The process of developing an individually tailored X-factor would also be contrary to the Commission's goal to develop an X-factor based on accessible and verifiable data. Development of an individually tailored X-factor would likely be administratively complex, and involve contentious discussions of issues among interested parties. Such a process would not serve the Commission's goal of developing a productivity offset based on accessible and verifiable data.

Assignment of X-factors would also place the Commission in the position of periodically having to assign each LEC a new productivity factor, which as a practical matter, would involve something similar to the full panoply of procedures required for a rate-of-return prescription, see 47 C.F.R. § 65.1 et seq. This process would place inordinate demands on both the Commission and the industry, particularly as it is likely that parties would petition the Commission to prescribe a new, higher productivity factor for any LEC perceived to be exceeding its customized productivity factor. In addition to the administrative burdens, this process would provide further uncertainty and disincentives for LECs to undertake efficiency measures, develop advanced telecommunications measures, and invest in network infrastructure.

This practice of regulating LECs in such a manner that their higher productivity level and future earnings potential made possible by efficiency measures and network investments would be taken away as soon as they are achieved, is precisely the result that would be obtained if the Commission were to retain sharing. Therefore, while mandatory assignment of a carrier specific X-factor may be seen as a desirable way to eliminate sharing -- inasmuch as a price cap plan with mandatory assignments would not require the use of sharing as an incentive to select the highest possible offset -- the Commission cannot avoid the deleterious impact of sharing on LEC efficiency, new services and investment by assignment of a carrier specific X-factor.

Issue 5e: Under what conditions would it be possible to eliminate the sharing mechanism from the long-term price cap plan?
Issue 5f: Should the low-end adjustment be eliminated?

Both these issues are addressed by the discussion below. As explained above, the long-term price cap plan should adopt a rolling average TFP-based industry average X-factor as the baseline productivity offset. The rolling average aspect of the productivity factor eliminates the need for a "backstop" mechanism. Most importantly, elimination of sharing is particularly appropriate under the increasingly competitive conditions of the local exchange market. USTA's proposal would provide substantial public interest benefits in the form of increased efficiencies and network development, decreased administrative burdens, and a means to facilitate the transition to greater competition.

While it does not affect price cap incentives to the same degree or in the same manner as sharing, the low-end adjustment is another relic of rate-of-return regulation that has no role in the Commission's long-term price cap plan under consideration in this proceeding. With the elimination of sharing as proposed by USTA, LECs should not be afforded an automatic upward adjustment for underearnings. The level of a productivity offset should not be tied to earnings measures in any way. Of course, LECs may always file tariff revisions when necessary.

C. The Commission Should Not Utilize Pricing Flexibility As An Incentive to Select a Higher Productivity Factor

In a related Notice, the Commission requests comment on pricing flexibility issues as they relate to the long-term LEC Price Cap plan, specifically to the issues raised where the plan includes multiple X-factor options.[21] The Commission asks whether relaxed regulatory relief would be a useful incentive to encourage price cap LECs to elect the X-factor most appropriate

---

[21] Second Further Notice of Proposed Rulemaking, CC Docket 94-1, Further Notice of Proposed Rulemaking, CC Docket No. 93-124, Second Further Notice of Proposed Rulemaking, CC Docket 93-197, released September 20, 1995.

to their circumstances. Such regulatory relief is most appropriately tied to the presence of competition, not to productivity. Pricing flexibility is needed now to permit LECs to set more efficient prices in order to prepare for competition, and to appropriately respond to competitive developments presently occurring in their service areas. See generally Comments of USTA on Second Further Notice of Proposed Rulemaking, CC Docket 94-1 (December 11, 1995). Moreover, the price cap plan is designed to be a transitional mechanism to a competitive environment, not a long-term regulatory regime. The result of increased competition will be that competitive services are removed from price cap regulation. See, e.g. Second Further Notice, para. 9. Linking pricing flexibility to the productivity offset utilized in the interim step of price cap regulation could serve to confuse the issue. While all LECs need relaxed regulatory relief to price flexibly in response to competition, not all LECs will be able to select the higher productivity factor in a multiple factor environment.

III. The Commission Should Adopt TFP And Eliminate Any Need for a Separate Common Line Formula

Issue 6a: Under what circumstances would the adoption of a particular X-factor method justify elimination of a separate common line formula?

Issue 6b: Assuming we decide to retain a separate common line formula, should we adopt a per-line common line formula or some other formula? What should the mechanics of that formula be?

TFP is a direct measure of productivity where all inputs (labor, capital, materials), and all outputs (lines, minutes, etc) are taken into account. Specifically, the output growth measure in the TFP calculation is Carrier Common Line (CCL) minutes of use (MOU) which therefore includes the full productivity effects of growth in minutes. Therefore, all changes in LEC productivity over time are captured regardless of whether they are driven by changes in minutes, lines, or any other output. No other adjustment is required. Using a TFP methodology and further adjusting the common line basket would result in "double counting"

productivity gains as TFP growth uses lines and minutes as measures of output growth.[22]

All traffic sensitive services are marked by economies of scale -- increased growth generates productivity gains. Thus, as more units of demand are carried on a LEC's network, an increase in productivity will be realized for all services - not just common line. Although the Commission concluded in the First Report and Order, at paras. 268-269, that LECs have little influence over common line usage growth,[23] this becomes irrelevant with the use of a TFP methodology. Neither who generates the demand nor which access service experiences the growth is relevant as any growth in demand will be captured by the estimate of TFP. Once the productivity factor is set based on TFP, the benefits of demand growth at the long-term trend level for all services will be passed on to access customers. It makes no difference what the common line growth rate is or which entity is stimulating demand. TFP incorporates the effect of input growth for all services.

The Commission's proposal to base carrier common line rates on historical rather than forecasted data for end user common line revenues is sound, and is consistent with the use of historical data elsewhere in the price cap formula. See FNPRM, para. 137 (Issue 6c). Even so, it would be preferable to eliminate the use of revenue requirement calculations, either prospective or historical, in the price management of End User Common Line charges

---

[22]As discussed supra, there is no meaningful way to calculate an interstate only TFP methodology. A productivity offset should reflect the entire range of diverse factors that cause changes in the unit cost of production for the LECs and should measure changes in the overall efficiency of production. Partial measures of productivity are inconsistent with the economics of price caps because they are confined to particular inputs or outputs. Since partial measures of productivity are not economically meaningful, USTA will not address the impact of other than a total company TFP methodology on the common line formula.

[23]Of course, this conclusion ignores the fact that LEC access charge reductions (when passed through by interexchange carriers) stimulate long distance calling which, in turn, results in increased access usage.

(EUCLs) for price cap LECs.

IV. The Commission Should Not Limit Exogenous Cost Treatment to Changes Which Result in a Jurisdictional Cost Shift

The Commission seeks comment on two issues related to the treatment of exogenous costs under the price cap plan:

Issue 7a: Is it feasible to fashion an X-factor that will routinely include costs currently classified as exogenous and exclude costs that the Commission has determined are not exogenous?

A meaningful X-factor cannot be fashioned so as to routinely include all costs currently classified as exogenous and exclude costs that the Commission has determined are not exogenous. Some exogenous cost changes permitted in the past would not have had an effect on TFP. These changes may be of at least two types: 1) shifts in jurisdictional cost allocations that do not affect total company results; and 2) accounting changes that do affect the economic measures of inputs or outputs used in the TFP approach. USTA believes that there will always be "non-standard" exogenous cost changes that will not be captured by an X-factor.

To the extent that future exogenous cost changes may be included in a particular X-factor, they should not get separate exogenous cost treatment under the price cap plan. Conversely, to the extent that such cost changes are not included, they should receive exogenous treatment on a case-by-case basis.

Issue 7b: Would it be reasonable to limit exogenous cost treatment to changes that result in a jurisdictional cost shift?

The Commission has already limited exogenous cost treatment to those accounting rule changes that result in an economic cost change (defined as having an impact on the LEC's discounted cash flow) and are both beyond the control of the carrier and not reflected in the

GDP-PI. Price Cap Review Order, para. 293. In light of this requirement, no legitimate purpose would be served by MCI's suggestion that exogenous costs should be further limited to only Commission-ordered changes that result in a shift in costs between the interstate and intrastate jurisdictions. Id., para. 287. Further, it would be arbitrary to automatically exclude an exogenous cost change that did result in an economic cost to the carrier solely because it did not impact jurisdictional separations. Of course, to the extent that a TFP-based X-factor already properly reflects an exogenous cost change, a LEC should not be permitted to adjust its PCI to account for that cost change.

Additionally, the procedures that the Commission adopted in the Price Cap Review Order to implement exogenous cost changes provide a further reason why MCI's suggestion should not be adopted. To the extent that the Commission considers a cost change that might justify exogenous treatment in the same proceeding that gave rise to the cost change, see Price Cap Review Order, para. 316, there will be ample opportunity for all parties to present their view as to the appropriate treatment of such cost change. The same opportunity will exist for cost changes that are considered in a waiver proceeding or are subject to a declaratory ruling.

V. The Commission Should Modify Its Treatment of the Interexchange Basket

In the Price Cap Review Order, the Commission stated that since LECs provide interexchange services in competition with AT&T, the productivity offset for this basket was set equal to that used by AT&T (3.0%). Price Cap Review Order, para. 249. In light of the competitive nature of these services, they should now be removed from price cap regulation. At a minimum, following the logic of the Price Cap Review Order requires that the Commission apply the same productivity offset as that used by AT&T. As AT&T has been declared non-dominant, see Motion of AT&T Corp. To be Reclassified as a Non-Dominant Carrier, Order, FCC 95-427 (October 23, 1995), this entails prescribing a productivity offset of zero for the LECs' interexchange basket.

CONCLUSION

The Commission should adopt policies and rules for the long-term price cap plan which are consistent with the policy objectives set forth in the FNPRM: adopt a productivity offset which is economically meaningful and based on accessible and verifiable data and eliminate sharing. The simplified Christensen TFP model for calculating the productivity offset as a moving average is the best model for achieving these goals.

Respectfully submitted,

UNITED STATES TELEPHONE ASSOCIATION

BY _____

Mary McDermott
Linda Kent
Charles D. Cosson

Its Attorneys

U.S. Telephone Association
1401 H Street, NW
Suite 600
Washington, DC 20005
(202) 326-7249

CERTIFICATE OF SERVICE

I, Robyn L.J. Davis, do certify that on January 16, 1996 comments of the United States Telephone Association were either hand-delivered, or deposited in the U.S. Mail, first-class, postage prepaid to the persons on the attached service list.

Robyn L.J. Davis

Edward R. Wholl
Campbell L. Ayling
Edward E. Niehoff
NYNEX Telephone Cos.
120 Bloomingdale Road
White Plains, NY 10605

Elizabeth Dickerson
MCI Telecommunications Corp.
1801 Pennsylvania Avenue, NW
Washington, DC 20006

Marc C. Rosenblum
Robert J. McKee
Peter H. Jacoby
Albert M. Lewis
AT&T
295 North Maple Avenue
Room 2255F2
Basking Ridge, NJ 07920

Marc E. Manly
AT&T
1722 Eye Street, NW
Washington, DC 20006

Alan Ciamporcero
Pacific Telesis
1275 Pennsylvania Avenue, NW
Suite 400
Washington, DC 20004

Michael J. Shortley, III
Rochester Telephone Corporation
180 South Clinton Avenue
Rochester, NY 14646

R. Michael Senkowski
Jeffrey S. Linder
Ilene T. Weinreich
Wiley, Rein & Fielding
(Tele-Communications Association)
1776 K Street, NW
Washington, DC 20006

Jay C. Keithley
Leon M. Kestenbaum
H. Richard Juhnke
Norina T. Moy
Sprint Corporation
1850 M Street, NW
11th Floor
Washington, DC 20036

W. Richard Morris
Sprint Corporation
P.O. Box 11315
Kansas City , MO 64112

Genevieve Morelli
Competitive Telecommunications
Association
1140 Connecticut Avenue, NW
Suite 220
Washington, DC 20036

Danny E. Adams
Jeffrey S. Linder
Wiley, Rein & Fielding
(Competitive Telecommunications
Association)
1776 K Street, NW
Washington, DC 20006

Jonathan E. Canis
Swidler & Berlin
(Intermedia Communications of
Florida, Inc.)
3000 K Street, NW
Suite 300
Washington, DC 20007

Robert M. Lynch
Richard C. Hartgrove
Thomas A. Pajda
Southwestern Bell Telephone Co.
One Bell Center
Room 3520
St. Louis, MO 63101

Edward D. Young, III
Sherry F. Bellamy
Bell Atlantic
1310 North Court House Road
8th Floor
Arlington, VA 22201

Michael E. Glover
Edward D. Shakin
Karen Zacharia
Bell Atlantic
1310 North Court House Road
8th Floor
Arlington, VA 22201

Dr. Lee L. Selwyn
Dr. David J. Roddy
Susan M. Gately
Economics and Technology, Inc.
One Washington Mall
Boston, MA 02018

Scott C. Lundquist
Sonia N. Jorge
Economics and Technology, Inc.
One Washington Mall
Boston, MA 02018

James S. Blaszak
Levine, Blaszak, Block & Boothby
1300 Connecticut Avenue, NW
Suite 500
Washington, DC 20036

Brian R. Moir
Moir & Hardman
(International Communications
Association)
2000 L Street, NW
Suite 512

Washington, DC 20036

Andrew D. Lipman
Russell M. Blau
Swidler & Berlin, Chtd.
(MFS Communications Co., Inc.)
3000 K Street, NW
Washington, DC 20007

John C. Smith
Aeronautical Radio, Inc.
2551 Riva Road
Annapolis, MD 21401

Margot Smiley Humphrey
Koteen & Naftalin
(National Rural Telecom Assn.)
1150 Connecticut Avenue, NW
Washington, DC 20036

Carol C. Henderson
American Library Association
110 Maryland Avenue, NE
Washington, DC 20002

W. Theodore Pierson,Jr.
Pierson & Tuttle
(Association for Local Telecommunication Services)
1200 19th Street, NW
Suite 607
Washington, DC 20036

J. Manning Lee
Teleport Communications Group, Inc.
One Teleport Drive
Staten Island, NY 10311

Charles A. Zielinski
Rogers & Wells
(Computer & Communications Industry Association)
607 14th Street, NW
Washington, DC 20005

Allan J. Arlow
Computer & Communications Industry Association
666 11th Street, NW
Washington, DC 20001

Anthony M. Alessi
Ameritech
1401 H Street, NW
Suite 1020
Washington, DC 20005

Gary M. Epstein
James H. Barker
Latham & Watkins
1001 Pennsylvania Avenue, NW
Suite 1300
Washington, DC 20004

M. Robert Sutherland
Richard M. Sbaratta
4300 Southern Bell Center
675 West Peachtree Street, NE
Atlanta, GA 30375

James Gattuso
Beverly McKittrick
Citizens for a Sound Economy Foundation
1250 H Stree,t NW
Washington, DC 20005

Dr. Jerome R. Ellig
Center for Market Processes
4084 University Drive
Suite 208
Fairfax, VA 22030

Richard McKenna, **HQE03J36**
GTE
P.O. Box 152092
Irving, TX 75015

Gail L. Polivy
GTE
1850 M Street, NW
Suite 1200
Washington, DC 20036

Tenley A. Carp
General Service s Administration
Office of General Counsel
Washington, DC 20405

Robert A. Mazer
Nixon, Hargrave, Devans & Doyle
One Thomas Circle, NW
Suite 800
Washington, DC 20005

Paul B. Jones
Janis A. Stahlhut
Time Warner Communications
300 First Stamford Place
Stamford, CT 06902

Susan M. Baldwin
Patricia D. Kravtin
Economics and Technology, Inc.
One Washington Mall
Boston, MA 02018

David R. Poe
Cherie R. Kiser
LeBoeuf, Lamb, Greene & MacRae
1875 Connecticut Avenue, NW
Washington, DC 20009

James T. Hannon
U S WEST Communications, Inc.
1020 19th Street, NW
Suite 700
Washington, DC 20036

Blaine Gilles
WilTel, Inc.
P.O. Box 21348
Tulsa, OK 74121

Peter A. Rohrbach
Linda L. Oliver
Hogan & Hartson
Columbia Square
555 13th Street, NW
Washington, DC 20004

Henry M. Rivera
Ginsburg, Feldman and Bress,
Chartered
1250 Connecticut Avenue, nW
Washington, DC 20036

Lisa M. Zaina
OPASTCO
21 Dupont Circle, NW
Suite 700
Washington, DC 20036

Alan J. Gardner
Jeffrey Sinsheimer
California Cable Television
Association
4341 Piedmont Avenue
Oakland, CA 94611

Terry L. Murray
Murray and Associates
101 California Street
Suite 4225
San Francisco, CA 94111

Frank W. Lloyd
Kecia Boney
Mintz, Levin, Cohn, Ferris,
Glovsky and Popeo, P.C.
701 Pennsylvania Avenue, NW
Suite 900
Washington, DC 20004

David C. Bergmann
Yvonne T. Ranft
Office of the Consumers' Counsel
State of Ohio
77 South High Street
15th Floor
Columbus, OH 43266

Anne U. MacClintock
Southern New England Telephone
Company
227 Church Street
New Haven, CT 06510

Barbara Stonebraker
Cincinnati Bell
201 E. 4th Street
Suite #102-300
Cincinnati, OH 45201

International Transcription Service
2100 M Street, NW
Suite 140
Washington, DC 20036

ATTACHMENT A

"Total Factor Productivity Methods for Local Exchange Carrier Price Cap Plans" including "Response to Appendix F: The Appropriate Data Set to Use in Analyzing Telephone Industry Input Price"

Laurits R. Christensen, Philip E. Schoech, and Mark E. Meitzen
Christensen Associates

TOTAL FACTOR PRODUCTIVITY METHODS FOR LOCAL EXCHANGE CARRIER PRICE CAP PLANS

Laurits R. Christensen
Philip E. Schoech
Mark E. Meitzen

December 18, 1995

TABLE OF CONTENTS

SECTION **PAGE**

Executive Summary i

Issue 1a. What is the most reasonable method to develop output price incides for TFP calcluation purposes? What data source should be used to develop output price indices? 3

Issue 1b. What is the most appropriate measure of the cost of capital for a TFP study? 9

Issue 1c. What are appropriate depreciation rates for a TFP study? 12

Issue 1d. What is the most reasonable method to estimate capital stock? 14

Issue 1e. Is the imputation of capital services from capital stock rather than from capital consumption reasonable? 20

Issue 1f. What is the most reasonable method for developing an implicit rental price? 21

Issue 1g. What is the most reasonable method for developing a labor index for inclusion in a TFP calculation? 23

Issue 1j. Is there a valid distinction between intrastate and interstate productivity for the purposes of calculating a TFP index and an input price index and, if so, does a satisfactory method exist to account for such differences? 26

Issue 1k. Is there a valid distinction between regulated and nonregulated productivity, or the productivity associated with specific services, such as video dialtone, or groups of services, for purposes of calculating a TFP index and an input price index? If so, does a satisfactory method exist to account for such differences? 27

The Simplified TFP Method 28

Appendix 1: A Comparison of BLS and Christensen Total Factor Productivity Measures 33

Appendix 2: Construction of Price Indexes for Local, Long Distance, and Intrastate Access Services 35

Appendix 3: Response to Appendix F: The Appropriate Data Set to Use in Analyzing Telephone Industry Input Prices 40

EXECUTIVE SUMMARY

TOTAL FACTOR PRODUCTIVITY METHODS FOR LOCAL EXCHANGE CARRIER PRICE CAP PLANS

Laurits R. Christensen, Philip E. Schoech
and Mark E. Meitzen
Christensen Associates
December 18, 1995

In its Fourth Further Notice of Proposed Rulemaking,[1] the FCC has raised a number of questions regarding the appropriate methods for measuring local exchange carrier total factor productivity (LEC TFP). In particular, various questions have been posed by the FCC regarding the TFP study we submitted in May of 1994 and updated in January of 1995.[2] In this paper, we respond to the issues directly relevant to the Christensen TFP methods.

In particular, the FCC has stated a concern that some of the data used in our TFP study are not accessible and verifiable. Because of this concern, we have developed a simplified method of TFP measurement based solely on publicly-available data. We have also simplified some of the computations, while continuing to apply standard practices in TFP

---

[1] Federal Communications Commission, Fourth Further Notice of Proposed Rulemaking, FCC 95-406, September 27, 1995.

[2] Laurits R. Christensen, Philip E. Schoech, and Mark E. Meitzen, "Productivity of the Local Operating Telephone Companies Subject to Price Cap Regulation," Christensen Associates, May 3, 1994, and "Productivity of the Local Operating Telephone Operating Companies Subject to Price Cap Regulation, 1993 Update," Christensen Associates, January 10, 1995. We refer to these collectively as our original study.

measurement. We believe that the simplified TFP method maintains accuracy and addresses concerns about verifiability.

Overview of Simplified TFP Method

The simplified TFP method is consistent with accepted productivity measurement practices and provides an accurate measure of productivity trends for LECs. It is based entirely on publicly-available data and contains other modifications to address concerns raised by the FCC. This allows the simplified model to be updated and verified in a straightforward manner. The simplified approach forms the basis of the "TFP Review Plan," submitted with the United States Telephone Association's comments in this proceeding.

We now summarize the differences between the methods and data sources in our original study and the methods and data sources in the simplified TFP study:

Output. The only way in which the measurement of output in the simplified model differs from the measurement of output in the original study is that the quantity of long distance service and the quantity of intrastate access service are derived by dividing booked revenue (as opposed to billed revenue), reported in the Form M (ARMIS 43-02), by the price indexes for long distance and intrastate access service.

Capital. There are five differences between the simplified model and the original TFP study regarding the measurement of capital. First, the simplified study uses the U.S. economy cost of capital implicit in the U.S. National Income and Product Accounts as the cost of capital in the rental price equation, instead of Moody's average yield on public utility bonds. Second, the simplified TFP method uses investment price indexes published by the U.S. Bureau of Economic Analysis instead of Telephone Plant Indexes. Third, the simplified TFP method employs beginning-of-year 1988 book values of gross plant, reported in the Form M, in the derivation of the capital benchmarks, instead of end-of-year 1984 current-cost of gross plant. Fourth, the simplified TFP method uses three-year moving averages of the cost of capital and capital gains in the rental price equation. Fifth, since some of the asset classes have the same BEA price indexes and depreciation rates, it is possible to simplify the computational procedures by consolidating those accounts. This consolidation does not affect the computed value of capital input. Buildings and cable and wire are consolidated into structures. Switching, transmission, and information origination/termination equipment are consolidated into communications equipment. General support equipment is not affected by this consolidation.

Labor. The simplified TFP method bases the quantity of labor input on the number of employees, reported in the Form M, instead of an index of management and non-management hours worked.

Materials. There is no difference in the way materials input is computed in the original TFP study and the simplified TFP method.

Simplified TFP Method Results

Table E-1 shows the results from the simplified method applied to the nine price cap companies included in our original study--Ameritech, Bell Atlantic, BellSouth, GTE, Nynex, Pacific Telesis, Southern New England, Southwestern Bell, and US West.

Shown in Table E-1 are the annual rates of growth in total output, total input, and TFP. In the original study, average annual TFP growth was found to be 2.4 percent over the 1984-1993 period and 2.8 percent over the 1988-1993 period. Using the simplified method with the nine companies in the original study, average annual TFP growth is 2.9 percent over the 1984-1993 period and 3.0 percent over the 1988-1993 period.

Table E-1
Comparison of LEC TFP Growth for Nine Companies in Original Christensen LEC TFP Study:
Original Results Versus Simplified Method
1984-1993

Year	Total Output Original	Total Output Simplified	Total Input Original	Total Input Simplified	TFP Growth Original	TFP Growth Simplified
1984						
1985	2.4%	2.8%	1.3%	0.6%	1.1%	2.2%
1986	3.0%	3.1%	0.2%	0.8%	2.8%	2.3%
1987	3.7%	3.8%	1.9%	1.1%	1.8%	2.7%
1988	5.2%	5.5%	3.1%	2.0%	2.1%	3.5%
1989	4.8%	4.6%	2.7%	2.8%	2.0%	1.8%
1990	3.7%	4.1%	-0.9%	-0.2%	4.6%	4.3%
1991	2.3%	2.4%	1.1%	0.6%	1.2%	1.8%
1992	1.9%	2.3%	-1.6%	-0.9%	3.5%	3.2%
1993	3.6%	4.2%	1.0%	0.1%	2.6%	4.1%
Average Growth						
1984-93	3.4%.	3.6%	1.0%	0.8%	2.4%	2.9%
1988-93	3.3%	3.5%	0.5%	0.5%	2.8%	3.0%

Table E-2 shows results of the simplified method for 1988 through 1994 with Lincoln and Sprint added to the sample. The starting year for the simplified study with the expanded sample of companies is 1988 rather than 1984. This is done to eliminate adjustments required to 1984-1987 data because of the Uniform System of Accounts Rewrite (USOAR) that took effect in 1988. The expanded sample also contains results for 1994. Using the expanded sample of companies, the simplified method produces average annual TFP growth of 2.9 percent over the 1988-1993 period. Over this

same period, U.S. economy TFP growth averaged 0.1 percent per year, resulting in a TFP growth differential between the LECs and the U.S. economy of 2.8 percent for the 1988-1993 period. For the 1989-1994 period, LEC TFP growth averaged 3.1 percent per year, U.S. TFP growth averaged 0.3 percent per year, resulting in a TFP growth differential of 2.8 percent.

Table E-2
LEC TFP Using the Simplified Method
Results for Expanded Sample of Eleven Price Cap Companies
1988-1994

Year	Total Output Growth	Total Input Growth	TFP Growth
1988			
1989	4.7%	2.9%	1.8%
1990	3.8%	0.0%	3.8%
1991	2.7%	0.7%	2.0%
1992	2.0%	-1.5%	3.5%
1993	4.0%	0.3%	3.7%
1994	3.8%	1.4%	2.4%
Average Growth			
1988-93	3.5%	0.5%	2.9%
1989-94	3.3%	0.2%	3.1%

Summary

In our original TFP study, our goal was to use the most accurate data available on LEC inputs and outputs to measure LEC TFP growth. In this paper, we show that the methods used in our original study provide an accurate measurement of LEC TFP growth since divestiture. We also

discuss how the simplified TFP method maintains accuracy while meeting the concerns raised by the FCC.

The methods we employed in our original LEC TFP study are rigorously developed from economic theory, and they provide economically meaningful measures of total factor productivity growth. These methods have been widely employed by numerous other productivity studies at the firm, industry, and national level. These methods are also very similar to those used by the U.S. Bureau of Labor Statistics (BLS), which has been publishing total factor productivity for the U.S. economy since 1983.

In most instances, the data in our original study were obtained from publicly-available sources. In some instances the data were obtained from internal company records, and in a few cases were derived from proprietary data. Since the FCC has stated a concern that some of the data used in our TFP study are not accessible and verifiable, we have developed a simplified method of TFP measurement based completely on publicly-available data. We believe that the simplified TFP method maintains accuracy as well as a proper balance between precision in measurement and verifiability.

TOTAL FACTOR PRODUCTIVITY METHODS FOR LOCAL EXCHANGE CARRIER PRICE CAP PLANS

Laurits R. Christensen, Philip E. Schoech
and Mark E. Meitzen
Christensen Associates
December 18, 1995

In its Fourth Further Notice of Proposed Rulemaking,[1] the FCC has raised a number of questions regarding the appropriate methods for measuring local exchange carrier total factor productivity (LEC TFP). In particular, various questions have been posed by the FCC regarding the TFP study we submitted in May of 1994 and updated in January of 1995.[2] We respond herein to the issues directly relevant to the Christensen TFP methods.

The methods we employed in our original LEC TFP study are the same as those employed by Christensen, Christensen, and Schoech[3] in their pre-divestiture study of the Bell System. They are rigorously developed from economic theory, and they provide economically meaningful measures of total factor productivity growth. These methods have also been widely employed by numerous other productivity studies at the firm, industry, and

[1] Federal Communications Commission, Fourth Further Notice of Proposed Rulemaking, FCC 95-406, September 27, 1995.
[2] Laurits R. Christensen, Philip E. Schoech, and Mark E. Meitzen, "Productivity of the Local Operating Telephone Companies Subject to Price Cap Regulation," Christensen Associates, May 3, 1994, and "Productivity of the Local Operating Telephone Operating Companies Subject to Price Cap Regulation, 1993 Update," Christensen Associates, January 10, 1995. We refer to these collectively as our original study.
[3] Laurits R. Christensen, Dianne C. Christensen, and Philip E. Schoech, "Total Factor Productivity in the Bell System, 1947-1979," Christensen Associates, September 1981.

national level.[4] These methods are also very similar to those used by the U.S. Bureau of Labor Statistics (BLS), which has been publishing total factor productivity for the U.S. economy since 1983. (Appendix 1 lists the similarities in the methods employed by the BLS and the methods we employed in our LEC TFP study.)

In our original TFP study our goal was to use the most accurate data available on LEC inputs and outputs to measure LEC TFP growth. In most instances, the data were obtained from publicly-available sources. In some instances the data were obtained from internal company records, and in a few cases were derived from proprietary data. The FCC has stated a concern that some of the data used in our TFP study are not accessible and verifiable. Because of this concern, we have developed a simplified method of TFP measurement based completely on publicly-available data. In addition this model has simplified some of the computations, while continuing to represent standard practices in TFP measurement. We believe that the simplified TFP method maintains accuracy and addresses concerns about verifiability.

In the remainder of this paper, we respond to questions raised by the FCC. We show that the methods used in our original study provide an accurate measurement of LEC TFP growth since divestiture. We discuss

[4] We have previously used these methods in studies of the U.S. economy, other European and Asian economies, the U.S. Postal Service, and the agriculture, railroad, airline, and electric utility industries.

how the simplified TFP method maintains accuracy while meeting the concerns raised by the FCC. Finally, we summarize the main features of the simplified TFP method and present its results.

Issue 1a. What is the most reasonable method to develop output price indices for TFP calculation purposes? What data source should be used to develop output price indices?

We believe that the methods employed in our original LEC TFP study are the most reasonable methods for developing output price indexes for TFP measurement. These methods provide a proper balance between the demands of economic theory and the constraints of data availability. Furthermore, we believe that the data sources we used in our original TFP study provide the most accurate basis for measuring LEC TFP growth. Most of the data sources are also publicly available. Only two of the data series used in the computation of output growth, billed long distance revenue and billed intrastate access revenue, are not obtained from publicly-available data sources.[5] Since concerns have been raised regarding data not obtained from publicly-available sources, the simplified TFP method that we are now proposing substitutes booked revenue--which is reported in the Form M and the ARMIS 43-02 Report--for billed revenue in the output computation. This modification results in little difference in the TFP results. By basing the

[5] Prior to the reporting of Actual Price Indexes (API's) we relied upon non-public data for the computation of the Special Access price index. However, once API's became available, they were incorporated into the study.

simplified model entirely on publicly-available data, we believe a balance is established between precision and the FCC's stated concerns that all data be accessible and verifiable.

Our computation of LEC output in the original TFP study was based on a two-step approach that is commonly used in productivity analysis. At the first stage, we identified the major categories of output: local service, interstate end-user access, interstate switched access, interstate special access, intrastate access, long distance, and miscellaneous service. Price and quantity indexes were established for each of the service categories. The quantity indexes were then aggregated into a quantity index of total output, using the Tornqvist index. The Tornqvist index is a member of the "superlative index" family, and is a proper basis for computing total output.[6]

The FCC asks whether our categorization of outputs is appropriate, specifically whether there should be more categories, fewer categories, or whether services should be combined differently. The seven service categories identified in our study are a reasonable categorization of LEC services, based on the revenue accounts reported in the Form M/ARMIS 43-02. One cannot construct a more detailed set of service categories or combine services differently with publicly-available data. One can base the

[6] A superlative index number is one that accurately reflects price and quantity changes for a wide variety of production structures. The employment of superlative index numbers guarantees that price changes are accurately captured in productivity analysis, even when the underlying production characteristics of the LECs are not known. For a discussion of superlative index numbers, see W.E. Diewert, "Exact and Superlative Index Numbers," Journal of Econometrics, Vol. 4 (1976), pp. 115-145.