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Examining telecommunication industry efficiencies in light of regulatory reform

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Examining Telecommunication Industry Efficiencies In Light Of Regulatory Reform

by

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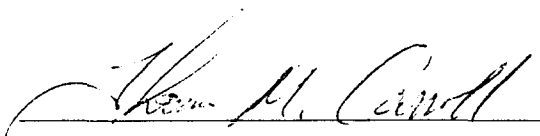

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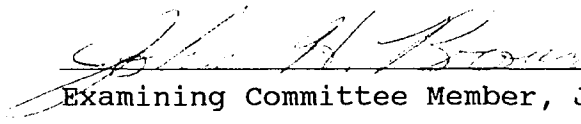

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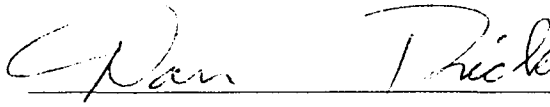

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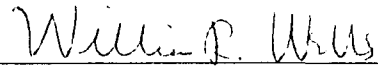

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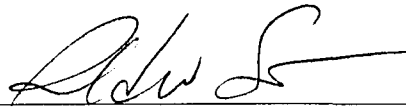

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ABSTRACT

This Thesis examines Telecommunications Industry efficiencies in the face of recent regulatory reforms.

Regulation was believed to be required because of the telecommunications industry's apparent natural monopoly. The promise of regulation was to act as a surrogate to competition in controlling the monopolist. Regulation should require the monopolist to operate as close to a competitive marginal cost as possible. With effective regulation, the consumer would then expect to be paying as low a price as possible for the service provided by the regulated monopolist.

Aside from commendable technological and systems improvements by the telephone companies, no significant improvement in operating efficiency would be expected with rate of return regulation reform.

Included in this discussion of telecommunication industry regulation is an event analysis of the trend of the employee per access line efficiency correlated with the announcement of regulatory reforms. A significant relationship is demonstrated.

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ACKNOWLEDGMENTS

It is with a great deal of appreciation that I wish to extend my thanks and appreciation for the hard work and support offered to me by Connie Dike in the preparation of this thesis. Also, my thanks to Aida Herrera in her typing assistance that was provided for this thesis.

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Most notably, however, extreme appreciation is extended to my wife Carol A. Flood for her continued support and encouragement in the completion of this sometimes arduous task.

Chapter 1

Introduction

Considerable debate has been raging over the telecommunications policy for the United States. Three significant issues are in the forefront. They include cross-subsidies, technological change, and regulation reform.

Since the deregulation of the long distance market took place in 1984, significant technological change has continued in the industry. Additional market niches of the telecommunications industry are exposed to competitive entry.

The Federal Communications Commission has adopted a pro-competitive stance permitting competitive exploitation of those market niches. Regulatory reform has been suggested to enable the industry to react to the evolutionary changes. This reform contains built-in incentives to encourage the regulated monopolist to react to the changing environment. Incentives attempt to simulate a competitive environment for the telecommunications manager.

The promise of one regulated firm delivering all telecommunication services had a certain amount of appeal for the Progressive movement of the early 1900's. One firm

should deliver telephone services for the least cost. With the recent competitive challenges in this industry, it is not clear that regulation has maintained the least cost across all services. Where there are examples of prices higher than competitive prices, cream skimming has continued through out the telecommunications industry.

The issue of real cost of service has been an ever pervasive problem. While there is evidence of competition in various sectors of the telecommunications industry, there is still a strong contention that the residential telecommunications market is a natural monopoly. Because of the economies of scale, it is unlikely that competition would be available to provide a market control mechanism for pricing in the residential sector.

As technology has continued to develop, the medium no longer restricts the provision of telecommunication services. Copper cable technology, as the only alternative for delivering telecommunication services, is now being replaced with fiber, wireless and coax technologies. These technologies are owned and utilized by other than telecommunications companies.

In recent years, the cable television industry has penetrated a significant portion of the marketplace in this country with their television services. Because of their fiber optic and coax networks, an alternative path for

delivery of residential telecommunication services now exists.

Additionally, cellular wireless telecommunication services have enjoyed a significant boom in recent years. Cellular wireless has achieved significant penetration in all the major markets in this country.

These additional delivery mechanisms for telecommunication services now available, notably the development of fiber optics, has also provided additional avenues for delivery of services. The placing of conduit systems and access ways to the customer is a crucial cost item for telecommunications. Existing infrastructures for other utilities have now, because of fiber optic technology, become a candidate for supporting the delivery of telecommunication services.

Because of the unobtrusive nature of fiber optics, fiber optic cables can be placed in power easements, gas easements and conduit systems without conflict. This opens up additional pathways for the delivery of telecommunication services. With this turn of events, it is doubtful that even the residential telecommunications market can remain a natural monopoly. The residential market, because of economies of scale, is considered the last possibility for competitive activity for telephone service.

Regulatory reform and price cap alternatives have been suggested as mechanisms, whereby responsible pricing can be

affected to all users of the telecommunication industry. The recently enacted FCC Price Cap Policy allows a telephone company to earn more than the allowed rate of return for interstate jurisdiction services, provided that it agrees to a maximum pricing constraint. Determining actual costs for the provision of services is one of the bigger problems of regulation. The complexity of both the technologies and the services provided in the telecommunications industry, have contributed to the problems for regulation.

In the midst of these trying times, a study of the behavior of telephone industry management would be helpful for policy makers. Does management react to regulatory changes? To assess that, I analyzed the output efficiency of the telecommunications industry. One might suspect that technology and improved systems of operations make improvements in output efficiency. If, however, improvements are demonstrated because of changes in regulatory policy, and not explainable by changes in technology, another improvement possibility exists. The other possibility could be that certain management discretion exists in the present structure that has not been optimized by the regulatory system. This management discretion would be the issue that rate of return regulation has been unable to address and the reason to investigate alternatives.

The rate of growth of output efficiencies was analyzed to provide evidence of efficiencies not adopted by telephone management until regulatory reforms are initiated. A timing correlation of efficiency improvements, with those periods of important rate regulation reform, supports the hypothesis here.

CHAPTER 2

LITERARY REVIEW

I direct your attention to my study entitled "Literary Review on the Subject of Economic Regulation of the Telecommunication Industry", dated May, 1993. Supportive information, appropriate to the issues of this study is cited.

The literary review has been categorized into several sections that are noteworthy for our purposes.

The first section discusses the theory of monopoly and natural monopoly. The cost function of a natural monopoly is everywhere subadditive. More clearly stated, costs are subadditive if a monopoly firm can produce a given output at a lower cost than what two or more firms can.[1] This would provide a basis for the belief that a natural monopoly telephone firm would have the lowest cost for its services. The prices for services of the telephone company would be sustainable based on its cost level.

Because of the complexity of the services provided in the telecommunications industry, an important issue in price sustainability has been that of rate design. Telephone

[1]W. W. Sharkey, The Theory of Natural Monopoly., (Cambridge: Cambridge University Press, 1982), 83.

companies provide multiple services using the same investment. A problem exists assigning the proper pricing of individual services with regard to the common cost and common facilities used to deliver all of the services.

Rate designs have been recommended by the industry that are based on the inverse elasticity rule or Ramsey Pricing. This discriminatory pricing plan would charge more profit margin on services with the low elasticity, e.g., basic services, and less profit margin on services with high elasticity, e.g. competitive services. This plan would provide the best basis for defense against competitive entry into the industry.[2]

Discriminatory pricing, or pricing of the same service at different rates for different customers, has never been politically popular in the regulation of telecommunications. Politically acceptable pricing of services has been a problem and a major contributor to unsustainability of many monopoly services. Subsidies for inelastic services such as basic residential services, have been provided from more elastic services such as long distance and business services. The pricing levels for subsidizing services created margins attracting competitive entry. For these unsustainable monopoly services, competition has the power

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[2]William J. Baumol et al., Contestable Markets and The Theory of Industry Structure (New York: Harcourt Brace Jovanovich, Inc., 1982), 224.

to provide the required constraints. Competition, however, would not provide all the answers for pricing consistent with the political agendas.[3] Rate design is an important matter facing the telephone industry.

The second section of the literary review continues with a discussion of the regulatory history. The Progressive movement's influence on regulation in this country, dating back to the early 1900's, has been very strong. It is important to understand that the business interest of the business leaders at the time, were just as influential in establishing regulation of certain industries as the motivation to protect the basic consumer.[4] Then, as well as now, businesses are interested in the benefits of regulation for their interests.

Regulatory constraint is covered in the Regulatory Policy section of the literary review. How to act as a proper competitive surrogate for the constraint of the monopolist, became the question.

Rate of return regulation was selected as the most viable vehicle for constraining the monopolist's activity in the telephone industry[5]. Rate of return regulation,

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[3]Baumol, 349.

[4]Otis L. Graham, Jr. The Great Campaigns: Reform and War in America, 1900-1928. (Englewood Cliffs: Prentice-Hall, 1971), 16.

[5]Michael A. Crew, The Economics of Public Utility Regulation. (Cambridge: MIT Press, 1986), 93-96.

however, showed significant shortcomings. Shortcomings are shown in the incentive to inflate the rate base and the lack of motivation to operate in the most efficient manner.[6]

In regulating the telecommunications industry, there are five major products that are addressed: 1)local access 2)local usage 3)inter-lata long distance services 4)long distance access 5)special services. The country was divided into regions for the purposes of differentiating long distance jurisdictions from local jurisdictions. This was accomplished with the deregulation of the long distance services. The regions were termed Local Areas of Transport Access, i.e. LATA. The FCC restricts the local exchange companies from providing inter-lata services.

Local access and usage are switched telephone services provided by the local exchange company to its residential and business end users. Long distance access is the switched service provide by the local exchange telephone company to the Long Distance Companies. The local company connects the end user to the long distance circuits. Special services are those non-switched dedicated circuit services provided by either the long distance or local telephone companies. Local access is viewed as a fixed cost service and local usage is a variable cost service based on distance and duration of calls. Inter-lata long distance

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[6]Crew, 120-134.

services and long distance access are considered variable cost services. Special Services are fixed cost services.

Given these varied amounts of services, regulation has created opportunities for gains by intervention of various agents. This is termed rent seeking. These rent seekers can be insiders within the telecommunications industry, employees of the firms, the regulatory commissions, outsiders, competitors, regulators, attorneys and lobbyists. The effects of this rent seeking activity are hidden from the regulatory process.[7]

Some of the movements that are experienced in the regulatory process are caused by rent seekers who desire to preserve their position or gain an advantage to their present rent seeking position. The interests of the various rent seekers in the regulatory process cause the politics of public utility regulation.

Regulation is not a precise science. The regulatory process reaches settlements by gaining concurrence between the regulating agencies, the regulated firms and other interested parties.[8] Resolutions are normally made by compromised stipulations. There is an opportunity in the

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[7]Crew, 263-268.

[8]Robert Britt Horwitz, The Irony of Regulatory Reform: the Deregulation of American Telecommunications. (New York: Oxford University Press, 1989), 124.-126.

regulatory process to deviate from the cost subadditivity precepts of a natural monopoly.

The next section, in the literary review, considers the regulatory commissions and the arduous task that regulatory agencies face.

Regulatory commissions are in a difficult position. Suspicious consumers view them as being captives of the firms that they are required to regulate.[9] Commissions are viewed by the regulated firms as a road-block to their ability to provide efficient services. The firms are ever resistant to the suggestions of micro-managing for the purposes of establishing precise costing information for the purposes of the regulatory process. Given the shortcomings of the rate of return regulation, incentive measures have been suggested to be employed by the regulatory commissions.[10] There is no clear consensus if those incentives should reward shareholders, managers or consumers.[11] The regulatory commissions appear to have no clear mandate or vehicle to address the regulatory problems.

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[9]Barry M. Mitnick, The Political Economy of Regulation: Creating, Designing, and Removing Regulatory Forms. (New York: Columbia University Press, 1980), 93-94.

[10]Kurt A. Strasser, Regulating Utilities with Management Incentives. (New York: Quorum Books, 1989), 1.

[11]Strasser, 106.

To understand the market of the telecommunications industry, a review of the next section discusses telecommunication history.

Curiously enough, the telecommunications industry was not born as a monopoly in the late 1800's. There were multiple telephone companies serving the same major market areas within the country. In 1907, American Bell company only commanded 49% of the market place. With the American Bell organization only making 8% on return in 1906, the company fell into the hands of the bankers of the J.P. Morgan, who reorganized it to American Telephone and Telegraph. Theodore Vail became the new Chairman of AT&T. He established a strategy to gain control of the available technology and accommodate any regulatory pressure on the telecommunication industry. Vail agreed to submit to price, service and rate return regulation. In return, Vail expected entry restrictions in the telecommunications industry and a guarantee of a fair rate of return.[12]

Throughout the history of the telecommunication industries, competitive challenges were continually made on the fringe markets of the industry. The telecommunications industry natural monopoly status has been repeatedly tested as technology presents new opportunities. The tests have

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[12]Gerald R. Faulhaber, Telecommunications in Turmoil: Technology and Public Policy (Cambridge: Ballinger Pub. Co., 1987), 2.

come from the development of private point to point radio systems, private telephone switching equipment and private fiber optic systems.

The next section cites the telecommunication policy issues that have been continuing throughout the regulatory process. Because of the fragmented nature of policy decisions in the United States regulatory environment, telecommunication policy has not necessarily been a consistent and standard thread through our economic history. The initial telecommunication policy, articulated by the Communications Act of 1934, was a provision of universal service for the country.[13] Since the late 1980's, more than 95% of all households in the country have telecommunication services. The universal service goal has virtually been met. The major policy issue for the country has changed. The new challenge will be to determine the best way telecommunication services can be provided for the future.

The issues that I have highlighted are as follows: 1)Inter-service cost subsidies complicate the natural monopoly precept of lowest cost for services in the multiproduct telecommunications industry. The lack of price sustainability of some services has allowed competitive entry, because of cross-subsidies. 2)Rate design has been the area of discussion about the solutions to price

[13]Walter G. Bolter et al., Telecommunications Policy for the 1990s and Beyond (Armonk: M.E. Sharpe, 1990), 81.

sustainability. 3)Telephone firms and other rent seekers have moved to benefit from the regulatory process.

The tough job of the imprecise regulatory process is seeking concurrence. The process has evolved to an era of incentive programs. These incentive programs, like telephone regulations, have been fragmented because of the many regulatory jurisdictions in this country. These issues serve as a platform to outline the model for this thesis.

CHAPTER 3

THEORETICAL MODEL

How responsive is telephone management to regulatory reform? Is there planning or implementation lags in their responses, or are their immediate actions that are evident? The management of a regulated telephone company deals with many constraints. Besides the typical business constraints, the regulatory constraint is a big factor to this industry.

The management of the telephone company is a very complex endeavor. Market factors, production factors, financial factors and economic factors are examples of influences on management. To explore my issue, I will deal with a small portion of the influences on the industry.

Federal Communication Commission Policy is a common regulatory factor with the twelve largest telephone companies. Telephone companies have state regulations that are important influences as well. The most desirable study would be to look at each company's action, while considering its unique state and federal regulatory environment. Most of the twelve largest telephone companies, representing 94% of the local telephone service in the country, serve in multiple states. Unfortunately, only expense data is available for the individual states, not employee data. Of

the expense data available, some of the expense is direct and some is allocated from sister operations and/or parent operations. Individual state data poses a problem of questionable usability.

Since I was unable to find company employee detail by state, each company was contacted to request the information. Most refused to supply the information because it was considered proprietary. For the companies that were willing to work with me, confusion developed on how to apportion shared employee resources. Restructuring and reorganization between the states during the period of study also contributed to this quandary. This search for viable data revealed that the best data would be company wide data, that is publicly reported with consistent meaning through the study period.

The behavior of the telecommunications manager is our focus. The profit optimizing manager would choose a course of action based on the regulatory constraints at the time. Even though the regulatory process desires to move the firm to a competitive marginal cost for the pricing of regulated services, there remains managerial discretion in the expenses of an operation. The amount of managerial discretion, due to imprecise information, is not available for review in the regulatory process. The existence of this discretionary margin may be shown, if management improves efficiency at some trigger point independent of any

technology or system improvements. Technology and system improvements take preparation and lead time that would lag any one trigger point. Personnel levels would be a resource that could be readily adjusted. A review of the total company data and federal regulatory reform would be appropriate to test for discretionary margin.

The theoretical model for this study is a review of the rate of growth of local exchange telecommunication companies' output efficiencies. With the divestiture of the regional Bell operating companies from AT&T in 1984, data became available for the individual local exchange telephone companies.

There are three market sectors to the local telephone company: 1)business services 2)residential services 3)access services. Access services are those services provided to the long distance telephone companies that connect to them. They provide access to the local business and residential customers by way of that connection.

Since 1985, operations information is available for the regional Bell operating companies and the other independent telephone companies. The employees, divided by the number of telephone service lines in billing, will be used as a measure of efficiency. The resulting index would be analyzed over the time period from 1985 to 1991. Over that period, the rate of change in efficiency will be analyzed to determine if any impacts of the various regulatory actions

in the industry occurred. The theoretical model can be expressed as follows:

$$\text{Employees/Access Line} = \text{Company}_i^{\gamma i} * \text{Ydummy}^{\delta} * e^{\beta \text{Trend}} .$$

The Company variable is set to a value of e at the observation of the company in question, or 1 if not.

The Ydummy variable is set to a value of e if it is year of regulatory action, or 1 if not. To test the one year effect, the dummy variable is triggered on for the represented year and then triggered off for all other years. To determine lasting effect the dummy variable is triggered on and left on after the represented year.

Along with the review of the local exchange telephone companies, the index of output per hour for all employees is analyzed. The index represents the total telephone industry for the 1980's, using 1977 as a base index of 100. The theoretical model can be expressed as follows:

$$\text{Index} = \alpha * \text{Ydummy}^{\delta} * e^{\beta \text{Trend}} .$$

In chapter 4 all parameters are discussed, as linear transformations are done for estimation purposes.

To assess the model the following assumptions of telecommunications industry are provided. During the 1980's, there were no extraordinary changes in

telecommunication technologies. Digital switching technologies were introduced in the late 1970's. Fiber optic technology was delivered in the early 1980's.

A gradual improvement trend was pervasive in the 1980's. Administrative system efficiencies experienced steady, but no dramatic improvements in any particular year during this period. It was appropriate to expect that the growth rate in efficiency would be stable through the 1980's.

The two major regulatory activities that occurred in telecommunications in the 1980's, would be long distance service deregulation and price cap regulation.

CHAPTER 4

THE DATA AND EMPIRICAL MODEL

To give the reader an appreciation of the data that have been collected, the following is presented for review. These data show the improvement that has been experienced in employees per access line for the average local telephone company and various telecommunications companies that were reviewed. It should be noted that an improvement in this context is a decline in employees per access line. The objective is a lower number of employees. The employee data are a proxy for cost. With reduced employees come reduced cost.

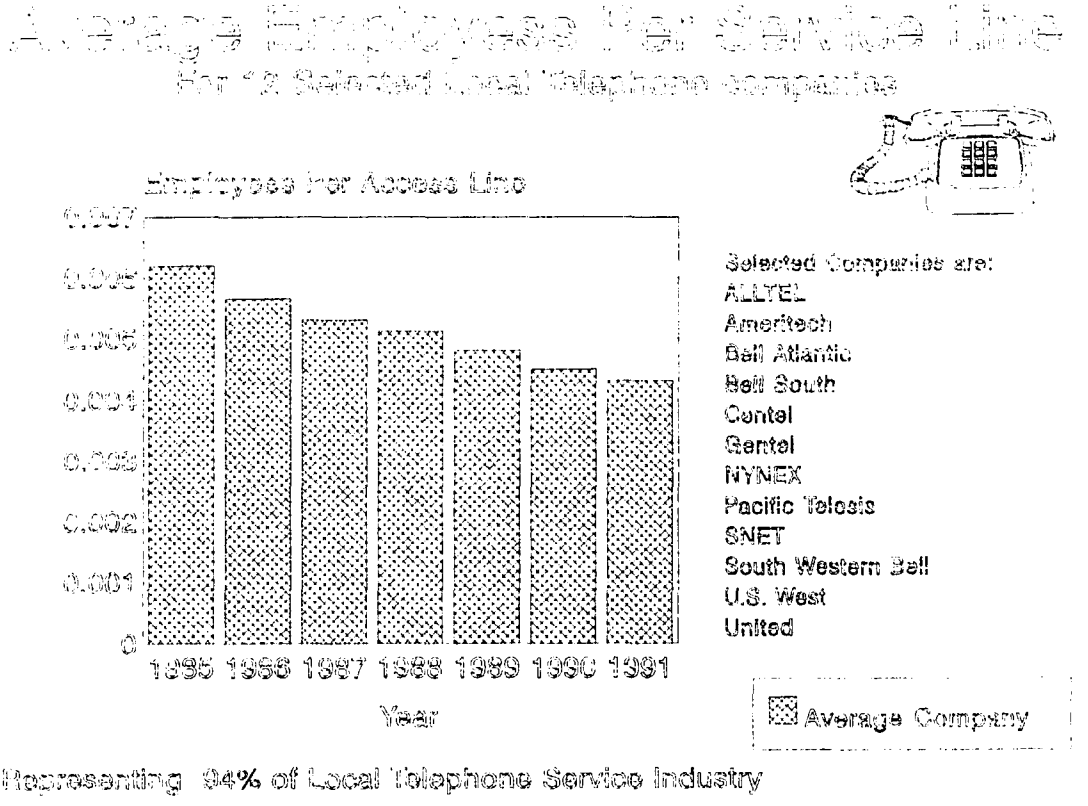

Figure 1 Average Employees Per Service Line (From United States Telephone Association PhoneFacts, 1985 - 1991)

This graph presents the average company efficiency. It would be helpful to look at the variety of results by company. The following three graphs depict the individual company indexes.

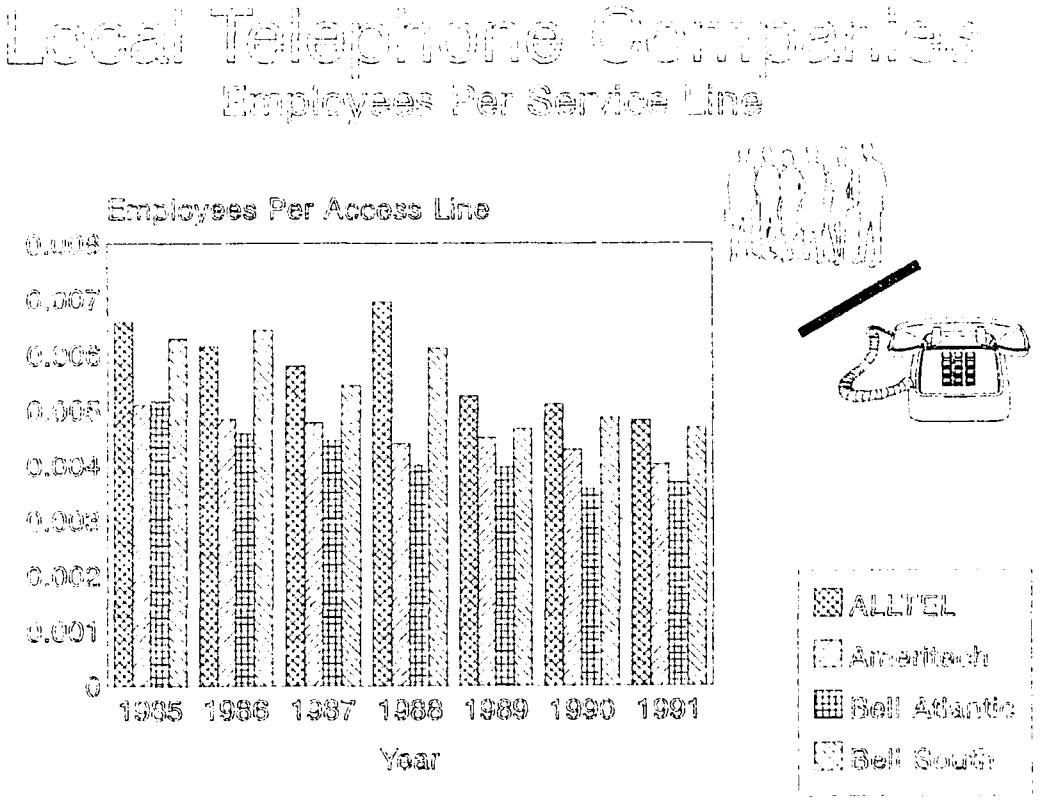

Figure 2 Local Telephone Companies Employees Per Service Line (From United States Telephone Association PhoneFacts, 1985 - 1991)

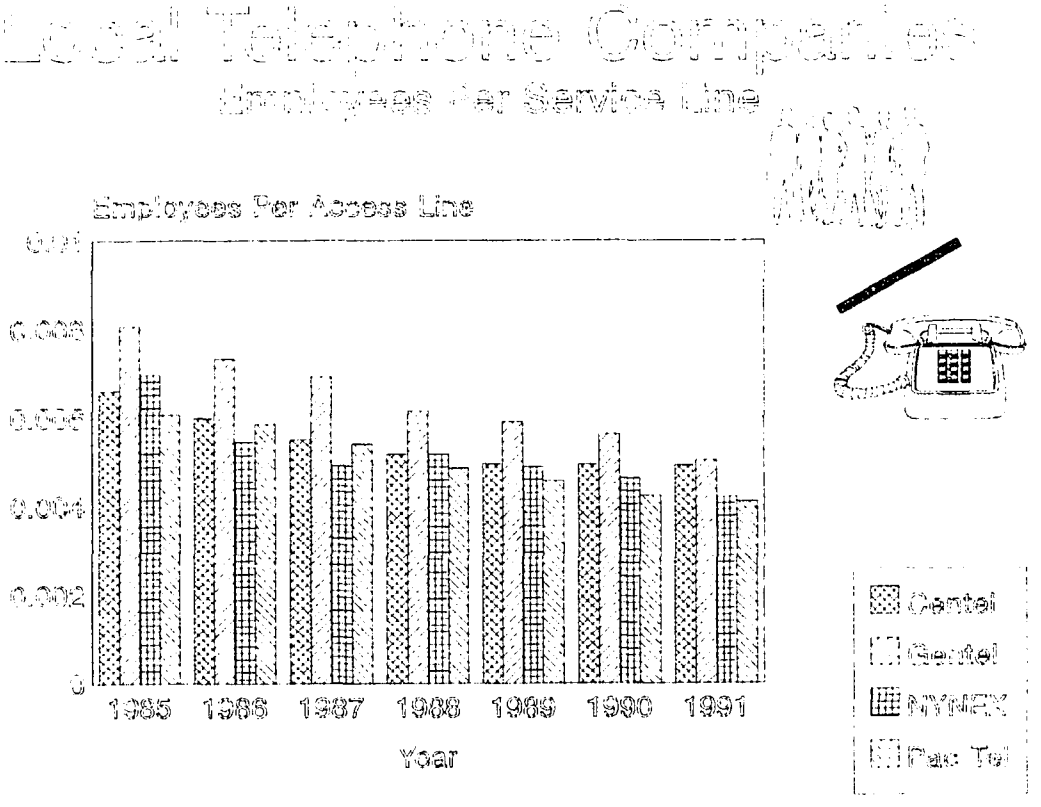

Figure 3 Local Telephone Companies Employees Per Service Line (From United States Telephone Association PhoneFacts, 1985 - 1991)

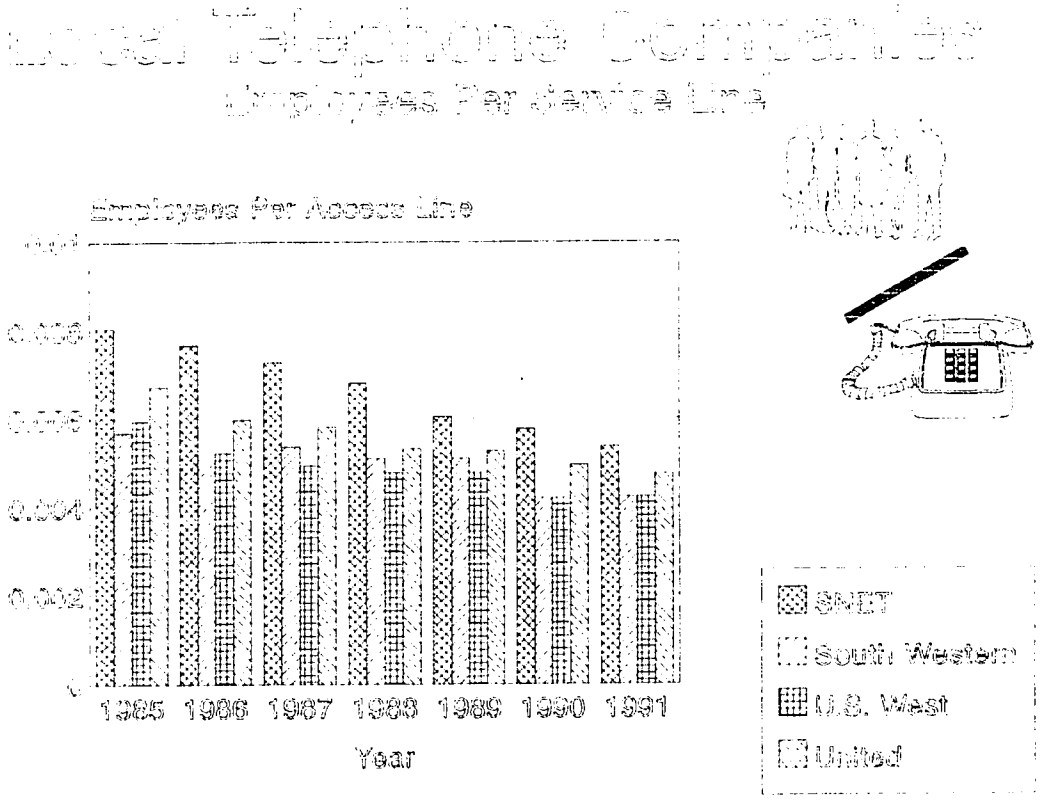

Figure 4 Local Telephone Companies Employees Per Service Line (From United States Telephone Association PhoneFacts, 1985 - 1991)

The output per hour for all employees of the total telecommunication industry was also considered. The following graph will show the trend during that period.

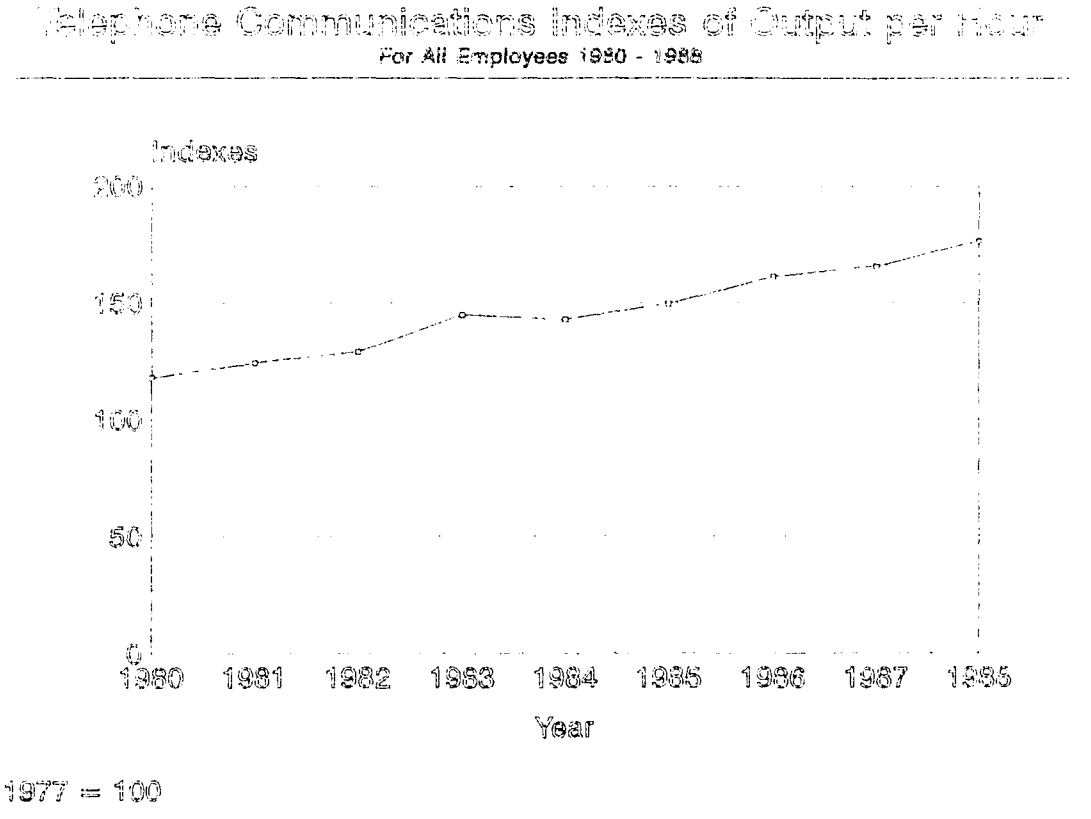

Figure 5 Telephone Communications Indexes of Output per Hour for All Employees 1980-1988 (From Statistical Abstract of the U.S., 1980-1989)

The theoretical model expressed in chapter 3 is transformed into a linear form by taking the natural logarithm for the purpose of estimation. The basic linear equation for the model would be:

$$\text{Ln(Employees/Access Line)} =$$
$$\text{Ln}(\alpha) + \beta\text{Trend} + \delta\text{Ln(Ydummy)} + \gamma_i\text{Ln}(\text{Co}_i) + \varepsilon_{it}$$

To test the significance of regulatory activity in the industry, dummy variables will be assigned for those years of the implemented regulatory change. Because of the linear transformation, the dummy variables are set on with a value of 1 and set off with a value of 0. In this model, β (beta), the coefficient of the Trend Variable, would be the growth rate of the index (Employees/Access Line). An improving growth rate would be a negative value. The coefficient δ (delta), represents the deviation from the growth rate of the index for the year specified. The variables significantly different from zero, would be required to show a correlation in timing for the year with regulatory action and a significant change in rate of growth in efficiency. The coefficient α (alpha) is the intercept and the fixed effect for the omitted company dummy variable. The coefficient γ (gamma) is a shift of the intercept for a specified company.

To substantiate the local telephone company findings, a rate of change of output efficiency model for the telecommunications industry has been analyzed for the 1980's. The index of output per hour for all employees for telephone communications was studied. The source for this data was The Statistical Abstract of the U.S. The theoretical model is transformed into a linear form by taking the natural logarithm for estimation as follows:

$$Ln(Index) = Ln(\alpha) + \beta Trend + \delta Ln(Ydummy) + \varepsilon_t$$

As in the pervious model, a dummy variable, for those years where regulatory changes were affected, was utilized . In this model an improving growth rate would be a positive number for the trend coefficient. The coefficients would have the same meaning as in the first model.

Chapter 5

Results

The null hypothesis for this thesis is as follows: A significant increase in efficiency should not be expected once alternative rate regulation for interexchange services was imposed, in 1991, on the local telephone companies.

Price Caps, or alternate rate regulation, was announced to be effective January 1, 1991, for the local exchange companies. A regression of the trend in improvement showed an annual 6% rate of growth in efficiency improvement, for the study period of 1985 through 1991. The following Table of the regression output is offered for review.

Table 1 Least Squares Regression with Dependent Variable of Logarithm(Employees/Access Line)

Number of observations: 84

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG
Constant	-4.9830287	0.0236397	-210.79052	0.0000
Trend Variable	**-0.0596905**	0.0036191	-16.493299	0.0000
ALLTEL	0.0619553	0.0280333	2.2100647	0.0304
Ameritech	-0.1774234	0.0280333	-6.3290327	0.0000
Bell Atlantic	-0.2653469	0.0280333	-9.4654332	0.0000
Bell South	0.0054549	0.0280333	0.1945885	0.8463
GENTEL	0.1619602	0.0280333	5.7774302	0.0000
NYNEX	-0.0555081	0.0280333	-1.9800815	0.0516
Pac Telesis	-0.0859299	0.0280333	-3.0652854	0.0031
SNET	0.2068086	0.0280333	7.3772600	0.0000
Southwestern	-0.0854026	0.0280333	-3.0464751	0.0033
U.S. West	-0.1107413	0.0280333	-3.9503533	0.0002
United	0.0183727	0.0280333	0.6553884	0.5144
Year 1991	0.0190404	0.0206848	0.9205034	**0.3605**

R-squared	0.928305	Mean of dependent var	-5.246221
Adjusted R-squared	0.914990	S.D. of dependent var	0.179876
S.E. of regression	0.052445	Sum of squared resid	0.192537
Log likelihood	136.0972	F-statistic	69.71975
Durbin-Watson stat	2.238176	Prob(F-statistic)	0.000000

This table indicates the year of 1991 did not show any significant change in that trend. Accordingly, the null hypothesis would have to be accepted. In 1991, the institution of price cap regulation for the local exchange companies on their inter-exchange services, did not have a significant impact on the rate of growth in efficiency improvements.

Pooled cross-sectional and time series data used in this regression required an additional test to insure that serial correlation was not brought about in the shifts to a

different company's data. The residuals of the initial regression were regressed against the lagged residuals excluding the year 1985 for each company. No significant relationship was shown between the residuals and lagged residuals. This additional test confirms no evidence of serial correlation in my analysis.

CHAPTER 6

DISCUSSIONS

The null hypothesis is accepted. No significant impact, due to the instituting of local exchange price cap regulations on interexchange services, is apparent in 1991. The data suggests that there was an impact, (using a 1 Tail Test) in the years of 1986-1987, on the rate of growth in efficiencies.

Table 2 Least Squares Regression with Dependent Variable of Logarithm(Employees/Access Line)

Number of observations: 84

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG
Constant	-4.9698129	0.0246480	-201.63165	0.0000
Trend Variable	**-0.0604489**	0.0031927	-18.933462	0.0000
ALLTEL	0.0619553	0.0275388	2.2497481	0.0276
Ameritech	-0.1774234	0.0275388	-6.4426752	0.0000
Bell Atlantic	-0.2653469	0.0275388	-9.6353921	0.0000
Bell South	0.0054549	0.0275388	0.1980825	0.8436
GENTEL	0.1619602	0.0275388	5.8811682	0.0000
NYNEX	-0.0555081	0.0275388	-2.0156354	0.0477
Pac Telesis	-0.0859299	0.0275388	-3.1203249	0.0026
SNET	0.2068086	0.0275388	7.5097242	0.0000
Southwestern	-0.0854026	0.0275388	-3.1011769	0.0028
U.S. West	-0.1107413	0.0275388	-4.0212848	0.0001
United	0.0183727	0.0275388	0.6671564	0.5069
Year 1986-1987	**-0.0261182**	0.0141347	-1.8478099	**0.0689**

R-squared	0.930812	Mean of dependent var	-5.246221
Adjusted R-squared	0.917963	S.D. of dependent var	0.179876
S.E. of regression	0.051520	Sum of squared resid	0.185804
Log likelihood	137.5921	F-statistic	72.44107
Durbin-Watson stat	2.209982	Prob(F-statistic)	0.000000

In this regression, the year dummy variable was set on for 1986 and 1987. The results for years 1986 and 1987, individually, were not significant. Why would regression results show evidence of response in 1986-1987 as opposed to 1991? Alternate regulation changes do not happen in any one particular period. It takes a significant lead time for the regulatory process to occur.

The reason for the lead time requirement becomes clear with a discussion of the process. Within the Telecommunications Industry, trade associations announce possible changes in alternatives for regulation. The FCC issues a notice of proposed rule making and asks for responses. After responses are received, proposed rules are issued by the FCC. Supplemental rules are announced as the issues are considered within an industry. Ultimately, an order is issued by the Federal Communications Commission citing the timing and what changes will be implemented.

In the case of Price Cap regulation, the National Telecommunications and Information Agency issued a notice of request for alternate rate regulation comments on October 10, 1986. The objectives for this request where to determine the effectiveness of rate of return regulation and to discuss alternatives. The alternatives were social contracts, market basket concepts, band pricing and price caps.

This request for comments was an opportunity for the telecommunications industry to formalize the various plans that had been circulating for alternate rate regulation. The FCC sent out their notice of proposed rule making in 1987, with adaptations continuing through 1988.

Ultimately, the FCC adopted price caps for AT&T effective July 1, 1989. Further, it adopted price caps regulation for local exchange companies for interstate jurisdictions effective January 1, 1991. The seeds were sewn for price cap regulations in October, 1986. This suggested those telephone company managers, on the basis of the inquiries initiated in 1986 and 1987, reacted immediately. They reacted on their expectations of what the new regulation environment for the telecommunications industry would be.

As verification, the regression results show that in the period of 1986 and 1987, there was a significant increase in rate of change of approximately 3%. These results suggest management discretion was exercised by local exchange telecommunication executives. They anticipated that their price cap scheme would be accepted. They would have every motivation to reduce expenses as quickly as possible, so as to optimize their income potential. At some point, the benefits of improving efficiency would be experienced by incentive price cap regulation. Apparently not all changes where effected in the last two months of

1986. Some improvements in growth rates continued on in 1987.

Regressions where run to determine if any other time periods showed significant impact on efficiency. None were found. Additionally, the year dummy variables where set on for a specific year; plus, all subsequent years to test for lasting effect. No significant lasting effects were evident.

To contrast these findings, efficiency data were accumulated for the total Telecommunications industry for the 1980's. This data included the entire industry, long distance as well as local exchange companies. To verify the experience in the local exchange telephone companies, an additional regression was run on the indices.

Table 3 Least Square Regression with Dependent Variable of Logarithm(Index of Output per Man-hour)

Number of observations: 9

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG
Constant	4.2816453	0.0087159	491.24661	0.0000
Trend Variable	0.0487702	0.0006165	79.104811	0.0000
Year 1983	**0.0617658**	0.0049101	12.579248	**0.0001**
Year 1986	**0.0212980**	0.0050572	4.2113887	**0.0084**

R-squared	0.999278	Mean of dependent var	4.973657
Adjusted R-squared	0.998845	S.D. of dependent var	0.134373
S.E. of regression	0.004566	Sum of squared resid	0.000104
Log likelihood	38.37599	F-statistic	2307.498
Durbin-Watson stat	2.095110	Prob(F-statistic)	0.000000

This regression shows, with significance, an improvement in the growth rate of the output index in 1983 and 1986. Why 1986? In 1986, the intent for alternate rate of regulation consideration for price caps was announced. The industry timing results did not precisely match the local exchange company results because of the influence of AT&T in the data. The initial price cap discussions where directed at AT&T. AT&T responded in late 1986. The local exchange companies reacted in late 1986 through 1987.

The reaction evident in 1983, is due to the telecommunications industry preparation for the deregulation of the long distance telephone service.

CHAPTER 7

CONCLUSION

On the basis of this analysis, telecommunication managers respond to regulatory reforms. In addition to long term improvements made available by changing technologies, short run improvements can be opted for by management. The amount of improvement may be controlled by management, based on the reforms initiated. Telecommunication management responds with rational expectation. They do not wait for rule or policy changes.

In the present incentive regulatory scheme the lowest cost for services is not assured. The discretionary margins are evident but this analysis does not show that all margins have been reduced. The resolution of problems caused by cross subsidies and rate design imperfections, may not provide price sustainability. If solutions in rate design are found with out reducing discretionary margins to competitive levels, price sustainability will not be attained. The issues of management discretion on operating choices seem to be fertile ground for consideration of telecommunication industry improvements in competitive price sustainability.

Additionally, the clarifying of which rent seeker is benefiting from regulatory efforts, would help provide information about improvements that can be made in the regulatory process.

Hopefully evidence presented in this study can point the way for additional improvements in the telecommunication industry.

APPENDIX I

DATA UTILIZED FOR REGRESSIONS

OBSERVATION	ACCESS LINES	EMPLOYEES	EMPLOYEES PER ACCESS LINES
ALLTEL			
1985	905200.0	5968.000	0.006593
1986	953943.0	5876.000	0.006160
1987	982996.0	5695.000	0.005794
1988	1084283.	7532.000	0.006947
1989	1123590.	5887.000	0.005239
1990	1157105.	5899.000	0.005098
1991	1210864.	5822.000	0.004808
Ameritech			
1985	14555000	74094.00	0.005091
1986	14755000	71170.00	0.004823
1987	15094000	71871.00	0.004762
1988	15469000	67783.00	0.004382
1989	15899000	71419.00	0.004492
1990	16278000	69430.00	0.004265
1991	16584000	66390.00	0.004003
Bell Atlantic			
1985	15090000	77750.00	0.005152
1986	15508973	70768.00	0.004563
1987	16056907	71260.00	0.004438
1988	16541000	65815.00	0.003979
1989	17056802	67197.00	0.003940
1990	17484000	62050.00	0.003549
1991	17750000	64922.00	0.003658
Bell South			
1985	14532000	91384.00	0.006288
1986	15045900	96886.00	0.006439
1987	15739470	85540.00	0.005435
1988	16407000	100280.0	0.006112
1989	16720367	77624.00	0.004642
1990	17721560	85960.00	0.004851
1991	17614736	82200.00	0.004667

OBSERVATION	ACCESS LINES	EMPLOYEES	EMPLOYEES PER ACCESS LINES
Centel			
1985	1299300.	8598.000	0.006617
1986	1354317.	8109.000	0.005988
1987	1422969.	7837.000	0.005507
1988	1503192.	7768.000	0.005168
1989	1590716.	7886.000	0.004958
1990	1670135.	8265.000	0.004949
1991	1593406.	7834.000	0.004917
Gen Tel			
1985	12721200	102763.0	0.008078
1986	13408250	98376.00	0.007337
1987	13937373	96623.00	0.006933
1988	14650000	90152.00	0.006154
1989	14891090	87990.00	0.005909
1990	15183743	85316.00	0.005619
1991	15632000	78700.00	0.005035
NYNEX			
1985	13623000	94900.00	0.006966
1986	13962255	76000.00	0.005443
1987	16046014	78890.00	0.004916
1988	14851000	76900.00	0.005178
1989	14960953	73222.00	0.004894
1990	15511119	71970.00	0.004640
1991	15409521	64852.00	0.004209
Pacific Telesis			
1985	11692000	71000.00	0.006073
1986	12068564	70711.00	0.005859
1987	12525000	67770.00	0.005411
1988	13093000	63618.00	0.004859
1989	14202949	65057.00	0.004581
1990	14558033	61760.00	0.004242
1991	14262000	58485.00	0.004101
Southern New England Tel			
1985	1674000.	13500.00	0.008065
1986	1711533.	13155.00	0.007686
1987	1779204.	12972.00	0.007291
1988	1839000.	12533.00	0.006815
1989	1875000.	11339.00	0.006047
1990	1904000.	11001.00	0.005778
1991	1887000.	10147.00	0.005377

OBSERVATION	ACCESS LINES	EMPLOYEES	EMPLOYEES PER ACCESS LINES
Southwestern Bell			
1985	10880000	62000.00	0.005699
1986	11772089	61774.00	0.005247
1987	11104974	59620.00	0.005369
1988	11340449	57970.00	0.005112
1989	11444061	58400.00	0.005103
1990	12562533	52864.00	0.004208
1991	12934679	54923.00	0.004246
U.S. West			
1985	11195000	66538.00	0.005944
1986	11332000	59221.00	0.005226
1987	11613000	57463.00	0.004948
1988	11878000	56749.00	0.004778
1989	12306536	58778.00	0.004776
1990	12562533	52860.00	0.004208
1991	12934679	54923.00	0.004246
United			
1985	3256800.	21913.00	0.006728
1986	3381332.	20221.00	0.005980
1987	3516814.	20427.00	0.005808
1988	3685337.	19594.00	0.005317
1989	3811980.	20115.00	0.005277
1990	3946812.	19593.00	0.004964
1991	4083205.	19411.00	0.004754

Observations	Index of Output per Hour for all Employees 1977 = 100
1980	118.1000
1981	124.4000
1982	129.1000
1983	145.1000
1984	143.0000
1985	149.8000
1986	161.3000
1987	165.9000
1988	176.7000

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