to illustrate the application of the joint products method. The cost study is called the Revenue Cost Analysis Study (RCAS). The RCAS model was developed

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[78] Those familiar with the joint-products concept will notice a deviation from the traditional presentation. Normally, price is determined by the quantity where marginal cost equals marginal revenue. This will allow the firm to earn a normal profit plus whatever monopoly profits the market will bear. Since the assumption is a regulated industry where only a normal profit is allowed, marginal cost is equated with demand to eliminate any monopoly profits.

[79] If reliable marginal cost data are available, they should be used. Otherwise, a cruder calculation such as that herein described will need to be adopted.

[80] Bridger M. Mitchell, *Incremental Cost of Telephone Access and Local Use,* (Santa Monica, CA: The Rand Corp.), 1990, 1-16.

by US West and the staff of the Colorado Public Utilities Commission. It was a refinement of the old Embedded Direct Cost method used by the Bell system in the late 1970s and early 1980s. RCAS was refined further by US West into a cost study that was purported to be an incremental cost study.

As presented in Table 1, RCAS can be used to illustrate the practical application of the joint products concept. First, let's assume that the direct cost of a product is a reasonable approximation of marginal cost and that the marginal cost to provide customer access is proportional to the direct cost of local usage, state LATA toll use, state carrier switched access and interstate carrier switched access.

TABLE I
ILLUSTRATIVE
REVENUE COST ANALYSIS STUDY (RCAS)
NON-PROPRIETARY DATA FROM A LEC
$(Millions)

| CATEGORY | COSTS |
|---|---|
| Customer Access | $438.41 |
| Local Usage | 132.26 |
| State LATA Toll Use | 48.12 |
| Interstate LATA Toll Use | 3.05 |
| State LATA Chan Services | 58.46 |
| Interstate Chan Services | 0.72 |
| State Carrier Access | |
| Switched | 10.48 |
| Dedicated | 3.81 |
| Billing | 2.54 |
| Interstate Carrier Access | |
| Switched | 76.69 |
| Dedicated | 31.51 |
| Billing | 12.37 |
| Miscellaneous | 3.78 |
| Inside Wire | 65.07 |
| LATA Operator Services | 31.93 |
| Supplemental Services | 28.82 |
| Other Services | 8.56 |
| Contract Services | 7.67 |
| Common to Firm | 105.67 |

Next, let's assume that each of these services are the relevant demands for customer access.

Thus, joint costs will consist of Customer Access, $438.41, which make up over 40 percent of the utility's total revenue requirement and must be allocated to the services that use the joint investment. The categories of services that share the joint investment are local service, intraLATA toll, interLATA toll, and interstate toll.[81] Assuming that marginal cost is proportional with direct cost, the applicable marginal costs are basic exchange, $132.26; intraLATA toll, $48.12; interLATA toll, $10.48; and interstate toll, $76.69. Under this scenario, we can determine an overall and service-specific revenue requirement that will enable the calculation of a price for each market component of customer access.

Table 2 shows the direct cost of the various network switched services. The direct cost of each category is summed. The proportion that each category makes up of the total direct cost for the four categories is calculated. For example, basic exchange makes up 49.43 percent of the sum of the direct costs of basic exchange, intraLATA toll, interLATA toll and interstate toll. Thus, 49.43 percent of customer access (the joint costs), $438.41, needs to be added to basic exchange direct cost to determine the basic exchange service revenue requirement. Using the joint-products method, the basic exchange revenue requirement would be $348.97 [$132+($438.41)0.4943]. The revenue requirement for intraLATA toll is $126.99 [$48.12+($438.41)0.1799]. The revenue requirement for interLATA toll and interstate toll is respectively $27.67 [$10.48+($438.41)0.0392] and $202.34 [$76.69+($438.41)0.2866]. The total joint products revenue requirement is $705.97, which is 66 percent of the total revenue requirement in this example.

The revenue requirements for access are based upon generally accepted economic principles of joint production. Customer access using these principles is the sum of submarkets for various services that use access. Prices subsequently charged

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[81] Some may argue that other services such as contract services, LATA operator services, billing and others also use the joint investment. They may in fact be correct in which case they would have to be included in the allocation of the joint cost. However, in this illustration the assumption is that only four services (basic exchange, intraLATA toll, interLATA toll and interstate toll) use the joint investment.

TABLE 2
APPLICATION OF JOINT PRODUCTS TO RCAS
$(Millions)

| CATEGORY | SERVICE SPECIFIC DIRECT COST | SERVICE AS A PERCENT OF TOTAL DIRECT COST | JOINT COST ATTRIBUTED TO EACH SERVICE | SERVICE SPECIFIC REVENUE REQUIREMENT |
|---|---|---|---|---|
| Basic Exchange | $132.26 | 49.43% | $216.71 | $348.97 |
| IntraLATA Toll | 48.12 | 17.99 | 78.87 | 126.99 |
| InterLATA Toll | 10.48 | 3.92 | 17.19 | 27.67 |
| Interstate Toll | 76.69 | 28.66 | 125.65 | 202.34 |
| Total Customer Access | $367.55 | 100.00% | $438.41 | $705.97 |

for customer access are based upon consideration of demand and marginal cost. The joint-products concept takes into account economic efficiency and, to some extent, equity. The role of judgement in the allocation process is severely reduced because a specific formula based upon existing direct costs is used to determine the revenue requirement for a service and consequently, its price. Also, the data are those commonly kept by telephone utilities.

The method has an additional strong point. The sum of the individual revenue requirements exhaust the total revenue requirement of the utility. Many of the methods proposed by telephone companies do not have this trait. The sum of the revenue requirements of the individual services does not sum to the total revenue requirement of the utility. Under these circumstances, an arbitrary allocation must be made if the utility is earn its allowed rate of return or perhaps, even continue in business.

The joint products method is intuitively compatible with our POTS definition. Under this definition, the utility provides basic telecommunications services through its common carriage function. Customers want access to that market to consume the services offered. The customers may be residential, small businesses, large businesses, long-distance carriers, information service providers, enhanced service providers, and

others. Each has needs to be satisfied, for example a long-distance carrier or information service provider that needs to be connected with a residential consumer without which its services could not be sold. Or it may be a residential customer that needs to be connected with the local school system or vice versa. Each user requires certain individual investments and generates certain individual costs. Each user utilizes certain joint investments without which the communication could not take place. The joint products method recognizes both the individual cost and the joint and common costs to all parties.

Costing/Pricing Methods for New POTS

Ordinarily we think of POTS as encompassing established existing services. Yet, this may not always be the case. Policy makers at some time may want to incorporate a new service or repackage existing services into POTS. The reasons for such action may vary, but whatever the reason, the costing methods discussed in this report are likely to work poorly. Why this is so pertains to new product marketing.

Often, in the early stages of product marketing the product cannot sustain a cost-based price such as an FDC-based price. One explanation for this is that the product may exhibit economies of scale. As output increases, cost and (consequently) price decrease. At the early stages of output, an FDC price may be too high to stimulate demand. In other words, people will not buy the product until the price is lower, which creates a Catch-22. For the price to be lower, a greater quantity must be sold, but to sell a greater quantity, the price must be lower. Thus, FDC methods may prohibit a new service from getting off the ground.

A second reason that FDC methods may not work well with a new service offering is that firms often use promotional rates to introduce a new product. Such rates are used to overcome consumer resistance, foster product acceptance, and achieve a noticeable market penetration.[82] If the service is regulated, promotional rates usually will be below FDC rates, making the FDC rates inappropriate to introduce a new product.

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[82] Richard P. Bagozzi, *Principles of Marketing Management*, (Chicago, IL: Science Research Associates, Inc.) 1986, 550-551.

Stand-alone rates do not have the same failings as FDC rates when it comes to the introducing a new product. Stand-alone rates are based on a hypothetical stand-alone system and a sharing of the savings of a multiple product production function. Also, rates can be set under the assumption of full-blown production and therefore would reflect any economies of scale and scope.

However, the first obvious criticism of the stand-alone approach is that rates are based upon a hypothetical system. Who knows whether the hypothetical system accurately represents costs? A second criticism is that the method is not useful for highly disaggregated services. A new service offering within the class of residential basic exchange service probably would overtax its capabilities.

In addition, the stand-alone method, as with FDC methods, will not set rates that could be considered promotional.

Many telephony analysts argue that marginal-cost pricing should be used, particularly when introducing a new product. Some argue for the use of short-run marginal cost and others for long-run marginal cost. The argument does have one major advantage in telephony: price will be lower with marginal-cost pricing, whether short-run or long-run, than FDC pricing when marginal cost is below average cost. Even so, marginal-cost pricing may not be the panacea for pricing of new products that its advocates believe it to be.

The reason is that economists usually think of marginal cost as downward sloping when economies of scale are present. The same problem may exist with marginal-cost pricing as with FDC costing/pricing methods. In the early stages of production a price equal to marginal cost may be too high to stimulate sufficient demand to make the product successful.

The problem is less likely to occur with marginal-cost pricing than with FDC pricing methods, yet nonetheless is a potential problem. This leaves the major advantage of marginal-cost pricing in the introduction of a new product to be that it potentially gets the price down to that of its FDC brother.

The joint-products method is saddled with the same problems as FDC methods in the pricing of a new product. Like FDC methods, the joint product method will cover all costs. It also will follow the utility's cost curve. Consequently, at lower

levels of production, the cost is likely to be greater than at higher levels of production. A joint-products-based price may be too high at low levels of production to stimulate sufficient demand to make the product successful.

The Solution--A Marketing Plan

The problem of pricing new product is soluble, however. Moreover, the solution can be applied to new services other than POTS and it can utilize existing price methods. Here's how it can work. Any new product should have a marketing plan, which should include expected penetration rates at various prices and the length of time required to achieve those rates. It also should include cost estimates for various levels of production. The marketing plan can form the basis for regulatory pricing and treatment of a new service.

If regulators should decide to allow the introduction of a new addition to POTS, a marketing plan should be submitted by the local exchange carrier. Regulators should require that the local exchange carrier stick closely to the approved marketing plan.

Policy makers should have a timeline for product acceptance, market penetration, and promotional activity. The marketing plan should have a definite end date. If the plan is to extend beyond a one-year timeframe, it should be reviewed annually to determine its status and whether it should be continued. The plan should be reviewed to determine if there is sufficient product acceptance for the service to be considered POTS. Also, a one-year time period should be sufficient to review new services for product acceptance.

The level of penetration is quite important. Policy makers should predetermine a level of penetration for any newly added POTS, and the service should reach the predetermined level within the timeframes proscribed by the marketing plan.

The marketing plan should include an estimate of the cost to provide the service based upon the cost method proscribed by the regulatory body. The estimated cost should reflect the anticipated level of penetration and then can form the basis for the promotional or marketing plan price. Price may be set at the estimated cost or

discounted from the estimated cost if further promotional pricing is considered necessary.[83]

Periodic reports should be submitted showing penetration levels and actual cost, based upon the regulatory body's approved cost method. At the end of the marketing plan a determination should be made as to whether its objectives were met. If the objectives were met, the service should be included into POTS and priced according to the method generally used by the regulatory body.

The Distribution of Risk and New POTS

A major point with new services, whether included in POTS or other regulated services, is the distribution of risk. The risk of new services should be shouldered by stockholders not ratepayers. After all, stockholders earn a return on their investment which is above the risk-free level. A very low risk return would be the rate of inflation plus 3 percent, the so-called natural rate of interest.

The allowed return on equity generally is 50 to 100 percent greater than the natural rate of interest. The addition to the natural rate of interest includes a number of risks.[84] Among those additional risks is the risk as well as the reward for the introduction of new services, whether the services are placed in POTS or some other category. To shift the risk of a new product from equity holders to ratepayers without a compensatory reduction in allowed return is an unfair redistribution of risk and income. The marketing plan avoids such redistribution while allowing the utility to introduce new services.

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[83] As a precautionary measure, policy makers may want to compare the marketing plan price to the marginal cost of the service. The reason is to ensure that the promotional price is above marginal cost. A price below short-run marginal cost could be considered predatory and subject to antitrust action.

[84] Included in those risks, among other things, are the position of equity holders relative to bond holders and other creditors and the general risk of business failure.