Gulf Power

Robert L. McGee, Jr.
Regulatory & Pricing Manager

One Energy Place
Pensacola, FL 32520-0780
850 444 6530 tel
850 444 6026 fax
rlmcgee@southernco.com

February 8, 2017

VIA ELECTRONIC FILING

Ms. Carlotta Stauffer
Commission Clerk
Florida Public Service Commission
2540 Shumard Oak Boulevard
Tallahassee, Florida 32399-0850

Re: Petition for rate increase by Gulf Power Company, Docket No. 160186-EI

Dear Ms. Stauffer:

Attached is the Rebuttal Testimony and Exhibit of Gulf Power Company Witness Daniel S. Merilatt.

(Document 11 of 16)

Sincerely,

Robert L. McGee, Jr.
Regulatory & Pricing Manager

BEFORE THE

FLORIDA PUBLIC SERVICE COMMISSION

DOCKET NO. 160186-EI

REBUTTAL TESTIMONY AND EXHIBIT

OF

DANIEL S. MERILATT

GULF POWER COMPANY

Before the Florida Public Service Commission
Rebuttal Testimony of
Daniel S. Merilatt
Docket No. 160186-EI
In Support of Rate Relief
Date of Filing: February 8, 2017

Q. Please state your name, business address and occupation.

A. My name is Dan Merilatt. My business address is 369 Altara Drive, St. Augustine, FL 32086. I am a professional economic analyst.

Q. Please describe your background and experience.

A. My experience within the utility industry began nearly 40 years ago at the Energy Resources Center of the University of Illinois at Chicago. I then accepted employment with the Illinois Commerce Commission in its Policy Analysis and Research Division.

Much of my experience was with the Southern Company, having started at Georgia Power in 1983. I worked at Georgia Power for 11 years in various analytical capacities within the marketing organization. In 1994, I transferred to Gulf Power Company where I was responsible for demand-side program evaluation and the economic content of all regulatory filings. In December 1997, I was named manager of Southern Company Services' Market Forecasting Department. In this role, I was responsible for the official Southern Company load and energy planning forecasts produced by our team for each of the then five operating subsidiaries.

I left Southern Company in June of 2001 for a position with GoodCents Solutions. At GoodCents, I helped design, propose, and promote demand response programs for electric utilities. I also led analytical consulting projects in the areas of forecasting, rate design and analysis, and program design and evaluation.

I joined Cooper Power Systems in April of 2007 as Manager of Demand Response Programs. I retired from Cooper Power Systems in 2011, but I have continued to accept occasional consulting projects and I continue to teach part-time at St. Johns River State College.

In parallel with my career in industry, I have consistently taught at local colleges and universities on the topics of economics, statistics, and quantitative methods at the undergraduate and MBA levels.

I have earned a BA in Economics from the University of Colorado, an MA in Economics from DePaul University, and have pursued doctoral work in economics at the University of Chicago. My full resume is attached as Exhibit DSM-1.

Q. Have you previously filed testimony in this proceeding?

A. No.

Q. For whom are you appearing as a witness?

A. I am appearing as a witness for Gulf Power Company (Gulf or the Company).

Q. What is the purpose of your rebuttal testimony?

A. The purpose of this rebuttal testimony is to reply to certain issues raised in one or more of the direct testimonies of Southern Alliance for Clean Energy and the League of Women Voters of Florida Witness Karl R. Rábago, Sierra Club Witness Jeffery M. Loiter, and Staff Witness Judy G. Harlow.

Q. Are you sponsoring any exhibits?

A. Yes. I am sponsoring two exhibits. Exhibit DSM-1 is my resume. Exhibit DSM-2 is an article by Ross C. Eriksson, David L. Kaserman, and John W. Mayo entitled "Targeted and Untargeted Subsidy Schemes: Evidence from Postdivestiture Efforts to Promote Universal Telephone Service."

Q. What are the issues to which you will be responding?

A. There are three central issues raised in whole or in part by one or more of the witnesses named above. These issues are:

1. Whether Gulf Power's proposed residential rate restructuring is "regressive," and will harm low income customers; (Rábago p. 5) (Loiter p. 3);

2. Whether Gulf Power's proposed residential rate restructuring will deprive residential customers of control over their monthly bill; (Rábago p. 29) (Loiter p. 3); and,

3. Whether Gulf Power's proposed residential rate restructuring will encourage greater electricity consumption, will discourage energy efficiency and conservation, and will penalize those who have made previous investments in energy efficiency and conservation. (Rábago p. 30) (Loiter p. 13) (Harlow p. 8)

I may along the way also respond to one or more points of secondary or tertiary importance or relevance that have been raised but my main focus is on the three issues enumerated above.

Q. Do you have a rate design philosophy that underpins your responses to the issues enumerated above?

A. Yes. In general, there are dual objectives in the design of electricity rates: equity and economic efficiency. Bonbright (1961 p. 292), who Witness Rábago invokes in his testimony, agrees with this and adds one other as a prerequisite to the other two:

> Three [objectives] may be called primary….They are (a) the revenue-requirement or financial need objective, which takes the form of a fair-return standard with respect to private utility companies; (b) the fair-cost apportionment objective, which invokes the principle that the burden of meeting total revenue requirements must be distributed fairly among the beneficiaries of the service; and (c) the optimum-use or consumer-rationing objective, under which the rates are designed to

> discourage the wasteful use of public utility services while promoting all use that is economically justified in view of the relationships between costs incurred and benefits received.

Regulatory authorities have a ***dual*** objective. Achieving some definition of equity or fairness without furthering economic efficiency is just as unacceptable as furthering economic efficiency without regard to equity concerns. A balance must be sought.

Q. Please elaborate.

A. The equity objective entails that the costs of producing electricity be fairly attributed and apportioned among the utility's customers. According to fundamental notions of fairness that are as I understand it, made explicit in the law of the various states, rates must be just, reasonable, and sufficient. The regulatory authority develops a total revenue target that will produce a level of shareholder return that is judged to be equitable to both the utility and to its customers. By the way, this fact in my judgment renders Witness Rábago's numerous references to Gulf's proposed changes as productive of "monopoly rents" spurious.

Having determined the total revenue target, the regulatory authority must then apportion it to the various classes of consumers to arrive at their respective contributions to the total revenue target. The determination of this revenue target (total revenue requirements) and its distribution among the customer classes is the principal means by which the equity objective is

achieved. As Bonbright (1961, p. 295) observed and reiterated in Bonbright, Danielson, and Kamerschen (1988, p. 390):

> As to the issue of fairness, a cost-price standard probably enjoys more wide spread acceptance than any other standard except for the even more popular tendency to identify whatever is fair with whatever is in one's self-interest.

Since Gulf Power is proposing a rate restructuring that is more reflective of cost-causation as evidenced by its cost of service study and because Gulf's expected revenue recovery will be limited to the revenue requirement ultimately decided by this Commission, Gulf's self-interest is effectively constrained by the regulatory process. I suggest that the self-interests of the intervenors be kept in mind when examining and evaluating their objections to the Company's proposed restructuring so that their self-interests will also be effectively constrained.

Q. And as to economic efficiency?

A. This equally important objective for the design of electricity rates involves the efficient allocation of society's scarce resources among alternative uses. At the most general level, an allocation of resources toward the production of goods and services is economically efficient when the additional cost of supplying a bit more electricity is just balanced by the additional value or benefit of its consumption.

While this definition of economic efficiency has been given rigorous theoretical elucidation, that articulation does not make its practical achievement very much easier for regulatory commissions. Still, prices provide the primary signals by which resources are directed toward their highest valued uses. Regulatory commissions have the responsibility to insure that the rate packages they approve perform this signaling function. Customers need to know whether it is relatively cheap or expensive to satisfy their demands for electricity and other things. Prices reflective of the marginal cost of supplying electricity provide those economic efficiency enhancing signals. Customers can compare the extra benefits from consuming a bit more or less electricity with the extra cost spent or saved by doing so. In that way no unexploited gains from voluntary exchange are left wanting.

Accepting the economic efficiency arguments for marginal cost pricing is much easier theoretically than practically. As Charles J. Cicchetti, William J. Gillen, and Paul Smolensky stated on page 135 in The Marginal Cost and Pricing of Electricity: An Applied Approach, a report to the National Science Foundation dated June 1976:

> The concept of marginal cost is itself a fairly simple one. The process of supplying electricity however, is rather complicated. Accordingly, the structure of marginal cost of electricity is also rather complicated. Inevitably, electricity tariffs must be modified and

simplified from actual marginal costs if tariffs are to perform the function of being price-signals.

Q. You stated that regulatory authorities when confronting the dual objectives of equity and economic efficiency in their rate and rate structure deliberations have a responsibility for balancing these objectives. Please elaborate.

A. A simple and widespread understanding of fair is if you by your actions cause a cost to be incurred, it is your responsibility to pay that cost. Therefore, the notion of cost-causation came to the fore. With that came the idea of studiously examining a utility's costs and dividing them to the extent possible into those types of costs that vary primarily with (1) the number of customers connected to the system; (2) the amount of capacity needed to serve the totality of connected customers; and (3) the amount of energy supplied to the totality of connected customers. The three categories of costs are then allocated to the various customer classes using methods that have been approved by the regulatory body.

Once costs have been fully distributed and adjusted so that when summed up, the total revenue requirement is just satisfied, rates are designed to recover these three categories of cost. Some of the rates will consist of a base charge, a schedule of demand charges, and a schedule of energy charges. The demand and energy schedules are often designed so that the last increment of demand or the last increment of supply is priced to reflect the marginal cost of supplying that increment. Some rates will drop one or

more of the components and subsume the costs attributable to the withdrawn components into the prices of the remaining billing determinants. Some rates will display seasonal, time-of-day, and even hourly variations in order to better balance the equity goal of cost-causation with the economic efficiency goal of proper price signaling.

The rate structures represented by the suite of rate and rider options offered to different customer classes or groups of customers within a class are meant to simultaneously balance the two objectives of equity and economic efficiency.

While the "optimal" balance is an elusive target, it is nevertheless incumbent that we continually strive to improve the status quo. It is my view that Gulf Power's rate restructuring proposal if approved will simultaneously reduce some of the unfairness in the current rate structure and improve the price signaling function of its rates.

Q. Witnesses Rábago and Loiter assert that Gulf's proposed redesign of the RS rate will harm those with low incomes. Is that true?

A. No. The current RS rate design, by assigning all capacity-related costs caused by residential customers on that rate to the energy charge creates a subsidy flowing from high-use customers toward low-use customers. It is a subsidy that is ***not specifically*** targeted for lower income customers.

Gulf Power is cognizant of and sensitive to the often times temporary but unfortunate circumstances that customers sometimes experience and it has many options, tools, and policies in place to help them out. In addition, in this proceeding, Gulf is proposing to reduce the existing RS subsidy that is *not specifically* targeted for low income customers and offer a new subsidy that is *specifically* targeted for them; the Low Income Rider to be known as a Customer Assistance Program (CAP) credit.

Q. Witnesses Rábago and Loiter are critical of the Company's proposed subsidy which is targeted for low income customers. (Rábago p. 4) (Loiter p. 4) Why is it better to have targeted subsidies?

A. In answer to that question, I would like to quote from and refer to an article by Ross C. Eriksson, David L. Kaserman, and John W. Mayo entitled "Targeted and Untargeted Subsidy Schemes: Evidence from Postdivestiture Efforts to Promote Universal Telephone Service" and published in the Journal of Law and Economics, Vol. 41, No. 2, October 1998, pp. 477- 502.

> Normative economic analysis traditionally has pointed toward the merits of policies wherein prices reflect the economic cost of providing a good or service. Subsidization policies are, nevertheless, common in a variety of industries. Where such subsidies occur, economists have long advocated targeting those subsidy flows to maximize their effectiveness and minimizing the allocative inefficiency caused by financing of the subsidy.

The article goes on to provide empirical evidence to support the long-held contention of economists that targeted subsidies accomplish their purposes better than untargeted or less targeted ones that only do so incidentally if at all and perhaps even subsidizing some who do not merit it. This article is attached as Exhibit DSM-2.

As I stated earlier, in furthering the economic-efficiency goal, regulatory commissions pay attention to a rate's price-signaling function, i.e. directing resources toward their higher valued uses. Pure allocative efficiency is disturbed less by targeted subsidies than by untargeted subsidies. So, if subsidies are desired, economists will universally recommend targeting them. This is exactly what the proposed redesign of the RS rate and the concomitant proposed Low Income Rider will better accomplish.

Q. Witnesses Rábago and Loiter also assert that Gulf Power's proposed residential rate restructuring will deprive residential customers of control over their monthly bill. Is that the case?

A. To me, this criticism is confounding. What I believe is meant by those making this criticism is that the base charge or that part of the bill that is fixed will be a greater fraction of the total bill than under the current RS. While that is true, that does not mean that customers have less control over their bill.

If customers use less electricity, their bill will be lower than if they don't. The implication is they have control. If some customers decide that the higher

base charge is, for them, too high, they have other residential rates and riders they can elect that have lower base charges and still give them control of their bill. Some customers prefer little to no control in this sense of the word and are willing to pay a bit more to ensure a fixed monthly or flat electric bill. Some customers may prefer the proposed residential three-part rate which charges them directly for the capacity-related costs they place on the system and in exchange get a lower base and a lower electric energy charge. Some customers may prefer a seasonally-differentiated time-of-use rate with a real-time critical peak price. To benefit most from this rate, customers will need to practice very active day-to-day and hour-to-hour control.

In short, Gulf Power's suite of residential rates and riders offers customers as much or as little control over their bills as they desire. In fact, it is because Gulf desires to meet its customers' wants subject only to the requirement that customers pay for the benefits they receive, that it offers so many pricing options.

Q. How do you respond to the third issue asserted that Gulf's proposed residential rate restructuring encourages greater electricity consumption, discourages energy efficiency and conservation, and penalizes those who have made previous investments in energy efficiency and conservation?

A. I will respond to each of those assertions separately.

Q. Does Gulf Power's proposed residential rate restructuring encourage greater electricity consumption?

A. The implication of the assertion is that if it does, then that is a bad thing. Consuming more electricity is only a bad thing, if the customer's perceived added benefit that attends that added consumption is less than the added cost of making that added electricity available to him. So long as customers value the added kWh consumption more highly than the marginal cost of supplying it, then that extra consumption is socially desirable—a good thing not a bad thing.

Q. But, will the residential rate restructuring result in greater electricity sales?

A. The rate restructuring is taking place simultaneously with a proposed increase in revenue requirements. So, at least two things are changing: (1) the total bill is on average rising and (2) the structure of the residential rate offerings is being altered. I will address each of these in turn.

(1) In response only to the increase in the total bill, the law of demand applies and, all other things equal, the amount of electricity demanded will decline. Note that increases in consumer incomes, increases in the prices of other sources of energy, decreasing consumer interest in conservation, and many other things that might happen simultaneously with the increase in the total bill, could partially or wholly offset the expected decrease in kWh consumption.

(2) Will the restructuring of the RS rate to include a higher base charge and a lower energy charge result in more kWh consumption, other things equal?

The answer to this must be divided into two parts. First, will the increase in the base charge increase kWh consumption? The answer is clearly no. Many customer responses are triggered by changes in their total bill. So, by the law of demand for those customers whose average total bill increases, their consumption will be curtailed, others things equal.

For those customers whose responses are triggered by changes in the total bill and for whom that total declines, other things being equal their consumption will increase, again by the law of demand.

For those customers whose response is triggered by declines in the marginal price they pay per kWh then, other things being equal, they will find it beneficial to increase their consumption of electricity, again by the law of demand.

While it cannot be known beforehand with certainty how all of this will net out, I do know that however it nets out, customers will be better able to weigh incremental benefits with incremental costs, thereby furthering economic efficiency. The result will better reflect cost-causation thereby furthering equity.

Q. Does Gulf Power's proposed residential rate restructuring discourage energy efficiency and conservation?

A. Assigning a smaller proportion of capacity-related demand costs to the energy price in the new RS rate, will result in a lower per unit marginal price for electric energy but one that is still higher than marginal cost. Consequently, it may well be that fewer *economically inefficient* but energy efficient options may be chosen by consumers. That is not a bad thing. The dual goal for the regulatory authority is equity and economic efficiency. They should not want consumers to choose things that cost society more than it values them. Moving the incremental electric energy price closer to marginal cost means that consumers will be better able to evaluate the extra benefits associated with energy efficiency and conservation alternatives against the electricity cost saving those choices will elicit.

Gulf Power's goal is not to discourage energy efficiency or conservation but to provide its customers with price signals that enable them to rationally evaluate these options. Consumers acting on their own behalf are better able to evaluate the relative costs and benefits of their own actions than is a central authority.

Q. Does Gulf Power's proposed residential rate restructuring penalize those who have made previous investments in energy efficiency and conservation?

A. I suppose many of you might have owned a home in 2007. If it was then valued at, say, $300,000, then by 2011, that same home might have been

valued in the market at only $150,000. Did the housing market collapse during the Great Recession penalize those who had purchased homes prior to the collapse? Yes. What about those who purchased homes during the depths of the housing market collapse? Did the rebound in the housing market benefit them? Again, yes. The point is that prices change and as they change the value of people's portfolio of assets change in value. Sometimes going up and sometimes going down. There is nothing that I know of that says that the value of investments in energy efficiency and conservation should somehow be insulated from changes in market conditions.

Gulf's proposed restructuring of its residential rates will better align costs with the causes of those costs and will enhance the signaling function of electricity prices. This, relative to the status quo, is a preferable state of affairs. If increased payback or fewer cost-effective energy efficiency or conservation alternatives result from achieving the higher goals of improved equity and economic efficiency, well, then we will be better off.

Q. Does that conclude your testimony?

A. Yes.

AFFIDAVIT

STATE OF FLORIDA)
)
COUNTY OF ST. JOHNS)

Docket No. 160186-EI

Before me the undersigned authority, personally appeared Daniel S. Merilatt, who being first duly sworn, deposes, and says that he is an Economics Instructor and Consultant to the Electric Utility Industry, and that the foregoing is true and correct to the best of his knowledge, information, and belief. He is personally known to me.

s/ Daniel S. Merilatt

Daniel S. Merilatt
Economics Instructor and Consultant

Sworn to and subscribed before me this 2nd day of Feb., 2017.

Kimberly Bunnell

Notary Public, State of Florida at Large

Commission No. FF 906249

My Commission Expires 08/04/2019

Kimberly Bunnell
State of Florida
My Commission Expires 08/04/2019
Commission No. FF 906249

Exhibit

Resume of Daniel Merilatt

Summary

Professional economist and manager with broad experience in the electric utility industry:

- Designing, implementing, and evaluating energy efficiency, conservation, and demand response programs for electric utilities
- Preparation of and testimony for regulatory approval — integrated resource plans, demand-side management plans, and rates and rate cases
- Pricing and rates specialist, with experience designing innovative rates and riders
- Utility planning manager and skilled professional in load, energy, and price forecasting

Taught graduate and undergraduate economics as an adjunct professor at seven different colleges or universities in Illinois, Georgia, and Florida

Specialties

Economic analysis, demand-side management, demand response, forecasting, model building, cost-benefit analysis, pricing and rate design, market research, competitor analysis, electric utility planning

Professional Full-Time Work Experience

April 2007— June 2011
Cooper Power Systems
Minneapolis, MN

Manager – Demand Response Programs
Designed, proposed, and promoted demand response programs for electric utilities; led analytical projects in the areas of demand response program design and evaluation; acted as one of Cooper's subject matter experts at industry conventions, workshops, and one-on-one with utility clients

June 2001— April 2007
GoodCents Solutions
Atlanta, GA

Vice President Demand-Side Program Services
Designed, proposed, and promoted demand response programs for electric utilities; led analytical consulting projects in the areas of forecasting, rate design and analysis, and program evaluation; provided expert witness services for electric utilities
Dec 1997— June 2001

Southern Company
Atlanta, GA

Manager Market Forecasting
Managed a staff of nine, including five economists, in the preparation of Southern Company's annual load and energy forecast and those for each of its five operating company subsidiaries

Dec 1994— Dec 1997
Gulf Power
Pensacola, FL

Marketing Specialist/Chief Economist
Managed the demand-side program evaluation and the economic content for Gulf Power's various rate and demand-side management regulatory filings; researched and reported on the changing economic and market conditions within Gulf Power's service territory—Gulf Power is a subsidiary of Southern Company

Nov 1983— Dec 1994
Georgia Power
Atlanta, GA

Team Leader/Senior Marketing Specialist
Led Georgia Power's Competitor Information and Analysis team; responsible for forecasting electricity pricing, rate analyses, and competitive assessments for nearly 100 electric cooperatives and municipals operating in the state 1987-1994
Other Positions with Georgia Power:
Senior Economic Analyst (Economic Evaluation Department) 1985-1987
Senior Research Analyst (Rates Department) 1983-1985

July 1982— Nov 1983
Illinois Commerce Com.
Springfield, IL

Economic Analyst
Investigated and analyzed and testified to questions with policy implications for the regulation of public utilities in Illinois
July 1981— July 1982
DeVry Institute

Chicago, IL

Assistant Professor
Taught economics and business to undergraduate, degree-seeking students

Aug 1979— Aug 1981
Univ. of Illinois
Chicago, IL

Research Economist
Employed by the Energy Resources Center of the University; I contributed the economic analysis to the energy questions we were asked to research

Professional Part-Time Teaching & Consulting Experience

Jan. 2015 to Present
St. Johns River State College
St. Augustine, Fl.
Part-time Economics instructor, Macro and Microeconomics

Oct. 2013 to Oct 2015
St. Johns County Library
St. Augustin, Fl.
Part-time Library Assistant

Apr 2013 to Aug 2013
GoodCents Solutions
Atlanta, GA
Economic Consultant: market evaluation and cost-benefit analysis for a conservation program implemented by GoodCents for a utility client in Indiana

Aug 2012 to Jan 2013
Consert Inc.
San Antonio, TX
Economic Consultant: built a market evaluation and cost-benefit analysis model for Consert and performed a competitor profiling project for them

January 2012
Cooper Power Systems
Minneapolis, MN

Economic Consultant: market evaluation and cost-benefit analysis for a prospective Cooper Power System's client

Aug 1997— Dec 1998
Pensacola Junior College
Pensacola, FL
Adjunct Professor/Economics

Sep 1993— Dec 1994
Keller Graduate School of Management
Atlanta, GA
Adjunct Professor/Statistics

Sep 1985— Dec 1994
Georgia State University
Atlanta, GA
Adjunct Professor/Economics: taught undergraduate and MBA courses in economics, econometrics, and quantitative methods for business and economics

Aug 1992— Dec 1992
Freeport Power
Freeport, Bahamas
Consultant: developed an analysis of the competitive position and economic development potential for the Bahamas

Apr 1986— Aug 1986
Integrated Communications Systems, Inc.
Atlanta, GA
Consultant: developed a proposal for a commercial/industrial field test for the real-time pricing of electricity

Fall 1983
Lincoln Land CC.
Springfield, IL
Adjunct Professor/Economics
September 1978 — August 1981
DePaul University
Chicago, IL
Adjunct Professor/Economics

Education

Fall 1976— Spring 1978
University of Chicago
Chicago, IL
PhD Studies—Economics—No Degree

Fall 1974— Spring 1976
DePaul University
Chicago, IL
Master of Arts Degree with Distinction—Economics

Fall 1971— Spring 1974
University of Colorado
Denver, CO
Bachelor of Arts Degree with Highest Honors--Economics

Awards

Pi Gamma Mu, May 1976
Phi Beta Kappa, December 1973

Publications (Selected Papers & Testimony)

Prepared Rebuttal Testimony concerning the Economic Efficiency of Gulf Power's Proposed Negotiated Rate Rider, before the Florida PSC, Docket No. 951161-EI, February 21, 1996.

Direct Testimony concerning the Economic Efficiency of Gulf Power's Proposed Negotiated Rate Rider, before the Florida Public Service Commission, Docket No. 951161-EI, January 19, 1996.

"Integrated Energy Planning: Supply Options, Customer Value, Demand Options", Georgia Public Service Commission's Workshop on Least-Cost Planning, December 1988, Athens, Ga.

"Real Time Pricing and Customer Interaction: The Georgia Power Experience", Edison Electric Institute Rate Research Committee and N.E.R.A. Marginal Cost Working Group, April, 1987, Williamsburg, Va.; 13th Energy Technology Conference, March 17, 1986, Washington, D.C.

Direct Testimony in the Matter of Efficient Capital Recovery Methods Under Inflationary Conditions, before the Illinois Commerce Commission, Docket No. 82 0892, June 1983.

"Prospects for the Electric Vehicle in the Chicago Area, 1980-2000"; Prepared for the Illinois Institute for Natural Resources, April 1981; with P.S. Galen, S. Jansen, S. Soot, and P. Sudhindra.; also presented to the 11th Annual Meeting of the Illinois Economics Association, October 30, 1981, St. Louis, Mo.

"Costs and Benefits: Nuclear vs. Coal", Chapter 6 of Nuclear Energy: Risks and Benefits, Ohio River Basin Energy Study Phase II, USEPA, December 1980, S.Jansen editor.
"Future Power Plant Availability Improvement", U.S.Department of Energy and the Illinois Commerce Commission, June 1980; with P.Sudhindra, C.Bays, and J.Harnett.

The Booth School of Business, University of Chicago

Targeted and Untargeted Subsidy Schemes: Evidence from Postdivestiture Efforts to Promote Universal Telephone Service

Author(s): Ross C. Eriksson, David L. Kaserman and John W. Mayo

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TARGETED AND UNTARGETED SUBSIDY SCHEMES: EVIDENCE FROM POSTDIVESTITURE EFFORTS TO PROMOTE UNIVERSAL TELEPHONE SERVICE*

ROSS C. ERIKSSON
University of Tennessee

DAVID L. KASERMAN
Auburn University

and

JOHN W. MAYO
Georgetown University

Abstract

Normative economic analysis traditionally has pointed toward the merits of policies wherein prices reflect the economic cost of providing a good or service. Subsidization policies are, nevertheless, common in a variety of industries. Where such subsidies occur, economists have long advocated targeting those subsidy flows to maximize their effectiveness and minimizing the allocative inefficiency caused by financing of the subsidy. Despite the apparent consensus in economic thought on this subject, empirical evidence of the relative effectiveness of targeted versus untargeted subsidies to date has been lacking. In this article, we address this lacuna by examining a set of large-scale targeted and untargeted subsidy flows that have developed side by side, each with the same nominal policy goal—promoting universal telephone service. Specifically, we test empirically the relative contributions of the alternative subsidy mechanisms in promoting the policy goal of maximizing subscription to the public switched telephone network. Our analysis indicates that targeted subsidy programs are considerably more effective than untargeted subsidies in promoting the goal of universal telephone service. Moreover, our results indicate that the financing mechanism used to generate subsidy flows may seriously erode the effectiveness of either targeted or untargeted subsidy policies.

I. Introduction

In the absence of a significant market failure, the central normative message of microeconomics is that prices generally should be established at

* An earlier version of this article was presented at the fourteenth annual Advanced Workshop in Regulation and Public Utility Economics. The authors would like to thank Alexander Belinfante, William Baumol, Bill Fox, Darlene Hannon, Stephen Mayo, Bruce Mottern, Pat Parker, David Sappington, and seminar participants at Georgetown University, Vanderbilt University, Washington University, and the University of Tennessee for helpful comments in the formulation and revision of this article. Finally, we are especially grateful to Sam Peltzman, an anonymous associate editor of the journal, and an anonymous referee for enabling several substantive improvements to the article. The usual caveat applies.

[*Journal of Law and Economics*, vol. XLI (October 1998)]

their respective marginal costs. In regulated industries, however, cross-subsidization policies often lead to prices that deviate systematically from these prescribed levels. Such deviations also occur in nonregulated industries where, for any of a variety of reasons, subsidization policies are implemented. These policies include a variety of in-kind transfer payments (for example, food stamps and housing subsidies) and overt subsidies (for example, agricultural subsidies). Where such subsidies occur, economists have long advocated targeting those subsidy flows in a way that minimizes the total amount of allocative inefficiency caused by nonmarginal cost pricing.[1]

In particular, it has been argued that failure to target subsidy recipients is economically wasteful in at least two respects.[2] First, such failure means that some individuals who do not ''need'' the subsidy to achieve the desired policy goal are unnecessary recipients. From a policy perspective, this is pure waste because the explicit or implicit expenditure on the untargeted individual fails to promote the desired end. Second, because failure to target the subsidy increases the amount of funds required to obtain a given effect, it also magnifies the economic distortions created in the sector generating these funds. If, for instance, tax revenues are the source of the financing, untargeted subsidies require higher levels of taxation than are necessary to achieve the desired policy objective. If, alternatively, the subsidy is financed through distortionary pricing of a related good or service, then the allocative inefficiencies imposed on these goods or services are, again, higher than necessary.

Despite repeated calls by economists for the targeting of subsidies, a variety of untargeted subsidy mechanisms remain in place. The perpetuation of such untargeted subsidy flows may be attributable to a variety of factors. For instance, untargeted subsidies may stem from the political benefits that are thought to be forthcoming as a result.[3] Alternatively, it is possible that

[1] See, for example, Alfred E. Kahn, The Road to More Intelligent Telephone Pricing, 1 Yale J. on Reg. 139 (1984); David L. Kaserman & John W. Mayo, Cross-Subsidies in Telecommunications: Roadblocks on the Road to More Intelligent Telephone Pricing, 11 Yale J. on Reg. 119 (1994); and Jerry Hausman, Rebuttal Testimony, Case No. 8659, Maryland Public Service Commission, October 26, 1994.

[2] Criticism of untargeted subsidy mechanisms dates back at least as far as Jules Dupuit, On the Measurement of the Utility of Public Works, in International Economic Papers No. 2, at 83–110 (R. H. Barback trans. 1952). See Robert B. Ekelund, Jules Dupuit and the Early Theory of Marginal Cost Pricing, 76 J. Pol. Econ. 462 (1968).

[3] The notion that the benefits of regulation may be used for the political gain of policy makers dates back to the seminal work of George Stigler, The Theory of Economic Regulation, 2 Bell J. Econ. 3 (1971); Richard A. Posner, Taxation by Regulation, 2 Bell J. Econ. 22 (1971); Richard A. Posner, Theories of Economic Regulation, 5 Bell J. Econ. 335 (1974); and Sam Peltzman, Toward a More General Theory of Regulation, 19 J. Law & Econ. 211 (1976). For recent empirical studies on the determinants of regulatory policy, see S. G. Donald & D. E. M. Sappington, Explaining the Choice among Regulatory Plans in the U.S. Tele-

the perpetuation of untargeted subsidy schemes is, at least in part, a consequence of the lack of quantitative evidence regarding the relative benefits or effectiveness of targeted versus untargeted subsidy schemes. Indeed, while calls by economists for targeted subsidy flows are common, empirical evidence of the relative effectiveness of such schemes relative to more broadly based subsidy flows is scarce.[4]

This lack of empirical evidence stems in part from the fact that situations that lend themselves to such testing do not commonly arise. In this article, however, we have identified a large-scale set of targeted and untargeted subsidy flows that have developed over the past decade and that exist side by side, each with the same nominal policy goal—promoting universal telephone service. As a consequence, we are able to test empirically the relative contributions of the alternative subsidy mechanisms in promoting the policy goal of maximizing residential subscription to the public switched telephone network.

The article proceeds as follows. First, in Section II we provide a background discussion of the evolution of telecommunications pricing and the policy instruments that have been adopted to promote universal service. Next, in Section III, we turn briefly to a conceptual model of the demand for access to the telecommunications network. Section IV provides a discussion of the data and an empirical model of household subscription to the public switched telephone network. Of particular importance, the empirical subscribership demand model accounts for the direct and indirect subsidy flows of three public policy programs that have been designed to promote universal service. Section V provides the estimation methodology and results. Finally, Section VI concludes the article.

II. Background

The Communications Act of 1934 codified the already-existing policy goal of promoting universal telephone service in the United States.[5] Over time, that goal has assumed increasing importance, becoming a, if not the,

communications Industry, 4 J. Econ. & Mgmt. Strategy 237 (1995); and David L. Kaserman, John W. Mayo, & Patricia L. Pacey, The Political Economy of Deregulation: The Case of Intrastate Long Distance, 5 J. Reg. Econ. 49 (1993).

[4] A comparative analysis of the efficacy of alternative subsidized housing programs is found in Stephen K. Mayo, Sources of Inefficiency in Subsidized Housing Programs: A Comparison of U.S. and German Experience, 20 J. Urb. Econ. 229 (1986).

[5] For nice treatments of the historical development of the telecommunications industry and the universal service goal, see Peter Temin (with Louis Galambos), The Fall of the Bell System (1987); Gerald Faulhaber, Telecommunications in Turmoil: Technology and Public Policy (1987); and Gerald W. Brock, The Telecommunications Industry: The Dynamics of Market Structure (1981).

predominant consideration in virtually all public policy debates surrounding this industry.[6] In the first major revision of the Communications Act of 1934, the Telecommunications Act of 1996 makes it clear that the universal service goal will remain central to telecommunications policy in the United States. In particular, the law requires the preservation and enhancement of universal service and calls upon the Federal Communications Commission (FCC) to consider and to adopt any policy changes necessary to accomplish this goal. In considering changes to existing policies, the FCC is explicitly required to consider six principles: (1) quality and rates; (2) access to advanced services; (3) access in rural and high cost areas; (4) equitable and nondiscriminatory contributions; (5) specific and predictable support mechanisms; and (6) access to advanced telecommunications services for schools, health care, and libraries.

Traditionally, the primary policy instrument used to pursue the goal of universal service has been the practice of pricing customer access to the telecommunications network and local usage on a bundled, flat-rate basis at less than the marginal cost of providing these combined services. The financing for this below-cost pricing has historically been generated by pricing long-distance services well in excess of their incremental cost.[7] Under this pricing policy, the proportion of households that subscribe to the telecommunications network (that is, the household penetration rate) has risen to nearly 94 percent.[8] The fact that household penetration statistics indicate a generally high level of subscribership cannot, however, be taken as an indication that the historical policy of residually pricing local exchange service at low levels has been causally responsible for observed household subscription statistics. Moreover, while the degree of household penetration has risen, it has not been without cost. For example, James M. Griffen estimates that in the early 1980s the welfare losses associated with this pricing structure were roughly $1.5 billion annually.[9] Others have placed even higher welfare losses on these pricing distortions.[10] Despite these costs, however, this system of pricing has remained politically popular, and only recently have there been signs of serious reform.[11]

[6] For a recent and explicit treatment of universal service, see the Telecommunications Act of 1996, § 254.

[7] Temin, *supra* note 5.

[8] See Federal-State Joint Board, Monitoring Report, CC No. 87-339 (May 1997).

[9] James M. Griffen, The Welfare Implications of Externalities and Price-Elasticities for Telecommunications Pricing, 64 Rev. Econ. & Stat. 59 (1982).

[10] See, for example, Robert W. Crandall & Leonard Waverman, Talk Is Cheap (1995).

[11] See Federal Communications Commission, CC No. 96-262 (May 7, 1997). Some insight into the dilatory pace of reform is offered by Kahn (*supra* note 1, at 153), who writes that ''[h]owever much they may be required for economic efficiency, justified by the non-traffic-

In the 1980s, two major policy changes prompted heightened concerns about the achievement and maintenance of universal service in the United States. First, the divestiture of AT&T from the Bell operating companies (BOCs) gave rise to a concern that the introduction of competition in the long-distance industry would lead to an end of the historical cross subsidization of telecommunications access and local usage. While this fear was logically misplaced,[12] it nonetheless gave rise to new policy initiatives to promote universal service. Second, in an effort to improve the efficiency of telecommunications pricing policies, the FCC initiated an End-User Access Charge Plan in January of 1984. This plan, which was designed to bring telephone prices for local and long-distance services closer to their economic cost, shifted part of the responsibility for covering the costs of providing access to customers. This was done through the imposition of an explicit subscriber line charge (SLC). Initially, this charge was set at $1.00 for residential customers and has, over time, grown to $3.50 per month per line. Because this charge effectively increased the price of flat-rate local telephone service, it gave rise to considerable concern over the commitment by telephone policy makers to the goal of universal service.[13]

As a result of these increased concerns over universal service, the FCC instigated three new policy initiatives designed to promote telephone subscribership. First, the FCC implemented, through the Joint Board, a joint federal and state effort to target certain households for specific telephone subsidies. This program, labeled the Lifeline plan, was first initiated in December 1984 and was subsequently modified to take on its current form in December 1985. Under this plan, eligible households are entitled to receive a waiver of the FCC-imposed SLC provided that the state match the federal reduction in the household's monthly telephone bill. Thus, for eligible households that currently participate in the Lifeline plan, the monthly recurring telephone bill may be reduced by up to $7.00. Eligibility criteria were left to the individual states but were subject to approval by the FCC.[14]

Second, in April of 1987, the FCC also implemented the Link-Up plan. Like the Lifeline plan, this plan is a targeted program designed to subsidize those households that are considered to be at risk of dropping off the public switched network in the absence of a subsidy. Unlike the Lifeline plan that

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sensitivity of access costs, and compelled by the pressures of competition, increases in the basic monthly rate are political poison.''

[12] Kaserman & Mayo, *supra* note 1.

[13] For instance, legislation to overturn the plan passed the U.S. House of Representatives in late 1983. Similar legislation was heavily debated in the Senate but ultimately failed.

[14] In general, local exchange companies rely on state-established means tests such as eligibility for food stamps or Medicaid in order to verify subscriber eligibility. For a complete listing of the state-by-state eligibility criteria, see Federal-State Joint Board, *supra* note 8.

provides for subsidization of the monthly recurring charges for subscription to the telephone network, however, the Link-Up plan provides a onetime subsidy for the expenses associated with initial subscription to the network. That is, it was felt that the initial installation charges imposed by local exchange companies (LECs) may prove to be a deterrent to subscription for certain low-income households. Accordingly, the FCC adopted a two-part subsidy to ease the burden associated with installation charges. First, for eligible households, federal subsidies will provide up to one-half of the initial installation charge associated with subscription to the public switched network, up to a maximum of $30.00 per household. Second, federal assistance is provided to defer the interest expenses associated with spreading the initial installation fees over a period up to 12 months.

Importantly, both the Lifeline and Link-Up plans are financed from charges imposed on interexchange carriers and, therefore, on interexchange calling. Specifically, after state programs are certified by the FCC, participating LECs are reimbursed through the National Exchange Carriers Association (NECA) based on expenses submitted to the NECA by the LECs. NECA then collects the requisite subsidies from interexchange carriers based on their market shares of presubscribed customers.

Both the Lifeline and Link-Up programs have grown rapidly since their inception. To date, 50 states, the District of Columbia, Puerto Rico, and the Virgin Islands participate in at least one of the optional telephone assistance programs. Nationwide, 5.2 million households participated in the Lifeline program in 1996, and roughly 4.6 million new connections were established under the Link-Up plan between 1987 and 1996.[15]

The third program implemented to promote universal service in the postdivestiture telecommunication industry was the High Cost Assistance (HCA) program. Unlike the targeted approach of subsidizing households that was adopted in the Lifeline and Link-Up plans, the HCA program creates a Universal Service Fund (USF) for reimbursing high-cost companies. Specifically, under the HCA program, LECs serving mainly rural areas whose costs are higher than the national average are eligible to be reimbursed for a portion of those higher costs.[16] Importantly, the funds reimbursed to these LECs under the HCA program are not targeted to households. That is, under this reimbursement mechanism, the subsidy flows to the companies rather than to specific households that are identified as being at risk of dropping off the network in the absence of the subsidy. Like the

[15] *Id.*

[16] These funds have historically gone to both Bell operating companies that serve both large urban and rural areas and to independent telephone companies that serve primarily rural areas.

Lifeline and Link-Up plans, funding for the HCA program is also provided through charges imposed on interexchange carriers.

The HCA plan was phased in over an 8-year period beginning in 1986 with full funding commencing in 1993. The growth of expenditures on the HCA program has been pronounced. By 1996, the total amount of the subsidy flows under the HCA program exceeded three-quarters of a billion dollars. The growth of expenditures on Lifeline, Link-Up, and HCA is shown in Figure 1.

The relative merits of these particular policy instruments can be, and have been, debated on theoretical grounds. The ultimate evaluation of these programs, however, involves an empirical evaluation of their realized benefits and costs.[17] Specifically, have the plans had the effect of increasing the degree of universal service? And, if so, how have the plans fared relative to one another in accomplishing this objective?

III. Subscription to the Telephone Network—Conceptual Considerations

To determine the effectiveness of public policy programs designed to promote universal service, it is necessary to (1) define what is meant by the term ''universal service,'' (2) standardize for the various factors other than the public policy programs that may have an influence on subscribership levels, and (3) determine how it is that the public policy programs affect the demand for access to the local telecommunications network. On the first matter, we simply define ''universal service'' to be a maximization of the percentage of households that subscribe to the public switched network.[18] On the second issue, we rely heavily on the extant telecommunications-demand literature.[19] Specifically, this literature offers a relatively established

[17] For an early analysis of telephone assistance programs, see Leland L. Johnson, Telephone Assistance Programs for Low-Income Households: A Preliminary Assessment (Rand Publication Series 1988).

[18] Admittedly, this definition abstracts from the ongoing debate regarding whether the traditional concept of universal service is adequate for the future in a rapidly evolving telecommunications industry. A thorough range of opinions on how the universal service concept may be modified is contained in the October 1994 comments filed with the FCC in CC Docket No. 80-286, ''In the Matter of Amendment of Part 36 of the Commission's Rules and Establishment of a Joint Board.''

[19] See, for example, Bridger M. Mitchell, Optimal Pricing of Local Telephone Service, 68 Am. Econ. Rev. 517 (1978); Carlos Martins-Filho & John W. Mayo, Demand and Pricing of Telecommunications Services: Evidence and Welfare Implications, 24 Rand J. Econ. 439 (1993); Paul Cain & James M. MacDonald, Telephone Pricing Structures: The Effects of Universal Service, 3 J. Reg. Econ. 293 (1991); and David L. Kaserman, John W. Mayo, & Joseph E. Flynn, Cross-Subsidization in Telecommunications: Beyond the Universal Service Fairy Tale, 2 J. Reg. Econ. 231 (1990). Much of the literature is summarized in Lester D. Taylor, Telecommunications Demand in Theory and Practice (1994).

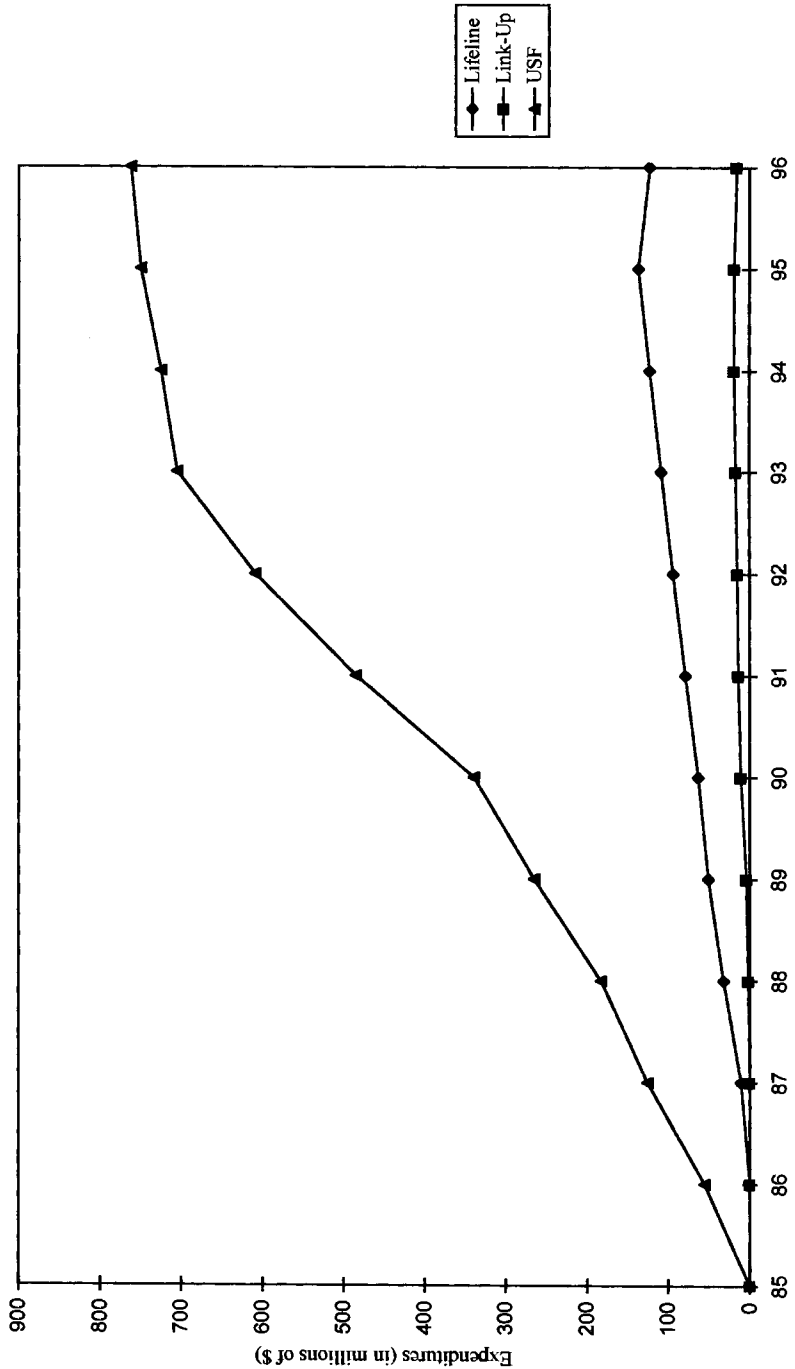

FIGURE 1.—Expenditures on Lifeline, Link-Up, and USF

framework to identify empirically relevant determinants of the demand for subscription to the telecommunications network (other than the public policy programs that have been designed to increase the level of subscribership). Because that literature is well established, we shall only briefly sketch the conceptual foundations of the empirical model.

Following Hausman, Tardiff, and Belinfante (1993), we assume that the decision to purchase access to the telephone network is based on a partial indirect utility function of the form

$$u = u(\boldsymbol{p}_a, \boldsymbol{p}_u, \boldsymbol{y}, \boldsymbol{z}, \epsilon), \tag{1}$$

where $\boldsymbol{p}_a$ is a vector consisting of the onetime installation charge and the monthly service charge, $\boldsymbol{p}_u$ is a vector of the local usage price (usually zero) and long-distance usage prices, $\boldsymbol{y}$ is income, $\boldsymbol{z}$ is a vector of household characteristics, and ϵ is a random parameter that is independently distributed across households. The decision to purchase access to the network, being a discrete choice, is made if and only if

$$\boldsymbol{u}_1 = \boldsymbol{u}[\boldsymbol{p}_a, \boldsymbol{p}_u, (\boldsymbol{y} - \boldsymbol{p}_a \cdot \boldsymbol{x}_a), \boldsymbol{z}, \epsilon] \geq u(\boldsymbol{p}_a, \boldsymbol{p}_u, \boldsymbol{y}, \boldsymbol{z}, \epsilon) = \boldsymbol{u}_0, \tag{2}$$

where $\boldsymbol{x}_a$ is a vector consisting of 1s if the consumer subscribes to the network and 0s if the consumer chooses not to subscribe, and $\boldsymbol{u}_1$ and $\boldsymbol{u}_0$ represent, respectively, the levels of utility when the consumer subscribes or chooses not to subscribe to the local telephone network. Clearly then, the demand for access to the telecommunications network depends, at least in part, upon consumers' underlying demand for usage of that network to place and receive calls.

Most consumers subscribe to the telephone network under so-called flat-rate calling plans wherein a fixed monthly fee is paid that allows the consumer to make an unlimited number of local calls with a marginal price per call of zero. In this case, the decision to subscribe or not is made based on a determination of whether the consumer surplus generated from the consumer's demand curve with a zero marginal price exceeds or falls short of the monthly fixed charges. More generally, for any price of usage and level of usage, an amount of consumer surplus, CS_A and CS_B, is generated for consumers A and B, respectively.[20] In this case, the decision to subscribe or not turns upon whether the consumer surplus generated from usage at a price of, say, P_u would exceed the monthly service fee imposed by the LEC for participation in the telephone network. Thus, individual usage demand and the price of local usage will influence access demand. Because access

[20] Such positive prices for usage occur under so-called measured usage subscription plans. Under such plans, the LEC assesses a usage price that is tied to the number of calls (messages) or the number of minutes called.

to the local network is necessary to subscribe to long-distance service, it follows that the demand for access to the local network also depends upon the price of long-distance phone service.

Now consider how it is that the various public policy programs affect the demand for access to the local telecommunications network. The effect of the Lifeline and Link-Up programs is to lower the prices faced by targeted households for access to the telecommunications network. The effectiveness of Lifeline and Link-Up depends upon the extent to which these programs encourage households, who would otherwise fail to subscribe, to connect to the network. Specifically, as a consequence of the lower initial installation charges and monthly service charges afforded by the Lifeline and Link-Up programs, some eligible households will subscribe that otherwise would not have. Note, however, that recipients of the targeted subsidies who would choose to subscribe to local service in the programs' absence effectively receive a transfer payment. In this case, a household's decision to connect to the local network is unaffected by the subsidy. The effectiveness of these programs, then, will depend critically upon the precision with which the targeted programs are aimed at households that would, in the absence of the subsidy, drop off the network.

In contrast to the targeted assistance programs, the HCA process begins with a local exchange company submitting cost data on loop and circuit equipment to NECA. On the basis of nationwide cost averages, NECA determines the amount of funds that will be reimbursed to the LEC. In particular, the higher are the company's costs relative to the national average, the greater the level of subsidy received.

For regulatory purposes, the treatment of HCA funds depends on whether the firm is subject to traditional rate-of-return regulation or price cap regulation. Under rate-of-return regulation, the HCA funds are used as a direct offset to the recipient company's intrastate revenue requirement.[21] Thus, in theory, prices for some combination of intrastate services including local, intrastate toll, and intrastate access are lower as a consequence of the revenue received from the HCA fund.[22] Which specific prices are affected and the degree of change in those prices brought about by the receipt of the HCA funds, however, is not clear. Specifically, the HCA is not in any systematic way tied to reductions in the price of basic residential service. Moreover, regulatory earnings reviews for smaller LECs, which are the pri-

[21] For financial reporting purposes, the HCA funds are treated as interstate funds.

[22] Because the HCA funds may temper the cost to consumers of receiving telephone service in rural areas, it may, to an unknown degree, alter the propensity of households to reside in rural areas. An empirical assessment of this effect, however, is beyond the scope of the present inquiry.

mary recipients of HCA, are considerably less frequent than those for larger telephone companies. Consequently, the tie between receipt of HCA funds and prices is attenuated.

The linkage, however weak, between receipt of HCA funds and local telephone rates under rate-of-return regulation evaporates altogether under price cap regulation. Specifically, the norm for price cap regulation is to take extant prices as the beginning rates. These rates are then modified by inflation, productivity, and exogenous policy changes over time.[23] To date, however, regulators have not adjusted price caps to account for variations in the level of HCA that LECs receive over time. Thus, under price cap regulation, it appears that there is no systematic linkage between the assistance received and the price of basic local telephone service.

In principle, the HCA program has the potential to affect the demand for access to the telecommunications network both directly through improvements in the quality of service (which would shift the demand for subscribership outward) and indirectly by lowering an LEC's own-source revenues that are required to cover the cost of providing subscriber access to the network. HCA will lower an LEC's average cost basis. Therefore, if constant returns to scale prevail in the local telecommunications industry, HCA has the potential to lower residential prices by the total amount of the subsidy divided by the number of households served.[24] Alternatively, if and to the extent that HCA funds are used to improve the quality of telephone services through plant upgrades or extensions to previously unserved areas, then it is possible that HCA expenditures directly enhance the demand for access and, thereby, subscribership.

While the targeted and untargeted programs are administered differently, they both potentially impact the penetration rate by lowering residential prices (keeping in mind that HCA may also impact the penetration rate directly by improving the quality of service). However, at least two possibilities exist that may stifle the potential benefits of HCA. First, the HCA subsidy may simply provide a transfer payment to customers who would otherwise remain connected to the local telecommunications network in the absence of the subsidy. While this same caveat is true of the targeted programs as well, it applies a fortiori in the case of HCA because the subsidy is untargeted. Second, HCA must actually lower residential access prices in

[23] For a more detailed discussion of price cap regulation, see Thomas P. Lyon, Incentive Regulation in Theory and Practice, in Incentive Regulation for Public Utilities (M. A. Crew ed. 1994).

[24] The potential price decrease may be, respectively, greater than or less than the amount of the subsidy normalized by the number of households to the extent that increasing or decreasing returns to scale prevail.

order to have a discernible impact on the household penetration rate. The wide degree of latitude afforded LECs in their use of the HCA subsidy, however, suggests the possibility that this subsidy may be diffused across a variety of services, in which case the potential benefits of the HCA subsidy to the goal of universal service will go unattained. As with the targeted programs, expenditures on HCA in a state, normalized by the number of households, represent an appropriate measure of the intensity of the untargeted subsidy program.

Motivated by the previous discussion, we specify a demand schedule for access at the market level as

$$PR = f(\boldsymbol{P}, \boldsymbol{S}, \boldsymbol{D}, \epsilon), \tag{3}$$

where PR is the percentage of households that subscribe to the telecommunications network (the penetration rate), $\boldsymbol{P}$ is a vector of prices that correspond to the price of subscribing to the network (for example, the price of initial installation and the fixed monthly charge for subscription) and the price of long-distance service, $\boldsymbol{S}$ is a vector of variables representing the subsidy efforts to promote universal service, $\boldsymbol{D}$ is a vector of demographic characteristics of the state's population including per capita income, and ϵ is a random disturbance term. Equation (3) provides the conceptual foundation for our empirical model of access demand to which we now turn.

IV. Subscription to the Telephone Network—Data and Empirical Model

To construct and estimate an empirical model of the demand for access to the public switched network, we gathered annual state-level data for the 48 contiguous states for the 1985–93 period. These data pertain to variables suggested by the access demand model described above. The dependent variable (PR) is the proportion of households within a state that subscribe to telephone service.[25] This penetration ratio is obviously bounded by 0 and

[25] The data available from the FCC are disaggregated only to the state level. While we are able to account for significant amounts of the interstate variation in household subscribership and the effectiveness of alternative subsidy mechanisms using these data, there are also intrastate variations in subscribership that are unaccounted for in these data. A more disaggregated examination of subscribership data is available using the Current Population Survey from the Census Bureau. These data, however, are collected less frequently and are based on samples that omit many rural and small metropolitan areas. Analysis using these alternative data have thus far been consistent with our empirical results reported *infra*. See, for example, Milton L. Mueller & Jorge Reina Schement, Universal Service from the Bottom Up: A Study of Telephone Penetration in Camden, New Jersey, 12 Info. Soc'y 273 (1996). Mueller and Schement examine subscribership using a combination of census data and household interviews. See also the comprehensive discussion in Milton L. Mueller, Universal Service: Competition, Interconnection, and Monopoloy in the Making of the American Telephone System (1997).

1. Accordingly, as described below, it is necessary to utilize econometric estimation techniques that account for the limited dependent variable and the corresponding estimation issues that result.

Among the exogenous demand determinants, the price vector (***P***) includes the residential installation rate (*IR*) charged by the BOC for initial subscription to the telephone network and the weighted average of the BOC's monthly recurring residential charge for unlimited local calling (*WFR*).[26] Also included in the price vector is the price of long-distance calling (*LD*), which is measured as the average revenue per minute for all AT&T long-distance calls.[27]

Next we turn to the variables comprising the subsidy vector (***S***). To account for the potential impact of the targeted subsidies on the penetration rate, the combined expenditure on the targeted subsidy schemes (Lifeline and Link-Up) for each state from 1985 through 1993 normalized by the number of households in the state (*LLLU*) is included as a measure of the magnitude of the targeted programs.[28] Next we utilize three different HCA variables in an attempt to measure the direct influence of the HCA program on the household penetration rate. First, the total expenditures on HCA for each state from 1985 through 1993 normalized by the number of households in the state (*USF*) are included as a measure of the magnitude of the untargeted subsidy flow designed to promote universal service. This variable is intended to provide a baseline understanding of what direct impact, if any, untargeted subsidy expenditures may have on the household penetration rate apart from any influence that such expenditures have on price.

Our second method for capturing the direct influence of the untargeted subsidy mechanism on household penetration is to include a separate normalized measure of HCA expenditures made exclusively to BOCs (*USFBOC*). Because BOC prices are represented in the model, this measure allows for a cleaner test of the hypothesis that HCA expenditures made to BOCs have had a direct impact on household penetration. Finally, we include USFBOC and a separate normalized measure of HCA expenditures

[26] Data constraints limit our ability to employ price data from independent telephone companies. Bell operating companies, however, provide roughly three-quarters of the access lines in the United States.

[27] Both a fixed-weight average revenue per minute for AT&T's basic schedule service and, alternatively, the actual revenues per minute for domestic residential long-distance service excluding calling cards, operator-handled calls, and directory assistance (but including the effects of discount calling plans) were utilized. Because no significant differences in our results emerged from these alternative price measures, we report only the former.

[28] For a given distribution of income, doubling the number of households and the total expenditures on subsidies should leave unchanged the proportion of households subscribing to local service. Therefore, the subsidy expenditure normalized by the number of households represents an appropriate measure of the intensity of the particular subsidy program.

made to independent telephone companies (ICOs) (*USFICO*). This latter approach has the advantage of detecting whether the direct impact of the untargeted subsidy payments made to ICOs and to BOCs on the penetration rate may differ in either magnitude or direction.

Finally, the vector of characteristics of the state's population (***D***) is included to account for the independent influence of demographic factors on household telephone subscription decisions. Included in this vector are the percentage of the state's population living below the poverty line (*PV*), which measures the portion of the state's population that may be eligible to receive targeted assistance, as well as an interaction term between poverty and expenditures on Lifeline and Link-Up (*PVLLLU*) to account for potential nonlinearities. We also include the percentage of the state's population that is black (*BL*), the percentage of the state's population that is of Hispanic origin (*HP*), and the percentage of the state's population that resides in rural areas (*RL*). The demographic variables (*RL, BL,* and *HP*) vary across states but not over time. To standardize for the cross-sectional variation in the observed penetration rates prior to the sample time period, we include the 1984 penetration rate (*PR*84). A variation in the approach to quantifying the role of income in the subscription decision is also included. Specifically, in lieu of the poverty variables, which are necessarily determined by governmental designations of the poverty line, we include *Y*, Y^2, and *YLLLU*, where *Y* is per capita income, Y^2 is income squared, and *YLLLU* is the corresponding interaction term. This serves to test the robustness of our results.

Assuming a linear form for equation (3), the model A to be estimated is

$$\begin{aligned} PR_{it} = {} & \alpha_0 + \alpha_1(WFR)_{it} + \alpha_2(IR)_{it} + \alpha_3(LD)_t \\ & + \alpha_4(LLLU)_{it} + \alpha_5(USF)_{it} + \alpha_6(PV)_i \\ & + \alpha_7(PVLLLU)_{it} + \alpha_8(RL)_i + \alpha_9(BL)_i + \alpha_{10}(HP)_i \\ & + \alpha_{11}(PR84)_i + \epsilon_{it}. \end{aligned} \tag{4}$$

As noted above, three alternative models are also estimated, first, to fully explore the potential direct impact of untargeted subsidies on the household penetration rate and, second, to test the robustness of our results. In model B we replace the general expenditure measure (*USF*) with HCA expenditures that flow to Bell operating companies (*USFBOC*). In model C we include *USFBOC* and *USFICO* in place of *USF*. Finally, in model D we replace *PV* and *PVLLLU* by *Y*, Y^2, and *YLLLU*.

A final objective of the empirical analysis is to model explicitly the effect of the untargeted subsidy expenditures from the USF on LEC prices and the subsequent impact, if any, on the household penetration rate. In so do-

ing, our analysis accounts not only for any direct impact that untargeted subsidies may have on household penetration through quality enhancements or equipment upgrades but also for any indirect impact that such expenditures may have through decreases in the monthly service charge. Following Kaserman, Mayo, and Flynn (1990), our model specification is

$$WFR_{it} = \beta_0 + \beta_1(LOOPCOST)_{it} + \beta_2(BUSINT)_i + \beta_3(USFBOC)_{it} + \mu_{it}. \quad (5)$$

Equation (5) allows for the prospect that untargeted subsidy payments to BOCs (*USFBOC*) influence residential monthly telephone rates after accounting for two other key determinants of local telephone rates.[29] Specifically, equation (5) also includes the BOC's local loop cost as measured by the non-traffic-sensitive costs of outside telephone wires, poles, and other facilities that link telephone customers to the local network (*LOOPCOST*). We expect that as these accounting costs increase, so will local residential rates. The other independent variable included in equation (5) is the ratio of business lines to total access lines within each state (*BUSINT*). Especially in an environment where local residential telephone rates have been set residually, the more prevalent are (generally higher-priced) business lines, the lower the monthly residential charge should be, ceteris paribus.[30] Equations (4) and (5) together form a recursive model. A complete description of the variables and data sources is provided in Table 1 along with some descriptive statistics associated with these variables.

V. Estimation Methodology and Results

The demand model underlying the empirical specification stems from a discrete choice model of household behavior, wherein households choose either to subscribe or not to subscribe to the public switched network. Given the aggregated nature of the dependent variable, we eschew the logit/probit estimation procedures and instead utilize a linear probability model. This specification of the dependent variable, however, predictably leads to heteroscedasticity because

$$VAR(PR_{it}) = \widehat{PR}_{it}(1 - \widehat{PR}_{it})/HH_{it},$$

[29] Because price data are unavailable for independent telephone companies, this equation could be estimated only for the Bell operating companies. There is, however, no a priori reason to believe that the impact of HCA expenditures on the prices charged by independent telephone companies should differ from the results obtained from equation (5).

[30] See Karen Palmer, A Test for Cross Subsidies in Local Telephone Rates: Do Business Customers Subsidize Residential Customers? 23 Rand J. Econ. 415 (1992), for prior evidence of cross subsidization from business to residential telephone service.

TABLE 1

VARIABLE DEFINITIONS, DESCRIPTIVE STATISTICS, AND DATA SOURCES

Variable	Definition	Mean	SD	Source
PR	Percentage of households with a telephone	.928	.032	1
WFR	BOC weighted average flat rate for single-party residential service	12.734	2.371	2
IR	BOC installation charge for a residential access line not requiring a field visit	33.076	8.805	2
LD	Fixed-weight average revenue per minute for AT&T's Basic Schedule Dial 1 + MTS	.147	.039	3
LL	Reimbursement by NECA plus matching state funds per household paid to LECs for the subscriber line charge waiver	.639	1.340	1
LU	Reimbursement by NECA per household paid to LECs for connection assistance	.043	.092	1
LLLU	LL + LU	.683	1.381	...
USF	Universal Service Fund per household	3.674	5.007	1
USFBOC	Payments to BOCs per household from the USF	.704	1.876	1
USFICO	Payments to ICOs per household from the USF	2.970	4.435	1
PV	Percentage of population below the poverty line in 1990	13.250	4.081	5
PVLLLU	PV × LLLU	8.387	15.843	...
Y	Disposable personal income per capita	13,181	2,114.58	4
Y^2	Income per capita squared	1.8e + 08	5.9e + 07	...
YLLLU	Y × LLLU	9,325.77	19,465	...
RL	Percentage of population residing in rural areas in 1990	32.240	14.526	5
BL	Percentage of population that was black in 1990	9.817	9.280	5
HP	Percentage of population of Hispanic origin in 1990	5.248	7.546	5
PR84	Percentage of households with a telephone in 1984	.914	.035	1
LOOPCOST	BOC local loop cost—refers to the non-traffic-sensitive costs of outside telephone wires, poles, and other facilities that link telephone customers to the local network	193.859	49.875	1
BUSINT	Ratio of business access lines to the total number of business and residential access lines in 1993	.274	.032	6

SOURCES.—(1) FCC's Monitoring Report, CC No. 87-339; (2) NARUC'S BOC exchange service telephone rates; (3) AT&T, internal document; (4) Regional Economic Information System, Bureau of Economic Analysis; (5) U.S. Bureau of the Census, 1990 Census of Population; (6) FCC's Statistics of Communications Common Carriers.

NOTE.—MTS = Message Toll Service; BOCs = Bell operating companies; NECA = National Exchange Carriers Association; LEC = local exchange company; ICO = independent telephone company; NARUC = National Association of Regulatory Utility Commissioners.

where

$$\widehat{PR}_{it} = PR_{it} - \epsilon_{it}$$

and HH_{it} is the number of households in state i in year t, is not constant across observations. We use a technique known as the minimum chi-square method to account for this problem of heteroskedasticity.[31] In large samples, $VAR(PR_{it})$ can be estimated by

$$PR_{it}(1 - PR_{it})/HH_{it}.$$

Therefore, one can use a weighted least-squares method to estimate equation (4) using as weights

$$w_{it} = [HH_{it}/PR_{it}(1 - PR_{it})]^{1/2}.$$

The estimation results of equation (4) and equation (5) are reported in Table 2.

Overall, the model estimation results of equation (4) are quite encouraging. Specifically, the explanatory power of the various model specifications is quite high with R^2s consistently in the neighborhood of .85. Moreover, the preponderance of the explanatory variables generate coefficient estimates that have the expected sign and that are statistically significant. Additionally, the basic estimation results are essentially invariant with respect to the particular model specification.[32]

Turning to the individual parameter estimates, we find that the coefficient estimates of the three price variables (*IR*, *WFR*, and *LD*) are highly significant and negative in sign, as expected. Thus, the installation charge, the monthly recurring charge, and long-distance rates are all seen to influence household penetration rates. The statistical significance of the installation rate (*IR*) and the weighted flat rate (*WFR*) provides evidence that these prices may (as assumed by the presence of the Lifeline and Link-Up programs) serve as potentially useful policy instruments to promote the goal of universal telephone service. The implied price elasticities, which are also reported in Table 2, are consistent with earlier telecommunications studies.[33]

[31] See G. S. Maddala, Limited Dependent and Qualitative Variables in Econometrics (1983).

[32] Beyond the model estimation results reported here, several other variants, including, for example, logarithmic specifications and models without the nonlinear terms, were also estimated with no changes in the basic results reported in Table 2.

[33] Lewis Perl, Residential Demand for Telephone Service 1983 (1983), finds that the elasticity of the installation rate is −.0034 while the elasticity of the flat rate is −.0175 for areas with a measured service option and −.0492 for areas where only flat-rate service is offered. However, Perl's study does not include a measure of long-distance prices. More recently, Jerry A. Hausman, Timothy Tardiff, & Alexander Belinfante, The Effects of the Breakup of AT&T on Telephone Penetration in the United States, 83 Am. Econ. Rev. 178 (1993), report an elasticity for the installation charge of −.02 and a price elasticity for basic access to measured rate service of −.0052.

An important finding stems from the estimated coefficient on the long-distance price variable (*LD*). Specifically, we find that long-distance prices are statistically significant and inversely related to the household penetration rate. This result is consistent with Hausman, Tardiff, and Belinfante, who, utilizing an aggregate index of long-distance prices, also find that such prices significantly influence the degree of universal service.[34]

We also find that household demographic characteristics are an important factor in the decision to purchase access to the telecommunications network. While the level of aggregation limits the inclusion of variables that vary only slightly across states (for example, age of household head and number of family members), we find that other demographic variables such as race and per capita income are strong predictors of the level of residential telephone subscription within a state. Consistent with prior studies of telecommunications demand, *BL* and *HP* are negative and statistically significant.[35] We find that as the percentage of a state's population below the poverty line increases, there is a negative and significant impact on the penetration rate. Also note that replacing *PV* and *PVLLLU* by *Y*, Y^2, and *YLLLU* in model D has almost no effect on the estimation results. We find that the coefficient of per capita income (*Y*) is positive and highly significant. The negative and significant coefficient of per capita income squared (Y^2), however, indicates that the influence of per capita income on a state's penetration rate diminishes as per capita income rises. Our calculated income elasticities are within the range of other reported income elasticities, including Lewis Perl's estimate of .1296[36] and Lester Taylor and Donald Kridel's estimate of .042.[37]

Finally, consider the impact on universal service caused by the targeted (Lifeline and Link-Up) and untargeted (HCA) programs. We find that the variable representing targeted subsidy expenditures (*LLLU*) has a positive

[34] Hausman, Tardiff, & Belinfante, *supra* note 33.

[35] While the key variables of interest include both time-series and cross-sectional variation, the demographic variables are measured at a single point in time (1990). There are two reasons for this. First, state-level data on demographic variables such as the percentage or the state's population residing in rural areas (*RL*) are not measured annually. Second, the principal source of variation in these variables is almost certainly to emanate cross-sectionally rather than from time-series variations within a given cross-sectional observation. Nevertheless, inclusion of a single cross-sectional observation of a given variable may result in inflated *t*-statistics. Given that the overwhelming source of variation in these variables is likely to be generated cross-sectionally, the magnitude of any inflation in the *t*-statistics reported below is likely to be small.

[36] Perl, *supra* note 33.

[37] Lester D. Tayor & Donald J. Kridel, Residential Demand for Access to the Telephone Network, in Telecommunications Demand Modeling (A. de Fontenay, M. H. Shugard, & D. S. Sibley eds. 1990).

and statistically significant effect on the penetration rate. The impact of the Lifeline and Link-Up programs, however, is found to depend on the level of affluence (poverty in models A–C and per capita income in model D) within the state. For instance, in models A–C the impact of the targeted Lifeline and Link-Up programs is given by $\alpha_{LLLU} + (\alpha_{PVLLLU})PV$, where α_x denotes the coefficient estimate of variable *x*. When evaluated at mean levels of poverty, the targeted Lifeline and Link-Up programs are found to positively influence subscriptions. Moreover, the positive impact of these programs grows as the percentage of the state's population living below the poverty line increases.

These estimation results indicate that, ceteris paribus, the expenditure on targeted subsidy mechanisms aimed at households judged to be at risk of dropping off the telephone network accomplish their intended purpose of promoting household penetration rates but with diminishing returns as poverty declines or the level of per capita income in the state rises. An important caveat to this conclusion stems from the fact that under the current method for raising the funds used for household assistance, long-distance costs (and, therefore, prices) are increased. And, as we have already noted, increases in long-distance rates negatively affect household penetration. Thus, a portion of the subscribership gains obtained with targeted subsidy programs is offset by the negative impact of the current (and likely future) funding mechanism.

The coefficient estimate of the variable representing total HCA expenditures (*USF*) is negative but insignificant in model A. That is, under this model specification, we cannot reject the null hypothesis that the untargeted HCA subsidy scheme has had no direct impact whatsoever on the household penetration rate in the postdivestiture period. In models B–D, we include *USFBOC* and *USFICO* in the estimation in place of *USF* and find evidence that untargeted subsidy payments to BOCs have had a positive direct impact on the penetration rate but that the coefficient estimate of *USFICO* is insignificant (and negative).

Equations (4) and (5) together form a recursive model. Accordingly, we estimate equation (5) using ordinary least squares. Again, the model estimation of equation (5) is revealing. Specifically, the coefficient of the BOC local loop cost variable (*LOOPCOST*) and the variable representing the level of business intensity (*BUSINT*) are both significant and, respectively, positive and negative, as expected. Additionally, we find that USF payments to BOCs (*USFBOC*) have contributed to the lowering of the BOC monthly service charge (*WFR*). Together with our findings that *WFR* is negatively related to the penetration rate, this result suggests that HCA expenditures made to BOCs have had a positive indirect impact on the penetration rate in addition to the direct impact.

TABLE 2

REGRESSION RESULTS

	Equation (5) (Minimum Chi-square Method)*								Equation (6) (OLS method)†	
	Model A		Model B		Model C		Model D			
Variable	Coefficient (*t*-Statistic)	Elasticity‡	Coefficient (*t*-Statistic)	Elasticity	Coefficient (*t*-Statistic)	Elasticity	Coefficient (*t*-Statistic)	Elasticity	Variable	Coefficient (*t*-Statistic)
R^2§	.8424		.8445		.8448		.8498			.2022
Intercept	.54622		.52036		.52795		.30930			15.53250
	(16.879)		(16.112)		(16.098)		(9.316)			(12.438)
WFR	−.00103	−.0142	−.00099	−.0136	−.00104	−.0142	−.00083	−.0114	LOOPCOST	.01460
	(−4.013)		(−3.903)		(−4.050)		(−3.115)			(5.508)
IR	−.00032	−.0114	−.00032	−.0115	−.00034	−.0121	−.00043	−.0152	BUSINT	−20.20702
	(−3.824)		(−3.903)		(−4.063)		(−5.177)			(−5.728)
LD	−.10593	−.0167	−.09941	−.0157	−.10514	−.0166	−.08421	−.0133	USFBOC	−.13469
	(−6.064)		(−5.925)		(−6.065)		(−4.697)			(−2.064)
LLLU	−.00605	.0013	−.00669	.0013	−.00744	.0014	.01202	.0017		
	(−2.142)		(−2.396)		(−2.610)		(2.987)			
USF	−.00009	−.0003								
	(−.413)									
USFBOC			.001613	.0012	.00162	.0012	.00157	.0012		
			(2.450)		(2.464)		(2.415)			
USFICO					−.00029	−.0009	−.00047	−.0014		
					(−1.298)		(−2.015)			

PV	−.00200	−.00196	−.00189		
	(−7.041)	(−7.015)	(−6.643)		
PVLLLU	.00059	.00064	.00070		
	(2.482)	(2.735)	(2.938)		
Y				2.21e-05	.0476
				(7.327)	
Y^2				−6.94e-10	
				(−7.118)	
YLLLU				−7.4e-07	
				(−2.826)	
RL	−.00013	−.00016	−.00015	−.00014	
	(−1.628)	(−2.041)	(−1.872)	(−1.701)	
BL	−.00040	−.00041	−.00043	−.00045	
	(−4.060)	(−4.236)	(−4.395)	(−4.571)	
HP	−.00039	−.00038	−.00038	−.00051	
	(−2.926)	(−2.942)	(−2.946)	(−4.309)	
PR84	.50351	.52977	.52319	.54732	
	(16.036)	(16.768)	(16.363)	(16.629)	

NOTE.—See definitions of variables in Table 1.

* Dependent variable PR.

† Dependent variable WFR.

‡ Elasticities were calculated using average prices, income, poverty, expenditures, and penetration rates.

§ For models A–D, the R^2 statistic for the minimum chi-square regressions is equal to $1 - \text{SSE}^*/\text{SST}^*$, where $\text{SSE}^* = (y - X\hat{\beta})'P'P(y - X\hat{\beta})$ and $\text{SST}^* = (y - \iota\tilde{y})'P'P(y - \iota\tilde{y})$, for $\tilde{y} = \iota'P'Py/\iota'P'P\iota$, $\iota = [1\ 1\ \ldots\ 1]$, and P, the transformation matrix containing the weights, w_{it}. It can be interpreted as the proportion of weighted variation in y explained by the regression. See George G. Judge *et al.*, The Theory and Practice of Econometrics 32 (2d ed. 1985).

To put these results in perspective, we provide some numerical examples using the results from model C and equation (5) to compare the relative contributions of the targeted and untargeted programs in promoting the goal of universal service. Because both *PR* and *LLLU* are normalized by the number of households, it follows that

$$\Delta SUB = [\alpha_{LLLU} + (\alpha_{PVLLLU})PV] (\Delta\$). \quad (6)$$

Equation (6) provides an estimate of the number of subscribers added to the network when expenditures on the Lifeline and Link-Up programs are increased by Δ$. For example, this equation suggests that an additional $10,000 expenditure on the targeted subsidy programs would lead to approximately 18 new subscribers if poverty is equal to its mean. However, if poverty is 1 SD above its mean, this figure increases to 47 new subscribers, while if it is 2 SDs above its mean, equation (6) indicates that an additional $10,000 will result in 75 new subscribers. Alternatively stated, where poverty rates are high, the cost of adding an additional subscriber via a targeted mechanism has proven to cost roughly $133.

Similarly, the gross additions to subscribership brought about by untargeted HCA expenditures is given by the combined direct and indirect effects of this subsidy. That is,

$$\Delta SUB = [\alpha_{USFBOC} + (\alpha_{WFR}) (\beta_{USFBOC})]\Delta\$, \quad (7)$$

where β_{USFBOC} is the coefficient estimate of *USFBOC* from equation (5). According to equation (7), an additional $10,000 expenditure made to BOCs under the HCA program would lead to approximately 15 new subscribers.[38] Thus, the cost of adding an additional subscriber via untargeted subsidies has been roughly $666.

Three conclusions follow from these calculations. First, for a given level of expenditures on the universal service programs, the targeted programs are more effective than the untargeted programs, particularly in states where the level of poverty or per capita income is, respectively, above or below its mean. Indeed, our estimates suggest that the targeted programs are up to five times more effective than the untargeted program in increasing household penetration in states where poverty is 2 SDs above its mean. Second, to the extent that untargeted expenditures impact the household penetration rate, they do so primarily directly rather than indirectly through price reduc-

[38] Given that the bulk of HCA expenditures have historically gone to ICOs (and noting the results from models C and D, which imply that the direct impact of HCA expenditures made to ICOs is negative), the relative effectiveness of the targeted programs may be more pronounced than the calculation reported here, which takes into account only the expenditures received by BOCs.

tions. Because the impact of untargeted expenditures on prices is diffuse, and the demand elasticity for access to the network is low, the increase in household penetration as a result of lower prices brought about by untargeted subsidy flows is exceedingly small.

Third, we recall that the HCA program is currently funded by a method that increases long-distance rates. Indeed, this negative impact of the financing mechanism on the household penetration rate is considerably more severe in the case of the untargeted HCA program because the total subsidy flow involved in the untargeted program is roughly 2.5 times higher than that for the targeted Lifeline and Link-Up programs. Thus, our findings strongly suggest that the untargeted subsidy program is not only expensive but may actually work against achievement of the policy objective of universal service.[39]

Finally, we should note that our results do not address the overall social welfare consequences of any of these subsidy mechanisms. That is, while targeted subsidies appear to be more effective and less distortionary than untargeted subsidies, this conclusion says nothing whatsoever about whether any such subsidy is warranted on economic grounds. Traditionally, subscribership subsidies have been justified by appeals to the so-called network externality. Recent research, however, points out that the bulk of that externality may be inframarginal and, therefore, Pareto irrelevant.[40] In addition, offsetting distortions caused by any feasible collection mechanism may well overcome any welfare improvements obtained by subsidization. Therefore, even a relatively efficient subsidy program using targeted payments may fail to improve welfare. Nonetheless, as long as policy makers continue to require these subsidies, it is important to recognize that the efficiency of alternative subsidy mechanisms in promoting their intended objectives may vary widely. Consequently, it is possible to draw clear inferences regarding the relative welfare consequences of targeted versus untargeted subsidy mechanisms.

[39] The ''tax'' increases imposed on long-distance carriers to finance the HCA expenditures may manifest themselves in a variety of ways in long-distance rates. Thus, it is difficult to pinpoint the negative consequences of the cost increases imposed on long-distance carriers. With 1993 HCA expenditures of just over $705 million and approximately 93 million subscribers, the cost imposed on interexchange carriers per subscribing household was in the neighborhood of $.63 per month. With typical long-distance residential bills of $20 per month, costs and prices may be roughly 3–4 percent higher than would have been the case absent the subsidy mechanism. Given the elasticity of subscription with respect to long-distance prices of .0167 (see model C), a price change of 3–4 percent results in a reduction of approximately one-half of a percentage point in the penetration rate (roughly 50,000 fewer households subscribed) as a consequence of the financing mechanism.

[40] Andy H. Barnett & David L. Kaserman, The Simple Welfare Economics of Network Externalities and the Uneasy Case for Subscribership Subsidies, 13 J. Reg. Econ. 245 (1998).

VI. Conclusions

Public policy programs designed to promote social goals through cross subsidization are not at all uncommon. In fact, in regulated industries, they are virtually ubiquitous. While economists have argued for some time that both the subsidy design and the financing of any such subsidy may influence the efficacy of such programs, relatively little comparative evidence on this subject has heretofore been brought to light.

The growing concern over the provision and maintenance of universal service in the postdivestiture period has given rise to large-scale subsidy mechanisms that are both targeted (Lifeline and Link-Up) and untargeted (HCA). The financing of both of these subsidy schemes presently occurs through charges (taxes) placed upon long-distance customers. The advent of these side-by-side programs has permitted us to examine their effectiveness in accomplishing the intended effect—the promotion of universal service.

On the basis of a demand model of household subscription decisions, we have developed an empirical model of household penetration rates for telephone service in the 48 contiguous states for the 1985–93 period. The estimation results provide considerable insight into the economic determinants of household subscription decisions. Additionally, the results generate important evidence regarding the efficacy of alternative subsidy mechanisms. As anticipated by economic logic and passed down by oral tradition within the economics community, targeted subsidy programs are found to be considerably more effective than their untargeted counterparts.

Also, given the negative and significant coefficient estimate on the price of long-distance service in our empirical analysis, the results indicate that the financing mechanism used to promote these subsidy programs has been counterproductive to the achievement of the intended goal. This finding underscores the importance of the financing mechanism used to support such subsidy programs. It is quite possible (and appears to be the case here) that the funding method used can frustrate achievement of the very objective being pursued, whether that objective is pursued through a targeted or untargeted subsidy scheme.

Bibliography

Barnett, Andy H., and Kaserman, David L. ''The Simple Welfare Economics of Network Externalities and the Uneasy Case for Subscribership Subsidies.'' *Journal of Regulatory Economics* 13 (1998): 245–54.

Brock, Gerald W. *The Telecommunications Industry: The Dynamics of Market Structure*. Cambridge, Mass.: Harvard University Press, 1981.

Cain, Paul, and Macdonald, James M. ''Telephone Pricing Structures: The Effects of Universal Service.'' *Journal of Regulatory Economics* 3 (1991): 293–308.

Crandall, Robert W., and Waverman, Leonard. *Talk Is Cheap.* Washington, D.C.: Brookings Institution, 1995.

Donald, Stephen G., and Sappington, David E. M. ''Explaining the Choice among Regulatory Plans in the U.S. Telecommunications Industry.'' *Journal of Economics and Management Strategy* 4 (1995): 237–65.

Dupuit, Jules. ''On the Measurement of the Utility of Public Works.'' Translated by R. H. Barback from *Annales des ponts et chausees,* 2d Ser., Vol. 7 (1844). In *International Economic Papers,* No. 2, pp. 83–110. London: Macmillan, 1952.

Ekelund, Robert B., Jr. ''Jules Dupuit and the Early Theory of Marginal Cost Pricing.'' *Journal of Political Economy* 76 (1968): 462–71.

Faulhaber, Gerald R. *Telecommunications in Turmoil: Technology and Public Policy.* Cambridge, Mass.: Ballinger Publishing, 1987.

Federal Communications Commission (CC Docket No. 96–262, May 7, 1997).

Federal-State Joint Board. *Monitoring Report* (CC Docket No. 87–339, May 1997).

Griffin, James M. ''The Welfare Implications of Externalities and Price-Elasticities for Telecommunications Pricing.'' *Review of Economics and Statistics* 64 (1982): 59–66.

Hausman, Jerry A. ''Rebuttal Testimony.'' Case No. 8659, Maryland Public Service Commission, October 26, 1994.

Hausman, Jerry A.; Tardiff, Timothy; and Belinfante, Alexander. ''The Effects of the Breakup of AT&T on Telephone Penetration in the United States.'' *American Economic Review* 83 (1993): 178–84.

Johnson, Leland L. *Telephone Assistance Programs for Low-Income Households: A Preliminary Assessment.* Rand Report 3603, February 1988. Santa Monica, Cal.: Rand Corporation, 1988.

Judge, George G., et al., *The Theory and Practice of Econometrics.* 2d ed. New York: Wiley, 1985.

Kahn, Alfred E. ''The Road to More Intelligent Telephone Pricing.'' *Yale Journal on Regulation* 1 (1984): 139–58.

Kaserman, David L., and Mayo, John W. ''Cross-Subsidies in Telecommunications: Roadblocks on the Road to More Intelligent Telephone Pricing.'' *Yale Journal on Regulation* 11 (1994): 119–47.

Kaserman, David L.; Mayo, John W.; and Flynn, Joseph E. ''Cross-Subsidization in Telecommunications: Beyond the Universal Service Fairy Tale.'' *Journal of Regulatory Economics* 2 (1990): 231–49.

Kaserman, David L.; Mayo, John W.; and Pacey, Patricia L. ''The Political Economy of Deregulation: The Case of Intrastate Long Distance.'' *Journal of Regulatory Economics* 5 (1993): 49–63.

Lyon, Thomas P. ''Incentive Regulation in Theory and Practice.'' In *Incentive Regulation for Public Utilities,* edited by Michael A. Crew, pp. 1–27. Boston: Kluwer Academic Publishers, 1994.

Maddala, G. S. *Limited Dependent and Qualitative Variables in Econometrics.* New York: Cambridge University Press, 1983.

Martins-Filho, Carlos, and Mayo, John W. ''Demand and Pricing of Telecommunications Services: Evidence and Welfare Implications.'' *Rand Journal of Economics* 24 (1993): 439–54.

Mayo, Stephen K. ''Sources of Inefficiency in Subsidized Housing Programs: A Comparison of U.S. and German Experience.'' *Journal of Urban Economics* 20 (1986): 229–49.

Mitchell, Bridger M. ''Optimal Pricing of Local Telephone Service.'' *American Economic Review* 68 (1978): 517–37.

Mueller, Milton L. *Universal Service: Competition, Interconnection, and Monopoly in the Making of the American Telephone System.* Cambridge, Mass.: MIT Press and AEI Press, 1997.

Mueller, Milton L., and Schement, Jorge R. ''Universal Service from the Bottom Up: A Study of Telephone Penetration in Camden, New Jersey.'' *Information Society* 12 (1996): 273–92.

Palmer, Karen. ''A Test for Cross Subsidies in Local Telephone Rates: Do Business Customers Subsidize Residential Customers?'' *Rand Journal of Economics* 23 (1992): 415–31.

Peltzman, Sam. ''Toward a More General Theory of Regulation.'' *Journal of Law and Economics* 19 (1976): 211–40.

Perl, Lewis J. ''Residential Demand for Telephone Service 1983.'' Prepared for Central Service Organization of the Bell Operating Companies, Inc. (BOCs). White Plains, N.Y.: National Economic Research Associates, Inc., December 1983.

Posner, Richard A. ''Taxation by Regulation.'' *Bell Journal of Economics* 2 (1971): 22–50.

Posner, Richard A. ''Theories of Economic Regulation.'' *Bell Journal of Economics* 5 (1974): 335–58.

Stigler, George J. ''The Theory of Economic Regulation.'' *Bell Journal of Economics* 2 (1971): 3–21.

Taylor, Lester D. *Telecommunications Demand in Theory and Practice.* Dordrecht: Kluwer Academic Publishers, 1994.

Taylor, Lester D., and Kridel, Donald J. ''Residential Demand for Access to the Telephone Network.'' In *Telecommunications Demand Modeling,* edited by A. de Fontenay, M. H. Shugard, and D. S. Sibley. Amsterdam: North-Holland Publishing Co., 1990.

Temin, Peter. ''Cross Subsidies in the Telephone Network after Divestiture.'' *Journal of Regulatory Economics* 2 (1990): 349–62.

Temin, Peter (with Louis Galambos). *The Fall of the Bell System.* Cambridge, Mass.: Cambridge University Press, 1987.