SOUTHERN BELL TELEPHONE AND TELEGRAPH COMPANY, INC.

DOCKET NO. 920260-TL

DIRECT TESTIMONY OF DAVID E. DISMUKES

ON BEHALF OF THE STAFF OF THE FLORIDA PUBLIC SERVICE COMMISSION

DIVISION OF AUDITING AND FINANCIAL ANALYSIS

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DIRECT TESTIMONY OF DAVID E. DISMUKES

Q. Would you please state your name and business address?

A. David E. Dismukes, 101 East Gaines Street, Tallahassee, Florida, 32399-0865.

Q. What is your current position?

A. I am currently a Planning and Research Economist in the Forecasting Section of the Division of Auditing and Financial Analysis at the Florida Public Service Commission.

Q. Would you please discuss your educational background?

A. Yes. I received a Bachelor of Arts degree from the University of West Florida and Master of Science degrees in both International Affairs and Economics from the Florida State University. I am currently a Ph.D. student in the department of economics at the Florida State University. At this time, I have completed all course work and residence requirements for the Ph.D. I have completed field course work in econometrics, international economics, and economic development.

Q. Are you a member of any professional associations?

A. Yes. I am a member of several professional associations. These associations include the American Statistical Association, the Econometric Society, the American Economic Association, the Eastern Economic Association, the Southern Economic Association, and the International Association of Energy Economists. I am also a member of Omicron Delta Epsilon, the national honorarium in the field of economics.

Q. Would you please describe your employment history in public utility regulation?

A. Yes. Between 1988-1992, I held several positions with Ben Johnson Associates, Inc. (BJA), an economic consulting firm specializing in the research and analysis of public utility issues. My areas of responsibility included assisting with the preparation of expert witness testimony, and the workpapers, schedules and exhibits which supported this testimony. My responsibilities also included assisting our various clients in the preparation of discovery, the preparation of cross-examination questions, and assisting legal counsel with the preparation of briefs. I also coordinated the firm's marketing efforts in responding to request for proposals by various commission staffs and public counsels throughout the United States. While at BJA, I also held a supervisory position overseeing the work product of several research and technical assistants.

In 1992 I joined the staff of the Florida Public Service Commission as an Economist in the Forecasting Section of the Division of Auditing and Financial Analysis. In 1993 I was promoted to the position of Planning and Research Economist. My current responsibilities include evaluating the accuracy of the forecasts submitted by the electric, telephone, and gas companies which come under the jurisdiction of the FPSC.

Q. Has your regulatory experience ever included the evaluation of any regulatory filings and proposals submitted by any telephone utilities?

A. Yes. I have evaluated several regulatory filings and proposals submitted by the following telephone utilities:

Pacific Northwest Bell Telephone Company, Inc. (Washington)
AT&T Communications, Inc. (Connecticut)
Michigan Bell Telephone Company, Inc. (Michigan)

Chesapeake and Potomac Telephone Company, Inc. (District of Columbia)

Breezewood Telephone Company, Inc. (Pennsylvania)

LDDS Communications, Inc. (Mississippi, Tennessee, Kentucky, Louisiana)

South Central Bell Telephone Company, Inc. (Mississippi, Tennessee, Kentucky, Louisiana)

US West Communications Inc. (Arizona, Colorado)

Southern New England Telephone Company, Inc. (Connecticut)

Alascom, Inc. (Alaska)

Central Telephone Company, Inc. (Nevada)

General Telephone Company, Inc. (Florida)

Central Telephone Company, Inc. (Florida)

Q. Has your regulatory experience ever included the evaluation of any rate design or policy issues submitted by any telephone utility in a regulatory proceeding?

A. Yes. I have evaluated a number of telephone rate design and policy issues. This includes the evaluation of basic telephone pricing structures, telephone cost studies, market structures and competition, alternative regulatory schemes, empirical analyses of the telephone industry, and public policy issues concerning the U.S. telecommunications infrastructure.

Q. Have you ever reviewed any empirical studies presented in a regulatory proceeding?

A. Yes. I have reviewed several empirical models that have been presented in regulatory proceedings. My analysis has focused upon reviewing model specification, data sources, modeling assumptions, and model diagnostics. I have analyzed various econometric models related to electricity use including end-use models, time-of-use models, and demand models which have incorporated estimates of price elasticity. In the telecommunications industry, I have had the opportunity to review statistical analyses estimating multifactor productivity changes, discrete choice models of the residential demand for local service, and several interLATA and intraLATA MTS demand models.

Q. Have you ever testified before the Commission as an expert witness?

A. Yes, in Docket Number 920188-TL I presented alternative price elasticity estimates for interLATA and intraLATA MTS demand. These estimates were used to determine the appropriate degree of stimulation which could arise from the price decreases proposed by GTE-FL for its switched access and intraLATA MTS services.

Q. What is the purpose of your present testimony?

A. The purpose of my testimony is twofold. First, I would like to present price elasticity estimates for both interLATA and intraLATA MTS demand. Second, I have presented a discussion of what I consider to be several empirical shortcomings in the data supporting Southern Bell's ELS proposals.

Q. Would you please explain how price elasticities can be used to determine stimulation or repression?

A. Yes. Elasticity estimates can be used to determine the degree of repression or stimulation that may arise from a change in the price of the service in question. The elasticity estimate that I have presented for interLATA MTS demand could be used in determining the degree of stimulation which may arise from the Company's proposed changes in switched access. The elasticity estimate for intraLATA MTS demand can be used if the Commission opts to implement some form of MTS rate reduction in lieu of accepting the Company's proposed extended local service (ELS) plan.

As a hypothetical example, consider a -0.25 price elasticity estimate for intraLATA MTS demand. This elasticity estimate would entail that a ten percent decrease in the price of intraLATA MTS would result in a 2.5 percent increase in the quantity demanded of this service. Given this example, one can see that higher estimated price elasticities will result in greater quantity increases as a result of a decrease in price. The extent to which an elasticity has been over or under estimated will determine the degree to which stimulation has been over or under estimated.

The importance of these estimates in distributing the revenue requirement has been recognized by the Commission in the past:

> The inclusion of repression and stimulation can significantly influence the estimate of the quantities demanded for a particular service, which, in turn, can markedly affect the revenue effect of a proposed price change. With rate of return regulation, repression and stimulation can materially affect the magnitude of rate changes needed in other services to attain the revenue requirement. [Order No. PSC-93-0108-FOF-TL]

Q. Have you prepared any exhibits in support of your testimony?

A. Yes. I have presented two exhibits for this purpose. Exhibit___DED-1 consists of 6 schedules. Exhibit___DED-2 is an exhibit with proprietary information and consists of 6 schedules and 2 figures.

Q. How is your testimony organized?

A. My testimony has been organized into four major parts. First, I present a discussion of the techniques used to develop estimates of stimulation for both interLATA and intraLATA MTS demand. Second, I discuss some implementation issues related to the application of these stimulation estimates to the Company's test year revenues. Third, I discuss some of empirical shortcomings in the data supporting the Company's ELS proposals. Fourth, I present my conclusions and recommendations.

InterLATA and IntraLATA Toll Demand Analyses

Q. Would you please discuss your analysis of interLATA MTS demand?

A. Yes. I have developed a model of interLATA MTS demand based upon the demand for the Company's originating switched access minutes of use. Originating switched access minutes of use in this model are assumed to represent the demand for interLATA MTS by end-users in Southern Bell's service territory. This approach, which has been previously accepted by the Commission, was used by both myself and GTEFL in Docket Number 920188-TL.

The model specification for interLATA MTS demand is based upon standard economic theory as well as contemporary econometric methods. The model posits that interLATA MTS demand is a function of price, income, calling area, and seasonality. Dynamics have been explicitly incorporated into the model in both the price and income variables. The incorporation of dynamics allows an empirical model to explicitly specify how customers react to changes in price and income over time. The model I am presenting reveals that it takes customers five-quarters to completely react to changes in both income and price.

The incorporation of dynamics is consistent with past Commission orders. With regards to past intraLATA demand analyses, the Commission noted that:

> It is intuitively plausible that individuals may exhibit a delayed response to a change in toll price, and that some individuals may require a period of greater than a year to adjust to a change in rates. We find that it is appropriate to consider this phenomenon when modeling intraLATA toll demand. [Ibid.]

The data used in this analysis is Florida-specific. The dataset employed consists of quarterly observations over the 1987-1992 time frame. Most of the data used in the analysis has been provided by Southern Bell through productions of documents. In many cases, the variables employed in this analysis are the same, or very similar, to those used by Southern Bell in its own modeling efforts.

The results of the interLATA MTS demand analysis reveal a long-run price elasticity of -0.68. This estimate is slightly higher than the -0.59 elasticity estimate approved by the Commission in Order PSC-93-0108-FOF-TL. A technical discussion of the interLATA model and the statistical results and diagnostics of this model has been presented in Exhibit___DED-1, schedule 2. A summary of all of my recommended stimulation estimates, has been presented in Exhibit___DED-1, schedule 1. Since the empirical literature in telecommunications demand is subject to a number of different opinions and conclusions, I have included ranges for each of the recommended elasticities. The lower range for my interLATA MTS elasticity is -0.44, while the upper range is -0.98.

Q. How do these results compare to other interLATA MTS demand analyses?

A. I believe these results are consistent with past and present studies in the analysis of long distance calling. A commonly held benchmark for the evaluation of elasticity estimates and demand models is the comprehensive review of the telephone demand literature presented by Dr. Lester Taylor (1980). In his monograph, Dr. Taylor reviewed numerous telephone demand models. In one table, Dr. Taylor has presented a number of state models created by the Bell System during the time period of 1976 through mid-1978 which were used to analyze intrastate toll demand [Lester D. Taylor. <u>Telecommunications Demand: A Survey and Critique</u> (Cambridge, Ballinger Publishing Company, 1980), p. 121.] The models evaluated use either messages or price deflated revenues (as opposed to minutes of use) as the dependent variable. As noted by Dr. Taylor, the price elasticities vary from -0.03 to - 0.44 in the short run and from -0.22 to -1.04 in the long run. [<u>Ibid.</u>]. The average of the short run estimates is -0.21, while the average of the long-run estimates is -0.67. I have included a summary of this table in Exhibit___DED-1, schedule 3.

Q. How do your estimates compare to more contemporary studies?

A. I believe that my estimates compare favorably with other more recent studies in the area of long distance telephone demand. Recently, I have had the opportunity to review several demand analyses prepared in Washington, Michigan, and Florida for interLATA switched access. These studies, many of which use methods similar to my own, present long run price elasticities for interLATA switched access in the range of -0.41 to -0.60. My estimate is slightly higher, but still lower than similar studies for longer distance calls. For instance, my estimate is still below a commonly cited study prepared for the FCC in order to estimate the price elasticity of interstate switched access for the local exchange carriers. This estimate yielded a long run price elasticity of -0.723. I would consider my intrastate estimate of -0.68 to be in the proper order of magnitude with this longer-haul interstate estimate. I have listed the results of the above studies in Exhibit___DED-1, schedule 4.

Q. Has the Company made similar estimates for interLATA demand?

A. No. The Company has used elasticity estimates generated by an intraLATA MTS demand model to approximate the effect of changes in the price of interLATA switched access. The results of this model are a short run elasticity of -0.34 and a long run elasticity of -0.69. The long run elasticity estimated by the Company is similar in magnitude to my elasticity estimate of -0.68. The problem rests with the methdodoloy used by the Company to reach this estimate. The Company has used intraLATA demand to approximate interLATA demand based upon the assumption that:

> ... to the extent that the end user's toll price sensitivity is not dependent upon whether or not the call crosses a LATA boundary, the use of the intraLATA own price elasticity

serves as a reasonable proxy for measuring switched access price responsiveness. [Sims Late Filed Deposition Exhibit 6, February 9, 1993]

I believe that this approach is inconsistent with one of the more commonly held empirical regularities in the analysis of telephone demand. This empirical regularity relates the size of the elasticity estimate to the average length of haul (ALOH) of the telephone call being analyzed. Dr. Taylor notes that:

> In general, the empirical estimates of price elasticities establish that the price elasticity becomes larger (in absolute value) as one goes from access lines to short-haul toll calls to long-haul toll calls to international calls. The same pattern also appears to hold for income elasticities. [[Lester D. Taylor, Telecommunications Demand: A Survey and Critique (Cambridge, Ballinger Publishing Company, 1980), p. 121.]

Dr. Taylor has noted that this empirical regularity is based on the concept of community of interest. The smaller the ALOH, the closer one gets to the relevant community of interest. As this occurs, calling becomes more of a necessity than a discretion -- this results in less price sensitivity. Thus, we would expect to see the elasticity for intrastate interLATA toll to be greater than intraLATA toll. Thus, using an intraLATA estimate for the stimulation of interLATA switched access is clearly incorrect. The estimated levels of stimulation that could result from using an intraLATA estimate (as opposed to an interLATA estimate) would be biased downwards.

For instance, assume that we wanted to estimate the amount of stimulation that could arise from a decrease in the price of interLATA switched access. Assume we have two estimates -- an interLATA estimate of -0.68 and an intraLATA estimate of -0.41. The first estimate entails that a 10 percent decrease in price will result in a 6.8 percent increase in demand. The second estimate entails that a 10 percent decrease in price will result in a 4.1 percent increase in demand. Clearly, using the lower (intraLATA) estimate will result in lower estimated levels of stimulation than using the higher (interLATA) estimate.

Q. Would you please discuss your analysis of intraLATA MTS demand?

A. Yes. My analysis of intraLATA MTS demand has been based upon an econometric cross-sectional model. A cross-sectional model has several advantages over the typical econometric time series methods commonly used to model MTS demand. One of the primary advantages is that these models tend to have much more data -- giving breadth and variety to the analysis. The goal of my intraLATA MTS demand analysis was to construct a model with the depth and detail we commonly find in local residential access demand models -- in particular, the detailed local access studies constructed by Lewis Perl in the early and mid-eighties.

My intraLATA MTS demand model has taken route specific MTS calling data from the Southern Bell service territory during 1990. The data consists of 2,813 MTS routes -- this encompasses all of the potential intraLATA calling combinations in the Company's service territory in 1990. The data was then matched to socio-economic characteristics taken during the 1990 census. The intraLATA MTS demand model posits that the demand for intraLATA MTS calling is a function of price, income, distance, and other socio-economic characteristic. A more detailed, technical discussion of the intraLATA MTS model and the statistical results and diagnostics of this model has been presented in Exhibit___DED-1, schedule 5.

The results from my intraLATA MTS demand analysis suggest a price elasticity estimate of -0.56. This estimate is very close to the -0.51 estimate previously accepted by the Commission in Order PSC-93-0108-FOF-TL. This estimate is lower than the Company's long run intraLATA MTS demand estimate of -0.69. A summary of my recommended intraLATA MTS stimulation estimate, and its estimated ranges, has been presented in Exhibit___DED-1, schedule 1.

Q. How do these estimates compare with other intraLATA demand studies?

A. I believe these estimates compare well relative to other estimates of intraLATA MTS demand. I have listed the results of some of the more recent demand elasticity estimates for intraLATA MTS demand in Exhibit___DED-1, schedule 4.

The results of my model also stand up very well with the most recent intraLATA demand models constructed by Dr. Lester Taylor and the National Telecommunications Demand Study (NTDS). NTDS is an ongoing study of telecommunications demand involving a consortium of the INDETEC Corporation, PNR & Associates, and a number of local exchange companies. The LECs provide account-level data on an annual basis for samples of their residential and business customers. BellSouth participates in this study and provides account-specific data from Florida to NTDS for modeling purposes.

The most recent NTDS intraLATA MTS demand study is also a cross-sectional analysis which is based upon 13,895 customer accounts. This analysis, however, does not incorporate the socio-economic variables that have been included in my analysis. The conclusions of the NTDS reveal a business intraLATA MTS price elasticity of -0.66 and a residential MTS price elasticity of -0.48. This analysis assumes an average length of haul of approximately 28 miles. The simple average between these two elasticities is -0.57. This estimate is slightly higher than my own estimate of -0.56 which is based upon an average length of haul of about 32 miles.

Implementation Issues

Q. Would you please discuss some of the implementation issues surrounding the application of these estimates to the Company's test year revenues?

A. Yes. I believe that there are two general implementation issues surrounding the application of stimulation estimates to any Company's test year revenues. The first issue regards selecting the proper length of time to be used in estimating the elasticity. For instance, should a short-run (one year) elasticity be used as opposed to a long-run elasticity? The second issue regards determining the appropriate "flow-through" of price reductions to end users. Selecting the appropriate flow through assumption is a particular problem in determining the amount of stimulation which may arise from a reduction in switched access.

Q. What arguments are promoted in determining the proper length of time over which the effects of price elasticity are felt?

A. Usually the controversy lies between using a one-year average elasticity and a long run elasticity. A one-year elasticity is usually justified on the basis that since the Commission is using one "test year" (whether it is historical or projected) only the effects which occur in that year should be taken into account. The Company has noted its reasons for using a one-year elasticity rest upon the rationale that:

> The formalized procedure for adjusting rates upward or downward centers about the relationships that exist among revenue, operating costs, and rate base during a prescribed period of time referred to as the "test or rate period". Therefore, an average one year elasticity is the appropriate factor. [Response to Staff Interrogatory 30-557].

Thus, any demand effects which occur beyond one year would be excluded from the revenue impact (and rate design) calculations. If an elasticity were estimated, and revealed a 5 quarter lag, only those effects which occur within one year would be taken into account. Thus 2 quarters of information that was included in the analysis would be ignored for rate design purposes.

A long run elasticity is usually justified on the basis that since long run impacts are known and quantifiable, they should be included in any revenue impact and rate design calculations. If these long run effects were not taken into account, the neglected stimulation would allow the Company to overearn in those periods where demand impacts are still being felt. In the above example, the revenue effects associated with the remaining two quarters would accrue to the Company and could be translated into higher earnings.

Q. What about flow-through assumptions?

A. These assumptions are as important as the elasticity estimate itself. There are generally two considerations that must be taken into account in the flow through assumption. One, is determining the assumed proportion of switched access to an interexchange carrier's cost. Two, is determining how much Southern Bell comprises of the entire state interLATA toll market.

The Company has presented its estimates of the impact of stimulation on revenues for its proposed reduction in switched access. These calculations have been presented in Schedule E-2 of the Minimum Filing Requirements (MFRs). These calculations assume that the cost of access comprises fifty percent of the cost of an interLATA MTS call. The Company has noted that:

> ...access makes up only a portion of an interexchange carrier's costs. Since [a] demand response is determined by end user reaction to changes in [an] interexchange carrier's rates, the percent change in switched access rates must be translated into a percent reduction in end user rates. For example, if access charges represent fifty percent of an interexchange carrier's charges to the end user then a ten percent reduction in switched access rates (if passed through "dollar-for-dollar" by the interexchange carrier) would result in a five percent reduction in end user rates. BellSouth used a factor of fifty percent to

approximate this effect. [MFR, Schedule E-2]

The Company has made no assumptions regarding what proportion Southern Bell comprises of the entire state interLATA toll market. This is an important omission since IXCs typically price on a state-wide basis. Since Southern Bell comprises only a portion of the entire state market, then only a portion of switched access reductions should be seen by end users.

Q. How do these implementation assumptions influence the estimated revenue impacts of stimulation?

A. Exhibit___DED-1, schedule 6 presents an example of how the revenue impacts of a price reduction in switched access change as implementation assumptions change. All of the examples presented in this schedule are based upon the Company's currently proposed switched access rate reductions. The rows of the schedule present different "scenarios", while the columns present different implementation assumptions. This analysis shows that by incorporating market share assumptions, the Company has overestimated the amount of stimulation which will arise from reductions in its switched access. However, the Company's estimates of stimulation fall short (under current proposals) once long run estimates of elasticity are incorporated into the analysis.

The first row in this analysis shows the revenue impacts of switched access reductions given the Company's current assumptions. Rows (2)-(4) present the Company's elasticity estimates under different assumptions, while rows (5)-(10) present the short run and long run elasticity estimates from my interLATA MTS demand model. The column (a) presents several elasticity assumptions. Column (b) indicates whether the elasticity estimate presented is either short-run or long-run. Column (c) presents a number of different cost flow through assumptions. Column (d) presents the assumed proportion Southern Bell comprises of the entire state interLATA MTS market. This approximation is simply the ratio of Southern Bell's switched access minutes of use to the total state switched access minutes of use for the year ending June 1993. Column (e) presents overall switched access revenues with stimulation. Column (f) presents the net change in revenues -- that is, the difference between the Company's current annual revenues and those revenues which will be earned given the proposed rate change. Column (g), presents the difference between the Company's assumptions and the revised assumptions analyzed in any particular row.

Row (1) is an abbreviated version of the stimulation analysis presented by the Company in MFR Schedule E-2. Here the Company has assumed a short run elasticity of -0.34 and access as comprising 50 percent of IXC costs. No market share assumptions were made in the Company's stimulation calculations. Under the Company's current rate proposals, changes in switched access charges will result in a $9.9 million loss. This loss includes the effects of stimulation which arise from the switched access price decrease. Rows (2)-(4) show the revenue impacts of maintaining the Company's elasticity estimate, but changing the "flow-through" assumptions from 60 to 70 percent. The positive dollar amounts in column (f) indicate the amount of stimulation that was overestimated due to omitting market share assumptions.

Rows (5)-(7) present the elasticities estimated from my interLATA MTS demand model. These are short run elasticities. The dollar loss associated with the switched access price decrease has been presented in column (f). Losses range from $10.5 million to $9.9 million as the flow through assumption changes. The positive dollar amounts in column (g) indicate overestimates of stimulation relative to the Company's current assumptions. Negative dollar amounts in column (f) indicate underestimates of stimulation. The analysis shows that, by neglecting market share assumptions, the Company has overestimated the amount of stimulation which will occur under its current proposals.

Rows (8)-(10) also present elasticities estimated from my interLATA MTS demand model. These estimates, however, are long-run elasticities. The dollar loss associated with the switched access price decrease has been presented in column (f). Losses range from $9.5 million to $8.5 million as the flow through assumptions change. The negative dollar amounts in column (g) indicate the amount of stimulation that was neglected due to different elasticities and different flow-through assumptions.

Quantitative Analysis of the Company's Extended Local Service Proposal

Q. How would you describe the empirical support backing up the Company's Extended Local Service (ELS) proposal?

A. I would state that there is little empirical support accompanying Southern Bell's ELS proposal. This is surprising given the scope and importance of the proposal. The Company has presented no descriptive statistics analyzing -- or even describing -- the current intraLATA toll market and how ELS will or will not change its basic structure. A basic analysis supporting this plan could include such information as: (1) the basic characteristics of traffic under 40 miles in the Bell service territory; (2) why this traffic is inherently different from other types of toll traffic; (3) factors which show the strength of the communities of interest within the 40 mile proposal; and (4) areas which are currently under going "EAS pressures" -- the degree of these pressures and how ELS will remedy these pressures. Unfortunately, none of the above information was provided with the ELS proposal.

Q. Have you prepared any analyses which may help in evaluating the ELS proposal?

A. Yes. You will recall that the intraLATA MTS demand model discussed earlier in my testimony was based upon a data set of some 2,813 toll routes in the Southern Bell service territory for 1990. This data could be used to answer some of the questions posed above. The data set includes such information as mileage, average calling rates, community of interest factors, etc. I have taken the opportunity to present various statistics from this data set to help the Commission in its decision regarding the ELS proposal. Since the Company considers this route-specific information to be proprietary, I have relegated my discussion and analysis of the intraLATA toll data to the schedules included in a separate exhibit -- Exhibit___DED-2.

Conclusions and Recommendations

Q. Would you please present your conclusions and recommendations?

A. Yes. My testimony presents elasticity estimates to be used in determining the amount of stimulation which could arise from a reduction in the Company switched access and intraLATA MTS services. My testimony has also presented an empirical analysis of the Company's intraLATA MTS routes and some relevant statistics which should be considered in reviewing the Company's ELS proposal.

I recommend that the Commission use the -0.68 long run elasticity estimate in determining the amount of switched access stimulation. While I have do not have a specific recommendation regarding which rate reduction flow-through assumption to use, I recommend that the Commission consider the importance of these assumptions and review the implementation analysis I have presented in my exhibit when making its decision. I would also like to recommend that should the Commission chose to implement some sort of intraLATA MTS reductions in this proceeding, it use the -0.56 elasticity estimate for intraLATA MTS demand stimulation. While I do not have any direct recommendations regarding the Company's ELS proposals, I would recommend that the Commission carefully consider the empirical information I have presented in Exhibit___DED-2 in arriving at its decision.

Q. Does this conclude your testimony?

A. Yes.

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Exhibit DED-1

Summary of Proposed Price Elasticities

Service	Duration	Lower Band	Base Estimate	Upper Band
InterLATA MTS	Short Run	-0.32	-0.51	-0.70
InterLATA MTS	Long Run	-0.44	-0.68	-0.98
IntraLATA MTS	Long Run /*1	-0.47	-0.56	-0.66

/*1 Cross sectional model equates short run to long run

InterLATA MTS Demand Model

Introduction

The purpose of this analysis is to develop an econometric model of interLATA MTS demand for the Southern Bell service territory in Florida. The results of this analysis are to be used to estimate the amount of usage that will be stimulated as a result of the interLATA switched access reductions proposed by Southern Bell in Docket 920260-TL.

This analysis attempts to incorporate dynamics through the use of a polynomial distributed lag (PDL) model. A PDL was chosen over the more traditional Koyck distributed lag model for several reasons. First, a PDL avoids many of the perceived problems associated with the inclusion of a lagged dependent variable as an independent variable. These problems include difficulties associated with the detection of both autocorrelation and cointegration. Second, many software packages now allow easy implementation of PDLs -- and because of this -- PDLs have become the model of preference in the telephone demand literature.

The remainder of this analysis has been organized into the following sections. The second section discusses the model specification and data used in the analysis. The third section presents the empirical results and discusses the diagnostics used in determining any potential violations of the statistical assumptions underpinning the model. The fourth section presents the recommendations and conclusions.

Model Specification and Data

The general specification for interLATA MTS demand can be presented as:

$$Q = f\left(Y, \frac{P_i}{P_n}, \ldots, \frac{P_{n-1}}{P_n}, S\right)$$

Where Q, the quantity of originating interLATA MTS calling is a function of real income (Y), the relative price of various substitute and complimentary services (P_i/P_n), and any seasonal variation (S). InterLATA demand, which is carried by interexchange companies (IXCs) and resellers, is not directly observable to a local exchange company (LEC). A LEC does have the ability, however, to observe changes in the demand for its switched access services. Switched access is a derived demand -- it is demanded as interLATA MTS is demanded. Thus, changes in the demand for switched access should generally be reflective of changes in the demand for interLATA MTS. Therefore, we will use switched access originating minutes of use to approximate interLATA originating MTS minutes of use.

Several modifications should be made to the above equation before it can be operationalized into a tractable empirical model. First, we will attempt to approximate individualized demands by dividing the equation through by access lines. This is a common approach in the analysis of telephone demand and is discussed in detail by Taylor (1980). Second, in order to avoid any potential problems with multicolinearity, only real own price effects will be considered. Thus, we can transform the above equation into the following:

$$Q' = g\ (\ Y',\ P',\ S\ )$$

Where:

$Q' = Q/A$

$Y' = Y/A$

$P' = P_{MTS}/P_{CPI}$

A = Access Lines

The above specification presents a static view of the interLATA MTS demand. Dynamics can be incorporated into the model by placing a polynomial distributed lag in the price term.

$$Q' = g\ (\ Y',\ \sum_{i=0}^{p} \gamma\ P',\ S\ )$$

Where

$$\gamma_i = \sum_{k=0}^{d} \alpha_k \times j$$

Where we chose the polynomials with length p and degree d. In this model, a second degree polynomial with a five quarter lag has been included in the price term. Income was checked for dynamic effects in the form of a PDL. The PDL term on income proved to be statistically insignificant. A straight five quarter lag appears to be the empirically best method for incorporating income dynamics into the model.

The exact specification for the interLATA MTS demand model can now be formed by:

$$lnQ_t = \beta_0 + \beta_1\ lnY_{t-5} + \sum_{i=0}^{p} \gamma_i\ lnP_t + \sum_{i=1}^{3} \delta_i\ S_t + e_t$$

The above model has been fit to a sample consisting of quarterly data for the period 1987-1992. InterLATA switched access minutes of use, income, and the consumer price index have been provided to

Staff by Southern Bell through various requests for production of documents. All of the data used in the estimation is Florida-specific. The interLATA MTS price index used in this analysis was constructed by Langin-Hooper Associates, Inc. for the state of Florida on behalf of GTEFL, Inc. This data was provided to Staff in Docket 920188-TL. The SAS/ETS statistical software was used in estimating the interLATA MTS demand model.

Empirical Results

The statistical results from the interLATA MTS demand model are presented below:

Ordinary Least Squares Estimates

SSE	0.005377	DFE	12
MSE	0.000448	Root MSE	0.021168
SBC	-80.7011	AIC	-87.3122
Reg Rsq	0.9286	Total Rsq	0.9286
Durbin-Watson	2.0314		

Variable	DF	B Value	Std Error	t Ratio	Approx Prob
Intercept	1	7.57184107	11.167	0.678	0.5106
LN_PRMTS**0	1	-0.29178637	0.110	-2.645	0.0214
LN_PRMTS**1	1	-1.38778E-17	.		
LN_PRMTS**2	1	0.07798319	0.029	2.645	0.0214
LN_FLPOP	1	1.65984908	1.697	0.978	0.3475
L5FLRPI	1	0.55087867	0.340	1.619	0.1315
Q1	1	0.00189980	0.014	0.132	0.8975
Q2	1	0.02292587	0.019	1.208	0.2501
Q3	1	0.02893948	0.014	2.115	0.0560

Restriction	DF	L Value	Std Error	t Ratio	Approx Prob
LN_PRMTS(-1)	-1	0.0005408127	0.001165	0.464	0.6507
LN_PRMTS(6)	-1	-0.000402057	0.001255	-0.320	0.7542

Variable	Parameter Value	Std Error	t Ratio	Approx Prob
LN_PRMTS(0)	-0.07658	0.029	-2.65	0.0214
LN_PRMTS(1)	-0.12763	0.048	-2.65	0.0214
LN_PRMTS(2)	-0.15316	0.058	-2.65	0.0214
LN_PRMTS(3)	-0.15316	0.058	-2.65	0.0214
LN_PRMTS(4)	-0.12763	0.048	-2.65	0.0214
LN_PRMTS(5)	-0.07658	0.029	-2.65	0.0214

```
Estimate of Lag Distribution

Variable      -0.153                                      0

LN_PRMTS(0)  |                        *********************|
LN_PRMTS(1)  |        *************************************|
LN_PRMTS(2)  |*********************************************|
LN_PRMTS(3)  |*********************************************|
LN_PRMTS(4)  |        *************************************|
LN_PRMTS(5)  |                       **********************|
```

```
Estimates of Autocorrelations

Lag    Covariance  Correlation  -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1

0       0.000283   1.000000     |                    |********************|
1      -5.86E-6   -0.020705     |                    |                    |
```

The definitions for the variables presented above are:

LN_PRMTS	=	Logarithm of real interLATA MTS price index;
LN_FLPOP	=	Logarithm of population per access line;
L5FLRPI	=	Logarithm of personal income per access line;
Q1	=	First quarter dummy variable;
Q2	=	Second quarter dummy variable;
Q3	=	Third quarter dummy variable.

The sum of the price terms LN_PRMTS(0) to LN_PRMTS(5) represents the long run price elasticity of -0.68. All of the coefficients on these lagged terms are statistically significant. The estimated income elasticity is within reasonable limits of 0.55. All of the remaining coefficients are also of expected signs and magnitudes. The summary measure of fit, the adjusted R-square, rests at approximately .93, indicating that the above model fits the data well. The Durbin-Watson d statistic rejects the null hypothesis of first order autocorrelation as does a visual inspection of the correlogram.

Conclusions and Recommendations

This analysis of interLATA MTS demand has employed a polynomial distributed lag to capture the dynamic effects that a price change has on the demand for interLATA services. A long run price elasticity of -0.68 is generated from this model. The resulting recommendation is that this long run estimate be used to approximate the effect that a change in switched access prices may have on the demand for interLATA switched access services.

Historical Estimates of Price Elasticity for Intrastate MTS Demand

		Price Elasticity		
State	Dependent Variable	Short Run	Long Run	Form of Model
State A-1	M	-0.16	NA	Linear
State A-2	M/MT	-0.15	-0.22	Log Koyck
State A-3	M/MT	-0.12	NA	Linear
State B-1	M/T	-0.32	-0.60	Log Koyck
State C-1	M	-0.07	-0.14	Log Koyck
State D-1	PDR	-0.35	-0.45	Log Koyck
State E-1	M/MT	-0.03	-0.85	Log F1-ADJ
State E-2	M/MT	-0.21	-0.73	Log Koyck
State E-3	M/MT	-0.17	-1.04	Log F1-ADJ
State E-4	M/T	-0.26	-1.04	Log Koyck
State E-5	M/MT	-0.13	-0.81	Log Koyck
State F-1	PDR/POP	-0.14	-0.62	Log Koyck
State G-1	PDR/POP	-0.16	-0.56	Log Koyck
State H-1	PDR	-0.37	-0.50	Log Koyck
State I-1	M/T	-0.44	-0.84	Log Koyck
State I-2	PDR/POP	-0.29	-0.64	Log Koyck
State I-3	M/T	-0.35	-0.96	Log Koyck
State I-4	M/T	-0.59	-0.59	Double Log
State J-1	PDR/POP	-0.14	-0.23	Log Koyck
State K-1	PDR/T	-0.21	-0.91	Log Koyck
State L-1	M	-0.20	-0.39	Log Koyck
State L-2	M	-0.23	-0.43	Log Koyck
State M-1	PDR/POP	-0.12	-0.69	Log Koyck
State M-2	PDR/POP	-0.17	-0.83	Log Koyck
State N-1	PDR/POP	-0.14	-0.82	Log Koyck
State N-2	PDR	-0.24	-0.86	Log Koyck
State N-3	PDR/POP	-0.15	-0.79	Log Koyck
State N-4	PDR/POP	-0.13	-0.91	Log Koyck
State O-1	PDR/POP	-0.07	-0.84	Log Koyck
State R-1	PDR/POP	-0.21	NA	Linear
State Q-1	PDR	-0.31	-0.37	Log Koyck
Average:		-0.21	-0.67	

Notes: M = Messages; MT = Main Telephones; T= Telephone Less Residential Extensions; PDR = Price Deflated Revenues; POP = Population; F1-Adj = Houthakker-Taylor Flow-Adjustment Model

Source: Lester Taylor, Telecommunications Demand: A Survey and Critique (Ballinger Publishing Company, 1980), pp. 122-124.

Recent Long Distance Demand Studies

Studies of Intrastate InterLATA MTS Demand

Study	Year	State/ Service Territory	Elasticity
Griffen	1982	N/A	-0.60
Breckenfelder	1990	Michigan	-0.54
Duncan & Perry	1992	Wisconsin	-0.40
Trimble	1992	Florida	-0.41
Dismukes	1992	Florida	-0.59
Gatto /*1	1988	Interstate	-0.72
Taylor & Taylor /*1	1993	Interstate	-0.63

Studies of Intrastate IntraLATA MTS Demand

Study	Year	State/ Service Territory	Elasticity
Christensen	1983	Michigan	-0.64
Doherty	1984	New York	-0.28
FPSC	1986	Florida	-0.52
Zona & Jacobs	1990	N/A	-0.47
Monroe & Kling	1990	Michigan	-0.64
Bailey	1991	US West	-0.50
Duncan & Perry	1992	California	-0.38
Perry	1992	Oregon	-0.38
Trimble	1992	Florida	-0.39
Dismukes	1992	Florida	-0.51
Taylor	1993	NTDS	-0.57

/*1 Based upon some interstate switched access data

A Cross-Sectional Model of IntraLATA MTS Demand

Introduction

The econometric analysis of the demand for telecommunications services originated well over twenty years ago. But despite its long history, several of the results of different modeling techniques are still being debated today. Over time, the literature has added a great deal of empirical sophistication but the basic questions regarding price elasticities, access externalities, and option value are still most pervasive. The literature in this area is large, diverse, and unfortunately relatively inaccessible. While some articles have appeared in academic journals, the bulk of the work has been presented in internal telephone company memoranda, conference presentations, and testimony before various state and federal regulators. No attempt is made here to survey the expansive literature. Instead, the reader is encouraged to review the dated, but extensive survey by Taylor (1980).

Probably one of the biggest problems with the empirical analysis of telephone demand is that methodological sophistication has far outpaced improvements in data collection. The sole exception may be in studies of basic local service and access. Problems with data collection and availability are particularly apparent in long distance demand studies (both interLATA and intraLATA). Most empirical analyses of long distance demand are based upon a very limited time series data set -- comprising at best, ten years worth of quarterly data.

The data employed in this analysis is cross-sectional in nature. The data consists of intraLATA MTS traffic on 2,813 long distance routes in the Southern Bell service territory for the year 1990. This data has been matched to socio-economic data obtained in the 1990 census. A long distance demand model with the richness of many of the local access model is then posited. The results of this model are then used to determine the amount of stimulation which may arise from any MTS reductions which could be proposed in Docket 920260-TL.

Model Specification and Data

The literature in the demand for telecommunications services has traditionally made a strong distinction between access and usage. Since the purpose of this analysis is to explain the determinants of intraLATA long distance calling (e.g. usage), the access component of demand will be ignored. Instead, we will concentrate on a general specification for intraLATA MTS demand.

$$Q_{ij} = f(p_{ij}, Y_{ij}, D_{ij}, Z_{ij})$$

Here, the index i = 1, ..., n represents points of origin, and the index j = 1, ..., k represents points of termination. Q_{ij} represents the quantity of calling in terms of minutes of use and is posited to be a function of prices (p_{ij}), income (Y_{ij}), distance (D_{ij}), and a vector of socio-economic variables (Z_{ij}). Prices in this model are merely the averaged revenues per minute of use per route.

Two slight modifications to the above specification need to be made. First, all of the observations will be scaled to the number of the access lines in the originating exchange. This places the analysis on an approximate individualized basis as described by Taylor (1980). Second, both prices and income need to be placed upon a real purchasing power basis. To accomplish this, prices and income have been adjusted for cost of living differences throughout the state of Florida. This has been done by dividing prices by a Florida-specific cost of living price index[1].

The vector Z_{ij} representing socio-economic can be expanded to reflect its component parts. This vector is comprised of the number of rural residents (R_{ij}), the number of minorities (M_{ij}), the number of high school graduates (H_{ij}), the number of college graduates (C_{ij}), the number of non-English speaking residents (N_{ij}), the average household size (A_{ij}), and the number of senior citizens (S_{ij}). We can now expand our calling function outlined above to:

$$Q_{ij} = f(\, p_{ij}\, , Y_{ij}\, , D_{ij}\, , R_{ij}\, , M_{ij}\, , H_{ij}\, , C_{ij}\, , N_{ij}\, , A_{ij}\, , S_{ij}\, , O_{ij}\,)$$

Since several of the routes in this analysis have optional calling plans (OCPs) in place, an indicator variable (O_{ij}) has been included in the above specification to identify whether or not a particular route has an OCP. With the above preliminaries complete, we can now specify the exact empirical model for the analysis of intraLATA MTS demand.

$$\begin{aligned} \ln Q_{ij} = \beta_0 + \beta_1 \ln p_{ij} + \beta_2 \ln Y_{ij} + \beta_3 \ln D_{ij} + \beta_4 \ln R_{ij} + \beta_5 \ln M_{ij} + \beta_6 \ln H_{ij} + \beta_7 \ln C_{ij} \\ + \beta_8 \ln N_{ij} + \beta_9 \ln A_{ij} + \beta_{10} \ln S_{ij} + \beta_{11} \ln O_{ij} + e_{ij} \end{aligned}$$

The above model has been fit to 1990 intraLATA MTS traffic data for 2,813 routes in the Southern Bell service territory. Each route was matched to its corresponding county, from which socio-economic data was matched. The source of the socio-economic data is the <u>Florida Statistical Abstract</u> and the 1990 US Census. The SAS statistical software was used for estimation purposes.

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[1]The Florida price index (FPI) is a set of numbers which reflects the price level in each county relative to the population weighted state average for one point in time. The FPI measures differences from place to place in contrast with the U.S. CPI which measures changes over time. So in this sense, the FPI measures the relative cost of living. State of Florida, Office of the Governor, Office of Planning and Budgeting, <u>Florida Price Level Index</u>, 1990.

Empirical Results

The statistical results from the intraLATA MTS demand model are presented below:

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob > F
Model	11	12257.76824	1114.34257	485.716	0.0000
Error	2801	6426.13433	2.29423		
C Total	2812	18683.90257			

Root MSE	1.51467	R-square	0.6561
Dep Mean	9.87571	Adj R-sq	0.6547
C.V.	15.33733		

Parameter Estimates

Variable	DF	Parameter Estimate	Std Error	t for H0: Parameter=0	Prob > |T|
INTERCEP	1	24.856196	1.71253708	14.514	0.0001
LN_RMOUP	1	-0.561802	0.09419387	-5.964	0.0001
LN_RPI	1	0.965133	0.16376185	5.894	0.0001
LN_RUR	1	-0.302926	0.05585606	-5.423	0.0001
LN_MINO	1	-0.243266	0.06243660	-3.896	0.0001
OCPID	1	1.872878	0.18416199	10.170	0.0001
LN_MILE	1	-1.913505	0.05767644	-33.177	0.0001
LN_HSGRD	1	-2.990586	0.20163250	-14.832	0.0001
LN_CLGRD	1	0.481873	0.12323150	3.910	0.0001
LN_NSEN	1	1.927506	0.18186627	10.598	0.0001
LN_AHHS	1	-7.926051	0.64917823	-12.209	0.0001
LN_PG65	1	-0.851608	0.15666733	-5.436	0.0001

The definitions for the variables presented above are:

LN_RMOUP = logarithm of average price;
LN_RPI = logarithm of personal income;
LN_RUR = logarithm of rural population;
LN_MINO = logarithm of minority population;
OCPID = OCP indicator variable;
LN_MILE = logarithm of distance;
LN_HSGRD = logarithm of high school graduates;
LN_CLGRD = logarithm of college graduates;
LN_NSEN = logarithm of non-English speaking residents;
LN_AHHS = logarithm of average household size;
LN_PG65 = logarithm of senior population.

The coefficient on the LN_RMOUP term indicates that the price elasticity of demand for Southern Bell intraLATA MTS is -0.56. Income elasticity, represented by the coefficient on the LN_RPI term is 0.96. All of the remaining coefficients are significant and of expected signs with the exception of the negative term on the number of high school graduates. The adjusted R square for the model is 0.65 -- which is exceptionally high for cross sectional data of this size and variability. Tests for heteroskedasticity proved to be negative.

Conclusions and Recommendations

This analysis of intraLATA MTS demand has used ordinary least squares on a cross sectional data set of 2,817 observations. The model includes traditional variables such as price, and income, as well as other socio-economic information such as the number of minorities, educational status, etc. Thus, this analysis departs from earlier work in that it emphasizes data quality instead of dense empirical methodology. The recommendations from this analysis is that a -0.56 price elasticity should be used for intraLATA MTS demand.

Analysis of Switched Access Stimulation Under Different Implementation Assumptions

	(a)	(b)	(c)	(d)	(e)	(f)	(g)
	Elasticity	Duration	Cost Flow Through	Market Share Flow Through	Annual Proposed Revenue With Stimulation	Net Change	Difference From Company Assumptions
1)	-0.34	Short Run	50%	0%	$256,150,100	($9,987,600)	$0
2)	-0.34	Short Run	50%	62%	255,379,686	(10,758,011)	767,241
3)	-0.34	Short Run	60%	62%	255,629,062	(10,508,636)	517,866
4)	-0.34	Short Run	70%	62%	255,879,392	(10,258,306)	267,536
5)	-0.49	Short Run	50%	62%	255,616,757	(10,520,940)	530,170
6)	-0.49	Short Run	60%	62%	255,914,255	(10,223,443)	232,673
7)	-0.49	Short Run	70%	62%	256,150,100	(9,924,770)	(66,019)
8)	-0.68	Long Run	50%	62%	256,150,100	(9,548,345)	(442,425)
9)	-0.68	Long Run	60%	62%	257,084,830	(9,052,867)	(937,903)
10)	-0.68	Long Run	70%	62%	257,582,679	(8,555,019)	(1,435,751)