Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of Special Access Rates for Price Cap Local Exchange Carriers	**WC Docket No. 05-25**

Reply Declaration

of

SUSAN M. GATELY

on behalf of

Ad Hoc Telecommunications Users Committee

July 29, 2005

TABLE OF CONTENTS

Introduction 1

ARMIS data and results are sufficiently robust to be used to evaluate RBOC performance in the special access market and to develop necessary regulatory remedits. 3

ARMIS results for the special access category can be used to develop an X-factor using either an "implicit X" methodology or a “Total Factor Productivity” methodology. 4

VERIFICATION 8

APPENDICES

Appendix 1: The 2005 “Implicit X” Model Calculating a Productivity Factor for Interstate Special Access

Appendix 2: The 2005 Update of the 1999 TFP Model Calculating a Productivity Factor for Interstate Special Access

Appendix 3: A Study of Total Factor Productivity in the Wisconsin Local Exchange Carrier Industry

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of Special Access Rates for Price Cap Local Exchange Carriers	WC Docket No. 05-25

REPLY DECLARATION OF SUSAN M. GATELY

Introduction

Susan M. Gately, of lawful age, declares and says as follows:

1. My name is Susan M. Gately; I am Senior Vice President of Economics and Technology, Inc. ("ETI"), Two Center Plaza, Suite 400, Boston, Massachusetts 02108. ETI is a research and consulting firm specializing in telecommunications and public utility regulation and public policy. I have participated in numerous proceedings before the Federal Communications Commission ("FCC" or "Commission") dating back to 1981, and have appeared as an expert witness in state proceedings before state public utility commissions. I submitted a Declaration in the initial round of this proceeding on June 13, 2005. My Statement of Qualifications is annexed as Attachment 1 to that initial June 13, 2005 Declaration and is not reproduced here.

2. I have been asked by the Ad Hoc Telecommunications Users Committee ("Ad Hoc") to comment upon the usefulness of the interstate special access results detailed in the FCC ARMIS reports for identifying problems in the functioning of the special access market, and for developing regulatory remedies. As discussed below, I find the ARMIS results to be sufficiently robust to allow their use in this proceeding. Secondly, I have been asked by the Ad Hoc Committee if it is possible to develop an "X"-Factor for special access services for use in the FCC's Price Cap regime, and if so, to develop such a factor. As detailed below, I find that it is possible to develop an interstate special-access-only value for "X", and I have done so using both an "implicit X" and a TFP-based methodology.

ARMIS data and results are sufficiently robust to be used to evaluate RBOC performance in the special access market and to develop necessary regulatory remedits.

3. Throughout this proceeding,questions have been raised as to the usefulness of ARMIS data to the Commission in reviewing market conditions and determining appropriate profitability levels for the RBOCs. ARMIS data and results *are* robust enough to be used to evaluate RBOC performance in the special access market and to develop necessary regulatory remedies. All of the criticisms that have been levied at the Commission's ARMIS data have been qualitative, not quantitative. The RBOCs have had ample opportunity in this proceeding to introduce quantitative evidence to support those criticisms, but no such evidence has been forthcoming.

4. The accounting results that are reported in ARMIS are real. ARMIS does not generate those accounting results: all it does is make them available in a consistent format for regulators to use. ARMIS is a regulatory tool that records actual separations results to which regulators at the state and federal level regulate. While the RBOCs' repeated references to the *separations freeze* that occurred in 2001 are made to suggest that ARMIS data is somehow flawed as a result of that action (it is not), they fail to focus upon the reason why the Commission and the Federal-State Joint Board bothered to undertake the effort to evaluate the separations process and initiate the freeze.

5. If the separations results reported in ARMIS were nothing more than the results of arcane regulatory exercises that had no real world implications, there would have been no need to implement a *freeze* of the state/interstate allocators in 2001. It is precisely because the

separations and cost accounting results quantified in ARMIS *do have a real world effect* that the FCC and Federal-State Joint Board found it necessary to freeze the allocators in 2001. Under law, the FCC is responsible for ensuring that the rates for services offered pursuant to the plant that falls on *its side* of the Federal/State separations line are just and reasonable. The states' regulatory responsibilities relate to the investment and expense results that fall on their side of that separations line.

6. Regardless of whether the RBOCs like them or not, the separations results *as reported in the ARMIS accounts* represent the real investment and expense dollars that this Commission needs to utilize in determining whether prices are just and reasonable. Absent imposing a requirement for the RBOCs to produce access service cost studies (something the Commission has been loathe to do), the separations results are the only tool this Commission has in its arsenal for ensuring just and reasonable rates.

ARMIS results for the special access category can be used to develop an X-factor using either an "implicit X" methodology or a "Total Factor Productivity" methodology.

7. Using ARMIS data, I have calculated an X-Factor for the interstate special access category as a whole using both the "implicit X" factor methodology used by the FCC in 1995,[1] and a Total Factor Productivity (TFP) result based upon a TFP methodology used by the FCC staff in its 1999 study. These studies and their results are described in more detail in Appendices 1, 2 and 3 attached to this declaration.

1. *See* AdHoc Initial Comments, at 43-44.

8. An "implicit X" is determined by calculating the value of the offset factor that would have been required to maintain RBOC earnings at their authorized level of 11.25. This methodology was initially developed by then Common Carrier Bureau staff members Chris Frentrup and Mark Uretsky as part of their work in the *Price Cap Performance Review for Local Exchange Carriers.*[2] ETI's "implicit X" study undertaken for this proceeding yielded a “X” for the special access category of 10.71%. Details of the study methodology and the data used to develop it are contained in Appendix 1 to this declaration.

9. A TFP-based "X" for interstate special access services was also developed by ETI. The general structure and approach to this TFP model is described in Appendix 3 to this declaration in a document original prepared for submission to the Wisconsin PSC. Specific adjustments to the TFP model described in Appendix 3 to translate that Wisconsin-specific model into an interstate special access-specific model, update the data and calculate a "special access-only" TFP, along with the data used to develop the results, are included in Appendix 2 to this declaration.

10. The Special Access Total Productivity Factor (SPAC TFP) model presented in Appendix 2 is based upon a TFP model which generally follows the methodology devised by the FCC Staff in their 1999 study submitted in the remand phase of the FCC's last price caps review

---

2. *Price Cap Performance Review for Local Exchange Carriers*, CC Docket No. 94-1, *First Report and Order*, 10 FCC Rcd 8961 (1995), at paras. 99-165.

proceeding.[3] My firm, Economics and Technology, Inc. (ETI) originally presented a version of the TFP model to two state regulatory commissions, the Utah Division of Public Utilities in 1999 and 2001[4], and the Public Service Commission of Wisconsin in 2003.[5] The SPAC TFP Model calculates a TFP Differential of 13.64% and an Input Price Differential of -2.63%, resulting in a five year average X-Factor of 11.01 for the interstate special access category as a whole.

11. The TFP model provided here today was used by the Utah DPU in setting an X-Factor for Qwest. The Utah DPU initally adopted a productivity factor for Qwest in 2000 as part of a stipulation between the Division and Qwest in the US West-Qwest merger case.[6] As a result of the stipulation, the Utah DPU did not evaluate the 1999 TFP model. However, in 2001, the Utah DPU revisited price cap regulation at the request of Qwest, and relied upon the TFP model presented by ETI to determine an appropriate productivity factor for Qwest. Using the TFP

3. *See, Price Cap Performance Review for Local Exchange Carriers*, CC Docket No. 94-1; *Access Charge Reform,* CC Docket No. 96-262, *Further Notice of Proposed Rulemaking*, FCC No. 99-345, 14 FCC Rcd 19717 (1999).

4. Utah Public Service Commission, *Application of Qwest Corporation for a Change in the Productivity Factor for Price Cap Regulation, R746-352*, Docket No. 01-049-78, Direct Testimony of Dr. Lee L. Selwyn, filed on behalf of the Utah Division of Public Utilities, November 14, 2001.

5. *See, A Study of Total Factor Productivity in the Wisconsin Local Exchange Carrier Industry*, prepared by Economics and Technology, Inc., for the Public Service Commission of Wisconsin, January 2003. This report is attached as Appendix 3.

6. Utah Public Service Commission, *Merger of the Parent Corporations of Qwest Communications Corporation, LCI International Telecom Corp. and US West Communications, Inc*, Docket No. 99-049-41, June 9, 2000.

Model presented by ETI, the Utah DPU based its adopted TFP differential (3.55%) on the average of two differentials. The first differential was calculated using an output measure of Dial Equipment Minutes (4.79%), and the second differential was calculated using an output measure based on access lines (2.3%). The Utah DPU adopted the input differential (1.41%) calculated by the ETI TFP Model.

VERIFICATION

The foregoing statements are true and correct to the best of my knowledge, information, and belief.

Susan M Gately

SUSAN M. GATELY

Appendix 1
July 29, 2005

The 2005 "Implicit X" Model
Calculating a Productivity Factor for Interstate Special Access

1 SUMMARY

An "implicit X" is determined by calculating the value of the offset factor that would have been required to maintain RBOC earnings at their authorized level of 11.25%. This methodology was initially developed by then Common Carrier Bureau staff members Chris Frentrup and Mark Uretsky as part of their work in the *Price Cap Performance Review for Local Exchange Carriers.*[2] ETI's "implicit X" study undertaken for this proceeding yielded an implicit X-Factor result for the special access category of 10.71%. Details of the study methodology and the data used to develop it are presented below.

2 DATA

Data for the Implicit X-Factor calculations is predominantly drawn directly from the FCC's ARMIS database (available at http://www.fcc.gov/wcb/eafs.). Data is drawn for each of the four RBOCs, Bellsouth, Qwest, SBC, and Verizon, annually from 1997 through 2004. Nine revenue and expense accounts are drawn from Report 43-01, the Annual Summary Report, at Table 1. Counts of DS-0 equivalent special access lines are drawn from Report 43-08, the Operating Data Report, at Table 3. GDP-PI is drawn from The Bureau of Economic Analysis, National Income and Product Accounts Table 1.1.4, Price Indexes for Gross Domestic Product (available at http://www.bea.gov/) and is drawn for the period 1996 through 2004.

The data are placed into four worksheets by RBOC, and a fifth worksheet is generated to represent the aggregate RBOC results by summing the inputs for each individual RBOC. The layout and mechanics of each worksheet are identical, and follow a structure of Lines (representing various inputs and calculations) and columns, each representing one year over the period 1997 (n=0) to 2004. The following list outlines the Lines used to calculate the implicit X-Factor. Lines representing data or user inputs are left unmarked, and lines representing calculations are denoted with an asterisk. Additionally, two user-changeable X-Factors (A and B) are included. X-Factor A is used in a calculation of an *ex post* Factor, taking into consideration extant X-factors and other actual marketplace conditions. X-Factor B is used in the calculation of an *ex ante* Factor, one which encompasses the effects of existing X-Factor adjustments and other marketplace conditions.

---

[2] *Price CapPerformance Review for Local Exchange Carriers*, CC Docket 94-1, First Report and Order, 10 FCC Rcd 8961 (1995) paras. 99 - 165.

LINE
1. Total Operating Revenues
2. Total Operating Expenses
3. Other Operating Income/Loss
4. Total Non-Operating Items
5. State Income Taxes
6. State Other Taxes
7. Federal Taxes
8.* Calculated Average State Tax Rate
9.* Marginal Federal Corporate Tax Rate
10.* Calculated Net Return
11. Total Plant In Service
12. Total Other Investments
13. Total Reserves
14.* Calculated Net Investment
15. Average Net Investment Per ARMIS
16. Net Return Per ARMIS
17.* Special Access Rate of Return
18. GDP-PI
19.* GDP-PI % change
20. DS-0 Equivalents
21. X-Factor A
22.* GDP-PI – X_a
23.* Price Index
24.* Adjusted (X_a) Total Revenues
25.* Adjusted (X_a) Net Return
26.* Adjusted (X_a) Rate of Return
27.* Price Per DS-0 Equivalent
28.* Actual DS-0 Equivalent Price Index
29. X Factor B
30.* GDP-PI – X_b
31.*Adjusted (X_b) Price Per DS-0 Equivalent
32.* Adjusted (X_b) Revenue
33.* Adjusted (X_b) Net Return
34.* Adjusted (X_b) Rate of Return

3 METHODOLOGY:

The first step in the process of determining an implicit X-factor is to establish existing rates of return for special access service. Rate of return is calculated using two inputs, Net Return, and Average Net Investment.

Calculating Net Return (Line 10)
Line 1 – Line 2 + Line 3 – Line 4 – Line 5 – Line 6 – Line 7

Net Return is calculated by starting with Total Operating Revenue, subtracting Total Operating Expense, adding Other Operating Income and Loss, and subtracting Non-Operating Items, State Other Taxes, State Income Taxes, and Federal Income Taxes.

Calculating Average Net Investment (Line 14)
Line 11 + Line 12 – Line 13
Average Net Investment is calculated by adding Total Plant in Service to Total Other Investments, and then subtracting Total Reserves.

Calculating Special Access Rate of Return (Line 17)
Line 10 ÷ Line 14
Special Access Rate of Return is calculated by dividing Net Return by Average Net Investment.

Calculating GDP-PI % Change (Line 19)
(Line 18_n – Line 18_{n-1}) ÷ Line 18_{n-1}
GDP-PI % Change for period N is calculated by subtracting the GDP-PI from period N-1 from GDP-PI in period N, and dividing the result by the GDP-PI for period N-1.

Calculating GDP-PI – X_a (Line 22)
Line 19 – Line 21
GDP-PI minus X is calculated by subtracting the user-entered X-factor A from GDP-PI % Change.

Calculating Price Index (Line 23)
User enters initial value, then $(\text{Line } 23)_{n-1}$ * (1 + Line 22)
The Price Index is calculated by multiplying the previous periods index value by one plus GDP-PI minus X. The initial value of the index for period zero should be user entered. A value of 100 starts the index at the actual historical rates and revenues, but can increased or decreased to reflect a rate re-initialization.

Calculating Adjusted Total Revenue (Line 24)
(Line 23*Line 1) ÷ 100
Adjusted total revenue is calculated by multiplying the price index by the total revenue, and dividing by 100.

Calculating Adjusted Net Return (Line 25)
(Line 24 – Line 2 + Line 3 – Line 4 – Line 6) * (1 – Line 8 – Line 9 + Line 8 * Line 9)
Adjusted Net Return is calculated by starting with Adjusted Total Revenue, subtracting Total Operating Expense, adding Other Income/Loss, and subtracting Non-Operating Items and State Other Taxes. This value is adjusted for Income taxes by multiplying by one minus the average state tax rate, minus the marginal federal tax rate, minus the state tax rate multiplied by the federal tax rate (which adjusts federal taxes by the amount paid as state taxes.)

Calculating Adjusted Rate of Return (Line 26)
Line 25 ÷ Line 14
The Adjusted Rate of Return is calculated by dividing Adjusted Net Return by Average Net Investment.

Calculating Price Per DS-0 Equivalent (Line 27)
Line 1 ÷ Line 20
Price Per DS-0 Equivalent is calculated by dividing Total Operating Revenue by the count of DS-0 Equivalents.

Calculating Actual DS-0 Equivalent Price Index (Line 28)
Line 27_n ÷ Line27_0
The DS-0 Equivalent Price is calculated by dividing the Price Per DS-0 Equivalent in Period N by the Price Per DS-0 Equivalent in the first period.

Calculating GDP-PI – X_b (Line 30)
Line 19 – Line 29
GDP-PI minus X is calculated by subtracting the user-entered X-factor B from GDP-PI % Change.

Adjusted Price Per DS-0 Equivalent (Line 31)
Initial Value is user entered, then (1 + Line 30) * (Line 31_{n-1})
The Adjusted Price Per DS-0 Equivalent is calculated by multiplying the previous price per DS-0 by 1 plus GDP-PI minus X.

Adjusted Revenue (Line 32)
Line 31 * Line 20
Adjusted Revenue is calculated by multiplying the Adjusted Price Per DS-0 by the current Count of DS-0 Equivalents.

Adjusted Net Return (Line 33)
(Line 32 – Line 2 + Line 3 – Line 4 – Line 6) * (1 – Line 8 – Line 9 + Line 8 * Line 9)
Adjusted Net Return is calculated by starting with Adjusted Revenue, subtracting Total Operating Expense, adding Other Income/Loss, and subtracting Non-Operating Items and State Other Taxes. This value is adjusted for Income taxes by multiplying by one minus the average state tax rate, minus the marginal federal tax rate, minus the state tax rate multiplied by the federal tax rate (which adjusts federal taxes by the amount paid as state taxes.)

Adjusted Rate of Return (Line 34)
Line 33 ÷ Line 14
The Adjusted Rate of Return is calculated by dividing Adjusted Net Return by Average Net Investment.

4 <u>CALCULATION OF RESULTS</u>:

EX POST X-FACTOR

The implicit *ex-post* X-Factor is calculated to represent the hypothetical *additional* annual X-Factor adjustment required–in addition to actual X-Factor and other adjustments that occurred–to bring current special access rates to a level that provides an 11.25% rate of return (the FCC's last authorized rate of return). Lines 21 through 26 provide the mechanism to determine this implicit X-Factor. The User may adjust the X-Factor as desired. The X-Factor flows into the GDP-PI – X calculation, which adjusts the unit price index to reflect the adjustment. The price index is then applied to Total Revenue for each period. This Adjusted Revenue is then converted to Adjusted Net Return by subtracting out Expenses and Taxes. Adjusted Net Return flows through into the calculation of Adjusted Rate of Return, which shows what the annual Special Access Rate of Return would have been had the hypothetical X-Factor been applied in addition to the X-Factor that was in place, as well as all other adjustments that occurred. The goal, in this case, is to arrive at an Implicit X-Factor that results in the Adjusted Rate of Return for the final period of the model being 11.25%. Users may either "guess and check" X-Factor values, or use the Solver function of Excel to calculate the X-Factor value that generates the desired ROR result. Using this methodolgy, the resulting X-Factor for the RBOCs that would lower the overall Special Access ROR to 11.25% is 10.71%.

EX ANTE X-FACTOR

The implicit *ex-ante* X-Factor is calculated to represent the required hypothetical *total* annual X-Factor adjustment–including X-Factor adjustments that actually occurred–needed to bring hypothetical special access rates to a level that, given actual demand, would provide an 11.25% rate of return (the FCC's last authorized rate of return) in the final period of the model. Lines 29 through 34 provide the mechanism to determine this implicit X-Factor. The User may adjust the X-Factor as desired. The X-Factor flows into the GDP-PI – X calculation, which in turn adjusts the Price Per DS-0 Equivalent to reflect the adjustment. The Price Per DS-0 is then multiplied by observed DS-0 Equivalent demand for each period to generate Adjusted Revenue. This Adjusted Revenue is then converted to Adjusted Net Return by subtracting out Expenses and Taxes. Adjusted Net Return flows through into the calculation of Adjusted Rate of Return, which shows what the annual Special Access Rate of Return would have been had the hypothetical X-Factor been applied. The goal, in this case, is to arrive at an Implicit X-Factor that results in the Adjusted Rate of Return for the final period of the model being 11.25%. Users may either "guess and check" X-Factor values, or use the Solver function of Excel to calculate the X-Factor value that generates the desired ROR result.

Appendix 1b
Interstate Special Access Implicit X-Factor Calulation

Average RBOC	Line	2004	2003	2002	2001	2000	1999	1998	1997	
Total Operating Revenues	1	$ 14,274,143	$ 13,440,013	$ 12,966,855	$ 12,413,852	$ 9,592,031	$ 7,141,094	$ 5,536,133	$ 4,312,543	
Total Operating Expenses	2	$ 5,901,790	$ 6,017,656	$ 5,409,380	$ 5,111,552	$ 4,873,419	$ 3,988,276	$ 3,404,629	$ 3,275,870	
Other Operating Income/Loss	3	$ 7,119	$ 5,649	$ 916	$ 5,416	$ 7,173	$ 8,139	$ (2,905)	$ 692	
Total Non-Operating Items	4	$ (4,478)	$ (7,358)	$ (14,666)	$ (29,259)	$ (24,887)	$ (11,335)	$ (6,805)	$ (5,134)	
State Income Tax	5	$ 676,077	$ 436,093	$ 437,066	$ 351,628	$ 226,031	$ 153,017	$ 99,441	$ 38,876	
State Other Taxes	6	$ 318,014	$ 316,334	$ 300,567	$ 264,714	$ 270,955	$ 238,857	$ 204,814	$ 180,719	
Federal Taxes	7	$ 2,477,236	$ 2,226,136	$ 2,269,091	$ 2,218,194	$ 1,358,614	$ 871,929	$ 550,512	$ 204,941	
Calculated Ave. State Tax Rate	8	8.06%	5.87%	5.77%	4.79%	4.76%	4.82%	4.66%	3.73%	
Marginal Federal Corporate Tax Rate	9	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	
Calculated Net Return	10	$ 4,912,623	$ 4,456,801	$ 4,566,333	$ 4,502,439	$ 2,895,072	$ 1,908,489	$ 1,280,637	$ 617,963	
Total Plant in Service	11	$ 33,546,623	$ 32,693,430	$ 31,692,854	$ 29,770,332	$ 26,598,723	$ 21,469,344	$ 17,648,741	$ 14,944,490	
Total Other Investments	12	$ 1,292,565	$ 1,218,755	$ 1,216,458	$ 1,200,538	$ 998,346	$ 573,240	$ 476,543	$ 348,552	
Total Reserves	13	$ 25,692,361	$ 23,676,962	$ 21,423,135	$ 19,213,196	$ 17,158,718	$ 13,602,014	$ 10,975,696	$ 8,919,970	
Calculated Ave. Net Investment	14	$ 9,146,827	$ 10,235,223	$ 11,486,177	$ 11,757,674	$ 10,438,351	$ 8,440,570	$ 7,149,588	$ 6,373,072	
Average Net Investment Per ARMIS	15	$ 9,146,832	$ 10,235,230	$ 11,486,181	$ 11,757,671	$ 10,438,349	$ 8,440,569	$ 7,149,582	$ 6,373,074	
Net Return Per ARMIS	16	$ 4,912,622	$ 4,456,785	$ 4,566,328	$ 4,502,439	$ 2,895,075	$ 1,906,740	$ 1,279,675	$ 617,253	
Special Access Rate of Return	17	53.71%	43.54%	39.76%	38.29%	27.73%	22.61%	17.91%	9.70%	
GDP-PI	18	108.30	106.00	104.10	102.40	100.00	97.87	96.48	95.42	93.859
GDP-PI % Change	19	2.17%	1.83%	1.66%	2.40%	2.18%	1.44%	1.11%	1.66%	
DS-0 Equivalents	20	125,299,458	112,182,616	97,486,400	82,506,666	68,255,874	48,820,920	34,069,485	26,306,341	
X-Factor (a)	21	**10.71%**	**<--USER VALUE**							
GDP-PI - X (a)	22	-8.55%	-8.88%	-9.06%	-8.31%	-8.53%	-9.27%	-9.60%	-9.06%	
Price Index	23	55.56	60.75	66.67	73.31	79.96	87.42	96.35	106.58	
Adjusted Total Revenues (a)	24	$ 7,930,168	$ 8,164,710	$ 8,645,173	$ 9,100,852	$ 7,669,568	$ 6,242,667	$ 5,334,071	$ 4,596,522	
Adjusted Net Return (a)	25	$ 1,029,017	$ 1,128,134	$ 1,807,330	$ 2,326,413	$ 1,583,129	$ 1,258,951	$ 1,071,222	$ 716,971	
Adjusted Rate of Return (a)	26	11.25%	11.02%	15.73%	19.79%	15.17%	14.92%	14.98%	11.25%	
Price Per DS-0 Equivalent	27	$ 113.92	$ 119.80	$ 133.01	$ 150.46	$ 140.53	$ 146.27	$ 162.50	$ 163.94	
Actual DS-0 Equivalent Price Index	28	0.69	0.73	0.81	0.92	0.86	0.89	0.99	1.00	
X-Factor (b)	29	**15.33%**	**<--USER VALUE**							
GDP-PI - X (b)	30	-13.16%	-13.50%	-13.67%	-12.93%	-13.15%	-13.89%	-14.22%	-13.67%	
Adjusted Price Per DS-0 Equivalent	31	$ 63.29	$ 72.88	$ 84.26	$ 97.61	$ 112.10	$ 129.07	$ 149.89	$ 174.73	
Adjusted Total Revenues (b)	32	$ 7,930,157	$ 8,176,406	$ 8,214,083	$ 8,053,145	$ 7,651,336	$ 6,301,448	$ 5,106,531	$ 4,596,522	
Adjusted Net Return (b)	33	$ 1,029,010	$ 1,135,290	$ 1,543,293	$ 1,678,041	$ 1,571,842	$ 1,295,316	$ 930,209	$ 716,971	
Adjusted Rate of Return (b)	34	11.25%	11.09%	13.44%	14.27%	15.06%	15.35%	13.01%	11.25%	

Appendix 1b
Interstate Special Access Implicit X-Factor Calulation

Verizon	Line	2004	2003	2002	2001	2000	1999	1998	1997	
Total Operating Revenues	1	$ 5,639,022	$ 5,221,000	$ 4,958,705	$ 4,671,667	$ 3,726,893	$ 2,819,250	$ 2,102,969	$ 1,651,571	
Total Operating Expenses	2	$ 3,007,805	$ 3,104,678	$ 2,647,888	$ 2,526,002	$ 2,394,114	$ 2,050,539	$ 1,597,196	$ 1,516,139	
Other Operating Income/Loss	3	$ 5,215	$ 4,025	$ (42)	$ 5,267	$ (328)	$ 7,826	$ (1,398)	$ 679	
Total Non-Operating Items	4	$ (4,197)	$ (5,312)	$ (9,939)	$ (18,623)	$ (15,549)	$ (8,104)	$ (6,567)	$ (3,108)	
State Income Tax	5	$ 199,730	$ 143,521	$ 149,928	$ 134,856	$ 84,946	$ 55,715	$ 21,657	$ 5,376	
State Other Taxes	6	$ 208,289	$ 196,505	$ 177,006	$ 162,146	$ 164,034	$ 137,778	$ 106,852	$ 91,956	
Federal Taxes	7	$ 718,273	$ 565,328	$ 633,908	$ 585,951	$ 318,334	$ 153,105	$ 90,180	$ (21,633)	
Calculated Ave. State Tax Rate	8	7.56%	6.75%	6.46%	6.22%	6.30%	7.10%	4.24%	3.86%	
Marginal Federal Corporate Tax Rate	9	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	
Calculated Net Return	10	$ 1,514,337	$ 1,220,305	$ 1,359,872	$ 1,286,602	$ 780,686	$ 438,043	$ 292,253	$ 63,520	
Total Plant in Service	11	$ 16,332,880	$ 15,803,785	$ 15,020,163	$ 14,281,238	$ 12,687,658	$ 10,847,782	$ 8,265,917	$ 6,612,490	
Total Other Investments	12	$ 726,203	$ 702,131	$ 644,306	$ 694,559	$ 567,390	$ 367,292	$ 290,341	$ 188,338	
Total Reserves	13	$ 12,272,505	$ 11,225,131	$ 10,016,131	$ 9,216,579	$ 8,138,640	$ 6,831,244	$ 5,137,203	$ 3,952,221	
Calculated Ave. Net Investment	14	$ 4,786,578	$ 5,280,785	$ 5,648,338	$ 5,759,218	$ 5,116,408	$ 4,383,830	$ 3,419,055	$ 2,848,607	
Average Net Investment Per ARMIS	15	$ 4,786,581	$ 5,280,791	$ 5,648,340	$ 5,759,217	$ 5,116,407	$ 4,383,827	$ 3,419,049	$ 2,848,609	
Net Return Per ARMIS	16	$ 1,514,339	$ 1,220,301	$ 1,359,867	$ 1,286,600	$ 780,691	$ 436,293	$ 291,291	$ 62,810	
Special Access Rate of Return	17	31.64%	23.11%	24.08%	22.34%	15.26%	9.99%	8.55%	2.23%	
GDP-PI	18	108.30	106.00	104.10	102.40	100.00	97.87	96.48	95.42	93.859
GDP-PI % Change	19	2.17%	1.83%	1.66%	2.40%	2.18%	1.44%	1.11%	1.66%	
DS-0 Equivalents	20	39,378,412	35,260,629	26,953,122	24,921,686	19,261,037	11,445,395	7,890,191	5,952,898	
X-Factor (a)	21	**9.60%**	**<--USER VALUE**							
GDP-PI - X (a)	22	-7.43%	-7.77%	-7.94%	-7.20%	-7.42%	-8.15%	-8.49%	-7.94%	
Price Index	23	72.76	78.60	85.22	92.57	99.75	107.75	117.31	128.19	
Adjusted Total Revenues (a)	24	$ 4,102,913	$ 4,103,788	$ 4,225,833	$ 4,324,710	$ 3,717,615	$ 3,037,602	$ 2,467,002	$ 2,117,144	
Adjusted Net Return (a)	25	$ 538,487	$ 492,129	$ 857,798	$ 1,012,207	$ 715,431	$ 522,456	$ 478,117	$ 320,471	
Adjusted Rate of Return (a)	26	11.25%	9.32%	15.19%	17.58%	13.98%	11.92%	13.98%	11.25%	
Price Per DS-0 Equivalent	27	$ 143.20	$ 148.07	$ 183.98	$ 187.45	$ 193.49	$ 246.32	$ 266.53	$ 277.44	
Actual DS-0 Equivalent Price Index	28	0.52	0.53	0.66	0.68	0.70	0.89	0.96	1.00	
X-Factor (b)	29	**17.91%**	**<--USER VALUE**							
GDP-PI - X (b)	30	-15.75%	-16.08%	-16.26%	-15.51%	-15.73%	-16.47%	-16.80%	-16.25%	
Adjusted Price Per DS-0 Equivalent	31	$ 104.19	$ 123.67	$ 147.36	$ 175.97	$ 208.28	$ 247.17	$ 295.89	$ 355.65	
Adjusted Total Revenues (b)	32	$ 4,102,913	$ 4,360,542	$ 3,971,925	$ 4,385,523	$ 4,011,623	$ 2,828,905	$ 2,334,665	$ 2,117,140	
Adjusted Net Return (b)	33	$ 538,488	$ 647,750	$ 703,421	$ 1,049,278	$ 894,494	$ 396,435	$ 395,744	$ 320,469	
Adjusted Rate of Return (b)	34	11.25%	12.27%	12.45%	18.22%	17.48%	9.04%	11.57%	11.25%	

Appendix 1b
Interstate Special Access Implicit X-Factor Calulation

SBC	Line	2004	2003	2002	2001	2000	1999	1998	1997	
Total Operating Revenues	1	$ 4,506,175	$ 4,428,745	$ 4,347,763	$ 4,374,968	$ 3,405,544	$ 2,480,543	$ 1,954,938	$ 1,494,486	
Total Operating Expenses	2	$ 1,640,739	$ 1,690,493	$ 1,537,557	$ 1,350,369	$ 1,465,291	$ 1,057,370	$ 1,071,780	$ 994,553	
Other Operating Income/Loss	3	$ 1,579	$ 1,423	$ 722	$ 237	$ 6,946	$ (137)	$ (227)	$ 877	
Total Non-Operating Items	4	$ 58	$ (1,400)	$ (2,832)	$ (5,739)	$ (4,741)	$ (1,406)	$ (430)	$ (1,991)	
State Income Tax	5	$ 200,712	$ 197,139	$ 190,954	$ 148,456	$ 93,185	$ 56,357	$ 50,522	$ 23,195	
State Other Taxes	6	$ 66,209	$ 70,528	$ 75,197	$ 55,551	$ 61,577	$ 62,010	$ 63,057	$ 51,753	
Federal Taxes	7	$ 892,055	$ 843,555	$ 861,129	$ 955,231	$ 593,146	$ 430,620	$ 243,746	$ 122,873	
Calculated Ave. State Tax Rate	8	7.00%	7.19%	6.79%	4.90%	4.77%	3.96%	5.72%	4.61%	
Marginal Federal Corporate Tax Rate	9	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	
Calculated Net Return	10	$ 1,707,981	$ 1,629,853	$ 1,686,480	$ 1,871,337	$ 1,204,032	$ 875,455	$ 526,036	$ 304,980	
Total Plant in Service	11	$ 9,370,633	$ 9,227,656	$ 9,114,449	$ 8,022,241	$ 7,623,212	$ 5,716,826	$ 5,199,595	$ 4,434,578	
Total Other Investments	12	$ 284,385	$ 263,291	$ 315,298	$ 214,186	$ 204,065	$ 52,654	$ 95,106	$ 86,821	
Total Reserves	13	$ 7,413,219	$ 6,910,618	$ 6,254,332	$ 5,190,697	$ 4,936,574	$ 3,555,890	$ 3,147,302	$ 2,616,832	
Calculated Ave. Net Investment	14	$ 2,241,799	$ 2,580,329	$ 3,175,415	$ 3,045,730	$ 2,890,703	$ 2,213,590	$ 2,147,399	$ 1,904,567	
Average Net Investment Per ARMIS	15	$ 2,241,800	$ 2,580,329	$ 3,175,416	$ 3,045,731	$ 2,890,702	$ 2,213,592	$ 2,147,399	$ 1,904,567	
Net Return Per ARMIS	16	$ 1,707,981	$ 1,629,850	$ 1,686,481	$ 1,871,335	$ 1,204,031	$ 875,456	$ 526,036	$ 304,980	
Special Access Rate of Return	17	76.19%	63.16%	53.11%	61.44%	41.65%	39.55%	24.50%	16.01%	
GDP-PI	18	108.30	106.00	104.10	102.40	100.00	97.87	96.48	95.42	93.859
GDP-PI % Change	19	2.17%	1.83%	1.66%	2.40%	2.18%	1.44%	1.11%	1.66%	
DS-0 Equivalents	20	49,646,795	45,543,054	41,108,058	31,592,086	27,095,927	21,881,920	14,965,298	11,803,472	
X-Factor (a)	21	**11.08%**	**<--USER VALUE**							
GDP-PI - X (a)	22	-8.91%	-9.25%	-9.42%	-8.68%	-8.90%	-9.63%	-9.97%	-9.42%	
Price Index	23	47.11	51.71	56.98	62.91	68.89	75.62	83.68	92.94	
Adjusted Total Revenues (a)	24	$ 2,122,639	$ 2,290,295	$ 2,477,507	$ 2,752,353	$ 2,346,011	$ 1,875,724	$ 1,635,874	$ 1,389,014	
Adjusted Net Return (a)	25	$ 252,202	$ 320,989	$ 526,097	$ 836,004	$ 514,258	$ 472,965	$ 307,172	$ 214,262	
Adjusted Rate of Return (a)	26	11.25%	12.44%	16.57%	27.45%	17.79%	21.37%	14.30%	11.25%	
Price Per DS-0 Equivalent	27	$ 90.76	$ 97.24	$ 105.76	$ 138.48	$ 125.68	$ 113.36	$ 130.63	$ 126.61	
Actual DS-0 Equivalent Price Index	28	0.72	0.77	0.84	1.09	0.99	0.90	1.03	1.00	
X-Factor (b)	29	**15.29%**	**<--USER VALUE**							
GDP-PI - X (b)	30	-13.13%	-13.46%	-13.64%	-12.89%	-13.11%	-13.85%	-14.18%	-13.63%	
Adjusted Price Per DS-0 Equivalent	31	$ 42.75	$ 49.22	$ 56.87	$ 65.85	$ 75.60	$ 87.00	$ 100.99	$ 117.68	
Adjusted Total Revenues (b)	32	$ 2,122,639	$ 2,241,419	$ 2,337,852	$ 2,080,369	$ 2,048,325	$ 1,903,835	$ 1,511,351	$ 1,389,017	
Adjusted Net Return (b)	33	$ 252,202	$ 291,504	$ 441,481	$ 420,611	$ 330,000	$ 490,514	$ 230,861	$ 214,264	
Adjusted Rate of Return (b)	34	11.25%	11.30%	13.90%	13.81%	11.42%	22.16%	10.75%	11.25%	

Appendix 1b
Interstate Special Access Implicit X-Factor Calulation

Qwest	Line	2004	2003	2002	2001	2000	1999	1998	1997	
Total Operating Revenues	1	$ 1,690,814	$ 1,645,766	$ 1,665,388	$ 1,543,752	$ 1,226,335	$ 921,313	$ 715,333	$ 566,877	
Total Operating Expenses	2	$ 558,515	$ 558,518	$ 566,347	$ 558,249	$ 519,208	$ 435,654	$ 363,889	$ 382,167	
Other Operating Income/Loss	3	$ 327	$ 171	$ (19)	$ (12)	$ 3	$ 553	$ (1,338)	$ (851)	
Total Non-Operating Items	4	$ (793)	$ (963)	$ (1,929)	$ (3,840)	$ (3,580)	$ (1,362)	$ 162	$ (14)	
State Income Tax	5	$ 96,446	$ 21,179	$ 16,714	$ 14,969	$ 16,119	$ 17,341	$ 6,378	$ 1,062	
State Other Taxes	6	$ 18,198	$ 24,493	$ 23,241	$ 22,176	$ 22,542	$ 17,999	$ 15,594	$ 19,472	
Federal Taxes	7	$ 338,738	$ 346,779	$ 354,092	$ 318,985	$ 220,692	$ 148,187	$ 105,867	$ 46,884	
Calculated Ave. State Tax Rate	8	8.51%	1.95%	1.52%	1.51%	2.27%	3.56%	1.82%	0.58%	
Marginal Federal Corporate Tax Rate	9	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	
Calculated Net Return	10	$ 680,037	$ 695,931	$ 706,904	$ 633,201	$ 451,357	$ 304,047	$ 222,105	$ 116,455	
Total Plant in Service	11	$ 3,621,864	$ 3,573,761	$ 3,548,926	$ 3,460,928	$ 2,949,322	$ 2,462,580	$ 2,061,448	$ 1,991,951	
Total Other Investments	12	$ 65,712	$ 72,129	$ 86,503	$ 138,898	$ 141,247	$ 94,981	$ 58,731	$ 51,435	
Total Reserves	13	$ 2,802,587	$ 2,588,901	$ 2,411,142	$ 2,183,151	$ 1,906,997	$ 1,612,750	$ 1,304,883	$ 1,186,541	
Calculated Ave. Net Investment	14	$ 884,989	$ 1,056,989	$ 1,224,287	$ 1,416,675	$ 1,183,572	$ 944,811	$ 815,296	$ 856,845	
Average Net Investment Per ARMIS	15	$ 884,989	$ 1,056,989	$ 1,224,287	$ 1,416,675	$ 1,183,572	$ 944,811	$ 815,296	$ 856,845	
Net Return Per ARMIS	16	$ 680,037	$ 695,931	$ 706,904	$ 633,201	$ 451,357	$ 304,047	$ 222,105	$ 116,455	
Special Access Rate of Return	17	76.84%	65.84%	57.74%	44.70%	38.14%	32.18%	27.24%	13.59%	
GDP-PI	18	108.30	106.00	104.10	102.40	100.00	97.87	96.48	95.42	93.859
GDP-PI % Change	19	2.17%	1.83%	1.66%	2.40%	2.18%	1.44%	1.11%	1.66%	
DS-0 Equivalents	20	11,729,294	10,725,761	10,295,176	9,909,447	8,936,109	8,198,265	6,496,308	5,589,980	
X-Factor (a)	21	**12.56%**	**<--USER VALUE**							
GDP-PI - X (a)	22	-10.40%	-10.73%	-10.91%	-10.16%	-10.38%	-11.12%	-11.45%	-10.90%	
Price Index	23	43.94	49.04	54.94	61.66	68.64	76.59	86.17	97.31	
Adjusted Total Revenues (a)	24	$ 743,010	$ 807,129	$ 914,930	$ 951,927	$ 841,713	$ 705,623	$ 616,395	$ 551,639	
Adjusted Net Return (a)	25	$ 99,561	$ 143,564	$ 209,485	$ 240,273	$ 192,830	$ 159,156	$ 150,229	$ 96,396	
Adjusted Rate of Return (a)	26	11.25%	13.58%	17.11%	16.96%	16.29%	16.85%	18.43%	11.25%	
Price Per DS-0 Equivalent	27	$ 144.15	$ 153.44	$ 161.76	$ 155.79	$ 137.23	$ 112.38	$ 110.11	$ 101.41	
Actual DS-0 Equivalent Price Index	28	1.42	1.51	1.60	1.54	1.35	1.11	1.09	1.00	
X-Factor (b)	29	**7.96%**	**<--USER VALUE**							
GDP-PI - X (b)	30	-5.80%	-6.13%	-6.31%	-5.56%	-5.78%	-6.52%	-6.85%	-6.30%	
Adjusted Price Per DS-0 Equivalent	31	$ 63.35	$ 67.24	$ 71.64	$ 76.46	$ 80.96	$ 85.93	$ 91.92	$ 98.68	
Adjusted Total Revenues (b)	32	$ 743,009	$ 721,250	$ 737,514	$ 757,667	$ 723,473	$ 704,481	$ 597,155	$ 551,638	
Adjusted Net Return (b)	33	$ 99,560	$ 88,830	$ 95,915	$ 115,915	$ 117,717	$ 158,440	$ 137,951	$ 96,395	
Adjusted Rate of Return (b)	34	11.25%	8.40%	7.83%	8.18%	9.95%	16.77%	16.92%	11.25%	

Appendix 1b
Interstate Special Access Implicit X-Factor Calulation

Bellsouth	Line	2004	2003	2002	2001	2000	1999	1998	1997	
Total Operating Revenues	1	$ 2,438,132	$ 2,144,502	$ 1,994,999	$ 1,823,465	$ 1,233,259	$ 919,988	$ 762,893	$ 599,609	
Total Operating Expenses	2	$ 694,731	$ 663,967	$ 657,588	$ 676,932	$ 494,806	$ 444,713	$ 371,764	$ 383,011	
Other Operating Income/Loss	3	$ (2)	$ 30	$ 255	$ (76)	$ 552	$ (103)	$ 58	$ (13)	
Total Non-Operating Items	4	$ 454	$ 317	$ 34	$ (1,057)	$ (1,017)	$ (463)	$ 30	$ (21)	
State Income Tax	5	$ 179,189	$ 74,254	$ 79,470	$ 53,347	$ 31,781	$ 23,604	$ 20,884	$ 9,243	
State Other Taxes	6	$ 25,318	$ 24,808	$ 25,123	$ 24,841	$ 22,802	$ 21,070	$ 19,311	$ 17,538	
Federal Taxes	7	$ 528,170	$ 470,474	$ 419,962	$ 358,027	$ 226,442	$ 140,017	$ 110,719	$ 56,817	
Calculated Ave. State Tax Rate	8	10.28%	5.02%	5.94%	4.65%	4.29%	4.96%	5.34%	4.27%	
Marginal Federal Corporate Tax Rate	9	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%	
Calculated Net Return	10	$ 1,010,268	$ 910,712	$ 813,077	$ 711,299	$ 458,997	$ 290,944	$ 240,243	$ 133,008	
Total Plant in Service	11	$ 4,221,246	$ 4,088,228	$ 4,009,316	$ 4,005,925	$ 3,338,531	$ 2,442,156	$ 2,121,781	$ 1,905,471	
Total Other Investments	12	$ 216,265	$ 181,204	$ 170,351	$ 152,895	$ 85,644	$ 58,313	$ 32,365	$ 21,958	
Total Reserves	13	$ 3,204,050	$ 2,952,312	$ 2,741,530	$ 2,622,769	$ 2,176,507	$ 1,602,130	$ 1,386,308	$ 1,164,376	
Calculated Ave. Net Investment	14	$ 1,233,461	$ 1,317,120	$ 1,438,137	$ 1,536,051	$ 1,247,668	$ 898,339	$ 767,838	$ 763,053	
Average Net Investment Per ARMIS	15	$ 1,233,462	$ 1,317,121	$ 1,438,138	$ 1,536,048	$ 1,247,668	$ 898,339	$ 767,838	$ 763,053	
Net Return Per ARMIS	16	$ 1,010,265	$ 910,703	$ 813,076	$ 711,303	$ 458,996	$ 290,944	$ 240,243	$ 133,008	
Special Access Rate of Return	17	81.91%	69.14%	56.54%	46.31%	36.79%	32.39%	31.29%	17.43%	
GDP-PI	18	108.30	106.00	104.10	102.40	100.00	97.87	96.48	95.42	93.859
GDP-PI % Change	19	2.17%	1.83%	1.66%	2.40%	2.18%	1.44%	1.11%	1.66%	
DS-0 Equivalents	20	24,544,957	20,653,172	19,130,044	16,083,447	12,962,801	7,295,340	4,717,688	2,959,991	
X-Factor (a)	21	**12.96%**	**<--USER VALUE**							
GDP-PI - X (a)	22	-10.79%	-11.13%	-11.30%	-10.56%	-10.78%	-11.51%	-11.85%	-11.30%	
Price Index	23	39.31	44.07	49.58	55.90	62.50	70.05	79.17	89.81	
Adjusted Total Revenues (a)	24	$ 958,452	$ 945,020	$ 989,210	$ 1,019,375	$ 770,798	$ 644,473	$ 603,966	$ 538,495	
Adjusted Net Return (a)	25	$ 138,764	$ 158,027	$ 187,523	$ 197,452	$ 158,481	$ 110,607	$ 131,009	$ 85,843	
Adjusted Rate of Return (a)	26	11.25%	12.00%	13.04%	12.85%	12.70%	12.31%	17.06%	11.25%	
Price Per DS-0 Equivalent	27	$ 99.33	$ 103.83	$ 104.29	$ 113.38	$ 95.14	$ 126.11	$ 161.71	$ 202.57	
Actual DS-0 Equivalent Price Index	28	0.49	0.51	0.51	0.56	0.47	0.62	0.80	1.00	
X-Factor (b)	29	**21.56%**	**<--USER VALUE**							
GDP-PI - X (b)	30	-19.39%	-19.73%	-19.90%	-19.16%	-19.38%	-20.12%	-20.45%	-19.90%	
Adjusted Price Per DS-0 Equivalent	31	$ 39.05	$ 48.44	$ 60.35	$ 75.35	$ 93.20	$ 115.61	$ 144.72	$ 181.92	
Adjusted Total Revenues (b)	32	$ 958,450	$ 1,000,530	$ 1,154,513	$ 1,211,863	$ 1,208,187	$ 843,422	$ 682,759	$ 538,495	
Adjusted Net Return (b)	33	$ 138,764	$ 192,298	$ 288,587	$ 316,753	$ 430,575	$ 233,506	$ 179,489	$ 85,843	
Adjusted Rate of Return (b)	34	11.25%	14.60%	20.07%	20.62%	34.51%	25.99%	23.38%	11.25%	

Appendix 2
July 29, 2005

The 2005 Update of the 1999 TFP Model
Calculating a Productivity Factor for Interstate Special Access

1. SUMMARY

The Special Access Total Factor Productivity (TFP) model presented in this Appendix is based on a TFP model which generally follows the methodology devised by the FCC Staff in their 1999 study submitted in the remand phase of the FCC's last price cap review proceeding.[1] Economics and Technology, Inc. (ETI) presented a version of this TFP model to two state regulatory commissions, the Utah Division of Public Utilities in 1999 and 2001,[2] and the Public Service Commission of Wisconsin in 2003.[3] The Special Access TFP Model, presented in this Appendix, calculates a Total Factor Productivity Differential of 13.64% and an Input Price Differential of –2.63%, resulting in a five-year average X-Factor of 11.01%.

The Utah DPU adopted a productivity factor for Qwest in 2000 as part of a stipulation between the Division and Qwest in the US West-Qwest merger case.[4] As a result, the Utah DPU did not evaluate the 1999 TFP model. However, in 2001, the Utah DPU revisited price cap regulation at the request of Qwest, and relied upon the TFP model presented by ETI to determine an appropriate productivity factor for Qwest.[5] For a detailed discussion of the TFP Methodology, please see the ETI Study prepared for the Wisconsin PSC in 2003, attached as Appendix 3.

The following sections highlight the most recent changes that have been made to the methodology and sources of data in the TFP model, since the model was submitted to the Wisconsin PSC in 2003. In summary, changes were made to the model to reflect three distinct adjustments: (1) the update of the model to include 2003 and 2004 data; (2) the

---

[1] *See, Price Cap Performance Review for Local Exchange Carriers*, CC Docket No. 94-1; *Access Charge Reform,* CC Docket No. 96-262, *Further Notice of Proposed Rulemaking*, FCC No. 99-345, 14 FCC Rcd 19717 (1999).

[2] Utah Public Service Commission, *Application of Qwest Corporation for a Change in the Productivity Factor for Price Cap Regulation, R746-352*, Docket No. 01-049-78, Direct Testimony of Dr. Lee L. Selwyn, filed on behalf of the Utah Division of Public Utilities, November 14, 2001.

[3] *See, A Study of Total Factor Productivity in the Wisconsin Local Exchange Carrier Industry*, prepared by Economics and Technology, Inc., for the Public Service Commission of Wisconsin, January 2003. This report is attached as Appendix 3.

[4] Utah Public Service Commission, *Merger of the Parent Corporations of Qwest Communications Corporation, LCI International Telecom Corp. and US West Communications, Inc*, Docket No. 99-049-41, June 9, 2000.

[5] The Utah DPU based its adopted TFP differential (3.55%) on the average of two differentials calculated using the TFP Model presented by ETI. The first differential was calculated using an output measure of Dial Equipment Minutes (4.79%), and the second differential was calculated using an output measure based on access lines (2.3%). The Utah DPU adopted the input differential (1.41%) calculated by the ETI TFP Model.

restriction of the analysis to include only interstate special access services; and (3) the limitation of the model period to 1992-2004. Each adjustment made to the model is discussed in more detail below.

2. UNIVERSAL ADJUSTMENTS

There were several universal adjustments made throughout the model, including:

- The time period covered by the TFP Model was restricted to the 1992-2004 period. Readily available FCC ARMIS data is available online for most accounts starting in 1992. ARMIS Reports 43-01 and 43-04 date back to 1990, while 43-02 dates back to 1992.
- The five-year average calculations were adjusted to reflect the 2000-2004 period.

3. INDIVIDUAL ADJUSTMENTS

Table 1: Summary Table of Annual Special Access Productivity Growth

No changes were made to the methodology or the sources of the data.

Table 2: Annual Special Access Productivity Growth

BLS NonFarm Business Sector Growth Rate (Column A)

The BLS TFP growth rate series was obtained from BLS website. The BLS TFP series was last updated with 2002 data. A five-year average of the available growth rates was used to estimate data values for 2003 and 2004.

LEC Output Growth Rate (Column B)

The LEC Output Growth Rate formula was changed to reference the Interstate Special Access Output Growth Rate, calculated in Table 4.

BLS Input Price Growth Rate (Column F)

The BLS Input Price Growth Rate series was obtained from the BLS website. The BLS series was last updated with 2002 data. A five-year average of the available growth rates was used to estimate data values for 2003 and 2004.

Table 3: LEC Total Company Output Index

This table calculates a weighted total company output index. Since the TFP model is restricted to interstate special access services, the weighting is not necessary.

Table 4: LEC Interstate Output Index

This table calculates a weighted interstate output index. Since the TFP model is restricted to interstate special access services, the weighting is not necessary.

Special Access Lines (Column F)

Special Access Lines for 2002-2004 were obtained from ARMIS Report 43-08, Table III.

Interstate Output Quantity Index (column J)

The formula was adjusted to calculate an output index based on special access lines.

Table 5: LEC Total Revenue by Type of Service (Excluding Misc. Services)
This table calculates total revenues by type of services. Since the TFP model is restricted to Interstate Special Access Services, Local Service and Intrastate Toll and Access Revenues are not necessary.

Table 6: LEC Interstate Revenues
This table calculates Total Interstate Revenues. Since the TFP model is restricted to Interstate Special Access Services, Interstate End-user and Switched Access Revenues are not necessary.

Special Access Revenues (Column C)
Special Access Revenues for 2002-2004 were obtained from ARMIS Report 43-02, Table I1.

Table 7: LEC Input Quantity Index
No changes were made to the methodology or the sources of the data.

Table 8: LEC Input Price Index
No changes were made to the methodology or the sources of the data.

Table 9: Factor Shares of Total Payments
No changes were made to the methodology or the sources of the data.

Table 10: Price of Labor
Labor Compensation (Column A)
Labor Compensation values were obtained from ARMIS Report 43-02, Table I1, and allocated to special access, based on the special access share of total TPIS, reported in ARMIS Report 43-01.

Number of Employees (Column A)
Number of Employees were obtained from ARMIS Report 43-02, Table I1, and allocated to special access, based on the special access share of total TPIS, reported in ARMIS Report 43-01.

Table 11: Materials Input Quantity
BLS Materials Price Index (Column A)
The BLS Materials Price Index series was obtained from the BLS website.
The most recent update incorporated the revised NAICS industry coding standards, and presented data for years 1997, 2001, and 2002. An estimated MPI value for 2001 was developed by splicing together the original and updated data series.[6] A five-year average of the available growth rates was used to estimate values for 2003 and 2004.

---

[6] The splicing of the two series was constructed in several steps. First, the index change in the original series 1997- 2000 was calculated. Second, the index change in the updated series 1997 – 2001 was calculated. Third, the percentage change from the original 97-00 index value was "reversed out" to the updated 97-01 index value. Fourth, this 00-01growth rate is then inserted at the end of the old series (1984-2000) to generate an annual 2001 index value. This estimated

Special Access Operating Expenses (Column B)
Special Access Operating Expenses are obtained from ARMIS Report 43-01.

Special Access Depreciation and Amortization Expenses (Column D)
Special Access Depreciation and Amortization Expenses are obtained from ARMIS Report 43-01.

<u>Table 12: Capital Quantity and Imputed Cost of Capital</u>
Benchmark (Column A)
The 1991 Capital Stock Quantity in the most recent total company TFP model[7] was calculated to be $139,077,718. The special access share of this 1991 Stock Quantity is allocated based on the special access share of 1991 total company TPIS, reported in ARMIS Report 43-01 (3.51%). The resulting estimate of Capital Stock Quantity is used in the TFP model as a 1991 benchmark.

TPIS Capital Additions (Column B)
TPIS Capital Additions are no longer reported in Table 14 of the TFP Model. Total company TPIS Capital Additions are obtained from ARMIS Report 43-02, Table B1b, and allocated to special access based on the special access share of total company TPIS, reported in ARMIS Report 43-01, Table 1.

BEA Composite Asset Price Index (Column C)
The BEA Composite Asset Price Index series is developed using three BEA chain-type price indices for three NIPA assets: Communications Equipment, Telecommunications Structures, and Equipment and Software, obtained from the BEA website, that are deflated by capital additions data series reported in ARMIS Report 43-02. Table Blb (Central Office Switching, Operator Systems, Information Original/Termination, and Central Office Transmission).

Since 2003, the BEA has instituted a complete revision of its NIPA table reporting to reflect new NAICS industry coding standards. As a result, the data required to generate the Composite Asset Price Index is no longer reported in the same format. Currently, the Equipment and Software Chain-type price index is available in two locations, NIPA 1.1.4 and NIPA 1.5.4. The Communications Equipment Chain-type price index can be found in NIPA 5.5.4. The Telecommunications Structures chain-type price index can be found in NIPA 5.4.4a and 5.4.4b. A five-year average of the available growth rates was used to estimate values for 2003 and 2004.

Special Access Operating Taxes (Column H)
Special Access Operating Taxes were obtained from ARMIS Report 43-04, Table 1.

2001 growth and index value thus becomes the basis for the 2002 index value, which is obtainable from the growth rate developed using the new series data.
[7]This previous version of the TFP was updated in 2004, however it was not finalized or filed in any regulatory proceeding.

Original Property Income with Depreciation and Taxes
The formula was adjusted to reference special access revenues in Table 6.

<u>Table 13</u>
Moody's Baa Corporate Bond Rate (Column A)
Moody's Baa Corporate Bond Rates for 2002-2004 were obtained from the *Economic Report of the President*, February 2005, Table B-73.

<u>Table 14</u>
With the limitation of the TFP model to the 1992-2004 period, the adjustment to Capital Additions is no longer necessary. Therefore, Capital Additions, Retires, Adjustment Factor, Adjusted Capital Additions, and Adjusted TPIS.EOY data is not necessary.

Special Access TPIS.BOY (Column A)
Total company TPIS.BOY values were obtained from ARMIS Report 43-02, Table B1b, and allocated to special access based on the special access share of total TPIS, reported in ARMIS Report 43-01. For Purposes of calculating TPIS.BOY, the previous year's allocation factor was used.

Special Access TPIS.EOY (Column C)
Total company TPIS.EOY values were obtained from ARMIS Report 43-02, Table B1b, and allocated to special access based on the special access share of total TPIS, reported in ARMIS Report 43-01.

Depreciation Accruals (Column H)
Total company Depreciation Accruals were obtained from ARMIS Report 43-02, Table B-5, and allocated to special access based on the special access share of total company Accumulated Depreciation, reported in ARMIS Report 43-01.

Adjusted Depreciation Rate (Column I)
The formula was adjusted to reference Special Access TPIS.EOY, instead of Adjusted TPIS.EOY.

Interstate Special Access
Total Factor Productivity
X-Factor Calculation

Table 1

Summary Table of Annual Special Access Productivity Growth

Year	Total Factor Productivity Differential A = Table 2	Input Price Differential B = Table 2	Annual Productivity Growth C = A+B
1993	41.2	3.8	45.0
1994	22.1	-0.7	21.4
1995	6.4	-0.8	5.6
1996	16.9	-5.5	11.3
1997	1.8	-0.8	1.0
1998	29.5	-7.5	22.1
1999	21.2	-6.0	15.2
2000	9.6	-3.0	6.6
2001	16.7	-7.0	9.7
2002	14.1	-1.2	13.0
2003	12.8	2.1	14.9
2004	15.0	-4.1	10.9
Avg. (00 - 04)	**13.64**	**-2.63**	**11.01 (X-Factor)**

Table 2

Annual Special Access Productivity Growth

Year	U.S. Nonfarm Business Sector TFP Growth Rate	LECs Output Growth Rate	LECs' Input Growth Rate	LECs' TFP Growth Rate	LECs' TFP Differential	U.S. Nonfarm Business Sector Input Price Growth Rate	LECs' Input Price Growth Rate	Input Price Differential	Total Company Productivity Growth
	A	**B = Table 4**	**C = Table 7**	**D = +B-C**	**E = +D-A**	**F**	**G = Table 8**	**H = +F-G**	**I = +E+H**
1992									
1993	0.428	40.787	-0.860	41.647	41.219	2.090	-1.687	3.777	44.995
1994	0.957	33.800	10.738	23.062	22.105	2.878	3.608	-0.730	21.375
1995	0.106	14.328	7.835	6.493	6.387	2.105	2.870	-0.765	5.622
1996	1.469	23.465	5.142	18.322	16.853	2.965	8.504	-5.539	11.314
1997	0.623	16.410	14.014	2.396	1.773	2.222	3.019	-0.797	0.976
1998	1.132	25.592	-5.084	30.676	29.543	2.817	10.285	-7.467	22.076
1999	1.120	35.199	12.883	22.316	21.197	2.636	8.626	-5.990	15.207
2000	1.207	28.090	17.329	10.760	9.553	3.978	6.961	-2.983	6.570
2001	0.000	19.054	2.369	16.684	16.684	1.193	8.189	-6.996	9.688
2002	1.980	17.683	1.582	16.101	14.121	2.729	3.885	-1.156	12.965
2003	1.088	13.794	-0.097	13.891	12.803	2.671	0.589	2.081	14.885
2004	1.079	11.330	-4.784	16.114	15.035	2.641	6.737	-4.096	10.940
Avg. (00 - 04)					**13.64**			**-2.63**	**11.01**

Sources: U.S. Nonfarm Business Sector TFP Growth Rate: BLS's Multifactor Productivity, Table 2, "Private Nonfarm Business: Productivity and Related Indexes, 1948-02"; U.S. Nonfarm Business Sector Input Price Growth Rate, BLS's Net Input Price, Table NFB 4b "Net Multifactor Productivity and Costs , 1948 to 2002: Private Nonfarm Business Sector (excluding Government Enterprises)"; 2003-3004 U.S. Nonfarm Business Sector TFP Growth Rate and U.S. Nonfarm Business Sector Input Price Growth Rate, based upon five-year average growth.

Table 3

LEC Total Company Output Index

	Revenue Shares			Quantities			Output Indices				
	Local	**Intrastate Toll**	**Interstate**	**Local DEMs (000s)**	**Intrastate DEMs (000s)**	**Interstate Quantity Index**	**Laspeyres Output Index**	**Paasche Output Index**	**Fisher Ideal Output Index**	**Total Company Output Index**	**Growth Rate %**
Year	**A= Table 5**	**B = Table 5**	**C = Table 5**	**D**	**E**	**F=Table 4**	**G**	**H**	**I**	**J**	**K**
1992	0.000	0.000	1.000	0.000	0.000	0.000					
1993	0.000	0.000	1.000	0.000	0.000	0.000					
1994	0.000	0.000	1.000	0.000	0.000	0.000					
1995	0.000	0.000	1.000	0.000	0.000	0.000					
1996	0.000	0.000	1.000	0.000	0.000	0.000					
1997	0.000	0.000	1.000	0.000	0.000	0.000					
1998	0.000	0.000	1.000	0.000	0.000	0.000					
1999	0.000	0.000	1.000	0.000	0.000	0.000					
2000	0.000	0.000	1.000	0.000	0.000	0.000					
2001	0.000	0.000	1.000	0.000	0.000	0.000					
2002	0.000	0.000	1.000	0.000	0.000	0.000					
2003	0.000	0.000	1.000	0.000	0.000	0.000					
2004	0.000	0.000	1.000	0.000	0.000	0.000					

Notes:
Laspeyres Output Index (Column G) calculation: A(previous) * D(current) / D(previous) + B(previous) * E(current) / E(previous) + C(previous) * F(current) / F(previous)
Paasche Output Index (Column H) calculation: 1/(A(current) * D(previous) / D(current) + B(current) * E(previous) / E(current) + C(current) * F(previous) / F(current))
Fisher Ideal Output Index (Column I) calculation: Square root of (H*G)
Total Company Output Index (Column J) calculation: J(previous) * I(current)

Table 4

LEC Interstate Output Index

	Revenue Shares			Quantities			Output Indices				
Year	End User	Interstate Switched Access	Special Access	Switched Access Lines	Switched Access Minutes	Special Access Lines	Laspeyres Output Index	Paasche Output Index	Fisher Ideal Output Index	Interstate Output Quantity Index	Growth Rate %
	A =Table 6	B =Table 6	C =Table 6	D	E	F	G	H	I	J	K
1992	0.000	0.000	1.000	0.000	0.000	6,752,827				1.000	
1993	0.000	0.000	1.000	0.000	0.000	10,153,615				1.504	40.787
1994	0.000	0.000	1.000	0.000	0.000	14,236,843				2.108	33.800
1995	0.000	0.000	1.000	0.000	0.000	16,430,055				2.433	14.328
1996	0.000	0.000	1.000	0.000	0.000	20,775,150				3.077	23.465
1997	0.000	0.000	1.000	0.000	0.000	24,479,958				3.625	16.410
1998	0.000	0.000	1.000	0.000	0.000	31,619,595				4.682	25.592
1999	0.000	0.000	1.000	0.000	0.000	44,959,747				6.658	35.199
2000	0.000	0.000	1.000	0.000	0.000	59,541,017				8.817	28.090
2001	0.000	0.000	1.000	0.000	0.000	72,038,505				10.668	19.054
2002	0.000	0.000	1.000	0.000	0.000	85,973,048				12.731	17.683
2003	0.000	0.000	1.000	0.000	0.000	98,689,043				14.614	13.794
2004	0.000	0.000	1.000	0.000	0.000	110,528,966				16.368	11.330

Sources: Special Access Lines: ARMIS Report 43-08: Table III.

Table 5

LEC Total Revenue by Type of Service (Excluding Miscellaneous Services)

Year	Local Service A	Intrastate Toll and Intrastate Access B	Interstate C = Table 6	Total D = A+B+C
1991	$0.000	$0.000	$2,119,037,000	$2,119,037,000
1992	$0.000	$0.000	$2,153,565,000	$2,153,565,000
1993	$0.000	$0.000	$2,097,997,000	$2,097,997,000
1994	$0.000	$0.000	$2,217,125,000	$2,217,125,000
1995	$0.000	$0.000	$2,529,667,000	$2,529,667,000
1996	$0.000	$0.000	$3,070,598,000	$3,070,598,000
1997	$0.000	$0.000	$3,851,028,000	$3,851,028,000
1998	$0.000	$0.000	$4,815,249,000	$4,815,249,000
1999	$0.000	$0.000	$6,149,841,000	$6,149,841,000
2000	$0.000	$0.000	$8,210,509,000	$8,210,509,000
2001	$0.000	$0.000	$10,614,651,000	$10,614,651,000
2002	$0.000	$0.000	$11,387,290,000	$11,387,290,000
2003	$0.000	$0.000	$12,551,835,000	$12,551,835,000
2004	$0.000	$0.000	$13,017,795,000	$13,017,795,000

Table 6

LEC Interstate Revenues

Year	End User A	Interstate Switched Access B	Special Access C	Total Interstate D = A+B+C
1991	$0.000	$0.000	$2,119,037,000	$2,119,037,000
1992	$0.000	$0.000	$2,153,565,000	$2,153,565,000
1993	$0.000	$0.000	$2,097,997,000	$2,097,997,000
1994	$0.000	$0.000	$2,217,125,000	$2,217,125,000
1995	$0.000	$0.000	$2,529,667,000	$2,529,667,000
1996	$0.000	$0.000	$3,070,598,000	$3,070,598,000
1997	$0.000	$0.000	$3,851,028,000	$3,851,028,000
1998	$0.000	$0.000	$4,815,249,000	$4,815,249,000
1999	$0.000	$0.000	$6,149,841,000	$6,149,841,000
2000	$0.000	$0.000	$8,210,509,000	$8,210,509,000
2001	$0.000	$0.000	$10,614,651,000	$10,614,651,000
2002	$0.000	$0.000	$11,387,290,000	$11,387,290,000
2003	$0.000	$0.000	$12,551,835,000	$12,551,835,000
2004	$0.000	$0.000	$13,017,795,000	$13,017,795,000

Source: Special Access Revenues: ARMIS Report 43-02, Table I1.

Table 7

LEC Input Quantity Index

	Input Shares			Quantities			Input Quantity Indices				
	Labor	Materials	Capital	Labor Quantity	Material Quantity Index	Capital Quantity Index	Laspeyres Input Quantity Index	Paasche Input Quantity Index	Fisher Ideal Input Quantity Index	Fisher Ideal Chained Input Quantity Index	Growth Rate %
Year	A = Table 9	B = Table 9	C = Table 9	D = Table 10	E = Table 10	F = Table 12	G	H	I	J	K
1991	0.285	0.223	0.492	14,561	1.000	1.000	1.00	1.00	1.000	1.00	
1992	0.288	0.205	0.507	14,253	0.887	1.032	0.985	0.984	0.984	0.984	-1.580
1993	0.311	0.196	0.493	13,824	0.823	1.065	0.993	0.990	0.991	0.976	-0.860
1994	0.284	0.248	0.467	14,167	1.192	1.106	1.114	1.112	1.113	1.087	10.738
1995	0.280	0.253	0.467	15,353	1.346	1.167	1.082	1.081	1.082	1.175	7.835
1996	0.314	0.207	0.479	17,060	1.233	1.270	1.051	1.054	1.053	1.237	5.142
1997	0.287	0.228	0.485	19,541	1.580	1.396	1.151	1.150	1.150	1.423	14.014
1998	0.307	0.089	0.604	21,226	0.647	1.549	0.943	0.957	0.950	1.353	-5.084
1999	0.301	0.060	0.638	25,342	0.547	1.783	1.137	1.138	1.137	1.539	12.883
2000	0.281	0.045	0.674	29,799	0.515	2.171	1.188	1.190	1.189	1.830	17.329
2001	0.277	-0.056	0.780	29,817	-0.716	2.579	1.020	1.028	1.024	1.874	2.369
2002	0.269	-0.059	0.790	26,262	-0.781	2.769	1.019	1.013	1.016	1.903	1.582
2003	0.283	-0.070	0.786	24,928	-0.921	2.854	1.000	0.998	0.999	1.902	-0.097
2004	0.290	-0.117	0.827	24,276	-1.567	2.884	0.952	0.955	0.953	1.813	-4.784

Notes:
Laspeyres Input Quantity Index (Column G) calculation: A(previous) * D(current) / D(previous) + B(previous) * E(current) / E(previous) + C(previous) * F(current) / F(previous)
Paasche Input Quantity Index (Column H) calculation: 1/(A(current) * D(previous) / D(current) + B(current) * E(previous) / E(current) + C(current) * F(previous) / F(current))
Fisher Ideal Input Quantity Index (Column I) calculation: Square root of (H*G)
Fisher Ideal Chained Input Quantity Index (Column J) calculation: J(previous) * I(current)
Growth Rate (Column K) calculation: LN (I(current)/I(previous))

Table 8

LEC Input Price Index

	Input Shares			Input Quantities			Input Price Indices				
Year	Labor A = Table 9	Material B = Table 9	Capital C = Table 9	Labor Price Index D = Table 10	Materials Price Index E = Table 11	Capital Price Index F = Table 13	Laspeyres Input Price Index G	Paasche Input Price Index H	Fisher Ideal Input Price Index I	Fisher Ideal Chained Input Price Index J	Growth Rate % K
1991	0.285	0.223	0.492	1.000	1.000	1.000	1.000	1.000	1.000	1.00	
1992	0.288	0.205	0.507	1.006	1.012	0.974	0.992	0.991	0.991	0.991	-0.872
1993	0.311	0.196	0.493	1.095	1.015	0.895	0.984	0.982	0.983	0.975	-1.687
1994	0.284	0.248	0.467	1.127	1.027	0.942	1.038	1.036	1.037	1.011	3.608
1995	0.280	0.253	0.467	1.140	1.030	0.993	1.029	1.029	1.029	1.040	2.870
1996	0.314	0.207	0.479	1.318	1.053	1.074	1.087	1.090	1.089	1.132	8.504
1997	0.287	0.228	0.485	1.244	1.075	1.174	1.031	1.030	1.031	1.167	3.019
1998	0.307	0.089	0.604	1.292	1.081	1.386	1.100	1.117	1.108	1.293	10.285
1999	0.301	0.060	0.638	1.319	1.070	1.578	1.089	1.091	1.090	1.410	8.626
2000	0.281	0.045	0.674	1.335	1.075	1.745	1.071	1.073	1.072	1.512	6.961
2001	0.277	-0.056	0.780	1.458	1.085	1.888	1.082	1.089	1.085	1.641	8.189
2002	0.269	-0.059	0.790	1.702	1.102	1.882	1.043	1.036	1.040	1.706	3.885
2003	0.283	-0.070	0.786	1.896	1.108	1.826	1.007	1.005	1.006	1.716	0.589
2004	0.290	-0.117	0.827	2.034	1.114	1.937	1.068	1.071	1.070	1.835	6.737

Notes:
Laspeyres Input Price Index (Column G) calculation: A(previous) * D(current) / D(previous) + B(previous) * E(current) / E(previous) + C(previous) * F(current) / F(previous)
Paasche Input Price Index (Column H) calculation: 1/(A(current) * D(previous) / D(current) + B(current) * E(previous) / E(current) + C(current) * F(previous) / F(current))
Fisher Ideal Input Price Index (Column I) calculation: Square root of (H*G)
Fisher Ideal Chained Input Price Index (Column J) calculation: J(previous) * I(current)
Growth Rate (Column K) calculation: LN (I(current)/I(previous))

Appendix 1a
Interstate Special Access
Total Factor Productivity
X-Factor Calculation

Table 9

Factor Shares of Total Payments

Year	Special Access Labor Compensation	Adjusted Material Payment	New Property Income with Depreciation and Taxes	Total Factor Payment	Labor Compensation Share	Material Payment Share	Property Income with Depreciation and Taxes Share
	A = Table 11	**B = Table 11**	**C = Table 13**	**D = A+B+C**	**E = A/D**	**F = B/D**	**G = C/D**
1991	603,809,113	472,406,887	1,042,821,000	2,119,037,000	0.285	0.223	0.492
1992	594,763,506	424,242,349	1,048,699,397	2,067,705,251	0.288	0.205	0.507
1993	627,407,066	394,750,748	993,550,522	2,015,708,335	0.311	0.196	0.493
1994	661,842,760	577,944,560	1,086,863,691	2,326,651,011	0.284	0.248	0.467
1995	725,758,325	655,141,017	1,208,652,928	2,589,552,270	0.280	0.253	0.467
1996	932,664,041	613,305,057	1,422,196,944	2,968,166,042	0.314	0.207	0.479
1997	1,008,405,891	802,485,367	1,708,462,278	3,519,353,536	0.287	0.228	0.485
1998	1,137,128,769	330,658,846	2,239,451,809	3,707,239,425	0.307	0.089	0.604
1999	1,385,876,272	276,293,704	2,934,688,091	4,596,858,067	0.301	0.060	0.638
2000	1,649,772,492	261,339,958	3,949,635,233	5,860,747,684	0.281	0.045	0.674
2001	1,802,532,964	(367,002,254)	5,077,870,794	6,513,401,504	0.277	-0.056	0.780
2002	1,853,569,808	(406,584,708)	5,432,439,027	6,879,424,128	0.269	-0.059	0.790
2003	1,959,852,899	(481,884,409)	5,435,390,284	6,913,358,775	0.283	-0.070	0.786
2004	2,047,109,281	(824,481,936)	5,827,082,704	7,049,710,049	0.290	-0.117	0.827

Table 10

Price of Labor

Year	Special Access Labor Compensation	Special Access Number Of Employees	Labor Price	Labor Price Index	Labor Price Change
	A	B	C = A/B	D	E
1991	603,809,113	14,561	41,467	1.000	
1992	594,763,506	14,253	41,730	1.006	0.633
1993	627,407,066	13,824	45,386	1.095	8.398
1994	661,842,760	14,167	46,717	1.127	2.891
1995	725,758,325	15,353	47,272	1.140	1.182
1996	932,664,041	17,060	54,668	1.318	14.535
1997	1,008,405,891	19,541	51,605	1.244	-5.766
1998	1,137,128,769	21,226	53,572	1.292	3.740
1999	1,385,876,272	25,342	54,686	1.319	2.059
2000	1,649,772,492	29,799	55,363	1.335	1.229
2001	1,802,532,964	29,817	60,452	1.458	8.795
2002	1,853,569,808	26,262	70,579	1.702	15.487
2003	1,959,852,899	24,928	78,620	1.896	10.790
2004	2,047,109,281	24,276	84,325	2.034	7.005

Source: Labor Compensation, Number of Employees: ARMIS Report 43-02, Table I1, allocated to Special Access based on Special Access share of total TPIS reported in ARMIS Report 43-01.

Table 11

Materials Input Quantity

Year	Material Price Index	Special Access Operating Expense	Adjusted Special Access Operating Expense	Special Access Depreciation & Amortization Expense	Special Access Labor Compensation	Special Access Material Expense	Special Access Material Quantity	Special Access Material Quantity Index
	A	B	C	D	E = Table 10	F = C - D - E	G = F / A	H
1991	1.000	1,588,042,000	1,588,042,000	511,826,000	603,809,113	472,406,887	472,406,887	1.000
1992	1.012	1,570,649,000	1,546,558,855	527,553,000	594,763,506	424,242,349	419,175,237	0.887
1993	1.015	1,580,140,000	1,557,051,813	534,894,000	627,407,066	394,750,748	388,821,821	0.823
1994	1.027	1,845,300,000	1,876,030,320	636,243,000	661,842,760	577,944,560	562,988,967	1.192
1995	1.030	2,124,777,000	2,141,579,342	760,680,000	725,758,325	655,141,017	635,897,473	1.346
1996	1.053	2,493,479,000	2,464,739,098	918,770,000	932,664,041	613,305,057	582,598,198	1.233
1997	1.075	2,996,261,000	2,903,201,258	1,092,310,000	1,008,405,891	802,485,367	746,622,528	1.580
1998	1.081	3,009,068,000	2,698,187,616	1,230,400,000	1,137,128,769	330,658,846	305,777,258	0.647
1999	1.070	3,604,697,000	3,168,967,976	1,506,798,000	1,385,876,272	276,293,704	258,337,033	0.547
2000	1.075	4,484,575,000	3,825,289,451	1,914,177,000	1,649,772,492	261,339,958	243,058,993	0.515
2001	1.085	4,702,654,000	3,551,943,710	2,116,413,000	1,802,532,964	(367,002,254)	(338,280,466)	-0.716
2002	1.102	4,970,487,000	3,705,690,101	2,258,705,000	1,853,569,808	(406,584,708)	(368,801,917)	-0.781
2003	1.108	5,522,962,000	3,940,943,491	2,462,975,000	1,959,852,899	(481,884,409)	(434,874,041)	-0.921
2004	1.114	5,383,327,000	3,708,828,345	2,486,201,000	2,047,109,281	(824,481,936)	(740,395,488)	-1.567

Note:

Adjusted Operating Expenses (Column B) Calculation: Change in Property Income (The difference between the New Property Income, Table 9, and the Original Property Income, Table 12) multiplied by an adjustment factor of .39, and then added to Special Access Operating Expenses. The .39 represents .34 Federal and .5 state taxes, See, FCC, *Price Cap and Access Reform Further Notice of Proposed Rulemaking,* at 47.

Sources: Material Price Index: Input/Output Tables compiled by the Bureau of Labor Statistics, 2003 and 2004 Material Price Index based upon five-year average growth; Special Access Operating and Depreciation and Amortization Expenses: ARMIS Report 43-01.

Table 12

Capital Quantity and Imputed Cost of Capital

Year	Benchmark A	Special Access TPIS Capital Additions B	BEA Composite Asset Price Index C	Capital Stock Quantity (000s) D	Capital Input Quantity Index E	Original Property Income with Depreciation and Taxes F	Depreciation and Amortization G = Table 11	Special Access Operating Taxes H	Property Income without Depreciation and Taxes I = F-G-H
1991	4,881,628	510,384	1.0000	4,881,628	1.000	1,042,821,000	511,826,000	243,902,000	287,093,000
1992		506,505	0.995	5,039,573	1.032	1,110,469,000	527,553,000	266,089,000	316,827,000
1993		519,220	0.994	5,199,396	1.065	1,052,751,000	534,894,000	250,104,000	267,753,000
1994		568,113	0.990	5,398,910	1.106	1,008,068,000	636,243,000	196,813,000	175,012,000
1995		682,689	0.994	5,697,424	1.167	1,165,570,000	760,680,000	204,061,000	200,829,000
1996		909,759	0.995	6,201,362	1.270	1,495,889,000	918,770,000	247,243,000	329,876,000
1997		1,054,772	0.996	6,814,642	1.396	1,947,077,000	1,092,310,000	347,581,000	507,186,000
1998		1,187,171	0.958	7,563,735	1.549	3,036,581,000	1,230,400,000	759,366,000	1,046,815,000
1999		1,557,276	0.925	8,703,319	1.783	4,051,942,000	1,506,798,000	1,084,014,000	1,461,130,000
2000		2,284,660	0.907	10,596,792	2.171	5,640,111,000	1,914,177,000	1,564,845,000	2,161,089,000
2001		2,456,756	0.891	12,591,647	2.579	8,028,410,000	2,116,413,000	2,453,877,000	3,458,120,000
2002		1,612,174	0.881	13,515,606	2.769	8,675,508,000	2,258,705,000	2,649,181,000	3,767,622,000
2003		1,223,412	0.879	13,934,358	2.854	9,491,848,000	2,462,975,000	2,575,134,000	4,453,739,000
2004		999,355	0.870	14,080,851	2.884	10,120,669,000	2,486,201,000	2,992,931,000	4,641,537,000

Notes:

BEA Composite Asset Price Index (Column C): The single composite asset price index that incorporates prices for three Bureau of Economic Analysis National Income and Product Account (NIPA) asset pri Communication Equipment, Telecommunication Structures, and Producer Durables.

Capital Stock Quantity (Column D) calculation prior year Capital Stock (Column D) less depreciation(Table 14, Column J) plus current year Capital Additions (Column B) deflated by current year BEA Comp (Column C).

Capital Input Quantity Index (Column E): D(current)/A(base year. 1991=1.0)

Original Property Income with Depreciation and Taxes (Column F): This is a residual value found by subtracting labor compensation and material payments from Total Factor Payments/Total Revenues. M formula is Special Access Revenues minus Special Access Operating Expenses plus Special Access Depreciation and Amortization Expense. *See, Price Cap Performance Review Fourth Report and Order,* 19

Sources: Special Access TPIS Capital Additions, ARMIS Report 43-02, allocated to special access based on the special access share of total TPIS reported in ARMIS report 43-01; BEA Composite Asset Pri of Economic Analysis National Income and Product Accounts (Table 1.5.4, 5.4.4a, 5.4.4b, and 5.5.4); Special Access Operating Taxes, ARMIS Report 43-04, Table 1.

Imputed Cost of Capital
J = I/D/1000
0.0588
0.0629
0.0515
0.0324
0.0352
0.0532
0.0744
0.1384
0.1679
0.2039
0.2746
0.2788
0.3196
0.3296

ces, including

osite Asset Price

lathematically, the
997 TFP Model.

ce Index: Bureau

Table 13

Competitive Cost of Capital

Year	Moody's Baa Corporate Bond Rate	Imputed Competitive Cost of Capital	Capital Stock Quantity	Original Property Income without Depreciation and Taxes	Adjusted Property Income without Depreciation and Taxes	Excess Profits	Original Property Income with Depreciation and Taxes	Adjusted Property Income with Depreciation and Taxes	Adjusted Imputed Cost of Capital	Competitive Cost of Capital Index
	A	B	C = Table 12	D = Table 12	E = B*C*1000	F = D-E	G = Table 12	H = G-F	I = (H/C)/1000	J
1991	9.80	0.0588	4,881,628	287,093,000	287,093,000	0	1,042,821,000	1,042,821,000	0.214	1.000
1992	8.98	0.0506	5,039,573	316,827,000	255,057,397	61,769,603	1,110,469,000	1,048,699,397	0.208	0.974
1993	7.93	0.0401	5,199,396	267,753,000	208,552,522	59,200,478	1,052,751,000	993,550,522	0.191	0.895
1994	8.62	0.0470	5,398,910	175,012,000	253,807,691	-78,795,691	1,008,068,000	1,086,863,691	0.201	0.942
1995	8.20	0.0428	5,697,424	200,829,000	243,911,928	-43,082,928	1,165,570,000	1,208,652,928	0.212	0.993
1996	8.05	0.0413	6,201,362	329,876,000	256,183,944	73,692,056	1,495,889,000	1,422,196,944	0.229	1.074
1997	7.86	0.0394	6,814,642	507,186,000	268,571,278	238,614,722	1,947,077,000	1,708,462,278	0.251	1.174
1998	7.22	0.0330	7,563,735	1,046,815,000	249,685,809	797,129,191	3,036,581,000	2,239,451,809	0.296	1.386
1999	7.87	0.0395	8,703,319	1,461,130,000	343,876,091	1,117,253,909	4,051,942,000	2,934,688,091	0.337	1.578
2000	8.36	0.0444	10,596,792	2,161,089,000	470,613,233	1,690,475,767	5,640,111,000	3,949,635,233	0.373	1.745
2001	7.95	0.0403	12,591,647	3,458,120,000	507,580,794	2,950,539,206	8,028,410,000	5,077,870,794	0.403	1.888
2002	7.80	0.0388	13,515,606	3,767,622,000	524,553,027	3,243,068,973	8,675,508,000	5,432,439,027	0.402	1.882
2003	6.77	0.0285	13,934,358	4,453,739,000	397,281,284	4,056,457,716	9,491,848,000	5,435,390,284	0.390	1.826
2004	6.39	0.0247	14,080,851	4,641,537,000	347,950,704	4,293,586,296	10,120,669,000	5,827,082,704	0.414	1.937

Notes:

Imputed Competitive Cost of Capital (Column B) calculation: Table 12 provides the 1991 Cost of Capital Index, which is used as a base point. Years 1992 - 2004 are calculated by adding the change in the Baa Corporate Bond Rate to the previous year Competitive Cost of Capital.

Source: Moody's Baa Corporate Bond Rate from Council of Economic Advisors, *Economic Report of the President*, February 2005, Table B-73.

Table 14

Capital Stock Adjustments and the Average Depreciation Rate

Year	Special Access TPIS.BOY A	Capital Additions B	Special Access TPIS.EOY C	Retires D =A+B-C	Adjustment Factor E	Adjusted Capital Additions F = B*E	Adjusted TPIS G = A+F-D	Special Access Depreciation Accruals H	Adjusted Depreciation Rate (%) I
1992	6,746,816	0.000	6,810,949	0.000	1.000	0.000	0.000	445,891	6.58
1993	6,808,411	0.000	7,095,803	0.000	1.000	0.000	0.000	482,348	6.94
1994	7,095,803	0.000	8,076,148	0.000	1.000	0.000	0.000	569,145	7.50
1995	8,076,148	0.000	9,654,719	0.000	1.000	0.000	0.000	669,962	7.56
1996	9,654,719	0.000	11,472,435	0.000	1.000	0.000	0.000	805,460	7.62
1997	11,472,435	0.000	13,688,516	0.000	1.000	0.000	0.000	953,114	7.58
1998	13,688,516	0.000	15,616,606	0.000	1.000	0.000	0.000	1,087,866	7.42
1999	15,616,606	0.000	19,220,188	0.000	1.000	0.000	0.000	1,314,473	7.55
2000	19,220,188	0.000	24,219,904	0.000	1.000	0.000	0.000	1,630,378	7.51
2001	24,219,904	0.000	27,254,517	0.000	1.000	0.000	0.000	1,809,101	7.03
2002	27,254,517	0.000	28,997,443	0.000	1.000	0.000	0.000	1,906,797	6.78
2003	28,722,120	0.000	29,800,401	0.000	1.000	0.000	0.000	1,980,658	6.77
2004	29,800,401	0.000	30,429,027	0.000	1.000	0.000	0.000	2,021,768	6.71
Avg. (92-04)									**7.20**

Note:
Adjustment Factor (Column E): Capital/expense shift factor, employed in the *1997 Price Cap Review Order.*
Adjusted Depreciation Rate (Column I) calculation: H/((A+C)/2)*100

Source: BOY and EOY total company TPIS reported in ARMIS Report 43-02, Table B1b, allocated to special access based on the special access share of total company TPIS reported in ARMIS 43-01, Table 1.; Total company depreciation accruals reported in ARMIS Report 43-02, Table B5, allocated to special access, based on the special access share of total company accumulated depreciation reported in ARMIS Report 43-01, Table 1.

A STUDY OF TOTAL FACTOR PRODUCTIVITY IN THE WISCONSIN LOCAL EXCHANGE CARRIER INDUSTRY

Public Service Commission of Wisconsin
Docket No. 1-AC-193

Scott C. Lundquist
Lee L. Selwyn
Sarah C. Bosley

January 2003

ECONOMICS AND TECHNOLOGY, INC.

TWO CENTER PLAZA, SUITE 400 • BOSTON, MASSACHUSETTS 02108

Executive Summary

A STUDY OF TOTAL FACTOR PRODUCTIVITY IN THE WISCONSIN LOCAL EXCHANGE CARRIER INDUSTRY

This report presents a study of total factor productivity in the Wisconsin telecommunications industry conducted by Economics and Technology, Inc. ETI was engaged for this project by the Public Service Commission of Wisconsin. This study is intended to give the Commission a better understanding of the historical and future anticipated productivity performance of the local exchange carriers ("LECs") operating in Wisconsin.[1] Among the various measures of productivity available, the total factor productivity ("TFP") growth rate, which takes into account all inputs (capital, labor, and materials) simultaneously, is generally accepted as giving the most accurate picture of the efficiency with which a firm produces its outputs. Our study is based on a TFP model which generally follows the methodology devised the FCC Staff in their 1999 study submitted in the remand phase of the FCC's last price cap review proceeding, CC Docket 94-1/96-262. ETI obtained the data used in the study from the Commission's database of industry statistics, carriers' annual reports, responses to ETI data requests, and (for certain economic data) government sources.[2]

We present both estimates of the annual growth in TFP, expressed relative to that experienced in the economy as a whole (the TFP "differential"), and the input price differential ("IPD"), which measures differences in the level of input prices faced by ILECs vs. the general economy. As the FCC and state regulators have recognized, the productivity offset or "X-factor" in a price cap formula should include both components (i.e., TFP differential + IPD = X-factor). The Commission may use this study as a basis to make adjustments to the X-factors applied to Ameritech Wisconsin and Verizon,[3] or to set appropriate X-factors for other carriers that elect price cap regulation in the future.

1. In addition, the Commission has engaged the firm of Christensen and Associates to perform a second, parallel TFP study in response to the RFP.

2. The Wisconsin State Telecommunications Association ("WSTA") assisted with data collection and aggregation from the smaller LECs.

3. The prices for the regulated services of these two carriers are currently capped at GDP-PI minus 3% and GDP-PI minus 2%, respectively.

Estimated productivity gains in the Wisconsin telecommunications industry

Measured TFP and input price growth tend to fluctuate, so that is more appropriate to rely upon an average of X-factors calculated over a period of time rather than any one particular yearly X-factor result. Table 1 presents our study results expressed as the average for the five year period 1997-2001. In addition to analysis of Wisconsin ILECs, we present results for an analysis of all large (Tier 1) LECs nationwide, as a benchmark.

Table 2.1

Summary Table of TFP Study Results

Study	Total Factor Productivity Differential TFP	Input Price Differential IPD	Annual Productivity Growth X-Factor
Tier 1 ILEC Study (National Benchmark)	4.9	3.4	8.3
All Reporting Wisconsin ILECs	3.9	4.1	8.0
Ameritech-Wisconsin	8.4	2.1	10.5
Verizon	2.6	3.2	5.8
Statutory Small ILECs	2.9	7.2	10.1
Small ILECs by Economic Definition	8.2	-3.1	5.1
Large ILECs by Economic Definition ("Big Four")	4.4	4.0	8.4

All results are the average for the five year period 1997-2001.

Key results from the study are as follows:

- The results for all reporting ILECs in Wisconsin are generally in line with those determined for the national benchmark study of Tier 1 ILECs. The former study produced a total X-factor (TFP differential plus IPD) of 8.0%, compared to the national benchmark level of 8.0%. The average TFP differential in Wisconsin is 4.9%, a percentage point higher than national level, but the Wisconsin ILECs enjoy a higher input price differential (4.1% vs. 3.4%).

- Ameritech-Wisconsin and Verizon both exhibit productivity results that exceed by large amounts the 3% and 2% X-factors currently applied in their respective price cap plans. Ameritech-Wisconsin appears to be experiencing even higher productivity gains than the national or Wisconsin norms, with an average TFP differential of 8.4% and a total X-factor of 10.5%. Verizon's average productivity level lags well behind Ameritech-Wisconsin and the two benchmarks (TFP differential of 2.6%, and X-factor of 5.8%), but nevertheless is substantially above its current 2% price cap offset.

- The overall X-factors for small and large ILECs under the statutory criterion of under/over 500,000 lines are similar (10.1% vs. 10.5%, where Ameritech Wisconsin is the only large ILEC). However, there do appear to be significant differences in the productivity experience of small ILECs versus large ILECs in the state when examined using a more economically-meaningful classification than the statutory criterion. Under that analysis, the large ILECs as a group show average productivity gains in line with the national large ILEC benchmark results. In contrast, the small ILECs exhibit an average X-factor of 5.1%, which is driven down by differences in the IPD.

Comparison of Ameritech Wisconsin and Verizon earnings to study results

Under price cap regulation, while a carrier may enjoy a limited period of supra-competitive earnings as an inducement to and reward for beating the benchmark X-factor on occasion, the expectation is that a properly-functioning price cap will eventually push down rates so that those excess earnings are temporary and relatively infrequent. In contrast, the results of our earnings analysis indicate that both Ameritech Wisconsin and Verizon have realized generally increasing rates of return during the period from 1996 through 2000. While Verizon's results show a significantly smaller rate of return than that realized by Ameritech Wisconsin, both show year-over-year earnings growth that is consistent with the observed differences between the two ILECs' X-factor results in our study (10.5% vs. 5.8%).

This pattern of continued earnings growth for both carriers further confirms that Verizon and Ameritech Wisconsin are realizing higher productivity growth than embodied in their current price cap X-factors. The X-factors in their price cap formulas (as well as any nascent competition) have been inadequate to constrain ILEC prices to competitive levels, so that the ILECs have been able to earn excess (non-economic) profits at the expense of Wisconsin ratepayers.

Sources of future anticipated productivity gains for Wisconsin ILECs

By looking at the manner in which carriers have increased their productivity in the past and considering cost and demand trends, one can identify some likely drivers of future productivity increases. These key drivers and their likely impacts are as follows:

- Technological advancement in telecommunications networks and the related operations support systems ("OSS") infrastructure are likely to continue to have a strong positive impact on ILEC productivity for the foreseeable future.

- A second important source of productivity improvements in recent years has been corporate restructuring activities, including but not limited to horizontal mergers between ILECs. While the scale of those mergers may not be duplicated in Wisconsin in the future, other opportunities likely exist to improve efficiency and productivity by consolidations and process improvements.

- An economic downturn can have a negative impact on demand for certain telecommunications services. However, the relationship between the economic business cycle and telecommunications demand is complicated by substitution effects and interactions with competitive entry. In the near-term, a weak economy may have a disproportionate impact on competitive local exchange carriers ("CLECs").

- CLECs' total market capitalization has fallen 86% since September 1999, and many CLECs have filed or are on the verge of filing for bankruptcy protection. To the extent that the CLECs still operating struggle more in an economic downturn, they are in a worse position to pull demand away from ILECs and thereby reduce their opportunities for TFP growth.

In the context of the wide disparity between the existing X-factors in the price cap plans applied to Ameritech Wisconsin and Verizon and the X-factor results determined by our TFP studies, there appears little reason to believe that future economic conditions or competitive losses would bring the companies' achievable productivity gains down to the levels assumed in those price caps.

Sensitivity testing of the TFP model

We conducted sensitivity tests on all major data inputs and key assumptions in the model. Within each test, the target input was successively increased or decreased by factors of 10% and 20%, providing four test results per input or sixty-four tests overall. These results confirm the conceptual and methodological soundness of the model, as it generated stable and understandable results over the entire range of the tests. Notably, the model is not very sensitive to the starting level of the imputed cost of capital (which is often a controversial input), with a 20% increase in this input causing the X-factor to fall 2%.

Conclusion and recommendations

The results of our TFP study confirms that Verizon and Ameritech Wisconsin are realizing higher productivity growth than embodied in their current price cap X-factors. The X-factors in their price cap formulas (as well as any nascent competition) have been inadequate to constrain ILEC prices to competitive levels, so that the ILECs have been able to earn excess (non-economic) profits at the expense of Wisconsin ratepayers.

Wisconsin ILECs' productivity will continue to benefit from technological advances in telecommunication, process improvements, and growth in demand for their services. In the context of the wide disparity between the existing X-factors in the price cap plans applied to Ameritech Wisconsin and Verizon and the X-factor results determined by our TFP studies, there appears little reason to believe that future economic conditions or competitive losses would bring the companies' achievable productivity gains down to the levels assumed in those price caps.

Therefore, the Commission should adjust the price cap X-factors upward to the degree that Wisconsin law allows,[4] to bring the price caps into better alignment with achievable productivity gains.

4. Wis. Stat. §196.196(1)(c) allows the Commission to increase the price cap X-factor by no more than one percentage point in any 12-month period to reflect "statewide changes in the productivity experience of the telecommunications industry."

Table of Contents

A STUDY OF TOTAL FACTOR PRODUCTIVITY IN THE WISCONSIN LOCAL EXCHANGE CARRIER INDUSTRY

EXECUTIVE SUMMARY i

INTRODUCTION 1

1 ETI'S TFP MODEL METHODOLOGY AND DESIGN ASSUMPTIONS 3

Measurement of total factor productivity 3

Time period of TFP analysis 5

Scope of LECs studied and data sources 5

Total company vs. jurisdictional basis for data 6

The role of national benchmarking vs. Wisconsin-specific productivity analysis 7

Input price growth differential (IPD) 10

Further details of ETI's productivity model 13

Summary of Calculated Total Company X-factors (Table 1) 13

Components of X-factor (Table 2) 13

Calculation of Total Company Output Index (Tables 3-6) 15

LEC Total Company Output Index (Table 3) 15

LEC Interstate Output Index (Table 4) 18

Total LEC Revenue by Type of Service (Table 5) 18

LEC Interstate Revenues (Table 6) 18

Calculation of Input Quantity Index and Input Price Index (Tables 7-14) 19

LEC Total Company Input Quantity Index (Table 7) 19

LEC Total Company Input Price Index (Table 8) 19

Factor Shares of Total Payments (Table 9) 19

Price of Labor (Table 10) 20

Materials Input Quantity (Table 11) 21

Capital Quantity and Imputed Cost of Capital (Table 12) 21

Cost of Capital (Table 13) 22

Capital Stock Adjustments and the Average Depreciation Rate (Table 14) 24

2 ANALYSIS OF LEC PRODUCTIVITY IN WISCONSIN 27

Overview of the TFP Studies that were conducted 27

Discussion of the TFP study results 28

Comparison to the existing price cap X-factors 29

Differences in productivity between large and small ILECs 29

Analysis of Ameritech-Wisconsin and Verizon earnings and comparison to study results 30

3 SOURCES OF FUTURE ANTICIPATED PRODUCTIVITY GAINS FOR WISCONSIN ILECS 33

Technological advancement 33

Effects of mergers, corporate restructuring, and process improvements 34

Impacts of economic conditions and competition 36

4 RESULTS OF SENSITIVITY TESTING 41

Summary of sensitivity test results 41

5 CONCLUSION 43

Tables

2.1 Summary Table of TFP Study Results 28

2.2 Rate of Return Estimates For Ameritech-Wisconsin and Verizon 31

2.3 Ameritech-Wisconsin Adjusted Rates of Return 31

3.1 Changes In CLEC Market Capitalization 38

Appendices

1 List of Wisconsin LECs Included in the ETI Studies' Dataset

2 Documentation of ETI's TFP Model

3 Tables of TFP Study Results

4 List of Sensitivity Test Results Presented

I INTRODUCTION

This report presents a study of total factor productivity ("TFP") in the Wisconsin telecommunications industry conducted by Economics and Technology, Inc. ("ETI") pursuant to the Request for Proposal PSB-002.[1] ETI was engaged for this project by the Public Service Commission of Wisconsin ("WI PSC" or "Commission") pursuant to Wis. Admin. Code §163.04(1)(bm).[2] This study is intended to give the Commission a better understanding of the historical and future anticipated productivity performance of the local exchange carriers ("LECs") operating in Wisconsin.[3] The results of this study and the other evidence contained in our Report may be used by the Commission as a basis to make adjustments to the price regulation frameworks applicable to electing LECs under Wis. Stat. §196.196.[4]

Consistent with the technical requirements of the RFP,[5] this report provides the following information to the Commission:

(1) An estimate of the productivity gains in the Wisconsin telecommunications industry for the years 1996-2001.

---

1. *A Request for Proposal for State of Wisconsin, Public Service Commission of Wisconsin, "Total Factor Productivity Study of the Wisconsin Telecommunications Industry", RFP PSB-002, July 22, 2002 ("RFP").*

2. This rule states in part that "[e]ach time the productivity factors are reviewed..., the commission shall provide for a productivity study for the telecommunications industry in this state."

3. In addition, the Commission has engaged the firm of Christensen and Associates to perform a second, parallel TFP study in response to the RFP.

4. Wis. Stat. §196.196 authorizes the Commission, upon notice and an opportunity for hearing, to ".... increase or decrease the gross domestic product price index percentage offset by a maximum of one percentage point in any 12-month period to reflect any statewide changes in the productivity experience of the telecommunications industry." These Commission reviews and potential adjustments may occur no more frequently than every three years. *Id.*

5. *See* RFP at Section 5.0 (Technical Requirements).

(2) Evidence relative to the Wisconsin telecommunications industry's ability to increase productivity in the future, including an explanation of why the Wisconsin telecommunications industry can expect future productivity gains/losses equal to the consultant's productivity estimate, and an identification of key criteria that would significantly impact a company's ability to realize the forecasted productivity efficiencies over the next 3 years.

(3) Evidence regarding whether any significant differences exist in historical productivity gains or future ability to increase productivity, between companies with more than or less than 500,000 access lines.

(4) A description of how the productivity estimate relates to, or can be reconciled with, earnings reported by Ameritech and Verizon over the time period which includes 1996-2001.

(5) A sensitivity analysis for key assumptions used, showing how the productivity figure would change if each of the key assumptions or methods were changed.

(6) A comparison of the estimated productivity for the telecommunications industry in Wisconsin to other recent TFP studies performed by other parties who used academically sound approaches that appeared in refereed journals.

The project was conducted under the overall direction of Scott C. Lundquist, Vice President of ETI. Contributing to this work were Sarah C. Bosley, Jillian P. Jewett, Hillary A. Thompson, Thomas P. Lyle, and Dr. Lee L. Selwyn. The authors would also like to acknowledge the assistance provided by Nick Lester, Wisconsin State Telecommunications Association ("WSTA") and Christopher Larson of the Commission Staff. The views expressed in this study are those of ETI, and do not necessarily reflect the views of the Commission or its Staff.

1 | ETI'S TFP MODEL METHODOLOGY AND DESIGN ASSUMPTIONS

Measurement of total factor productivity

Productivity refers to the efficiency with which firms can combine inputs such as employees, investment capital, and raw materials to generate products or services to sell in the marketplace. Over time, firms in a competitive marketplace typically are able to improve their productivity by virtue of technological improvements, increased skills of employees, management innovations, or a combination of such factors.

In telecommunications, there have been extensive cost-reducing and service-improving changes resulting from the deployment of a wide variety of hardware and software components, such as digital switching, fiber optic transport, and new signaling technologies. These efficiency improvements translate directly into cost reductions that under competitive market conditions would be passed on to the LEC business and residential customers. Thus, in developing a price cap mechanism, a productivity growth rate is properly included in the offset against economy-wide inflation.

Among the various measures of productivity available, the total factor productivity ("TFP") growth rate, which takes into account all inputs (capital, labor, and materials) simultaneously, is generally accepted as giving the most accurate picture of the efficiency with which a firm produces its outputs. The TFP methodology has been widely used to develop productivity offsets in ILEC price cap plans both at the federal and state level. Despite this prevalence of price cap regulation and regulators' reliance on TFP estimates, recent economic literature provides comparatively little guidance to the specific application of the TFP methodology to the telecommunications sector, or its use in determining the proper value of the X-factor.[6] In response to the Technical Requirements

6. In addition, this lack of economic literature is noted by Bernstein and Sappington (1999), at 1. Bernstein, J. I. and Sappington D."Setting the X-Factor in Price-Cap Regulation Plans." Journal of Regulatory Economics Vol. 16 No. 1 (1999), 5-25 ("Bernstein and Sappington (1999)"). This article is also available from the National Bureau of Economic Research (continued...)

listed in the Request for Proposals ("RFP") for this project,[7] ETI conducted a review of the academic economic literature for the years 1995-2002 for recent telecommunications TFP studies and related research in this area. Only three journal articles with direct relevance to telecommunications TFP studies were found. In 1999, Jeffrey Bernstein and David Sappington issued a paper analyzing the impact of the input price differential, limited spans of regulatory control, and endogenous inflation rates on the appropriate X-factor. In addition, two recent studies have attempted to quantify the productivity gains attributable to price cap regulation.[8] These studies compute historical X-factors over a multi-year period, and their methodology provides some guidance relevant to the estimation of Wisconsin ILECs' TFP. Later in this chapter, we explain the specific calculation methods applied in the ETI model, and those discussions include comparisons to the methodologies used in the academic studies. However, neither study presents any estimates for telecommunications sector TFP later than year 1991.

Under the TFP approach, productivity is measured as the ratio of an index of outputs to an index of inputs over a given period of time. The growth in productivity is simply the amount by which the ratio changes over time. As applied to the LECs, the output index represents the quantities of services provided, expressed either directly (i.e., in terms of minutes of use or number of lines) or indirectly (i.e., derived by dividing revenues by an index of output prices). The output index is derived by weighting these quantities on the basis of their relative shares of revenues. The input index consists of the three major factors of production, including labor, material, and capital services provided by plant and equipment, weighted according to their relative share of factor payments.

The specific TFP model applied in this Report is based upon the model developed by the FCC staff and presented in its 1999 study of LEC TFP.[9] The FCC staff devised its methodology in the course of a long and thorough investigation of productivity issues that took place in the context of the FCC's development of a price cap regulatory framework for the interstate services of LECs, and the 1999 study represented an update and refinement to an earlier staff study released in 1997. Before embarking on a discussion of the methodological details of the TFP model that ETI has applied in this project, it will be useful to highlight some of the basic study design choices that we have made. These include: (1) the time period over which TFP should be calculated; (2) scope of LECs studied and data sources; (3) the choice of total company versus jurisdictional operations; and

6. (...continued)
website at: http:www.nber.org/w6622. All page references herein are from the NBER version.

7. See RFP, Section 5.0 (Technical Requirements), at Item 10.

8. Resende, Marcelo "Productivity growth and regulation in U.S. local telephony," *Information Economics and Policy* Vol. 11 (1999) pp. 23-44 ("Resende (1999)"). Gort, Michael, Sung, Nakil, "Competition and Productivity Growth: The Case of the U.S. Telephone Industry," *Economic Inquiry* Vol. 37 No. 4 (1999) pp. 678-691 ("Gort and Sung (1999)").

9. See *In the Matter of Price Cap Performance Review for Local Exchange Carriers and Access Charge Reform*, CC Docket Nos. 94-1 and 96-262, Further Notice of Proposed Rulemaking, FCC 99-345, rel. November 15, 1999, Appendix B ("The 1999 FCC Staff Study").

(4) the role of national benchmarking vs. Wisconsin-specific productivity analysis. Finally, we discuss the role of the Input Price Differential ("IPD") in an evaluation of productivity and the determination of an X-factor for LEC price cap plans.

Time period of TFP analysis

We have analyzed the TFP of Wisconsin LECs for the period 1996-2001, which is the default time period specified in the RFP.[10] As a general proposition, when evaluating TFP for the purposes of setting a price cap plan's X-factor, the time period of a TFP analysis should encompass the longest historical time period for which relevant regulatory and market conditions exist. The longer the time period, the more likely the data set is to reflect the wide range of cost conditions facing these companies. Moreover, given the significant year-to-year fluctuation in the data, from a statistical standpoint, a longer time period will provide more robust results. In prior studies, ETI has used a time period spanning from the most recent year for which data is available, back to 1991, the first year that price cap regulation was in effect for the LECs in the interstate jurisdiction.[11] However, attempting to analyze the entire set of 84 Wisconsin ILECs entails a significant data acquisition and analysis challenge. Given the passage of the *Telecommunications Act of 1996* and sweeping changes in the regulatory and competitive environment that LECs have experienced since that time, the period 1996-2001 (with 2001 being the latest year for which data is available) is reasonable to gain an understanding of productivity conditions in the state.

Scope of LECs studied and data sources

The target set of LECs for the study was all 84 incumbent LECs ("ILECs") currently operating in Wisconsin, as called for in the RFP.[12] Much of the Wisconsin LEC-specific data required for the study was obtainable from the Commission's database of LEC annual report statistics or the individual carriers' annual reports filed with the Commission. ETI obtained additional LEC data from the FCC's ARMIS database.[13]

---

10. RFP at Section 5.0 (Technical Requirements). As explained below, our Tier 1 LEC benchmark analysis updates ETI's prior study and thus includes TFP calculations for 1991-2001, although the period 1996-2001 remains the most relevant to the purposes of setting an X-factor.

11. For example, in our 1999 study submitted to the Utah Public Service Commission, the study timeframe was 1991-1998.

12. RFP at Section 5.0 (Technical Requirements). As agreed upon with Staff, Competitive LECs ("CLECs") were not included in the scope of the study, in part because CLECs tend to be dissimilar in many operational and financial respects from ILECs, and also because of the likely difficulties in obtaining usable CLEC data on a public basis.

13. Automated Reporting Management Information System (ARMIS), http://www.fcc.gov/wcb/armis.

After identifying the data that is available from public sources, ETI prepared a set of data requests to Wisconsin carriers for those pieces of data that are essential inputs to our TFP study, but are not publically available. Some of these items were not available because they are not part of regulatory reporting requirements; other data has been deemed confidential and thus are not available to the public. In collaboration with the Wisconsin State Telecommunications Association ("WSTA") and individual carrier representatives (for Ameritech, Verizon, TDS and Century Tel), ETI prepared a template for the carriers to complete and return with the requested data. WSTA agreed to aggregate the data requested from the smaller carriers before ETI received the data in order to retain the confidentiality of the data for individual carriers. CenturyTel elected to provide aggregate data to ETI in order to maintain confidentiality. The cooperation of the carriers and WSTA has been essential to the success of the data collection process and ETI appreciates WSTA's work with regard to data aggregation. Using this approach, the study and all workpapers containing data will remain public because we have been able to avoid the proprietary issues that would otherwise exist without such aggregation.

However, several carriers failed to provide data in response to the ETI and WSTA requests. The non-responsive carriers are identified in the carrier listings supplied in Appendix 1 to this Report.

Total company vs. jurisdictional basis for data

ETI has used total company data for the TFP study rather than jurisdictional data, i.e., the data we relied upon encompasses both the intrastate and interstate operations of each studied LEC. While some of the Wisconsin carriers operate in multiple states, the carriers allocate inputs and outputs to particular state operations for the overwhelming majority of data that carriers report. This is true for the Wisconsin annual reports, as well as at the FCC level where carrier data is available from ARMIS.

Reliance on total company measures of TFP is common among state price cap plans. When those plans were being introduced in the 1990s, the FCC was also applying price cap regulation with X-factors that were based on a total company approach to evaluating TFP. Consequently, it would have been inconsistent for state regulators to apply intrastate-only measures of TFP while the FCC applied the total company method. In fact, during that timeframe, setting an X-factor for intrastate services based on intrastate-only TFP would have given the ILEC an unjustified revenue windfall. This would occur because interstate services tended to have faster output growth rates than intrastate services, which all other things being equal would mean higher realized TFP. Thus, given that the FCC's X-factor choice averaged the (higher) interstate TFP and the (lower) intrastate TFP, a state PUC that choose to apply only its (lower) intrastate TFP would allow the (higher) interstate TFP to go unrecognized.

Given that the interstate price cap plan for Tier 1 LECs ceased with advent of the CALLS pricing plan in year 2000,[14] this concern is no longer a priority. However, another consideration limits the ability to conduct accurate intrastate-only and state-specific TFP results. Because intrastate and interstate services are generally provisioned jointly over a common set of inputs, as an economic matter there is no clear-cut method to properly allocate the costs of those inputs between jurisdictions. For comparison purposes, an intrastate-only X-factor can be approximated by a calculation that includes only intrastate-specific outputs in the LEC output index, with no revision made to the ILEC total company input index. However, that approach assumes intrastate and interstate inputs are growing at approximately the same rate, and was not undertaken in this study.

The role of national benchmarking vs. Wisconsin-specific productivity analysis

The Technical Requirements of the RFP indicates that the study "should be limited, to the extent possible, to the analysis of statewide data," but that regional or national data may be considered if justified by the consultant.[15] The RFP also requested that we "address the issue of the economically appropriate basis for measuring productivity changes for telecommunications firms that are multi-state and national in scope, and provide a recommended solution..."[16] ETI explored these issues with Staff during the course of the project and have adopted an approach that we believe accommodates the RFP and the need for economically-relevant productivity benchmarks for development of LEC price cap X-factors in Wisconsin.

---

14. The US Court of Appeals reversed and remanded for further consideration certain aspects of the FCC's decision in its 1999 price caps review, for example, the FCC's decision to set the interstate X-factor at 6.5%. However, the Court ruling went to the manner in which the FCC interpreted the results of the TFP model, and not to the underlying TFP model developed by FCC staff. The FCC conducted TFP studies for various time periods and then selected an X-factor from the high end of the "zone of reasonableness." The court found that the FCC was unable to justify its decision for giving less weight to the two lowest TFP results. In response to the remand, the FCC opened a proceeding to represcribe the X-factor in which the FCC Staff presented its TFP model based on the approach used in the 1997 Order but updated to include more recently available data (*In the Matter of Price Cap Performance Review for Local Exchange Carriers*, FCC CC Docket No. 94-1; *Access Charge Reform*, FCC CC Docket No. 96-262, *Further Notice of Proposed Rulemaking*, Released November 15, 1999). At the same time, an access charge and universal service reform proposal was submitted by the Coalition for Affordable Local and Long Distance Services ("CALLS"), which would keep the X-factor at 6.5% as a method for reducing access charges. The CALLS Proposal was a political compromise that was successful in resolving several heretofore unresolved issues. The CALLS plan was ultimately adopted in May of 2000 (and effective July 1, 2000), thus ending the need for the FCC to prescribe an X-factor through the use of a productivity study (*In the Matter of Performance Review for Local Exchange Carriers*, FCC CC Docket No. 94-1; *Low-Volume Long Distance Users*, FCC CC Docket No. 99-249; *Federal-State Joint Board On Universal Service*, FCC CC Docket No. 96-45, *Sixth Report and Order in CC Docket Nos. 96-262 and 94-1; Report and Order in CC Docket No. 99-249; Eleventh Report and Order in CC Docket No. 96-45*, Rel. May 31, 2000.

15. RFP at 11.

16. *Id.*

The impetus for this project is the legislative requirement that the Commission consider at least every three years whether the X-factors applied for price cap regulation should be adjusted to reflect "any statewide changes in the productivity experience of the telecommunications industry."[17] To facilitate each such review, the Commission solicits a study of "the telecommunications industry in this state," which is to address specific itemized factors impacting productivity, "plus additional evidence relative to a utility's ability to increase productivity in the future."[18]

In this context, recall that under a price cap system, a LEC should have the incentive to operate more efficiently than the average firm in the industry. Such incentives are created if a LEC under price caps has the opportunity to reap the benefits (in the form of higher profits) of operating more efficiently than its peers in the industry. Similarly, the firm should suffer the consequences of being less efficient than its peers (in the form of lower profits). Thus, a key question is to define the appropriate peer group for productivity benchmarking purposes. There are advantages and disadvantages to using a nationwide versus state-specific (in this case, Wisconsin-specific) peer group.

The primary advantage of examining Wisconsin-specific TFP data for this purpose is that it will most closely reflect the economic conditions faced by the carriers operating in the state. That is, if the business climate in Wisconsin is markedly better (worse) than that faced elsewhere in the country, for example, then Wisconsin LECs' productivity might reflect greater (less) demand for their telecommunications services. However, if the scope of the TFP analysis is too closely correlated to the LEC(s) to which the resulting X-factor will be applied, it can lead to economic incentives that are precisely the opposite of those desired in a price cap system (as described above).

The reason for this can be seen by considering the consequences of using an ILEC's own historical productivity as the benchmark for setting the X-factor applied to that ILEC's regulated services' rates. With a company-specific, state-wide productivity benchmark, the less efficient the ILEC is, the lower the measured productivity growth, and hence X-factor, will be, resulting in higher rates for consumers. Conversely, the more efficient the LEC's actual performance, the higher the X-factor, with the result being lower profits for the LEC than what would be achieved under a national or regional benchmark. The incentives such a system of regulation would produce are just the opposite from those prevailing in a competitive market and are, thus, undesirable for the purpose of establishing a price cap plan. In sum, if the X-factor too closely mirrors the ILEC's own historical performance as determined by a TFP study, the ILEC is essentially competing against itself and does not have the appropriate incentives to make operating performance improvements.

This problem may be reduced, but not necessarily eliminated, by expanding the peer group to include other ILECs operating in the state. To the extent that one or more ILECs serve a high proportion of the access lines in the state, then the average historical productivity performance of ILECs in the state may be dominated by those ILECs' performance, causing the benchmark to be distorted in the manner described above.

---

17. Wis. Stat. §196.196(1)(c).

18. Wis. Admin. Code §163.04(1)(bm).

Under Wis. Stat. §196.196, the threshold for "large" vs. "small" ILECs in Wisconsin is defined as over or under 500,000 lines. By this definition, all ILECs are defined as "small" except for Ameritech. Consequently, a study of "large" ILEC productivity under this definition is not directly useful for purposes of setting a price cap, because it would include only Ameritech and thus would not result in an appropriate benchmark for an X-factor, as just explained. In addition, if defined in this fashion, the "small" category would group together four carriers (Ameritech, Verizon, CenturyTel, and TDS) that all have more than 150,000 access lines and are part of corporate entities with national scope, with eighty much smaller companies with an average size of about 3400 access lines. For these reasons, we believe that the preferable dividing line for large vs. small ILECs in Wisconsin is to group together the 80 smaller ILECs as "small," and Ameritech, Verizon, CenturyTel, and TDS, as the "large" category (or what we refer to as the "Big Four").

For this reason, although we are providing TFP results for Wisconsin ILECs in conformance with the RFP and legislative requirements to apply a small vs. large criterion of 500,000 lines, we also provide study results based on the Big Four vs. small (non-Big Four) carrier groupings. These results aid in our identification of differences between large and small carriers' ability to realize productivity gains. For purposes of establishing X-factors for price cap regulation, we believe that the national-level TFP (and IPD) results for the Tier 1 ILECs that we present are most appropriate to use as a benchmark for the larger ILECs operating in Wisconsin (i.e., any of the Big Four). For the smaller ILECs (i.e., exclusive of the Big Four), no single ILEC dominates the productivity results, so that it is reasonable to use our study results for the smaller ILEC group as a benchmark for any of the smaller ILECs that may elect to enter into price cap regulation.

To summarize, we are presenting separate estimates of annual changes in TFP (and IPD) for several different groupings of carriers. These groupings are as follows:

- All ILECs currently operating in the state for which sufficient data was available (referred to as the "reporting ILECs").
- Small ILECs as defined by statute (under 500,000 access lines); this group includes all reporting ILECs except for Ameritech.
- Large ILECs as defined by statute (over 500,000 access lines), which equates to Ameritech-Wisconsin only. In addition, we present Verizon-only results given that it is also currently subject to a price cap.
- Because the statutory "Large ILEC" group includes only Ameritech and it is incorrect as an economic matter to apply a price cap X-factor based on a carrier's own past performance, we provide productivity results for all large ILECs (Tier 1) nationally as an appropriate benchmark for Ameritech's productivity performance.
- Small ILECs as defined by economic criteria; this group includes all ILECs in the state except for Ameritech, Verizon, CenturyTel, and TDS, and has an average company size of approximately 3,400 access lines.

- Large ILECs as defined by economic criteria; this group includes Ameritech, Verizon, CenturyTel, and TDS, and has an average company size of approximately 760,000 access lines.[19]

Input price growth differential (IPD)

An important feature of the ETI model is that it produces estimates of the input price differential ("IPD") as well as TFP. The IPD represents the inflation rate applicable to the prices that the firm pays its suppliers to purchase the inputs required to produce the products and services that it sells to its customers, relative to the inflation rate for those inputs used by the general economy. Thus, the IPD reflects gains in productivity of the supplier sector serving the LECs, above and beyond those experienced in the general economy. In a competitive market, firms have the incentive to operate more efficiently and innovatively, i.e., to improve productivity and cut costs, in order to increase their profits. Over time, competition will flow through to consumers, via lower prices, the benefits of improved productivity in the supply chain, as well as the firms' internal productivity gains (as measured by TFP). Because the overall objective of a price cap plan is to mimic competitive markets and, thus, pass along the benefits of competition to consumers, the productivity enhancements observed in the LECs' supply chain also need to be taken into account in the price cap's X-factor.

The rate of input price inflation differs from industry to industry, and is influenced by its mix of inputs (labor, capital, materials) and the rate and direction of price changes affecting each of those inputs. The local telephone industry, being highly capital-intensive and highly technology-impacted, has enjoyed strong decreases in the prices of its inputs in recent years. As a result, if the IPD were not taken into account when setting a price cap X-factor, the effect would be to use economy-wide average input price changes as surrogates for a LEC-specific input price index, which would overstate the rate of input price growth confronting incumbent LECs.

However, while industry-specific input price growth rates differ from the economy-wide input price growth rate, their movements are not independent. General inflation conditions will affect individual input factor markets, albeit to differing degrees. When constructing an industry-specific input price index, it is thus necessary to maintain some relationship between that index and an economy-wide measure of input price inflation. When the price cap formula allows LEC prices to grow at the rate of economy-wide output prices, as the Wisconsin price cap plans do,[20] this relationship is appropriately established by formulating the industry-specific input price index as a differential relative to an economy-wide input price inflation index.

---

19. Year 2001 line counts are as follows: Ameritech, 2.0-million; Verizon, 410,000; CenturyTel, 490,000; TDS, 151,000.

20. Wis. Stat. §196.196(1)(c)(1) and Wis. Admin. Code §163.04(2).

This can be demonstrated by considering the theoretical relationships between output price movements, total factor productivity, and input prices.[21] First, under competitive market conditions, a firm is not able to earn economic profit, i.e., the firm is just able to cover costs, including a normal or competitive return to capital. Under these conditions, the firm's (or industry's) output price growth, OP(F) — which under price cap regulation is to be modeled by the price cap index formula or PCI — will just equal the firm's (or industry's) input price growth, IP(F), less the firm's productivity growth, TFP(F):

$$OP(F) = IP(F) - TFP(F)$$

Thus, from a purely theoretical perspective, in keeping with the objective of price cap regulation to simulate the competitive market result, it is the regulated firm's input price growth, IP(F), that would directly determine the competitive level of the regulated firm's output price growth, OP(F), in conjunction with the regulated firm's productivity growth, TFP(F).

However, it has been general practice in telecommunications price cap regulation plans to index the regulated firm's output price growth, OP(F), to an economy-wide output price index, OP(E) such as GDP-PI. Since input prices for the regulated firm or industry, IP(F), do not necessarily grow at the same rate as output prices for the economy as a whole, OP(E), the use of the economy-wide output price index, OP(E), in the PCI formula requires a specific adjustment to reflect the difference, D, between the two, i.e., the difference between OP(E) and IP(F):

$$D = OP(E) – IP(F) \text{ or rearranging, } IP(F) = OP(E) - D$$

Substituting in for IP(F):

$$OP(F) = [OP(E) – D] – TFP(F)$$

Rearranging terms:

$$OP(F) = OP(E) – [TFP(F) + D]$$

We now have a PCI formula governing the growth in output prices for the regulated firm (or industry), OP(F), that can be expressed in terms of an output price index for the economy as a whole, OP(E), and an X-factor, where the X-factor can be thought of as the sum of two components, the productivity growth for the firm or industry, TFP(F), and D, the amount by which national output prices, OP(E), grow faster than industry input prices, IP(F):

$$X = TFP(F) + D$$

21. See the 1999 FCC Staff Study at 42-45 for a theoretical derivation of the X-factor as the sum of differentials that parallels the discussion that follows here.

Substituting in for D, the X-factor can be expressed as:

X = TFP (F) + [OP (E) – IP (F)]

In addition, because the economy in the aggregate is competitive, economy-wide inflation growth, OP(E), will be equal to the growth in economy-wide input prices, IP(E), minus the growth in economy-wide productivity TFP(E).

OP (E) = IP (E) – TFP (E)

Substituting in for OP (E) in the X-factor formula above, the X-factor can be expressed as:

X= TFP (F) + [[IP(E) – TFP(E)] – IP(F)],

A final rearranging of terms yields the following as the differential X-factor formula:

X = [(TFP(F) - TFP(E)] + [(IP(E) - IP(F)],

where TFP(F) is a measure of productivity growth for the LECs, TFP(E) is a measure of productivity growth for the economy as a whole, IP(E) is a measure of input price growth for the economy as a whole, and IP(F) is a measure of input price growth for the LECs.

Based on its similar analysis and a thorough investigation of the issues raised by the IPD in the course of its final price caps review proceeding, the FCC strongly affirmed its earlier conclusion that the X-factor must include both a measure of total factor productivity (TFP) growth and a measure of input price changes.[22] In particular, having reviewed a substantial and highly contentious record, the FCC solidly laid to rest claims by incumbent local exchange companies (ILECs) that the input price differential applicable to ILECs is equal to zero.[23] Indeed, as the FCC pointed out, the input price differential is part and parcel of a TFP-based X-Factor.[24] Consistent with the findings of the FCC (as well as several state regulatory commissions), ETI recommends that the Commission should take into account the available evidence on the input price differential, as well as TFP, when considering changes to the X-factor to update the price cap formulas applied to Wisconsin ILECs.

---

22. *In the Matter of Price Cap Performance Review for Local Exchange Carriers*, FCC CC Docket No. 94-1, *Fourth Further Notice of Proposed Rulemaking*, Released September 27, 1995, at para. 25; *In the Matter of Price Cap Performance Review for Local Exchange Carriers*, FCC CC Docket No. 94-1; *Access Charge Reform*, FCC CC Docket No. 96-262, *Fourth Report and Order in CC Docket No. 94-1; Second Report and Order in CC Docket No. 96-262* ("Fourth Report and Order"), Released May 21, 1997, at paras. 95-106.

23. *Id*., at para. 102.

24. *Id*., at para. 98.

Further details of ETI's productivity model

This section of our Report provides further details of the methodology employed in the model that ETI has used to calculate the TFP and IPD estimates presented in Chapter 2. ETI's basic productivity model consists of fourteen linked tables in Excel® format. The tables generally proceed from the final results back through the intermediary calculations and input assumptions, and comprise four modules, namely:

- Summary of Calculated Total Company X-factors (Table 1)
- Components of X-factor (Table 2)
- Calculation of Total Company Output Index (Tables 3 - 6)
- Calculation of Input Quantity Index and Input Price Index (Tables 7-14)

The discussion below is organized accordingly, and should be read in conjunction with review of the model tables presented in Appendix 2 (Documentation of ETI's Model). In general, we refer to the "All Reporting Wisconsin ILECs" version of the model first, and then refer to other versions (e.g., the Tier 1 ILEC model), where differences (other than data inputs) exist. Appendix 2 also supplies additional documentation of the formulas applied in each table and the specific data sources used for this project.

Summary of Calculated Total Company X-factors (Table 1)

Table 1 provides a summary of the calculated X-factor based on data for the years 1996-2001, assuming application of the TFP and the IPD results.[25] For example, referring to the "All Reporting Wisconsin ILECs" study, the calculated X-factor for the period from 1997 to 2001 is 8.0%. This number is derived by taking the sum of the input price differential and the total factor productivity differential (as calculated in Table 2). Also displayed on this table, X-factor calculations are presented for each year from 1997 to 2001, which allows for a comparison of the recommended X-factor, and average X-factors calculated over that period. As shown in Table 1, there has been significant volatility in the X-factor on an annual basis, which is largely due to the use of indices Accordingly, it is appropriate to evaluate the X-factor results on an average basis so that those fluctuations are smoothed out.

Components of X-factor (Table 2)

Table 2 details the calculation of both the Input Price Differential (IPD) and Total Factor Productivity (TFP) Differential. Shown are the figures that go into the calculation of these two differentials, and the results of the calculation. To calculate the input price differential, the LECs'

25. Because the Tier 1 ILEC benchmark study is an update of ETI's previous TFP study for the Utah Division of Public Service, we have included the full span of results available, i.e. years 1986-2001.

Input Price Growth Rates, calculated in Table 8 as the growth in the LEC Input Price Index, is compared to the U.S. Nonfarm Business Sector input price growth as measured by the Bureau of Labor Statistics (former subtracted from the latter). To calculate the total factor productivity differential, the LECs' total factor productivity growth rates (defined as the growth in the total company output index (calculated in Tables 3-6) minus the growth in the input quantity index (calculated in Tables 7-14)) is compared against the U.S. Nonfarm Business Sector productivity growth rates as measured by the Bureau of Labor Statistics (latter subtracted from the former). Again, it is the sum of these two differentials that yields the LEC Price/Productivity Differential, otherwise known as the X-factor.

In their 1999 article in the Journal of Regulatory Economics, Bernstein and Sappington address the need for an input price differential included as a component of the x factor where the regulated firms are expected to face input price growth rates that differ from economy-wide input growth. As stated by the authors:

> ...[i]f the regulated firms are expected to face lower (respectively, higher) input price growth rates or are deemed capable of achieving higher (respectively, lower) rates of productivity growth than are typical elsewhere in the economy, then the rate of growth of output prices in the regulated sector should be restricted below (respectively, allowed to exceed) the economy-wide inflation rate.[26]

To compute the input price differential, Bernstein/Sappington calculated the difference between the input price growth of the entire economy and the corresponding price growth for the regulated sector, as done in the ETI model.[27]

It should be noted, however, that Bernstein/Sappington apply a scaling factor to the application of the input price differential.[28] This scaling factor (which is also applied to the TFP comparisons between the entire economy and the regulated sector) is applied in consideration of the possible differences in the profit to cost ratio between the regulated sector and the economy as a whole. In a fully competitive market, this scaling factor equals 1 (a firm's costs are exactly equal to its profits). The Bernstein/Sappington scaling factor adjusts the x factor to allow telecommunications excess earnings equivalent to the excess earnings in the general economy.

The ETI model does not include such a scaling factor, nor are we aware of any implementations of this concept in other telecommunications TFP studies. However, our approach to developing a competitive cost of capital would likely control for any such profit differences. First, the ETI model makes an explicit adjustment in the ILEC cost of capital calculation (Table 13) to eliminate excess

26. Bernstein and Sappington (1999), at 9.

27. As illustrated by Appendix 2, Table 2, Columns E and H, this method parallels the input price differential developed in the ETI model.

28. Bernstein and Sappington (1999), at 9.

profits within the industry. Second, our competitive cost of capital calculations includes yearly adjustments to control for investor's expected returns (specifically, changes in Moody's Baa corporate bond rate) taken from the general economy (as opposed to telecommunications specific capital).[29] To the extent there are any excess profits generated in the general economy, inclusion of this series means that they would be reflected in the cost of capital that we apply to the ILECs. See the discussion of Table 13 below for more details on this calculation.

Calculation of Total Company Output Index (Tables 3-6)

LEC Total Company Output Index (Table 3)

Table 3 shows the calculation of the LEC Total Company Output index. The values found on Table 5, total LEC revenue, are used to calculate revenue shares for each of the three categories, Local, Intrastate Toll, and Interstate. Using the revenue shares as weighting factors for the three categories, both Laspeyres and Paasche output indices are calculated. These output indices are then used to calculate the LEC Total Company Output Index using a chained Fisher Ideal Index, which is calculated by taking the Fisher Ideal Index (the square root of the product of the Laspeyres result and the Paasche result) and weighting the current year's value by the previous year's value. Finally, in the rightmost column of the table, the growth rate of the index is calculated. This number is then used in Table 2, as part of the calculation of the LECs' TFP growth rate.

As explained in the 1999 FCC Staff study,[30] the Laspeyres quantity index, Q_L is defined as

$$Q^L (p^0, p^1, x^0, x^1) = p^0 x^1 / p^0 x^0$$

where $p^t > 0$ is a vector of prices in period t = 0, 1 and x > 0 is the corresponding vector of quantities. The Paasche quantity index, Q_P, is defined as

$$Q^P (p^0, p^1, x^0, x^1) = p^1 x^1 / p^1 x^0.$$

The Fisher Ideal Index is simply the geometric mean of these two indices, i.e.

$$Q^F (p^0, p^1, x^0, x^1) = ((p^0 x^1 / p^0 x^0) (p^1 x^1 / p^1 x^0))^{½}.$$

As the FCC Staff observed, the Fisher Ideal Index has strong theoretical merits for application to the calculation of TFP, especially when applied on a chain-weighted basis in which each successive index value is the product of the prior year's value times the current year's Fisher Ideal Index value:

29. *See* Appendix 2, Table 13.

30. See 1999 FCC Staff Study at 33.

> The chained Fisher Ideal Quantity Index addresses one of the most fundamental problems in measuring output - the choice of the base period with which all other periods are compared. Since changes in the Fisher Ideal Quantity Index are calculated using weights of adjacent years, the chaining of the annual changes allows for the effect of changes in relative prices. Thus, the Fisher Ideal Chained Quantity Index calculates an index that is appropriate for each period and avoids having to update a fixed-weight index. It also negates the substitution bias that is inherent in a fixed-weight index. Finally, the chain-type index provides a more accurate measure of current period output during periods of significant price changes.[31]

ETI has used the chained Fisher Ideal Index method for calculation of both the output and input quantity series developed in our studies, as did the FCC Staff.[32]

Local dial equipment minutes (DEMs) are used as the measure of local output. Intrastate toll output is represented by intrastate DEMs. For interstate output, the output index calculated in Table 4 is used as the measure of quantity. In certain instances, ETI was required to develop estimated DEMs values, which are discussed further below.

Arguably, a usage measure such as DEMS (or similarly, minutes of use) best represents the basic function of telecommunications, which is to provide connectivity between two points for communications purposes. As a single metric of output, the use of DEMs is preferable to using calls or even lines, since it better reflects the increased usage of the LEC networks that has occurred as a result of the growth of the Internet. Moreover, compared to those alternatives, the DEMs measure probably correlates better with growth in vertical services, such as call waiting, call forwarding, and Caller ID. These latter types of services have experienced substantial growth over the price cap period and constitute an increasingly important component of LECs' total local output.

An alternative to physical measures of output is to use a revenue-based measure. Of course, a revenue-based approach is an indirect measure of output, since revenues will be affected by changes in price levels as well as the underlying output supplied. When applying a revenue-based measure, an economist typically will effect adjustments to take into account the price changes that may have occurred in each year. However, as a practical matter, it can be difficult to accurately capture all relevant price changes given the hundreds of thousands of individual tariffed and non-tariffed pricing elements that a LEC will typically employ. The potential for varying timing of price changes throughout the year presents another dimension of this problem. Resende (1999) attempts to avoid those complexities by using nominal revenue figures deflated by consumer price index (CPI) values for telephone services.[33] However, that approach is clearly not workable for analysis of the TFP of individual LECs or subsets of the total LEC industry, because individual LECs' price changes may

31. *Id.* at 34 (footnotes omitted).

32. *Id.*

33. Resende (1999), at 31.

vary widely from the aggregate represented by the CPI, so that the underlying physical quantities would become distorted.[34] In the context of an existing price cap plan, it may appear attractive to deflate total booked revenues in each year by the annual change in the price cap index (PCI). However, that method will not take into account any price changes in nonregulated services which are outside the scope of the price cap. In summary, while revenues-based measures of output can be constructed, they do not demonstrate any clear advantage over more direct physical measures of output.

In certain instances, local and intrastate DEMS values were not available and needed to be estimated. Notably, Verizon's reported local DEMs value for 2000 was 10.385-billion, some 59% higher than the previous year's value, and thus appears to be anomalous. In addition, Verizon's local DEMs for 2001 was not available. In all other years of the study period, Verizon's annual growth rates for local MOU were virtually identical to its local DEMs growth rates. Therefore, we estimated year 2000 and 2001 values for Verizon's local DEMs by applying the corresponding local MOU growth rates, based on the MOU data presented in Verizon's Annual Reports. The same process was used to develop the 2001 local DEMs value for Wisconsin Bell, which also was not available.

Year 2001 intrastate DEMs were not available for either carrier. In contrast to the observed local DEMs / local MOU relationship, the carriers' growth rates for intrastate DEMs over the study period were not similar to the growth rates seen for toll MOU. Wisconsin Bell states that its toll MOU values reflect only originating minutes, which may be an explanatory factor.[35] Consequently, we developed estimates for each carriers' 2001 intrastate DEMs from the average growth rate for intrastate DEMs over the prior years of the study period, i.e., 1996-2000.[36] This is the same approach that was applied in the Tier 1 ILEC study, where 2001 DEMs values also were not available and needed to be estimated.

For CenturyTel of the Midwest-Kendall ("Kendall"), local and intrastate DEMs were not available for 1996-1998. Given that Kendall had less than 600 switched access lines in 1996 and 1997, and its impact on output would be *de minimus*, for those years we assumed them to be zero. For 1998, Kendall's access lines grew to 86,242 with the purchase of exchanges from Wisconsin Bell, so for that year we estimated local and intrastate DEMs from the 1999 values, ratioed

34. In addition, a CPI-Telephone Service series is typically constructed using an assumed mix ("basket") of services, that is not necessarily consistent with the service mix supplied by individual LECs (which should be reflected in the output factor shares).

35. See, e.g., Wisconsin Bell 1997 Annual Report at 56, Note N. As stated therein, the same holds true for another candidate for comparison, toll telephone calls.

36. In the case of Verizon, we excluded the year 2000 value from the average to avoid distortions caused by the significant reduction in Verizon's access lines occurring that year due to its sale of exchanges to CenturyTel. The resulting estimate represents a 0.1% increase from the prior year's reported value.

downward by the change in switched access lines for those two years.[37] None of the CenturyTel companies reported either DEMs statistic for 2001, so an estimate was required. Our standard method of using the average growth rate over the prior five years would overstate usage because of the intervening acquisition of significant numbers of exchanges and access lines by CenturyTel. However, CenturyTel's DEMs usage per line appears relatively stable over the study period, and this statistic is not affected by line acquisitions. Accordingly, we have estimated 2001 values for CenturyTel's aggregate local DEMs and intrastate DEMs by applying the average rate of growth in the respective DEMs series for the years 1996-2000 (2.0% and 0.8%, respectively), to the 2000 values ratioed upward by the change in switched access lines between the two years. Additional estimates were made relative to the small ILEC dataset obtained in part with the assistance of WSTA. These are described in the Study Workpapers.

LEC Interstate Output Index (Table 4)

Table 4 shows the calculation of the interstate output index, which is used in the calculation of the Total Company Output index in Table 3. Using revenue shares derived from Table 6, the LEC interstate revenues table, as weighting factors for quantities of number of access lines, number of switched access minutes, and number of special access lines, a Laspeyres Output Index and a Paasche Output Index are separately calculated. Similar to the construction of the Total Company Output series, the Interstate Output Index is then calculated by using a chained Fisher Ideal Output Index, which combines the results from the Laspeyres and Paasche indices by taking the square root of the product of the two indices, and then weights the current year's value by the previous year's value.

Total LEC Revenue by Type of Service (Table 5)

Table 5 shows the calculation of total LEC revenue, by type of service. Total revenue in this case is equal to the sum of Local Service Revenue, Intrastate Toll and Intrastate Access Service Revenue, and the total Interstate Service Revenue as calculated in Table 6, LEC Interstate Revenue.

LEC Interstate Revenues (Table 6)

Table 6 shows the calculation of total interstate revenue used in the calculation of total company revenue in Table 5. Total interstate revenue is defined to be the sum of end user revenue, interstate switched access revenue, and special access revenue for all the RBOCs.

---

37. As noted below, there has been little growth in the CenturyTel companies' DEMs usage per line over the study period, so this simple ratio is reasonable to apply here.

Calculation of Input Quantity Index and Input Price Index (Tables 7-14)

LEC Total Company Input Quantity Index (Table 7)

Table 7 shows the calculation of the LEC Total Company Input Quantity Index. The shares calculated in Table 9, the Factor Shares of Total Payments, are used as weighting factors. These weighting factors are applied to the labor quantity (which is equal to the number of employees as shown in Table 10, Price of Labor), a capital quantity index (as calculated in Table 12, Quantity of Capital), and the materials quantity index (as calculated in Table 11, Materials Input Quantity), in order to calculate the Laspeyres and Paasche input quantity indices. These indices are then used to calculate a Fisher Ideal input quantity index. Finally, the Growth rate of the Fisher Ideal Chained Input Quantity index is calculated. This value is used in Table 2 as the LECs' Input Growth Rate to calculate the LECs' total factor productivity growth rate.

LEC Total Company Input Price Index (Table 8)

Table 8 shows the calculation of the LEC Total Company Input Price Index. The shares calculated in Table 9 (Factor Shares of Total Payments) are used as weighting factors which are applied to each of the three input categories (i.e., labor, capital, materials). Specifically, these weighting factors are applied to a labor price index (as calculated in Table 10, Price of Labor), a capital price index (as calculated in Table 13 Cost of Capital), and a materials price index (as shown in Table 11, Materials Input Quantity) in order to calculate the Laspeyres and Paasche input quantity indices. These indices are then used to calculate a Fisher Ideal input quantity index. Finally, the growth rate of the Fisher Ideal chained input quantity index is calculated. This value is used in Table 2 as the LECs' input growth rate to calculate the LECs' total factor productivity growth rate.

Factor Shares of Total Payments (Table 9)

The calculation of shares of payments relating to labor, materials and property are calculated in Table 9. The share of total payments accounted for by each of these three categories is calculated by dividing the total amount attributable to each category by the total factor payments. This ratio is used as a basis for weighting the indices for labor, materials, and capital prices, as well as the labor, material and capital quantities, in calculating the input quantity index and the input price index. The amount used for Labor is the adjusted labor compensation, as it appears on Table 10, Price of Labor. For materials, the value of adjusted materials payment, which appears in Table 11, Materials Input Quantity as materials expense, is used as a basis for calculating the share of total payments. The amount for capital is the value of property income with depreciation and taxes, as adjusted to reflect the competitive cost of capital as developed on Tables 12 and 13.

Price of Labor (Table 10)

Table 10 shows the calculation of the Labor Price Index. The starting point for this calculation is total labor compensation, which includes both Salary and Wage compensation and also Benefits. Total labor compensation is divided by the number of employees to determine the price of labor. This number is then converted to an index, using 1996 as a base year (1985 for the Tier 1 ILEC model), which represents the labor price index in calculating the Total LEC Input Price Index.

We note that Resende (1999) computes the labor price by dividing the total compensation by the total number of employees, in the same manner employed by ETI to determine the labor price index.[38] While Resende does not include benefits (defining total compensation as wages plus salaries minus benefits), the ETI model includes wages, salaries and benefits. Any calculation of the price of labor that entirely excludes benefits will misstate the true cost of labor, as benefits now typically constitute a significant portion (upwards of 20%) of an employee's total compensation.[39] In addition, recent trends in labor compensation data indicate that the proportion of an employee's total compensation paid in benefits is increasing. WSTA data indicates that, while benefits accounted for 25.3% of total employee compensation in 1998, by 2001 that figure had grown to 36%.[40]

In the original, 1999 version of the TFP study that ETI conducted for the Utah Division of Public Utilities, we applied an adjustment to the Labor Compensation series to take into account unusually high levels of benefits booked by the ILECs, that were due in part to one-time charges reflecting accounting rule changes and payouts of employee severance packages. These charges occurred at a time that ILECs were making substantial reductions to their staffing levels. The adjustment removed all recorded benefits in excess of the historical average level of benefits (twenty percent). While that adjustment had a relatively small impact on the TFP result, it was consistent with the goal of having the TFP series reflect the most accurate possible representation of economic cost trends, rather than changes in accounting costs.

When ETI prepared its 2000 update to the Utah TFP study, we found that benefits were no longer reported separately from other compensation by the ILECs in either ARMIS or the Statistics of Common Carriers, so it was no longer possible to effect that adjustment. Since that time, other factors such as the recent rise in health insurance premiums have also driven increases in the level of compensation paid via benefits, for both ILECs and the general economy. For these reasons, we have not applied an excess benefits adjustment in the studies presented in this Report.

---

38. *See* Appendix 2, Table 10, Column H. Resende (1999), at 30.

39. See, e.g., Data Collection Form For Wisconsin LEC Total Factor Productivity Study, Provided by WSTA, Reported as of November 27, 2002.

40. *Id.*

Materials Input Quantity (Table 11)

The calculation of the materials quantity index is shown in Table 11. In order to calculate this index, an amount for materials expense is calculated by subtracting depreciation and amortization expense and adjusted employee compensation, as calculated in Table 10, Price of Labor, from adjusted total operating expense. This residual approach is also applied in each of the published TFP studies that we consulted in the course of our literature review. In the ETI model, the resulting materials expense figure for each year is then divided by the materials price index obtained from the Input/Output Tables compiled by the Bureau of Economic Analysis of the U.S. Department of Commerce, to calculate the quantity of materials. The materials quantity is then converted to an index, by dividing each year's term by the first year value (1996 for the Wisconsin ILEC studies, and 1985 for the Tier 1 ILEC study). This index is then used to calculate the LEC Total Company input quantity index in Table 7.

In the Wisconsin ILEC studies, ETI made certain adjustments to carriers' booked expense values to remove the effects of one-time accounting entries that were not caused by one-time changes in economic costs. Verizon North's total operating expense for 1999 was adjusted by $14.8-million to eliminate a one-time pension settlement gain of $14.8-million booked to Account 6720.[41] Similarly, Wisconsin Bell's 1999 total operating expense was adjusted by $35.0-million for the same reason, plus an additional $5.6 million to eliminate a one-time accrual to Account 6210 of un-invoiced receipts.[42] Wisconsin Bell's 1999 total operating taxes were adjusted to remove a deferred tax true-up that was associated with its 1998 sale of exchanges to CenturyTel. For this adjustment, ETI reduced the booked total operating tax value by $97.0-million, which is the difference between the value reported for Account 7250 (Provision for Deferred Operating Income Taxes-Net) in 1999 ($65.44-million), and its average over years 1996-1999 (negative $31.6-million).[43]

Capital Quantity and Imputed Cost of Capital (Table 12)

Table 12 shows the calculation of the capital input quantity index that is used on Table 7 in the calculation of the LEC Total Company input quantity index. Additionally, Table 12 shows the calculation of the imputed price of Capital, used on Table 13 to calculate the cost of capital index. Adjusted capital additions and the adjusted depreciation rate, taken from Table 14, Capital Stock Adjustments and the Average Depreciation Rate, and the BEA composite asset price index, derived from figures released by the Bureau of Labor and Statistics, are used to calculate each years capital stock quantity.

---

41. See Verizon-North 1999 Annual Report at 56, Note B.

42. See Wisconsin Bell 1999 Annual Report at 56, Notes H and B, respectively.

43. See *id.* at 44.

Capital stock quantities are calculated using the perpetual inventory method. The published TFP studies that we reviewed also use the perpetual inventory method, which allows the removal of embedded inflation from booked depreciation values.[44] The ETI method entails depreciating the *prior year* net capital stock figure (gross communication plant minus depreciation) and adding to this the current year capital additions deflated by the current year BEA composite asset price. This method is similar to the method used by Resende in his analysis of the impact of alternative forms of regulation, although Resende recomputes the *current* year net capital stock figure for each year and applies the deflator to this figure.[45] The deflation effect of these two methods is the same.

ETI's model applies the calculation method used by the 1999 FCC Staff study, in which each year's capital stock quantity is equal to the prior years, adjusted for depreciation, plus the ratio of adjusted capital additions divided by the BEA composite asset price index.[46] The capital stock quantity is then converted to an index, called the capital input quantity index, and is used on Table 7 in the calculation of the total LEC input quantity index. The Tier 1 ILEC study uses the same benchmark (i.e., starting year) capital stock value as applied by the FCC Staff in their 1999 TFP study, which used 1985 as the base year.[47] For the Wisconsin ILEC studies, we developed benchmark capital stock values based on carriers' reported TPIS and accumulated depreciation figures, using a base year of 1992. As shown in our sensitivity tests, the model's results are not very sensitive to changes in the initial capital stock value.

The imputed cost of capital calculation is a component of the method used to develop the capital costs input index, and is explained immediately below.

Cost of Capital (Table 13)

In order to remain a viable business, LECs must provide a return on investment capital that satisfies investors' expectations, given the range of alternative investment opportunities (exhibiting varying mixes of financial risk and reward) that are available in the capital marketplace. Because actual investor requirements are not directly observable, estimating a competitive cost of capital entails a substantial amount of judgement and is likely to engender controversy. In this model, we have chosen to use the method initially proposed by the FCC Staff, subject to refinements which remove those portions of LEC property income (i.e., depreciation and taxes) which are not impacted by movements in the competitive cost of capital. The Staff method uses the publicly reported Moody's Baa corporate bond rate and the Commission's last prescribed rate of return (11.25% in

---

44. While Gort and Sung (1999) provide few details, they state that they applied the conventional perpetual inventory method. *Id.* at 690.

45. Resende, at 29.

46. See 1999 FCC Staff Study at 37.

47. This figure is $109,602,959,000, which represents net total plant in service (TPIS) for Tier 1 ILECs in 1985. *Id.* at Table B-7.

1991) to calculate an imputed cost of capital series, from which a competitive cost of capital index is derived. This imputed cost of capital series is then used to adjust LEC property income, which is combined with depreciation and taxes to construct the capital cost input series.

Other methods, and in particular, ones that use other indices of the competitive cost of capital, are available. For example, in the FCC's last price cap review proceeding on remand, USTA presented an alternative proposal that the FCC rely upon the rate of return series reported by Value Line for a sample of 875 large industrials.[48] That approach implicitly assumes that the risk faced by the ILECs being studied are equal to the risk confronted by large industrial firms taken as a group. That assumption is questionable, given the ILECs' long history of franchise monopoly privileges and protections, continued regulatory oversight, and protracted transition to a more competitive market environment, all of which tend to differentiate the ILECs from typical large industrial firms. In any case, sensitivity analyses reveal that the application of a range of acceptable alternative competitive cost of capital indices result in similar, and generally higher, X-factors than produced using the proposed FCC Staff method. Accordingly, for simplicity's sake, and to remain on the conservative side, we utilize the proposed FCC Staff method, which adjusts the imputed cost of capital on an aggregate basis using the publicly available Moody series. Moreover, while the Staff method relies strictly upon the cost of debt for measuring the change in the competitive cost of capital, that method is consistent with the conventional risk premium approach to calculating the cost of equity.[49]

The calculation of the cost of capital series is shown on Table 13. However, this calculation begins with the cost of capital benchmark derived in Table 12 of the Tier 1 ILEC study, following the FCC Staff methodology.[50] The benchmark value is determined using a base value from the year 1991 — the first full year of LEC price cap regulation in the interstate jurisdiction, a year for which it is reasonable to assume the cost of capital was at a competitive level given explicit FCC findings regarding going-in rates and rate of return. The benchmark cost of capital for 1991 is calculated by dividing property income after depreciation and taxes are removed (since changes in the competitive cost of capital would not impact these components of property income), by the capital stock quantity. For the Wisconsin ILEC studies, the resulting value of the competitive cost of capital series for year 1996 is applied as the starting point.[51]

From this starting point, the imputed competitive cost of capital for other years is calculated based on changes in Moody's Baa Corporate Bond Rate. For example, the imputed competitive cost of capital for 1992 is 0.02443, which is equal to the imputed price of capital calculated on Table 12

---

48. Comments of Frank M. Gollop, *Economic Assessment of the 1999 X-Factor Model Proposed by the FCC Staff*, Attachment 2, USTA Comments, CC Docket No. 94-1, 96-262, January 7, 2000 ("Gollop Comments"), at 7.

49. Under the risk premium approach, the cost of equity is calculated by adding a specified fixed increment to the cost of debt, such that the change in the cost of capital over the study period is determined by the change in debt.

50. See 1999 FCC Staff Study at 22.

51. See the Wisconsin ILEC studies at Table 12, Column J.

for 1991, 0.03263, plus the change in the bond rate from 1991 to 1992 (-0.0082). The imputed cost of capital series is intended to represent the rental price of capital. If the ILECs were operating in a perfectly competitive marketplace, then theoretically the rental price of capital could also be derived by dividing ILEC property income by ILEC capital stock. In reality, without further adjustment, the latter approach does not work well in the context of determining the appropriate X-factor where the absence of an effectively competitive local exchange market has permitted the price cap LECs to earn persistent excess profits.

Table 13 of our model applies a residual earnings method in which the cost of the capital input initially is assumed to equal all returns in excess of those required for the non-capital inputs (i.e., labor and materials). Under the residual earnings method, capital's share of total payments (shown on Table 9) is equal to LEC property income, defined as total LEC revenues less payments to labor and material inputs. Where excess profits exist, the return to capital determined residually in the fashion described above will be greater than that required under competitive market conditions. Thus, to use the residual earnings method to calculate the appropriate X-factor requires a downward adjustment to LEC property income to remove excess profits (defined as profits above the level that would be permitted under the discipline of a competitive market).

This necessary adjustment is performed in Table 13 in the following manner. The imputed competitive cost of capital is used to develop an adjusted property income without depreciation and taxes (again, depreciation and taxes are removed from the calculus since changes in the competitive cost of capital would not impact these components of property income). The adjusted property income series (without depreciation and taxes) is compared to the original series (without depreciation and taxes), with the difference between the two providing a measure of excess profits. These excess profits are then added to the original property income series that includes depreciation and taxes to produce an adjusted property income series that includes depreciation and taxes. An adjusted imputed cost of capital series is then derived based upon the resulting adjusted property income series and capital stock quantity. Finally, the derived imputed cost of capital series is converted to an index by dividing each year's value by the base year value (i.e., 1985 in the Tier 1 ILEC study). This competitive cost of capital index is then used on Table 8 as the capital price index in calculating the LEC input price index. The adjusted property income series is used in the calculation of factor shares of total payment on Table 9.

Capital Stock Adjustments and the Average Depreciation Rate (Table 14)

Table 14 shows the calculation of capital stock adjustments, and the average depreciation rate. Total Plant in Service (TPIS) for the end of the year is subtracted from the sum of TPIS from the beginning of the year and capital additions to determine the amount of retires for the year. This number is then subtracted from the sum of the TPIS beginning of the year number and adjusted capital additions to calculate an adjusted end of the year TPIS figure. In order to calculate an adjusted depreciation rate, the average of this adjusted end of the year TPIS figure and the beginning of the year TPIS figure is taken. The figure for depreciation accruals is then divided by the average

TPIS number to calculate an adjusted depreciation rate. The average of this adjusted depreciation rate is then used on Table 12 in the calculation of capital stock quantity.

2 | ANALYSIS OF LEC PRODUCTIVITY IN WISCONSIN

Overview of the TFP Studies that were conducted

As noted earlier in this Report,[52] ETI applied its TFP model to several different groupings of ILECs in Wisconsin, and also developed a study using all Tier 1 ILECs nationwide as another useful benchmark for evaluations of TFP and X-factor levels. The resulting studies include, in order of convenience:

- Tier 1 ILEC Study (National Benchmark)
- All Reporting Wisconsin ILECs
- Ameritech-Wisconsin only
- Verizon only
- Statutory Small ILECs, i.e. all reporting ILECs except for Ameritech-Wisconsin
- Small ILECs by Economic Definition, i.e. all reporting ILECs except for Ameritech-Wisconsin, Verizon, CenturyTel, and TDS
- Large ILECs by Economic Definition ("Big Four"), i.e. Ameritech-Wisconsin, Verizon, CenturyTel and TDS[53]

---

52. See pages 6-7.

53. Because TDS did not respond to ETI's data request, we were unable to include them in our studies. However, we continue to apply the term "Big Four" to this category for convenience.

There is likely to be significant year-to-year variation in measured TFP and input price growth for both the LECs and the economy as a whole, given the multitude of influences on these variables.[54] Thus, strictly as an empirical matter, it is appropriate to rely upon an average of X-factors calculated over a period of time rather than any one particular yearly X-factor result. The primary results for all of these studies, expressed as the average over the five year period 1997-2001, are presented together in Table 1 below. More detailed results are presented in Appendix 3 (Tables of TFP Study Results), which provides Tables 1 and 2 of the model for each study that we conducted. Those tables supply both year-to-year values for the TFP differential, IPD, and X-factor, and also their subcomponents such as inputs growth and outputs growth. The remaining model tables for each study, plus additional calculations and data, are provided in the Study Workpapers.

Table 2.1

Summary Table of TFP Study Results

Study	Total Factor Productivity Differential TFP	Input Price Differential IPD	Annual Productivity Growth X-Factor
Tier 1 ILEC Study (National Benchmark)	4.9	3.4	8.3
All Reporting Wisconsin ILECs	3.9	4.1	8.0
Ameritech-Wisconsin	8.4	2.1	10.5
Verizon	2.6	3.2	5.8
Statutory Small ILECs	2.9	7.2	10.1
Small ILECs by Economic Definition	8.2	-3.1	5.1
Large ILECs by Economic Definition ("Big Four")	4.4	4.0	8.4

All results are the average for the five year period 1997-2001.

Discussion of the TFP study results

Our first observation is that the Table 1 results for all reporting ILECs in Wisconsin are generally in line with those determined for the national benchmark study of Tier 1 ILECs. The former study produced a total X-factor (TFP differential plus IPD) of 8.0%, compared to the national

54. The empirical evidence bears this out as shown in the year to year calculations of the X-factor as shown in Table 1 of each study.

benchmark level of 8.0%. The average TFP differential in Wisconsin is 4.9%, a percentage point higher than national level, but the Wisconsin ILECs enjoy a higher input price differential (4.1% vs. 3.4%). Certain aspects of the model, notably the treatment of labor compensation, may cause some shifting between the TFP and the IPD without significantly changing the overall X-factor,[55] and this may be occurring here.

Comparison to the existing price cap X-factors

Second, it is striking that both studies produced substantially higher X-factors than the initial X-factor values prescribed by the Wisconsin legislature, i.e. 3% for statutorily-defined "large" ILECs (namely, Ameritech-Wisconsin) and 2% for the "small" ILECs. Given that Ameritech-Wisconsin has operated under a GDP-PI minus 3% price cap since 1994, and Verizon came under a GDP-PI minus 2% cap in 1995, these results compel the conclusion that the historical price caps have been inadequate to drive prices of the carriers' regulated services to something approaching competitive levels. This conclusion is confirmed by the earnings analysis described later in this chapter (page 30).

Moreover, based on the results of the Ameritech-Wisconsin only study, Ameritech-Wisconsin appears to be experiencing even higher productivity gains than the national or Wisconsin norms, with an average TFP differential of 8.4% and a total X-factor of 10.5%. Verizon's average productivity level lags well behind Ameritech-Wisconsin and the two benchmarks (TFP differential of 2.6%, and X-factor of 5.8%), but nevertheless is substantially above its current 2% price cap offset.

Differences in productivity between large and small ILECs

Turning to the issue of large vs. small carrier differences in productivity gains,[56] comparing the results between "large" and "small" carriers as defined by the statutory distinction (above/below 500,000 lines)[57] may lead to the conclusion that the differences are minor, judging from the average total X-factors for the "large" and "small" categories of 10.5% and 10.1%.[58] More pronounced differences in their respective TFP differentials (8.4% vs. 2.9%) and IPDs (2.1% vs. 7.2%) suggest otherwise, however. From an economic standpoint, this categorization only works to obscure

---

55. All other things being equal, an increase in total labor compensation without an accompanying change in the number of employees would drive an increase in the unit price of labor faced by the LEC, which increases the IPD, at the same time that it depresses the TFP. See the discussion of the labor compensation input sensitivity test.

56. This issue was specifically identified in the RFP as Item (4).

57. Wis. Stats. §196.196(1)(c).

58. The "large" category is the Ameritech-Wisconsin only result, since it is the only carrier with more than 500,000 lines in the state.

underlying productivity trends, because it improperly mixes carriers that have very different scales and operational characteristics. As explained earlier in this Report (page 6), the statutory "small" category groups together four carriers (Ameritech, Verizon, CenturyTel, and TDS) that all have more than 150,000 access lines and are part of corporate entities with national scope, with eighty much smaller companies with an average size of about 3400 access lines. A much more economically rational classification scheme is to group together the 80 smaller ILECs as "small," and Ameritech, Verizon, CenturyTel, and TDS, as the "large" category.[59]

Interestingly, the results from the latter classification method reveal greater productivity differences between small and large carriers. On average, the small ILECs have been achieving total productivity gains as measured by the X-factor of 5.1%, compared to 8.4% for the large carrier group. It must be noted here that these results are less reliable than the results for the larger carriers (and All Reporting ILECs study), because a significant fraction of the smaller carriers could not be included in our dataset due to data limitations, and various estimates had to be developed for a number of the small ILEC inputs (see the discussion in Chapter 1 and the Study Workpapers). Nevertheless, the 5.1% X-factor result for the small ILEC category is still well above the 2% that would currently apply to any of the small ILECs that elected price cap regulation under Wis. Stat. § 196.196(1).[60]

Analysis of Ameritech-Wisconsin and Verizon earnings and comparison to study results

Ameritech Wisconsin and Verizon elected price cap regulation under Act 496 effective 1994 and 1995 respectively. The price cap applied to Ameritech Wisconsin is GDP-PI minus 3% , and that for Verizon is GDP-PI minus 2% . Given that our TFP studies demonstrate that the actual productivity gains realized by each carrier over the intervening years has been on average in the 6% to 10% range, the question arises as to whether the carriers have retained the benefits of that additional productivity as excess earnings.[61] Table 2.2 below presents unadjusted rate of return calculations based on the net operating income of each company, divided by the net telecommunications plant in service (TPIS).

59. As noted elsewhere, TDS had to be dropped from the study for lack of sufficient data.

60. An ILEC with fewer than 150,000 lines may also elect to file a company-specific price regulation plan subject to Commission approval. Wis. Stat. §196.196(4).

61. This issue is raised in the Technical Requirements of the RFP as Item (5).

Table 2.2

Rate of Return Estimates For Ameritech Wisconsin and Verizon

Ameritech	Net Operating Income A	Rate Base B	Rate of return C = A/B
1996	168,698,753	1,487,671,639	11.34%
1997	181,521,027	1,429,156,658	12.70%
1998	197,224,232	1,368,317,180	14.41%
1999	126,072,450	1,362,075,613	9.26%
2000	270,031,177	1,392,899,929	19.39%
2001	267,528,474	1,427,434,692	18.74%
Source: Ameritech Annual Report, Total Company Income Statement			
Verizon	**Net Operating Income A**	**Rate Base B**	**Rate of return C = A/B**
1996	65,063,260	537,317,626	12.11%
1997	31,045,279	484,804,746	6.40%
1998	31,009,147	479,512,604	6.47%
1999	62,759,596	476,089,992	13.18%
2000	47,003,100	329,836,914	14.25%
2001	41,336,551	350,796,745	11.78%
Source: Verizon North Annual Report, Total Company Income Statement			

Table 2.3 below presents the Ameritech Wisconsin rates of return with an adjustment to the year 1999 value. This adjustment removes the effect of a large deferred operating income tax payment resulting from the sale of certain Ameritech Wisconsin exchanged and booked in 1999. The 1999 deferred operating income tax payment was set equal to the average expense booked to this account from 1996-1998.

Table 2.3

Ameritech Wisconsin Adjusted Rates of Return

Ameritech	Net Operating Income A	Rate Base B	Rate of return C = B/C
1996	$ 168,698,753.00	$ 1,487,671,639.00	11.34%
1997	$ 181,521,027.00	$ 1,429,156,658.00	12.70%
1998	$ 197,224,232.00	$ 1,368,317,180.00	14.41%
1999	$ 223,112,541.00	$ 1,362,075,613.00	16.38%
2000	$ 270,031,177.00	$ 1,392,899,929.00	19.39%
2001	$ 267,528,474.00	$ 1,427,434,692.00	18.74%

Ameritech Adjustments: Net Ameritech Revenues for 1999 have been increased to remove a large provision for deferred operating income taxes resulting from the sale of exchanges booked in 1999. Total Operating Income Taxes have been recomputed based on the average Provision for Deferred Operating Income Taxes--Net booked by Ameritech in 1996-1998.

The purpose of an X-factor in a price cap plan is to reflect a reasonable anticipated level of achievable productivity, which a given carrier may exceed (and thereby earn higher profits) or not achieve (and thus realize lower earnings or losses). If the X-factor is set correctly, then earnings over time would be expected to remain relatively constant, as price levels decline at the same pace as the annual productivity gains.[62] Thus, while a carrier may enjoy a limited period of supra-competitive earnings as an inducement to and reward for beating the benchmark X-factor on occasion, the expectation is that a properly-functioning price cap will eventually push down rates so that those excess earnings are temporary and relatively infrequent. In contrast, the results shown in Tables 2.2 and 2.3 indicate that both Ameritech Wisconsin and Verizon have realized generally increasing rates of return during the period from 1996 through 2000.[63] Where rates of return have decreased, this decrease appears related to unusually high accounting charges such as deferred tax payments. While Verizon's results show a significantly smaller rate of return than that realized by Ameritech Wisconsin, both show year-over-year earnings growth and are consistent with the observed differences between the two ILECs' X-factors in our study (10.5% vs. 5.8%).[64]

Moreover, it confirms the legitimacy of the excess profits adjustment performed in the TFP model to avoid distorting the cost of capital inputs by including earnings beyond those required by the capital markets. Notably, the Ameritech Wisconsin only model exhibits a sustained increase in the calculated excess profits level, similar to the earnings growth trends shown in Tables 2 and 3 above.[65]

This pattern of continued earnings growth for both carriers further confirms that Verizon and Ameritech Wisconsin are realizing higher productivity growth than embodied in their current price cap X-factors. The X-factors in their price cap formulas (as well as any nascent competition) have been inadequate to constrain ILEC prices to competitive levels, so that the ILECs have been able to earn excess (non-economic) profits at the expense of Wisconsin ratepayers. To ensure that the rates paid by Wisconsin consumers reflect realized productivity gains and approach as closely as possible the pricing levels that would prevail in a competitive marketplace, the X-factor would need to be increased substantially for each carrier.

62. For illustrative purposes, we are leaving out the impact of changes in the GDP-PI on prices.

63. Verizon and Ameritech, like the rest of the economy, realized slight declines in rates of return for 2001. Note that the Moody's Baa corporate bond rate series and competitive cost of capital calculated in our model also declined in 2001. (See, e.g., All Reporting Wisconsin ILECs study at Table 13).

64. See Table 2.1.

65. See Table 13, Column G of the model for the Ameritech Wisconsin only study.

3 SOURCES OF FUTURE ANTICIPATED PRODUCTIVITY GAINS FOR WISCONSIN ILECS

Because total factor productivity reflects the change in all of a firm's outputs minus the changes in all of its inputs to production, it will be impacted to varying degrees by adjustments over time in virtually all aspects of a firm's operations. In the case of complex, multi-product firms like the LECs, it is particularly daunting to attempt to predict the level of productivity gains that could be achieved in the future.[66] Nevertheless, by looking at the manner in which carriers have increased their productivity in the past and considering cost and demand trends, one can identify some likely drivers of future productivity increases.

Technological advancement

First and foremost, technological advancement in telecommunications networks and the related operations support systems ("OSS") infrastructure are likely to continue to have a strong positive impact on ILEC productivity for the foreseeable future. For many capital goods that are heavily used by ILECs, such as semiconductors, computers, digital switching equipment, and fiber-optic based transmission systems, price levels continue to fall as their capabilities expand. And as these advances are incorporated into the ILECs' networks, they will continue to drive their unit costs lower. One important example is that the unit costs of fiber transmission facilities have been falling at a precipitous rate in recent years. This point is highlighted in an article appearing in the January 2001 issue of Scientific American, "The Triumph of the Light" by Gary Stix. The article reports that "the number of bits a second (a measure of fiber performance) doubles every nine months for every dollar spent on the technology." In other words, the cost per unit of transport is cut by 50% every nine months. Put another way, over the past five years, the cost per unit of telecommunications transport has fallen by more than 98%! Like the familiar exponential trend for computer memory (and in fact, driven by some of the same underlying innovations) that personal computers have taken

66. Indeed, if regulators could successfully do this at the individual firm level, it would amount to a prospective form of rate of return regulation.

for granted for years, today's fiber optic systems have capacities that were unthinkable a decade ago, and tomorrow's will do much the same. One consequence of these trends is that the cost structure of ILEC networks is shifting away from usage-sensitive costs towards fixed costs, in which the incremental costs of providing an additional minute of use are edging closer to zero. As new technologies relieve potential sources of network congestion, this shift will continue.

For example, while already an established technology for private network applications, ATM switching is just starting to penetrate the public switched telephone network. In other jurisdictions, Verizon has already begun to deploy next-generation switching technology into its public switched telephone network ("PSTN"), starting with two large switching centers in New Jersey and Florida. Known as "voice trunking over ATM[67] switches," ("VToA"), the technology has been described in a recent Verizon press release as "designed to provide Verizon with faster call routing, greatly expanded network capacity and the ability to deliver new services, while enabling a seamless transition for Verizon customers."[68] According to Verizon's VToA program manager:

> Packet-switching technology will enable Verizon to provide customers with all the high quality services they have today, and realize efficiencies which do not exist in today's circuit-switching environment.[69]

Effects of mergers, corporate restructuring, and process improvements

In addition to technological change, a second important source of productivity improvements in recent years has been corporate restructuring activities, including but not limited to horizontal mergers between ILECs. As is well known, today's Verizon is the outcome of two mergers, first when Bell Atlantic merged with NYNEX and then with GTE. Verizon has established itself as the largest local exchange carrier in the country. Verizon's switched access line count increased by nearly 20.4-million lines from year end 1997 to year-end 2001, and now serves about 36% of all switched access lines nationwide, up from 24% in 1997.[70] Among other benefits, increases in the scale of Verizon's network operations have had a significant downward impact on the prices Verizon pays for new network equipment.

67. "ATM" refers to Asynchronous Transfer Mode, an advanced form of packet-switching technology that uses a standardized cell size and allows dynamic allocation of bandwidth. See Newton H., *Newton's Telecom Dictionary*, 17th Edition: CMP Books, Gilroy California, at 63.

68. "Verizon Introduces Voice Transmission Over Packet Switching Provided by Nortel Networks," Verizon News Release, July 2, 2002. Source: http://newscenter.verizon.com/nr, downloaded 9/27/02.

69. *Id.*

70. Federal Communications Commission, Bureau of Wireline Competition, Industry Analysis and Technology Division, *Statistics of Communications Common Carriers*, Rel. November, 1998 and September, 2002.

At the time that Bell Atlantic and GTE petitioned the FCC to approve their merger, Bell Atlantic Corp.'s Vice President and Controller Doreen Toben specifically contended that one of the benefits of the merger would be reduced costs for capital purchases, and characterized the merger savings it would realize from this and other sources as "hard, real, and certain."[71] She went on to state:

> Still more recently, the experience with the Bell Atlantic-NYNEX merger has reconfirmed that these merger efficiencies are real. The very substantial cost savings estimated at the time of the Bell Atlantic-NYNEX merger were subsequently increased and the increased targets are being achieved. For 1998, we projected an increased expense savings of $450 million, and we are achieving those savings. By 2000, we projected annual expense savings of $1.1 billion; we are on track to achieve those savings. In addition, for 1998 and beyond, we projected annual capital savings of $300 million; we are achieving those savings as well.[72]

Similarly, Ameritech Wisconsin and its affiliates have realized significant cost savings from merger and restructuring as well. Its parent company, SBC, indicated that it expected cost savings synergies from its 1998 merger with Southern New England Telephone ("SNET"), "particularly from using SBC's scope and scale to drive costs out of the business."[73] SBC stated that it has "learned from the SBC/Pacific Telesis merger that scope and scale, especially in the purchasing area, are tangible and significant."[74] SBC's Managing Director - Corporate Development stated that "we know that SNET pays over 20 percent more for purchases of switching and transport equipment than we do at SBC."[75] SBC also indicated that the savings experienced in contract negotiations for the combined SBC/Pacific Telesis "tend to support the consultants' estimates" during the SBC/PTG merger discussions of procurement savings (expense and capital) in the 7%-10% range.[76]

---

71. *In the Matter of GTE Corporation, Transferor, and Bell Atlantic Corporation, Transferee, For Consent to Transfer Control*, CC Docket No. 98-184, Declaration of Doreen Toben (September 30, 1998), at para. 2.

72. *Id.*, at para. 7.

73. Exhibit A to SBC Response to MCI-4, "Remarks for Don Kiernan, Kathy Dowling, Jim Ellis, John Klug and Don Shassian, SNET Acquisition and Constitutional Challenge Victory," January 5, 1998, at SBCSNET004573 in *Joint Application of SBC Communications, Inc. and Southern New England Telecommunications Corporation for Approval of a Change of Control*, Connecticut Department of Public Utility Control Docket No. 98-02-020.

74. *Id.*

75. *Id.*

76. SBC Response to OCC-12. However, according to a study conducted by SBC, procurement savings had originally been estimated at only 3% for the SBC-PacTel merger. *See*, *In the Matter of the Joint Application of Pacific Telesis Group ("Telesis") and SBC Communications Inc. ("SBC") for SBC to Control Pacific Bell*, California Public Utilities Commission Docket No. 96-04-038, Decision 97-03-067, (March 31, 1997),177 PUR 4th 462 at page 30.

While the scale of those mergers may not be duplicated in Wisconsin, other opportunities likely exist to improve efficiency and productivity by consolidations and process improvements. Spurred by the unbundling requirements of the *Telecommunications Act of 1996* and the promise of Section 271 approvals of interLATA services authority, the larger ILECs have invested millions of dollars in modernizing their OSS infrastructure, which has introduced greater automation into service ordering, installation, and repair and maintenance activities that have traditionally been labor-intensive. While somewhat less visible than the adoption of new network technologies, the cost savings and efficiency improvements from continued investments in OSS should be significant. For example, in other jurisdictions, Verizon recently has been replacing its long-used Service Order Processor ("SOP") and Customer Records Information System ("CRIS") with a new-generation integrated ordering and billing system known as expressTRAK.[77] A similar overhaul of the legacy systems used by Verizon in its Wisconsin operations could be one such source of productivity improvements. More generally, given the complexity of the operational and administrative requirements of a modern local exchange network, it appears that technology-assisted process improvements will continue to play a key role in enhancing efficiency and productivity growth.

Impacts of economic conditions and competition

Given that growth in outputs represents half of the TFP concept, factors that could serve to reduce demand for ILECs' services could slow down or halt TFP growth. In other litigated proceedings and regulatory contexts, some ILECs have pointed to adverse economic conditions and growth in competition as important constraints on their ability to continue high levels of productivity gains.

It is true that an economic downturn can have a negative impact on demand for certain telecommunications services, as for example, the pace of new businesses needing access lines slows. However, the relationship between the economic business cycle and telecommunications demand is actually more complex than that, because of substitution effects and its interactions with competitive entry. For example, when businesses or individuals cut back on travel due to a weak economy or concerns in the post-September 11th environment, some of the foregone travel may be replaced by increased telephone and Internet usage.

Moreover, in the near-term, a weak economy may have a disproportionate impact on competitive local exchange carriers ("CLECs") because many of them have been in a precarious financial situation for some time. Since the high point of the stock market, the vast majority of CLEC stocks have plummeted, and numerous competitive LECs have filed or are on the verge of filing for

77. See *In the Matter of Verizon Washington, DC Inc.'s Compliance with the Conditions Established in Section 271 of the Federal Telecommunications Act of 1996*, D.C. PSC Formal Case No. 1011, OSS Declaration on Behalf of Verizon Washington, DC Inc. July 3, 2002, at 10-11.

bankruptcy.[78] In August 2001, CLEC analysts at Morgan Stanley Dean Witter noted that the market capitalization of CLECs as a group had fallen off by 65.8% since January 1, 2001.[79] The situation has certainly not improved for CLECs over the past year. See Table 3.1 below.

---

78. One of the pioneering data LECs ("DLECs"), NorthPoint, filed for bankruptcy on January 16, 2001. Another DSL provider, HarvardNet, pulled out of the DSL market in December 2000. HarvardNet decided to restructure its business to focus on Web hosting, citing the capital intensive nature of the DSL market, as well as the "recent dramatic downturn in the financial markets" as reasons for discontinuing its DSL service. "DSL Providers NorthPoint, HarvardNet Cut Jobs," *TR Daily*, December 7, 2000, provided in Attachment 9. Additionally, Covad, Rhythms, and McLeod have also filed for Chapter 11 protection.

79. Morgan Stanley Dean Witter, Equity Research: North America, Industry: Competitive Local Exchange Carriers (CLECs), August 14, 2001, at 1, provided in Attachment 10. In an earlier report issued by MSDW, its analysts indicated that "[u]nlike the last two CLEC market corrections, we do not believe that the current one is likely to end with the entire group rocketing back because, over the next six months, we expect news headlines to be peppered with reports of additional bankruptcies." Morgan Stanley Dean Witter, Equity Research: North America, Industry: Competitive Local Exchange Carriers (CLECs), November 7, 2000, at 2, provided in Attachment 10.

Table 3.1 Changes In CLEC Market Capitalization								
	September 30, 1999				September 24, 2002			
		In Millions				In Millions		
Company	**stock price**	**Shares out-standing**	**Market Cap**		**stock price**	**Shares out-standing**	**Market Cap**	**% change from 9/30/99 to 10/16/01**
Adelphia	$ 28.00	51.42	$ 1,439.67		–	–	–	–
Allegiance	$ 63.00	64.86	$ 4,086.48		$ 0.90	123.40	$ 111.06	-97%
AT&T Corp	$ 47.44	3,195.63	$ 151,592.86		$ 11.95	3850.00	$ 46,007.50	-70%
Commonwealth Tele	$ 44.00	22.11	$ 972.77		$ 35.02	23.50	$ 822.97	-15%
Connectiv	$ 19.63	87.27	$ 1,712.58		$ 25.33	88.80	$ 2,249.30	31%
CoreCom	$ 37.19	72.05	$ 2,679.43		–	–	–	–
CTC Communications	$ 16.44	14.55	$ 239.24		$ 0.12	27.40	$ 3.29	-99%
CTCI	$ 47.00	19.93	$ 936.49		$ 14.10	18.70	$ 263.67	-72%
Intermedia	$ 25.00	50.99	$ 1,274.64		–	–	–	–
Focal	$ 23.94	60.65	$ 1,451.72		$ 0.50	4.94	$ 2.47	-100%
Global Crossing	$ 26.50	794.77	$ 21,061.42		–	–	–	–
GST Telecomm Inc	$ 7.03	37.71	$ 265.18		–	–	–	–
Northpoint	$ 24.31	125.24	$ 3,044.88		–	–	–	–
ICG Communications	$ 15.56	47.34	$ 736.77		–	–	–	–
Level 3 Communications	$ 52.22	341.08	$ 17,810.58		$ 3.69	406.40	$ 1,499.62	-92%
Worldcom	$ 76.88	1,880.22	$ 144,541.84		–	–	–	–
RCN	$ 49.69	76.18	$ 3,785.42		$ 0.68	109.70	$ 74.60	-98%
Sprint	$ 54.25	785.21	$ 42,597.39		$ 9.56	979.00	$ 9,359.24	-78%
Time Warner Telecom	$ 20.88	104.54	$ 2,182.75		$ 0.95	114.80	$ 109.06	-95%
Winstar Comm Inc	$ 39.06	54.93	$ 2,145.89		–	–	–	–
XO Comm/Nextel	$ 61.38	315.45	$ 19,360.84		–	–	–	–
Total CLEC			423,918.84				60,502.77	-86%
Source: carrier 10Q reports, www.thedigest.com/stocks/								
Note: – Indicates that the company has filed chapter 11, or has been delisted from the Nasdaq.								

The dramatic decreases in CLEC share prices indicate that (1) investors have less confidence in these companies' ability to succeed with business plans premised upon competing with ILECs; and (2) the companies themselves now will have much more difficulty attracting capital with which to pursue their business plans. Telecommunications is an industry requiring a substantial amount of up-front investment, and a lack of capital with which to pursue market entry will surely adversely impact a carrier's ability to gain market share, and may well drive some companies out of business or into Chapter 11 (as it did for NorthPoint, Covad, Rhythms, HarvardNet, and McLeod). In fact, industry officials and financial analysts indicate that they do not expect the capital markets to open up anytime soon for most cash-starved CLECs, which is likely to force more CLECs to sell assets or go into bankruptcy.[80] As *The Economist* recently observed:

> The telecom bust is some ten times bigger than the better known dotcom crash: the rise and fall of telecom may indeed qualify as the largest bubble in history. Telecom firms have run up total debts of around $1 trillion. And as if this were not enough, the industry has also disgraced itself by using fraudulent accounting tricks in an attempt to conceal the scale of the disaster.[81]

To the extent that the CLECs still operating struggle more in an economic downturn, they are in a worse position to pull demand away from ILECs and thereby reduce their opportunities for TFP growth. *As The Economist* goes on to note, "[t]he likely winners, it is already clear, are the former "Baby Bells" in America and the former monopoly incumbents in Europe."[82]

One important opportunity that CLECs have had to enter and compete in the local marketplace has been the availability of unbundled network elements ("UNEs") of the ILEC networks, particularly the UNE-Platform ("UNE-P") arrangement. UNE-P allows a CLEC to lease the entire loop, port, and local switching serving a former ILEC customer at a discounted, wholesale rate, as a means to acquire the customer without building out entirely new facilities. However, the FCC is currently engaged in a triennial review of which unbundled network elements ("UNEs") ILECs must lease to competitors. As reported on in trade and national press, the consensus is that the FCC will more than likely eliminate the UNE-Platform ("UNE-P") option as an unbundling requirement. A recent *Wall Street Journal* article states that "the new local-phone service options could still be derailed by the expected policy change form the FCC"[83] adding that "people familiar with the situation say the FCC is likely to pass a new policy early next month that could ultimately allow the

---

80. "Facing "Fight of Our Lives", Nation's CLECs Seek to Ramp up Support in Congress, On Wall Street", *Telecommunications Reports*, December 11, 2000, provided in Attachment 9.

81. "The great telecoms crash," *The Economist*, July 20, 2000, at 9.

82. *Id.*

83. "Why You Have the Wrong Local Phone Service," Jane Spencer, *Wall Street Journal*, January 8, 2003, at D3, Column 1.

Baby Bells to jack up some of the rates they charge competitors."[84] *Telephony* reports that "[d]umping UNE-P and TELRIC altogether would be tantamount to an auto mechanic rigging out an engine because the timing belt needs to be adjusted. In this economic climate, it would be virtually impossible for any competitive carrier to enter the local market absent the ability to lease UNEs."[85]

In fact, ILECs have already been anticipating the dismissal of UNE-P and have developed resale policies to be in effect after the FCC order is delivered. Boldly, in mid-November 2002 SBC released a proposal that would eliminate UNE-P in the business market after the FCC order is released and provide a two-year transition period for residential UNE-P customers.[86] Should the FCC act as anticipated and eliminate the UNE-P requirement, the prospects for competitive pressure on the major ILECs — including Ameritech and Verizon in Wisconsin — will be dampened even further. As a result, the ILECs would be less likely to lose demand to CLECs which would reduce their anticipated productivity gains.

In conclusion, in the context of the wide disparity between the existing X-factors in the price cap plans applied to Ameritech Wisconsin and Verizon and the X-factor results determined by our TFP studies, there appears little reason to believe that future economic conditions or competitive losses would bring the companies' achievable productivity gains down to the levels assumed in those price caps. Therefore, the Commission should adjust the price caps upward to the degree that Wisconsin law allows,[87] to bring the price caps into better alignment with achievable productivity gains.

84. *Id.,* at D3, Column 1.

85. "Tuning Up UNE-P," Glenn Bishoff, *Telephony*, September 23, 2002, http://currentissue.telephonyonline.com/ar/telecom_tuning_unep/.

86. *SBC Proposes Transition Plan to a Viable Wholesale Model,* Press Release, November 21, 2002, http://www.sbc.com/press_room/news_search/1,5932,31,00.html?query=20339.

87. Wis. Stat. §196.196(1)(c) allows the Commission to increase the price cap X-factor by no more than one percentage point in any 12-month period to reflect "statewide changes in the productivity experience of the telecommunications industry."

4 | RESULTS OF SENSITIVITY TESTING

As part of our investigation, we conducted a series of sixteen sensitivity tests of our TFP model.[88] For this purpose, we started with the All Reporting ILECs version of the model and varied model inputs for year 2001, to determine how these affected the TFP, IPD, and X-factor results for that year. Since the model's formulas are essentially the same from year to year, one can extrapolate from these tests conclusions regarding the model's behavior. Of course, the final results from the model are five-year averages, which attenuate the impacts of changes in any single year such as those made in the testing. The tests that we performed encompass the major data inputs to the model, such as local, intrastate toll, and interstate revenues, local and intrastate dial equipment minutes (DEMs), etc. and also key assumptions, such as the initial level of capital stock (the benchmark capital stock) and the initial imputed cost of capital. Within each test, the target input was successively increased or decreased by factors of 10% and 20%, providing four test results per input or sixty-four tests overall. These results confirm the conceptual and methodological soundness of the model, as it generated stable and understandable results over the entire range of the tests. The results are briefly summarized below, but are also supplied in full detail in Appendix 3 (List of Sensitivity Test Results Presented).

Summary of sensitivity test results

Local, Intrastate, Interstate revenues. The model is moderately sensitive to these inputs, and increases/decreases have relatively symmetrical impacts.

Local DEMS. Changes in this model input have a strong impact, and somewhat more for an increase than a decrease. As a primary component of the physical measure of LEC output, this result is expected.

Intrastate DEMs. Changes to the level of intrastate DEMs have a moderate impact on the results,

88. These tests respond to Item (9) in the RFP's Technical Requirements.

with a 20% increase causing the overall X-factor to rise by 42%. Note that the TFP result increases by 388%, but is signed negative because the base case TFP result for 2001 assumed in the testing is a negative number (-0.69).

Interstate switched access lines, minutes, and special access lines. These inputs are used to construct the interstate quantity index. The model is moderately sensitive to these inputs, and slightly more for a decrease than an increase.

Labor compensation, number of employees. While the model's TFP result is strongly sensitive to a decrease/increase in labor compensation (with TFP increasing when labor compensation falls and vice versa), there is an offsetting change to the IPD so that the overall X-factor will not change. This makes sense, because a change to total labor compensation without an accompanying change in the number of employees means that there has been a change in the unit price of labor faced by the LEC. For similar reasons, a decrease in the number of employees increases the TFP result but also reduces the IPD correspondingly, so that the overall X-factor does not change. And as one would expect, a simultaneous increase to both inputs by the same percentage amount combines these impacts, and thus decreases the TFP result by more but leaves the overall X-factor unchanged.

Operating expense. Changes to this input have a dramatic effect on the TFP result, in the expected direction, i.e., a reduction in operating expense increases the TFP result and vice versa. Because materials costs are calculated residually from operating expense, the material quantity index is strongly impacted by operating expense changes.

Capital stock benchmark. The model is relatively insensitive to the choice of the capital stock benchmark level, with the X-factor result remaining within 1% of the base value when the benchmark is raised or lowered by 20%.

BEA Composite Asset Price Index. This input, which is used to deflate the capital stock, also has little impact on the X-factor results, with compensatory effects on the TFP and IPD levels.

Imputed cost of capital. The model is not very sensitive to the starting level of the imputed cost of capital, with a 20% increase in this input causing the X-factor to fall 2%. This is understandable because the capital input price and quantity indices will be affected primarily by year-to-year changes and not the starting level.

5 | CONCLUSION

Our TFP study has presented a large amount of data and results for the Commission's consideration, and we recommend that the Commission use those results in determining whether to adjust the productivity offsets or "X-factors" applied in ILEC price cap plans in the state. The primary findings from our TFP study are as follows:

- The results for all reporting ILECs in Wisconsin are generally in line with those determined for the national benchmark study of Tier 1 ILECs. The former study produced a total X-factor (TFP differential plus IPD) of 8.0%, compared to the national benchmark level of 8.0%. The average TFP differential in Wisconsin is 4.9%, a percentage point higher than national level, but the Wisconsin ILECs enjoy a higher input price differential (4.1% vs. 3.4%).

- Ameritech-Wisconsin and Verizon both exhibit productivity results that exceed by large amounts the 3% and 2% X-factors currently applied in their respective price cap plans. Ameritech-Wisconsin appears to be experiencing even higher productivity gains than the national or Wisconsin norms, with an average TFP differential of 8.4% and a total X-factor of 10.5%. Verizon's average productivity level lags well behind Ameritech-Wisconsin and the two benchmarks (TFP differential of 2.6%, and X-factor of 5.8%), but nevertheless is substantially above its current 2% price cap offset.

These results compel the conclusion that the historical price caps have been inadequate to drive prices of the carriers' regulated services to something approaching competitive levels. This conclusion is confirmed by our earnings analysis.

Under price cap regulation, while a carrier may enjoy a limited period of supra-competitive earnings as an inducement to and reward for beating the benchmark X-factor on occasion, the expectation is that a properly-functioning price cap will eventually push down rates so that those excess earnings are temporary and relatively infrequent. In contrast, the results of our earnings analysis indicate that both Ameritech Wisconsin and Verizon have realized generally increasing rates of return during the period from 1996 through 2000. While Verizon's results show a significantly smaller rate of return than that realized by Ameritech Wisconsin, both show year-over-year earnings growth that is consistent with the observed differences between the two ILECs' X-factor results in our study (10.5% vs. 5.8%).

This pattern of continued earnings growth for both carriers further confirms that Verizon and Ameritech Wisconsin are realizing higher productivity growth than embodied in their current price cap X-factors. The X-factors in their price cap formulas (as well as any nascent competition) have been inadequate to constrain ILEC prices to competitive levels, so that the ILECs have been able to earn excess (non-economic) profits at the expense of Wisconsin ratepayers.

Moreover, in the context of the wide disparity between the existing X-factors in the price cap plans applied to Ameritech Wisconsin and Verizon and the X-factor results determined by our TFP studies, there appears little reason to believe that future economic conditions or competitive losses would bring the companies' achievable productivity gains down to the levels assumed in those price caps. To ensure that the rates paid by Wisconsin consumers reflect realized productivity gains and approach as closely as possible the pricing levels that would prevail in a competitive marketplace, the X-factor would need to be increased substantially for each carrier. Therefore, the Commission should adjust the price caps upward to the degree that Wisconsin law allows,[89] to bring the price caps into better alignment with achievable productivity gains.

89. Wis. Stat. §196.196(1)(c) allows the Commission to increase the price cap X-factor by no more than one percentage point in any 12-month period to reflect "statewide changes in the productivity experience of the telecommunications industry."

Appendix 1 — LIST OF WISCONSIN LECS INCLUDED IN THE ETI STUDIES' DATASET

Large LECs	
6720	Wisconsin Bell
2180	Verizon North - Wisconsin Operations
1910	CenturyTel of Fairwater-Brandon-Alto, LLC
2050	CenturyTel of Forestville, LLC
2815	CenturyTel of the Midwest-Kendall, LLC
2930	CenturyTel of Wisconsin, LLC
3070	CenturyTel of Larsen-Readfiled, LLC
3810	CenturyTel of Monroe County, LLC
4260	CenturyTel of the Midwest-Wisconsin, LLC
4590	CenturyTel of Southern Wisconsin, LLC
5530	CenturyTel of Northwest Wisconsin, LLC
6040	CenturyTel of Northern Wisconsin, LLC
	Telephone Data System (TDS) companies (Note: these companies were dropped due to lack of response to ETI's data request.

Smaller LECs / ICOs	
Utility ID	Utility Name
330	BALDWIN TELECOM, INC.
390	BAYLAND TELEPHONE INC
820	BRUCE TELEPHONE COMPANY INC
1170	CLEAR LAKE TELEPHONE COMPANY INC
1230	COCHRANE COOPERATIVE TELEPHONE CO
1350	COON VALLEY FARMERS TELEPHONE CO
1940	FARMERS INDEPENDENT TELEPHONE CO
3790	FRONTIER COMMUNICATIONS OF MONDOVI
6050	FRONTIER COMMUNICATIONS OF WI INC
5210	FRONTIER COMMUNICATIONS ST CROIX
2420	HAGER TELECOM, INC.
2560	HILLSBORO TELEPHONE COMPANY INC
4860	INDIANHEAD TELEPHONE CO.
3230	LUCK TELEPHONE COMPANY
3310	MANAWA TELEPHONE COMPANY INC
3400	MARQUETTE ADAMS TELEPHONE COOP INC
3690	MILLTOWN MUTUAL TELEPHONE COMPANY
4070	NELSON TELEPHONE COOPERATIVE
4210	NORTHEAST TELEPHONE COMPANY
5340	SHARON TELEPHONE COMPANY
5660	SPRING VALLEY TELEPHONE COMPANY INC
5680	STATE LONG DISTANCE TELEPHONE CO
5950	TRI COUNTY TELEPHONE COOP INC
6000	UNION TELEPHONE COMPANY
6090	VERNON TELEPHONE COOPERATIVE
6750	WITTENBERG TELEPHONE COMPANY
6770	WOOD COUNTY TELEPHONE COMPANY

List of ICOs not included in the ETI studies' dataset (White = non-reporting carrier, shaded = insufficient data) Note: The TDS Companies were non-reporting and were also dropped.	
Utility ID	Utility Name
150	AMERY TELCOM INC
170	AMHERST TELEPHONE COMPANY
450	BELMONT TELEPHONE COMPANY/KIESLING
470	BERGEN TELEPHONE COMPANY
590	BLOOMER TELEPHONE COMPANY
1070	CHEQUAMEGON TELEPHONE COOP INC
1090	CHIBARDUN TELEPHONE COOPERATIVE INC
1132	CITIZENS TELECOMMUNICATIONS COMPANY
1130	CITIZENS TELEPHONE COOPERATIVE INC
1460	CUBA CITY TEL EXCHANGE CO/KIESLING
6150	FRONTIER COMMUNICATIONS VIROQUA INC
3090	LA VALLE TELEPHONE COOPERATIVE, INC
2970	LAKEFIELD TELEPHONE COMPANY
3110	LEMONWEIR VALLEY TELEPHONE COMPANY
3900	MOSINEE TELEPHONE COMPANY
3940	MOUNT HOREB TELEPHONE COMPANY
4160	NIAGARA TELEPHONE COMPANY
4870	PRICE COUNTY TELEPHONE COMPANY
1410	RHINELANDER TELEPHONE COMPANY (1)
5080	RICHLAND GRANT TELEPHONE COOPERATIVE
5490	SIREN TELEPHONE COMPANY INCORPORATED
5560	SOMERSET TELEPHONE COMPANY INC
6440	WEST WISCONSIN TELCOM COOP INC

Appendix 2

DOCUMENTATION OF ETI'S TFP MODEL

Table of Contents | Documentation of ETI's TFP Model

Introduction

Basic Information

Data Sources

Table 1. Summary Table of Annual Company Productivity Growth

Table 2. Annual Total Company Productivity Growth

Table 3. LEC Total Company Output Index

Table 4. LEC Interstate Output Index

Table 5. LEC Total Revenues by Type of Service (Excluding Miscellaneous Service)

Table 6. LEC Interstate Revenues

Table 7. LEC Total Company Input Quantity Index

Table 8. LEC Total Company Input Price Index

Table 9. Factor Shares of Total Payments

Table 10. Price of Labor

Table 11. Material Input Quantity

Table 12. Capital Quantity and Imputed Cost of Capital

Table 13. Competitive Cost of Capital

Table 14. Capital Stock Adjustments and Average Depreciation Rate

Workpapers

INTRODUCTION

The ETI total factor productivity (TFP) model calculates annual estimates of TFP and the input price differential (IPD) for local exchange carriers (LECs) via a series of fourteen linked tables in an Excel® spreadsheet model. The model is based on the Total Factor Productivity Model developed by the Federal Communications Commission Staff in CC Docket 94-1, and subsequently updated in a 1999 Staff Study.[1] Data for the Wisconsin ILEC Studies was obtained through the Wisconsin Public Service Commission ("WPSC") database (as described below in the data sources section), provided to ETI by the WPSC, and through responses from data requests by ETI to Wisconsin telecommunications companies. Data in the ETI Tier 1 ILEC Benchmarking Study was obtained from the following publicly available sources: the Federal Communications Commission, the Bureau of Economic Analysis of the U.S. Department of Commerce, and the Bureau of Labor Statistics of the U.S. Department of Labor.

---

1. *Price Cap Performance Review for Local Exchange Carriers, Access Charge Reform,* Further Notice of Proposed Rulemaking, in CC Docket Nos. 94-1 and 96-262, FCC 99-345 (rel. November 15, 1999). Tables 2-14 provided in this Manual are based on Tables B1-B13 as provided in Appendix B of the FCC's Further Notice, with appropriate data revisions.

BASIC INFORMATION

Type of Data

The data used in the TFP model can be classified into four categories: calculated, linked, constant and inputted. The definitions of each are as follows:

Calculated Data. A data series that is constructed using a formula that references other cells in the table and/or model.

Linked Data. Data that is linked to another data series that was calculated in a different table in the model.

Constant Data. Data that is not affected by the updating process. An example would be the "Benchmark" data series in Table 12, Column A.

Inputted Data. Data series that is updated with new data for each year.

Data Sources

"Wisconsin Public Service Commission Database"

This refers to the information provided to ETI from the Wisconsin Public Service Commission. It consists of a portion of their database that contains information from reporting carriers' annual reports. The portion of the database we were provided with contained, in Access® format, the non-confidential annual report information for reporting carriers in Wisconsin for the years 1996-2001 and 1986-1995. The annual reports can also be viewed on-line through either the Online PDF Annual Report Request System or the Online Annual Report Data System via http://psc.wi.gov/a_annlrpt/default.htm.

FCC ARMIS Reports

FCC's Automated Management Reporting Information System (ARMIS). This database can be accessed by going to the FCC homepage, http://www.fcc.gov, selecting the Common Carriers Bureau under "Bureaus and Offices," and then selecting "ARMIS Reports" found under "Documents." (The current URL for ARMIS is http://www.fcc. gov/ccb/armis/.)

The Federal-State Joint Board Monitoring Reports

The Federal-State Joint Board Monitoring Reports are released annually. The report can be found by accessing the FCC website at http://www.fcc.gov, selecting the Common Carriers Bureau under "Bureaus and Offices," and then selecting "Industry Analysis Reports" under Documents. At "the FCC State Link," select the "Federal-State Joint Board Monitoring Reports," and then select to view the most recent report.

The Bureau of Labor Statistics

The Bureau of Labor Statistics' (BLS) website can be accessed at http://www.bls.gov/. The BLS Multifactor Productivity Website can be accessed at http://www.bls.gov/mfp /home. htm. The BLS Office of Employment Projections website can be accessed at http://www. bls.gov/emp/home.htm.

The Bureau of Economic Analysis

The Bureau of Economic Analysis (BEA) website can be accessed at http://www.bea.doc.gov/. The BEA department of National Income and Product Accounts (NIPA) can be accessed at http://www.bea.doc.gov/bea/dn/nipaweb/.

The Economic Report of the President

The Economic Report of the President for any given year can be accessed through the United States Government Printing Office at http://www.access.gpo.gov/eop/.

Table 1. Summary Table of Annual Company Productivity Growth

Total Factor Productivity Differential (Column A) Linked to Table 2.

Input Price Differential (Column B) Linked to Table 2.

Annual Productivity Growth (Column C) Calculation.
C=A+B.

Table 1

Summary Table of Annual Company Productivity Growth

Year	Total Factor Productivity Differential	Input Price Differential	Annual Productivity Growth
	A = Table 2	**B = Table 2**	**C = A+B**
1996			
1997	5.1	-2.1	3.0
1998	7.2	5.8	13.0
1999	4.1	1.4	5.5
2000	4.8	7.3	12.1
2001	-1.8	8.3	6.4
Avg. (97 - 01)	**3.89**	**4.13**	**8.02 (X-Factor)**

Table 2. Annual Total Company Productivity Growth

U.S. Nonfarm Business Sector TFP Growth Rate (Column A) Data Input.
The Multifactor Productivity series is published by the BLS. This series is updated and revised periodically by the BLS. The BLS's Multifactor Productivity Website can be accessed at http://www.bls.gov /mfp/ home.htm. The BLS Series ID for this Series is MPU750023 (K).

LECs' Output Growth Rate (Column B) Linked to Table 3.

LECs' Input Growth Rate (Column C) Linked to Table 7.

LECs' TFP Growth Rate (Column D) Calculation.
D=+B-C.

LECs' TFP Differential (Column E) Calculation.
E=+D-A.

U.S. Nonfarm Business Sector Input Price Growth Rate (Column F) Data Input.
The U.S. Nonfarm Business Sector Input Price Growth Rate is published by the BLS. The series is updated and revised periodically by the BLS. The BLS's Multifactor Productivity Website can be accessed at http://www.bls.gov/mfp/home.htm. The data used comes from a table entitled "Net Multifactor Productivity and Costs, Private Nonfarm Business Sector (Excluding Government Enterprises): Shares and Multifactor Measures, Indexes," currently this table is labeled "NFB 4 b."

LECs' Input Price Growth Rate (Column G) Linked to Table 8.

Input Price Differential (Column H) Calculation.
H=+F-G

Annual Productivity Growth (Column I) Calculation.
I=+E+H.

Table 2

Annual Total Company Productivity Growth

Year	U.S. Nonfarm Business Sector TFP Growth Rate	LECs' Output Growth Rate	LECs' Input Growth Rate	LECs' TFP Growth Rate	LECs' TFP Differential	U.S. Nonfarm Business Sector Input Price Growth Rate	LECs' Input Price Growth Rate	Input Price Differential	Total Company Productivity Growth
	A	**B = Table 3**	**C = Table 7**	**D = +B-C**	**E = +D-A**	**F**	**G = Table 8**	**H = +F-G**	**I = +E+H**
1996									
1997	0.995	7.797	1.731	6.067	5.072	2.567	4.633	-2.067	3.005
1998	1.181	11.749	3.333	8.416	7.235	2.977	-2.803	5.780	13.015
1999	0.683	11.338	6.514	4.824	4.142	2.799	1.447	1.352	5.494
2000	1.734	10.840	4.272	6.568	4.834	4.497	-2.795	7.292	12.126
2001	1.148	-1.362	-0.668	-0.694	-1.843	3.210	-5.082	8.292	6.449
Avg. (97 - 01)					**3.89**			**4.13**	**8.02**

Inputs: U.S. Nonfarm Business Sector TFP Growth Rate: BLS's Multifactor Productivity, Table 2, "Private Nonfarm Business: Productivity and Related Indexes, 1948-00"; U.S. Nonfarm Business Sector Input Price Growth Rate, BLS's Net Input Price, Table NFB 4b "Net Multifactor Productivity and Costs , 1948 to 2000: Private Nonfarm Business Sector (excluding Government Enterprises)"; 2001 U.S. Nonfarm Business Sector TFP Growth Rate and U.S. Nonfarm Business Sector Input Price Growth Rate, based upon 1996-2000 average growth.

Table 3. LEC Total Company Output Index

Revenue Shares: Local (Column A) Linked to Table 5.

Revenue Shares: Intrastate Toll (Column B) Linked to Table 5.

Revenue Shares: Interstate (Column C) Linked to Table 5.

Quantities: Local DEMs (Column D) Data Input.
The Local DEMs data for the Wisconsin ILEC studies was obtained through discovery requests by ETI and the responses provided by those companies. For the Tier 1 ILEC benchmarking study Local Dial Equipment Minutes (DEMs) are from the Federal-State Joint Board Monitoring Reports. In the 2001 Monitoring Report, Local DEMs are reported in Table 8-7. Year 2001 values for local DEMs are not yet available. Therefore, ETI developed estimated values. See Chapter 1 and the Study Workpapers for further details concerning those estimates.

Quantities: Intrastate DEMs (Column E) Data Input.
The Intrastate DEMS data for the Wisconsin ILEC studies was obtained through discovery requests by ETI and the responses provided by those companies. For the Tier 1 ILEC benchmarking study, Intrastate DEMs are from the Federal-State Joint Board Monitoring Reports. In the 2001 Monitoring Report, Intrastate DEMs are reported in Table 8-8. Year 2001 values for intrastate DEMs are not yet available. Therefore, ETI developed estimated values. See Chapter 1 and the Study Workpapers for further details concerning those estimates.

Quantities: Interstate Quantity Index (Column F) Linked to Table 4.

Output Indices: Laspeyres Output Index (Column G) Calculation.
A(previous) * D(current) / D(previous) + B(previous) * E(current) / E(previous) + C(previous) * F(current) / F(previous).

Output Indices: Paasche Output Index (Column H) Calculation.
1/(A(current) * D(previous) / D(current) + B(current) * E(previous) / E(current) + C(current) * F(previous) / F(current)).

Output Indices: Fisher Ideal Output Index (Column I) Calculation.
Square root of (H*G).

Output Indices: Total Company Output Index (Column J) Calculation.
J(previous) * I(current).

Growth Rate (Column K) Calculation.
LN(J(current)/J(previous))*100

Table 3

LEC Total Company Output Index

	Revenue Shares			Quantities			Output Indices				
	Local	Intrastate Toll	Interstate	Local DEMs (000s)	Intrastate DEMs (000s)	Interstate Quantity Index	Laspeyres Output Index	Paasche Output Index	Fisher Ideal Output Index	Total Company Output Index	Growth Rate %
Year	**A= Table 5**	**B = Table 5**	**C = Table 5**	**D**	**E**	**F=Table 4**	**G**	**H**	**I**	**J**	**K**
1996	0.516	0.226	0.258	35,571,872,473	6,535,760,315	1.000	1.000	1.000	1.000	1.000	
1997	0.532	0.198	0.269	38,364,953,557	6,733,035,633	1.129	1.081	1.082	1.081	1.081	7.797
1998	0.555	0.181	0.265	42,113,566,805	7,215,318,899	1.381	1.126	1.123	1.125	1.216	11.749
1999	0.570	0.167	0.263	45,450,498,181	7,507,393,911	1.756	1.123	1.117	1.120	1.362	11.338
2000	0.587	0.153	0.260	48,989,831,966	8,993,332,533	2.016	1.116	1.113	1.114	1.518	10.840
2001	0.599	0.138	0.263	46,440,922,359	9,503,412,553	2.095	0.988	0.985	0.986	1.497	-1.362

Notes:
Laspeyres Output Index (Column G) calculation: A(previous) * D(current) / D(previous) + B(previous) * E(current) / E(previous) + C(previous) * F(current) / F(previous)
Paasche Output Index (Column H) calculation: 1/(A(current) * D(previous) / D(current) + B(current) * E(previous) / E(current) + C(current) * F(previous) / F(current))
Fisher Ideal Output Index (Column I) calculation: Square root of (H*G)
Total Company Output Index (Column J) calculation: J(previous) * I(current)

Inputs: Local and Intrastate Dial Equipment Minutes (DEMs)

Table 4. LEC Interstate Output Index

Revenue Shares: End User (Column A) Linked to Table 6.

Revenue Shares: Interstate Switched Access (Column B) Linked to Table 6.

Revenue Shares: Special Access (Column C) Linked to Table 6.

Quantities: Switched Access Lines (Column D) Data Input.
The Switched Access Lines for the Wisconsin ILEC studies was obtained by taking the sum of total business and total residential access lines for each company and each exchange listed in the Wisconsin Public Service Commission database. For the Tier 1 ILEC benchmarking study, switched access lines are from the FCC ARMIS Report 43-08, "Table III, Access lines in service by customer." The total RBOC "Mobile Access Lines" was subtracted from the total RBOC "Total Switched Access Lines" to arrive at the Total Switched Access Lines (excluding Mobile) for the purpose of the TFP Model.

Quantities: Switched Access Minutes (Column E) Data Input.
The Switched Access Minutes for the Wisconsin ILEC studies was obtained through discovery requests by ETI and the responses provided by those companies. For the Tier 1 ILEC benchmarking study, switched access minutes are from the FCC ARMIS Report 43-08, "Table IV. Telephone Calls."

Quantities: Special Access Lines (Column F) Data Input.
The Special Access Lines for the Wisconsin ILEC studies was obtained through discovery requests by ETI and the responses provided by those companies. For the Tier 1 ILEC benchmarking study, the Special Access Lines are from the FCC ARMIS Report 43-08 , "Table III, Access lines in service by customer." All of the individual RBOC quantities were added together to obtain a total for RBOC "Special Access Lines (non-switched) Analog" and another total for RBOC "Special Access Lines (non-switched) Digital." These two totals were added together to arrive at the Total Special Access Lines for the purpose of the TFP Model.

Output Indices: Laspeyres Output Index (Column G) Calculation.
A(previous) * D(current) / D(previous) + B(previous) * E(current) / E(previous) + C(previous) * F(current) / F(previous).

Output Indices: Paasche Output Index (Column H) Calculation.
1/(A(current) * D(previous) / D(current) + B(current) * E(previous) / E(current) + C(current) * F(previous) / F(current)).

Output Indices: Fisher Ideal Output Index (Column I) Calculation.
Square root of (H*G).

Output Indices: Total Company Output Index (Column J) Calculation.
J(previous) * I(current).

Growth Rate (Column K) Calculation.
LN(J(current)/J(previous))*100

Table 4

LEC Interstate Output Index

	Revenue Shares			Quantities			Output Indices				
	End User	Interstate Switched Access	Special Access	Switched Access Lines	Switched Access Minutes	Special Access Lines	Laspeyres Output Index	Paasche Output Index	Fisher Ideal Output Index	Interstate Output Quantity Index	Growth Rate %
Year	**A =Table 6**	**B =Table 6**	**C =Table 6**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**
1996	0.31809	0.52957	0.15234	2,905,482	6,180,647,533	73,303	1.000	1.000	1.000	1.000	
1997	0.30640	0.50943	0.18417	3,030,390	6,951,318,433	97,178	1.129	1.129	1.129	1.129	12.153
1998	0.38354	0.39280	0.22366	3,135,614	6,909,936,801	240,757	1.280	1.168	1.223	1.381	20.100
1999	0.32990	0.41331	0.25679	3,212,836	7,595,778,418	530,972	1.318	1.228	1.272	1.756	24.073
2000	0.33815	0.35076	0.31109	3,211,526	7,828,681,565	829,114	1.157	1.139	1.148	2.016	13.794
2001	0.35232	0.27609	0.37158	3,059,778	7,761,275,210	982,102	1.038	1.040	1.039	2.095	3.822

Notes:
Laspeyres Output Index (Column G) calculation: A(previous) * D(current) / D(previous) + B(previous) * E(current) / E(previous) + C(previous) * F(current) / F(previous)
Paasche Output Index (Column H) calculation: 1/(A(current) * D(previous) / D(current) + B(current) * E(previous) / E(current) + C(current) * F(previous) / F(current))
Fisher Ideal Output Index (Column I) calculation: Square root of (H*G)
Total Company Output Index (Column J) calculation: J(previous) * I(current)

Inputs: Switched Access Lines, Interstate Switched Access Minutes and Special Access Lines.

Table 5. LEC Total Revenues by Type of Service (Excluding Miscellaneous Service)

Local Service (Column A) Data Input.
The Local Service Revenues for the Wisconsin ILEC studies was obtained through the Wisconsin Public Service Commission database. Specifically the local service revenue number is the result of the sum of account numbers 5001-5004,5040,5050,5060, and 5069. For the Tier 1 ILEC benchmarking study, Local Service Revenues are from FCC ARMIS Report 43-02, "Table I1, Income Statement Accounts."

Intrastate Toll and Intrastate Access (Column B) Data Input.
The intrastate Toll and Intrastate Access Revenues for the Wisconsin ILEC studies was obtained through the Wisconsin Public Service Commission database . Specifically the revenue number is the sum of account numbers 5084 and 5100. For the Tier 1 ILEC benchmarking study, Intrastate Toll and Intrastate Access Revenues are from the FCC ARMIS Report 43-02, "Table I1, Income Statement Accounts." The "State Access Revenues" (Row 5084) and "LD Network Service Revenues (Acct. 5100)" (Row 525) were summed to produce total RBOC Intrastate Toll and Intrastate Access Service Revenues.

Interstate (Column C) Linked to Table 6.

Total (Column D) Calculation.
D=A+B+C.

Table 5

LEC Total Revenue by Type of Service (Excluding Miscellaneous Services)

Year	Local Service	Intrastate Toll and Intrastate Access	Interstate	Total
	A	**B**	**C = Table 6**	**D = A+B+C**
1996	$794,626,894	$348,597,945	$396,970,314	$1,540,195,153
1997	$835,279,224	$311,169,009	$422,713,110	$1,569,161,343
1998	$932,376,977	$303,520,323	$445,007,962	$1,680,905,262
1999	$1,030,057,760	$302,679,419	$475,422,535	$1,808,159,714
2000	$1,103,380,341	$288,107,455	$488,958,949	$1,880,446,745
2001	$1,109,880,576	$255,994,692	$487,556,834	$1,853,432,102

Inputs: Local Service, Intrastate Toll and Intrastate Access Revenues

Table 6. LEC Interstate Revenues

End User (Column A) Data Input.
The End User Revenues for the Wisconsin ILEC studies was obtained through the Wisconsin Public Service Commission database, account number 5081 "End User Revenue". For the Tier 1 ILEC benchmarking study, End User Revenues are from ARMIS Report 43-02, "Table I1, Income Statement Accounts."

Interstate Switched Access (Column B) Data Input.
Interstate Switched Access Revenues for the Wisconsin ILEC studies was obtained through the Wisconsin Public Service Commission database, account number 5082 "Switched Access Revenue". For the Tier 1 ILEC benchmarking study, Interstate Switched Access Revenues are from FCC ARMIS Report 43-02, "Table I1, Income Statement Accounts."

Special Access (Column C) Data Input.
Special Access Revenues for the Wisconsin ILEC studies was obtained through the Wisconsin Public Service Commission database, account number 5083 "Special Access Revenue". For the Tier 1 ILEC benchmarking study, Special Access Revenues are from FCC ARMIS Report 43-02, "Table I1, Income Statement Accounts," under Report 43-02.

Total Interstate (Column D) Calculation.
D=A+B+C.

Table 6 LEC Interstate Revenues				
	End User	**Interstate Switched Access**	**Special Access**	**Total Interstate**
Year	**A**	**B**	**C**	**D = A+B+C**
1996	$126,271,795	$210,224,204	$60,474,315	$396,970,314
1997	$129,520,139	$215,341,482	$77,851,489	$422,713,110
1998	$170,678,055	$174,798,806	$99,531,101	$445,007,962
1999	$156,840,555	$196,496,786	$122,085,194	$475,422,535
2000	$165,343,562	$171,507,190	$152,108,197	$488,958,949
2001	$171,778,457	$134,610,543	$181,167,834	$487,556,834

Inputs: End User, Interstate Switched Access and Special Access Revenues

Table 7. LEC Total Company Input Quantity Index

Input Shares: Labor (Column A) Linked to Table 9.

Input Shares: Materials (Column B) Linked to Table 9.

Input Shares: Capital (Column C) Linked to Table 9.

Quantities: Labor Quantity (Column D) Linked to Table 10.

Quantities: Material Quantity Index (Column E) Linked to Table 10**.**

Quantities: Capital Quantity Index (Column F) Linked to Table 12.

Input Quantity Indices: Laspeyres Output Index (Column G) Calculation.
A(previous) * D(current) / D(previous) + B(previous) * E(current) / E(previous) + C(previous) * F(current) / F(previous).

Input Quantity Indices: Paasche Output Index (Column H) Calculation.
1/(A(current) * D(previous) / D(current) + B(current) * E(previous) / E(current) + C(current) * F(previous) / F(current)).

Input Quantity Indices: Fisher Ideal Output Index (Column I) Calculation.
Square root of (H*G).

Input Quantity Indices: Total Company Output Index (Column J) Calculation.
J(previous) * I(current).

Growth Rate (Column K) Calculation.
LN(J(current)/J(previous))*100.

Table 7

LEC Total Company Input Quantity Index

	Input Shares			Quantities			Input Quantity Indices				
	Labor	Materials	Capital	Labor Quantity	Material Quantity Index	Capital Quantity Index	Laspeyres Input Quantity Index	Paasche Input Quantity Index	Fisher Ideal Input Quantity Index	Fisher Ideal Chained Input Quantity Index	Growth Rate %
Year	A = Table 9	B = Table 9	C = Table 9	D = Table 10	E = Table 10	F = Table 12	G	H	I	J	K
1996	0.215	0.345	0.440	7,284	1.000	1.356	1.000	1.000	1.000	1.000	
1997	0.186	0.356	0.458	6,113	1.076	1.440	1.019	1.016	1.017	1.017	1.731
1998	0.176	0.376	0.448	5,398	1.135	1.560	1.036	1.032	1.034	1.052	3.333
1999	0.163	0.364	0.474	5,345	1.203	1.721	1.067	1.068	1.067	1.123	6.514
2000	0.148	0.349	0.502	5,507	1.166	1.903	1.044	1.043	1.044	1.172	4.272
2001	0.170	0.306	0.523	5,527	0.960	2.125	0.997	0.989	0.993	1.164	-0.668

Notes:
Laspeyres Input Quantity Index (Column G) calculation: A(previous)*D(current)/D(previous)+B(previous)*E(current)/E(previous)+C(previous)*F(current)/F(previous)
Paasche Input Quantity Index (Column H) calculation: 1/(A(current)*D(previous)/D(current)+B(current)*E(previous)/E(current)+C(current)*F(previous)/F(current))
Fisher Ideal Input Quantity Index (Column I) calculation: Square root of (H*G)
Fisher Ideal Chained Input Quantity Index (Column J) calculation: J(previous) * I(current)
Growth Rate (Column K) calculation: LN (I(current)/I(previous))

Table 8. LEC Total Company Input Price Index

Input Shares: Labor (Column A) Linked to Table 9.

Input Shares: Materials (Column B) Linked to Table 9.

Input Shares: Capital (Column C) Linked to Table 9.

Input Quantities: Labor Price Index (Column D) Linked to Table 10.

Input Quantities: Material Price Index (Column E) Linked to Table 11.

Input Quantities: Capital Price Index (Column F) Linked to Table 13.

Input Price Indices: Laspeyres Output Index (Column G) Calculation. A(previous) * D(current) / D(previous) + B(previous) * E(current) / E(previous) + C(previous) * F(current) / F(previous).

Input Price Indices: Paasche Output Index (Column H) Calculation. 1/(A(current) * D(previous) / D(current) + B(current) * E(previous) / E(current) + C(current) * F(previous) / F(current)).

Input Price Indices: Fisher Ideal Output Index (Column I) Calculation. Square root of (H*G).

Input Price Indices: Total Company Output Index (Column J) Calculation. J(previous) * I(current).

Growth Rate (Column K) Calculation. LN(J(current)/J(previous))*100.

Table 8

LEC Total Company Input Price Index

Year	Input Shares			Input Quantities			Input Price Indices				
	Labor	Material	Capital	Labor Price Index	Materials Price Index	Capital Price Index	Laspeyres Input Price Index	Paasche Input Price Index	Fisher Ideal Input Price Index	Fisher Ideal Chained Input Price Index	Growth Rate %
	A = Table 9	B = Table 9	C = Table 9	D = Table 10	E = Table 11	F = Table 13	G	H	I	J	K
1996	0.215	0.345	0.440	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
1997	0.186	0.356	0.458	1.099	1.021	1.046	1.049	1.046	1.047	1.047	4.633
1998	0.176	0.376	0.448	1.181	1.027	0.950	0.974	0.970	0.972	1.018	-2.803
1999	0.163	0.364	0.474	1.195	1.016	0.985	1.014	1.015	1.015	1.033	1.447
2000	0.148	0.349	0.502	1.074	1.021	0.959	0.973	0.972	0.972	1.005	-2.795
2001	0.170	0.306	0.523	1.161	1.027	0.845	0.954	0.947	0.950	0.955	-5.082

Notes:

Laspeyres Input Price Index (Column G) calculation: A(previous)*D(current)/D(previous)+B(previous)*E(current)/E(previous)+C(previous)*F(current)/F(previous)

Paasche Input Price Index (Column H) calculation: 1/(A(current)*D(previous)/D(current)+B(current)*E(previous)/E(current)+C(current)*F(previous)/F(current))

Fisher Ideal Input Price Index (Column I) calculation: Square root of (H*G)

Fisher Ideal Chained Input Price Index (Column J) calculation: J(previous) * I(current)

Growth Rate (Column K) calculation: LN (I(current)/I(previous))

Table 9. Factor Shares of Total Payments.

Labor Compensation (Column A) Linked Table 11.

Adjusted Material Payment (Column B) Linked Table 11.

New Property Income with Depreciation and Taxes (Column C) Linked Table 13.

Total Factor Payment (Column D) Calculation.
D=A+B+C.

Labor Compensation Share (Column E) Calculation.
E=A/D.

Material Payment Share (Column F) Calculation.
F=B/D.

Property Income with Depreciation and Taxes Share (Column G) Calculation. G=C/D.

Table 9

Factor Shares of Total Payments

Year	Labor Compensation	Adjusted Material Payment	New Property Income with Depreciation and Taxes	Total Factor Payment	Labor Compensation Share	Material Payment Share	Property Income with Depreciation and Taxes Share
	A = Table 11	**B = Table 11**	**C = Table 13**	**D = A+B+C**	**E = A/D**	**F = B/D**	**G = C/D**
1996	309,394,848	496,473,815	632,049,362	1,437,918,025	0.215	0.345	0.440
1997	285,419,205	545,474,384	701,509,628	1,532,403,217	0.186	0.356	0.458
1998	270,788,689	578,871,989	690,879,415	1,540,540,093	0.176	0.376	0.448
1999	271,360,578	606,650,343	790,174,162	1,668,185,083	0.163	0.364	0.474
2000	251,129,368	591,367,556	850,511,315	1,693,008,239	0.148	0.349	0.502
2001	272,445,469	489,294,583	836,668,578	1,598,408,630	0.170	0.306	0.523

Table 10. Price of Labor

Labor Compensation (Column A). Data input.
For the years 1996 and 1997, Labor Compensation data for the Wisconsin ILEC studies was obtained through the Wisconsin Public Service Commission database by summing the "salary wage" amount and "benefit amount". For the years 1998-2001 the data was obtained through discovery requests by ETI and the responses provided by those companies. For the Tier 1 ILEC benchmarking study, Labor Compensation data was obtained from the FCC ARMIS Report 43-02, "Table I1, Income Statement Accounts." The ARMIS reports no longer separately identify benefit amounts from salary and wages.

Number Of Employees (Column B). Data input.
For the years 1996 and 1997, the Number of Employees data was obtained through the Wisconsin Public Service Commission database, the sum of 3 categories of employees; "officers", "Other Employees", and "Supervision and Other Management". For the years 1998-2001, the data was obtained through discovery requests by ETI and the responses provided by those companies. For the Tier 1 ILEC benchmarking study, Employee data was obtained from FCC ARMIS Report 43-02, "Table I1, Income Statement Accounts."

Labor Price (Column C) Calculation.
C=A/B.

Labor Price Index (Column D) Calculation.
D(current)/D(base year, 1985=1.0)

Labor Price Change (Column E) Calculation.
LN(E(current)/E(previous))*100.

Table 10

Price of Labor

Year	Labor Compensation	Number Of Employees	Labor Price	Labor Price Index	Labor Price Change
	A	B	C = A/B	D	E
1996	309,394,848	7,284	42,476	1.000	
1997	285,419,205	6,113	46,693	1.099	9.465
1998	270,788,689	5,398	50,165	1.181	7.172
1999	271,360,578	5,345	50,769	1.195	1.198
2000	251,129,368	5,507	45,602	1.074	-10.734
2001	272,445,469	5,527	49,294	1.161	7.785

Inputs: Labor Compensation, Number of Employees

Table 11. Material Input Quantity

Material Price Index (Column A) Data Input.
For both the Wisconsin ILEC studies and the Tier 1 ILEC benchmarking study, the Material Price Index is calculated using data from the BLS Office of Employment Projections' Input/Output matrix ("I/O Matrix"). From the I/O Matrix, Commodity inputs to the communications industry are obtained. Each of the 192 commodity inputs (representing 192 industries) to the communications industry are weighted as a share of total commodity inputs to the communications industry. The calculated weight of each of the 192 commodity input is multiplied times its corresponding output deflator (also obtained from the BLS). These values were then transformed into a standard index series to produce the Material Price Index.

Commodity Input Data from BLS

The BLS commodity inputs to the communications industry are retrieved from the I/O Use Matrix. The BLS I/O Use Matrix can be obtained from the Office of Employment Projections' website, at http://www.bls.gov/emp/empind3.htm.

The Communications Industry

In the current year, the "Telephone and Telegraph Communications and Communications Services" is identified as industry "119."

Output Deflator Data

Output deflators are calculated by the BLS's Office of Employment Projections, which can be accessed on the web through http://www.bls.gov/emp/empind2.htm. A file labeled "Industry output, with preliminary data for the years 1997-1998" contains the data on output deflators. The "industry output chain weighted deflator," which is identified by Series Code "3" is the output deflator used in the calculation of the Material Price Index.

Industries that do not have an associated output deflator

A surrogate output deflator is provided for the industry that does not have an associated deflator. A surrogate output deflator was constructed using Foreign Exchange Rates (See, Sheet "C" of "MPI_Calculations.xls"). To do this it was necessary to obtain the foreign exchange rates for Canada, Germany (under the EMU from 1998 on), UK and Japan. The foreign exchange rates can be found in the Economic Report of the President, which is released annually in January. The weighted foreign exchange rate is calculated based on the weights that were used by AT&T in 1997.

Total Operating Expenses (Column B) Data Input.
The Total Operating Expenses for the Wisconsin ILEC studies was obtained through the Wisconsin Public Service Commission Database. Specifically, the total expenses number is the sum of accounts; 6110, 6120, 6210, 6230, 6310, 6410, 6510, 6530, 6540, 6220, 6560, 6610, 6620, 6710, 6720, and 6790. For the Tier 1 ILEC benchmarking study, Total Operating Expenses are from the FCC ARMIS Report 43-02, "Table I1, Income Statement Accounts.

Adjusted Operating Expense (Column C) Calculation.
Change in Property Income (the difference between New Property Income (Table 9) and Original Property Income (Table 12)) multiplied by a tax adjustment factor of 0.39 minus RBOC Excess Benefits (Table 10), and then added to Total Operating Expenses (Column B).

Depreciation & Amortization Expense (Column D) Data Input.
The Depreciation and Amortization Expense for the Wisconsin ILEC studies was obtained through the Wisconsin Public Service Commission database. Specifically, account number 6560 "Depreciation and Amortization Expense". For the Tier 1 ILEC benchmarking study, Depreciation and Amortization Expenses are from ARMIS Report 43-02, "Table I1, Income Statement Accounts."

Adjusted Labor Compensation (Column E) Linked to Table 10.

Material Expense (Column F) Calculation.
E=B-C-D.

Material Quantity (Column G) Calculation.
F=E/A.

Material Quantity Index, 1985 = 1.0 (Column H) Calculation.
F(current)/F(base year, 1985=1.0)

Table 11

Materials Input Quantity

Year	Material Price Index (1996=1.00)	Operating Expense	Adjusted Operating Expense	Depreciation & Amortization Expense	Labor Compensation	Material Expense	Material Quantity	Material Quantity Index (1996 = 1.0)
	A	**B**	**C**	**D**	**E = Table 10**	**F = C - D - E**	**G = F / A**	**H**
1996	1.00000	1,187,351,558	1,158,655,098	352,786,435	309,394,848	496,473,815	496,473,815	1.000
1997	1.02100	1,271,403,964	1,261,090,533	430,196,944	285,419,205	545,474,384	534,253,708	1.076
1998	1.02722	1,294,524,440	1,255,141,407	405,480,729	270,788,689	578,871,989	563,531,022	1.135
1999	1.01596	1,374,402,347	1,335,128,889	457,117,969	271,360,578	606,650,343	597,122,019	1.203
2000	1.02137	1,382,086,267	1,329,495,607	486,998,683	251,129,368	591,367,556	578,992,166	1.166
2001	1.02681	1,350,327,710	1,278,774,362	517,034,310	272,445,469	489,294,583	476,519,923	0.960

Note:
Adjusted Operating Expenses (Column B) Calculation: Change in Property Income (The difference between the New Property Income, Table 9, and the Original Property Income, Table 12) multiplied by an adjustment factor of .39, and then added to Total Operating Expenses. The .39 represents .34 Federal and .05 state taxes, See, FCC, *Price Cap and Access Reform Further Notice of Proposed Rulemaking,* at 47.

Inputs: Material Price Index: Input/Output Tables compiled by the Bureau of Labor Statistics. 2001 Material Price Index based upon 1996-2000 average growth. The series has been rebased to 1996 = 1.00. Total Operating and Depreciation and Amortization Expenses

Table 12. Capital Quantity and Imputed Cost of Capital

Benchmark (Column A)

The Tier 1 ILEC study applies the same values as used in the 1999 FCC Staff TFP study (see *infra* at Table B-7), which represent net TPIS (gross TPIS.BOY minus accumulated depreciation). For the Wisconsin ILEC studies, respective benchmark capital stock values were set equal to the carriers' reported TPIS.BOY minus accumulated depreciation, using a base year of 1992.

Adjusted Capital Additions (Column B) Linked to Table 14.

BEA Composite Asset Price Index (Column C) Data Input.

The BEA Composite Asset Price Index was obtained from the same source for both the Wisconsin ILEC studies and the Tier 1 ILEC benchmarking study. The BEA Composite Asset Price Index incorporates prices for three NIPA asset prices: Communications Equipment Chain-type price index (NIPA Table 7.8, line 39); Telecommunications Structures Chain-type price index (NIPA Table 7.7, Line 45); and Equipment and Software Chain-type price index (NIPA Table 7.1, Line 39). These chain-type price indices can be obtained from the BEA website at http://www.bea.doc. gov/bea/dn/nipaweb/. In order to calculate the BEA Composite Asset Price Index, it was necessary to weight the three chain-type price indices listed above with their corresponding capital additions.

The capital additions data that was used to weight the three BEA asset price indices were constructed using data from the FCC ARMIS Report 43-02, "Table B1b. Balance Sheet Accounts (Plant Accounts). The categories of "additions", "Buildings" (Row 2121), "Cable & Wire" (Row 2410), "Central Office-Switching" (Row 2210), "Operator Systems" (Row 2220), "Information Origination/Termination" (Row 2310), "Central Office-Termination" (Row 2230), "Land and Support" (Row 2110), and "Land" (Row 2111) were all used in the calculation.

Capital Stock Quantity (Column D) Calculation.

Prior year Capital Stock (Column D) less Depreciation (Table 14) plus current year Adjusted Capital Additions (Column B) deflated by current year BEA Composite Asset Price (Column C). In the Tier 1 ILEC study, capital stock is expressed in thousands for convenience.

Capital Input Quantity Index (Column E) Calculation.

D(current)/D(base year, 1985=1.0)

Original Property Income with Depreciation and Taxes (Column F) Calculation.

Total Revenues (Table 5) minus Total Operating Expenses (Table 11) plus Depreciation and Amortization Expense (Table 11).

Depreciation and Amortization (Column G) Linked to Table 11.

Total Operating Taxes (Column H) Data Input.
Total Operating Taxes for the Wisconsin ILEC studies was obtained from the Wisconsin Public Service Commission database, specifically account number 7200, "Operating Taxes". For the Tier 1 ILEC benchmarking study, Total Operating Taxes are from ARMIS Report 43-02, "Table I1, Income Statement Accounts."

Property Income without Depreciation and Taxes (Column I) Calculation.
I=F-G-H

Imputed Cost of Capital (Column J) In the Tier 1 ILEC study, this is calculated as J=I/D(previous)/1000. For the Wisconsin ILEC studies, the 1996 value from the Tier 1 study's imputed cost of capital series (Table 13, Column B) is applied as an input.

Table 12

Capital Quantity and Imputed Cost of Capital

Year	Benchmark	Capital Additions	BEA Composite Asset Price Index	Capital Stock Quantity	Capital Input Quantity Index	Original Property Income with Depreciation and Taxes	Depreciation and Amortization	Total Operating Taxes	Property Income without Depreciation and Taxes	Imputed Cost of Capital
	A	B = Table 14	C	D	E	F	G = Table 11	H	I = F-G-H	J
1992	1,683,949,004	282,721,233	1.057	1,683,949,004	1.000					
1993		289,234,914	1.058	1,830,851,104	1.087					
1994		273,759,748	1.057	1,952,333,474	1.159					
1995		329,620,403	1.047	2,120,442,022	1.259					
1996		338,752,737	1.050	2,283,921,164	1.356	705,630,030	352,786,435	244,702,559	108,141,036	0.0151
1997		326,914,536	1.048	2,424,238,295	1.440	727,954,323	430,196,944	239,235,085	58,522,294	
1998		392,001,681	1.019	2,626,782,774	1.560	791,861,551	405,480,729	267,452,422	118,928,400	
1999		464,530,723	0.990	2,898,580,429	1.721	890,875,336	457,117,969	294,412,226	139,345,141	
2000		512,852,473	0.978	3,205,269,648	1.903	985,359,161	486,998,683	305,074,053	193,286,425	
2001		592,745,881	0.965	3,578,462,223	2.125	1,020,138,702	517,034,310	267,274,094	235,830,298	

Notes:

BEA Composite Asset Price Index (Column C): The single composite asset price index that incorporates prices for three Bureau of Economic Analysis National Income and Product Account (NIPA) asset prices, including Communication Equipment (Table 7.8, Line 39), Telecommunication Structures (Table 7.7, Line 45), and Producer Durables (Table 7.1, Line 39).

Capital Input Quantity Index (Column E): D(current)/D(base year. 1985=1.0)

Original Property Income with Depreciation and Taxes (Column F): This is a residual value found by subtracting labor compensation and material payments from Total Factor Payments/Total Revenues. Mathematically, the formula is Total Revenues minus Operating Expenses plus Depreciation and Amortization Expense. *See, Price Cap Performance Review Fourth Report and Order,* 1997 TFP Model.

Imputed Cost of Capital (Column J): This is the 1996 value of the Imputed Cost of Capital series developed in the Tier 1 ILEC study, Table 13, Column B.

Table 13. Competitive Cost of Capital

Moody's Baa Corporate Bond Rate (Column A) Data Input.
The source of information for the Moody's Baa Corporate Bond Rate was the same for both the Wisconsin ILEC studies and the Tier 1 ILEC benchmarking study. The Baa Corporate Bond rate can be found in the Economic Report of the President, which is released annually in January. However, the Baa Corporate Bond rate series published in the Economic Report of the President, is often 1-2 years dated (for example the Economic Report of the President that was released in January 2001 includes annual data through 1999 only). Therefore ETI obtained this data via the website, http://www.bondmarkets.com/Research/C3.shtml, where the Corporate Bond Rate is calculated on a more regular basis.

Imputed Competitive Cost of Capital (Column B) Calculation.
Table 12 of the Tier 1 ILEC study develops the Imputed Cost of Capital for 1991, which is used as a base point. Years 1985 - 1990 are calculated by subtracting the change in The Moody's Baa Corporate Bond Rate from the next year Competitive Cost of Capital. For years 1992 - 1998, the calculation is similar, although the change in the Baa Corporate Bond Rate is added to the previous year Competitive Cost of Capital. For the Wisconsin ILEC studies, the 1996 value of that series is applied as the base year Imputed Cost of Capital.

Capital Stock Quantity (Column C) Linked to Table 12.
In the Tier 1 ILEC study, capital stock is expressed in thousands for convenience.

Original Property Income without Depreciation and Taxes (Column D)
Linked to Table 12.

Adjusted Property Income without Depreciation and Taxes (Column E). Calculation. E=B*C.
In the Tier 1 ILEC study, a factor of 1000 is applied (see Column C).

Excess Profits (Column F). Calculation.
F=D-E.

Original Property Income with Depreciation and Taxes (Column G). Linked to Table 12.

Adjusted Property Income with Depreciation and Taxes (Column H). Calculation. H=G-F.

Adjusted Imputed Cost of Capital (Column I). Calculation.
I=H/C. In the Tier 1 ILEC study, a factor of 1000 is applied (see Column C).

Competitive Cost of Capital Index (Column J). Calculation.
I(current)/I(base year, 1985=1.0)

Table 13

Competitive Cost of Capital

Year	Moody's Baa Corporate Bond Rate	Imputed Competitive Cost of Capital	Capital Stock Quantity	Original Property Income without Depreciation and Taxes	Adjusted Property Income without Depreciation and Taxes	Excess Profits	Original Property Income with Depreciation and Taxes	Adjusted Property Income with Depreciation and Taxes	Adjusted Imputed Cost of Capital	Competitive Cost of Capital Index
	A	B	C = Table 12	D = Table 12	E = B*C	F = D-E	G = Table 12	H = G-F	I = (H/C)	J
1996	8.05	0.01513	2,283,921,164	108,141,036	34,560,368	73,580,668	705,630,030	632,049,362	0.277	1.000
1997	7.86	0.01323	2,424,238,295	58,522,294	32,077,599	26,444,695	727,954,323	701,509,628	0.289	1.046
1998	7.22	0.00683	2,626,782,774	118,928,400	17,946,264	100,982,136	791,861,551	690,879,415	0.263	0.950
1999	7.87	0.01333	2,898,580,429	139,345,141	38,643,967	100,701,174	890,875,336	790,174,162	0.273	0.985
2000	8.36	0.01823	3,205,269,648	193,286,425	58,438,579	134,847,846	985,359,161	850,511,315	0.265	0.959
2001	8.00	0.01463	3,578,462,223	235,830,298	52,360,174	183,470,124	1,020,138,702	836,668,578	0.234	0.845

Notes:
Imputed Competitive Cost of Capital (Column B) calculation: Table 12 provides the 1991 Cost of Capital Index, which is used as a base point. Years 1985 - 1990 are calculated by subtracting the change in Moody's Baa Corporate Bond Rate from the next year's Competitive Cost of Capital. For years 1992 - 2000, the calculation is similar, although the change in the Baa Corporate Bond Rate is added to the previous year's Competitive Cost of Capital.

Input: Moody's Baa Corporate Bond Rate

Table 14. Capital Stock Adjustments and Average Depreciation Rate

TPIS.BOY (Column A) Data Input.
The Total Plant in Service (TPIS) for the beginning of the year, end of year, and capital additions for the Wisconsin ILEC studies are from the Wisconsin Public Service Commission database. The total for each is the sum of accounts; 2112-2116, 2121-2124, 2211, 2212, 2215, 2220, 2231, 2232, 2311, 2321, 2341, 2351, 2362, 2411, 2421-2426, 2431, 2441, 2681, 2682, 2690. For the Tier 1 ILEC benchmarking study, Total Plant in Service (TPIS), beginning of year (TPIS.BOY), end of year (TPIS.EOY) and capital additions, are from the FCC ARMIS Report 43-02, "Table B1b, Balance Sheet Accounts (plant accounts)." The data was summed for all RBOCs to produce an RBOC total for TPIS BOY, TPIS EOY, TPIS Additions, Land BOY, Land EOY and Land Additions. Land is excluded from TPIS for purposes of the TFP model, therefore the land investment was subtracted from each TPIS total.

Capital Additions (Column B) Data Input.
See **TPIS.BOY**.

TPIS.EOY (Column C) Data Input.
See **TPIS.BOY**.

Retires (Column D) Calculation.
D=A+B+C.

Adjustment Factor (Column E) Constant Data Value.

Adjusted Capital Additions (Column F) Calculation.
F=B*E.

Adjusted TPIS.EOY (Column G) Calculation.
G=A+F-D.

Depreciation Accruals (Column H) Data Input.
Depreciation Accruals for the Wisconsin ILEC study were obtained from the Wisconsin Public Service Commission database, "annual accrual amount". For the Tier 1 ILEC benchmarking study, Depreciation Accruals are from FCC ARMIS Report 43-02, "Table B5, Analysis of Entries in Accumulated Depreciation."

Adjusted Depreciation Rate (%) (Column I) Calculation.
H/((A+G)/2)*100.

Table 14

Average Depreciation Rate

Year	TPIS.BOY	Capital Additions	TPIS.EOY	Depreciation Accruals	Depreciation Rate (%)
	A	B	C	D	E
1992	4,047,161,670	282,721,233	4,168,414,896	235,559,900	5.73
1993	4,168,414,896	289,234,914	4,291,269,742	261,524,301	6.18
1994	4,291,269,742	273,759,748	4,434,934,143	262,004,133	6.00
1995	4,434,934,143	329,620,403	4,656,332,483	332,825,154	7.32
1996	4,455,744,199	338,752,737	4,665,314,835	348,403,253	7.64
1997	4,655,950,199	326,914,536	4,864,751,006	427,666,458	8.98
1998	4,864,751,005	392,001,681	5,087,559,631	404,256,849	8.12
1999	5,087,150,884	464,530,723	5,417,022,073	453,705,478	8.64
2000	5,770,876,676	512,852,473	5,852,980,198	481,821,369	8.29
2001	5,852,980,199	592,745,881	6,359,012,880	499,844,403	8.19
Avg. (1992-2001)					**7.51**

Note:
Depreciation Rate (Column E) calculation: D/((A+C)/2)*100

Source: TPIS.BOY and TPIS.EOY (excluding Land), Capital Additions, and Depreciation Accruals

Appendix 3 | Tables of TFP Study Results

Table of Contents | TABLES OF TFP STUDY RESULTS

Tier 1 ILEC Study (National Benchmark)

All Reporting Wisconsin ILECs

Ameritech-Wisconsin

Verizon

Statutory Small ILECs

Small ILECs by Economic Definition

Large ILECs by Economic Definition ("Big Four")

Results for Tier 1 ILECs (National Benchmark Study)

Table 1

Summary Table of Annual Company Productivity Growth

Year	**Total Factor Productivity Differential**	**Input Price Differential**	**Annual Productivity Growth**
	A = Table 2	**B = Table 2**	**C = A+B**
1985			
1986	3.2	2.9	6.1
1987	1.9	1.3	3.1
1988	0.4	6.2	6.6
1989	0.8	3.7	4.6
1990	4.4	1.0	5.4
1991	1.9	3.2	5.1
1992	3.0	4.3	7.3
1993	4.8	2.1	7.0
1994	-0.6	0.0	-0.6
1995	4.0	2.7	6.6
1996	10.0	-3.0	7.0
1997	4.4	4.8	9.3
1998	7.3	2.1	9.3
1999	7.2	0.4	7.6
2000	1.7	4.0	5.6
2001	3.8	5.8	9.6
Avg. (97 - 01)	**4.88**	**3.42**	**8.30 (X-Factor)**

Results for Tier 1 ILECs (National Benchmark Study)

Table 2

Annual Total Company Productivity Growth

Year	U.S. Nonfarm Business Sector TFP Growth Rate A	LECs' Output Growth Rate B = Table 3	LECs' Input Growth Rate C = Table 7	LECs' TFP Growth Rate D = +B-C	LECs' TFP Differential E = +D-A	U.S. Nonfarm Business Sector Input Price Growth Rate F	LECs' Input Price Growth Rate G = Table 8	Input Price Differential H = +F-G	Total Company Productivity Growth I = +E+H
1985									
1986	1.488	3.201	-1.477	4.678	3.190	2.056	-0.883	2.939	6.129
1987	0.105	3.766	1.791	1.975	1.870	3.859	2.592	1.267	3.137
1988	0.735	6.512	5.388	1.124	0.389	5.338	-0.874	6.212	6.601
1989	0.209	4.387	3.332	1.056	0.847	2.203	-1.513	3.717	4.563
1990	0.000	4.762	0.362	4.400	4.400	3.451	2.458	0.992	5.392
1991	-1.049	3.291	2.490	0.801	1.851	1.854	-1.378	3.232	5.083
1992	1.984	3.446	-1.564	5.010	3.025	3.275	-0.999	4.274	7.299
1993	0.516	5.806	0.449	5.357	4.841	2.089	-0.025	2.114	6.956
1994	1.024	5.393	4.921	0.472	-0.552	3.107	3.113	-0.007	-0.558
1995	0.407	5.382	1.019	4.363	3.957	2.603	-0.053	2.656	6.613
1996	1.410	8.093	-3.342	11.435	10.025	2.737	5.719	-2.982	7.043
1997	0.995	9.738	4.311	5.427	4.432	2.567	-2.280	4.847	9.279
1998	1.181	8.749	0.308	8.441	7.260	2.977	0.887	2.089	9.349
1999	0.683	11.402	3.512	7.891	7.208	2.799	2.401	0.398	7.606
2000	1.734	8.608	5.188	3.420	1.686	4.497	0.535	3.963	5.648
2001	1.148	8.176	3.191	4.984	3.836	3.210	-2.571	5.781	9.617
Avg. (97 - 01)					**4.88**			**3.42**	**8.30**

Sources: U.S. Nonfarm Business Sector TFP Growth Rate: BLS's Multifactor Productivity, Table 2, "Private Nonfarm Business: Productivity and Related Indexes, 1948-00"; U.S. Nonfarm Business Sector Input Price Growth Rate, BLS's Net Input Price, Table NFB 4b "Net Multifactor Productivity and Costs , 1948 to 2000: Private Nonfarm Business Sector (excluding Government Enterprises)"; 2001 U.S. Nonfarm Business Sector TFP Growth Rate and U.S. Nonfarm Business Sector Input Price Growth Rate, based upon 1996-2000 average growth.

Results for All Reporting Wisconsin ILECs

Table 1

Summary Table of Annual Company Productivity Growth

Year	Total Factor Productivity Differential A = Table 2	Input Price Differential B = Table 2	Annual Productivity Growth C = A+B
1996			
1997	5.1	-2.1	3.0
1998	7.2	5.8	13.0
1999	4.1	1.4	5.5
2000	4.8	7.3	12.1
2001	-1.8	8.3	6.4
Avg. (97 - 01)	**3.89**	**4.13**	**8.02 (X-Factor)**

Results for All Reporting Wisconsin ILECs

Table 2

Annual Total Company Productivity Growth

Year	U.S. Nonfarm Business Sector TFP Growth Rate	LECs' Output Growth Rate	LECs' Input Growth Rate	LECs' TFP Growth Rate	LECs' TFP Differential	U.S. Nonfarm Business Sector Input Price Growth Rate	LECs' Input Price Growth Rate	Input Price Differential	Total Company Productivity Growth
	A	**B = Table 3**	**C = Table 7**	**D = +B-C**	**E = +D-A**	**F**	**G = Table 8**	**H = +F-G**	**I = +E+H**
1996									
1997	0.995	7.797	1.731	6.067	5.072	2.567	4.633	-2.067	3.005
1998	1.181	11.749	3.333	8.416	7.235	2.977	-2.803	5.780	13.015
1999	0.683	11.338	6.514	4.824	4.142	2.799	1.447	1.352	5.494
2000	1.734	10.840	4.272	6.568	4.834	4.497	-2.795	7.292	12.126
2001	1.148	-1.362	-0.668	-0.694	-1.843	3.210	-5.082	8.292	6.449
Avg. (97 - 01)					**3.89**			**4.13**	**8.02**

Sources: U.S. Nonfarm Business Sector TFP Growth Rate: BLS's Multifactor Productivity, Table 2, "Private Nonfarm Business: Productivity and Related Indexes, 1948-00"; U.S. Nonfarm Business Sector Input Price Growth Rate, BLS's Net Input Price, Table NFB 4b "Net Multifactor Productivity and Costs , 1948 to 2000: Private Nonfarm Business Sector (excluding Government Enterprises)"; 2001 U.S. Nonfarm Business Sector TFP Growth Rate and U.S. Nonfarm Business Sector Input Price Growth Rate, based upon 1996-2000 average growth.

Results for Ameritech-Wisconsin only

Table 1

Summary Table of Annual Company Productivity Growth

Year	Total Factor Productivity Differential	Input Price Differential	Annual Productivity Growth
	A = Table 2	**B = Table 2**	**C = A+B**
1996			
1997	12.7	-2.3	10.4
1998	8.9	3.6	12.5
1999	9.7	-1.5	8.2
2000	10.1	4.8	14.9
2001	0.4	6.2	6.6
Avg. (97 - 01)	**8.37**	**2.14**	**10.51 (X-Factor)**

Results for Ameritech-Wisconsin only

Table 2

Annual Total Company Productivity Growth

Year	U.S. Nonfarm Business Sector TFP Growth Rate	LECs' Output Growth Rate	LECs' Input Growth Rate	LECs' TFP Growth Rate	LECs' TFP Differential	U.S. Nonfarm Business Sector Input Price Growth Rate	LECs' Input Price Growth Rate	Input Price Differential	Total Company Productivity Growth
	A	**B = Table 3**	**C = Table 7**	**D = +B-C**	**E = +D-A**	**F**	**G = Table 8**	**H = +F-G**	**I = +E+H**
1996									
1997	0.995	8.233	-5.478	13.711	12.716	2.567	4.854	-2.287	10.429
1998	1.181	12.216	2.124	10.092	8.911	2.977	-0.598	3.575	12.486
1999	0.683	12.559	2.186	10.373	9.691	2.799	4.331	-1.532	8.159
2000	1.734	11.129	-0.696	11.825	10.090	4.497	-0.271	4.768	14.859
2001	1.148	-1.869	-3.457	1.588	0.440	3.210	-2.954	6.164	6.604
Avg. (97 - 01)					**8.37**			**2.14**	**10.51**

Sources: U.S. Nonfarm Business Sector TFP Growth Rate: BLS's Multifactor Productivity, Table 2, "Private Nonfarm Business: Productivity and Related Indexes, 1948-00"; U.S. Nonfarm Business Sector Input Price Growth Rate, BLS's Net Input Price, Table NFB 4b "Net Multifactor Productivity and Costs , 1948 to 2000: Private Nonfarm Business Sector (excluding Government Enterprises)"; 2001 U.S. Nonfarm Business Sector TFP Growth Rate and U.S. Nonfarm Business Sector Input Price Growth Rate, based upon 1996-2000 average growth.

Results for Verizon only

Table 1 Summary Table of Annual Company Productivity Growth			
	Total Factor Productivity Differential	**Input Price Differential**	**Annual Productivity Growth**
Year	**A = Table 2**	**B = Table 2**	**C = A+B**
1996			
1997	1.4	-11.7	-10.2
1998	-2.3	10.8	8.4
1999	17.7	-3.2	14.6
2000	-6.9	2.1	-4.8
2001	3.1	17.8	21.0
Avg. (97 - 01)	**2.61**	**3.18**	**5.79 (X-Factor)**

Results for Verizon only

Table 2

Annual Total Company Productivity Growth

Year	U.S. Nonfarm Business Sector TFP Growth Rate	LECs' Output Growth Rate	LECs' Input Growth Rate	LECs' TFP Growth Rate	LECs' TFP Differential	U.S. Nonfarm Business Sector Input Price Growth Rate	LECs' Input Price Growth Rate	Input Price Differential	Total Company Productivity Growth
	A	B = Table 3	C = Table 7	D = +B-C	E = +D-A	F	G = Table 8	H = +F-G	I = +E+H
1996									
1997	0.995	10.549	8.138	2.411	1.416	2.567	14.232	-11.665	-10.249
1998	1.181	-2.274	-1.138	-1.136	-2.318	2.977	-7.788	10.764	8.447
1999	0.683	17.037	-1.394	18.431	17.748	2.799	5.972	-3.174	14.575
2000	1.734	-10.365	-5.179	-5.185	-6.919	4.497	2.369	2.128	-4.792
2001	1.148	-2.501	-6.781	4.279	3.131	3.210	-14.619	17.829	20.960
Avg. (97 - 01)					**2.61**			**3.18**	**5.79**

Sources: U.S. Nonfarm Business Sector TFP Growth Rate: BLS's Multifactor Productivity, Table 2, "Private Nonfarm Business: Productivity and Related Indexes, 1948-00"; U.S. Nonfarm Business Sector Input Price Growth Rate, BLS's Net Input Price, Table NFB 4b "Net Multifactor Productivity and Costs , 1948 to 2000: Private Nonfarm Business Sector (excluding Government Enterprises)"; 2001 U.S. Nonfarm Business Sector TFP Growth Rate and U.S. Nonfarm Business Sector Input Price Growth Rate, based upon 1996-2000 average growth.

Results for Statutory Small ILECs

Table 1 Summary Table of Annual Company Productivity Growth			
	Total Factor Productivity Differential	**Input Price Differential**	**Annual Productivity Growth**
Year	**A = Table 2**	**B = Table 2**	**C = A+B**
1996			
1997	-0.6	-1.4	-2.1
1998	13.0	15.8	28.9
1999	2.7	-2.9	-0.3
2000	-1.8	9.4	7.6
2001	1.4	15.0	16.4
Avg. (97 - 01)	**2.94**	**7.16**	**10.10 (X-Factor)**

Results for Statutory Small ILECs

Table 2

Annual Total Company Productivity Growth

Year	U.S. Nonfarm Business Sector TFP Growth Rate	LECs' Output Growth Rate	LECs' Input Growth Rate	LECs' TFP Growth Rate	LECs' TFP Differential	U.S. Nonfarm Business Sector Input Price Growth Rate	LECs' Input Price Growth Rate	Input Price Differential	Total Company Productivity Growth
	A	B = Table 3	C = Table 7	D = +B-C	E = +D-A	F	G = Table 8	H = +F-G	I = +E+H
1996									
1997	2.985	9.654	7.283	2.372	-0.613	7.700	9.138	-1.438	-2.051
1998	3.543	11.361	-5.191	16.552	13.009	8.930	-6.914	15.844	28.853
1999	2.048	13.743	9.044	4.699	2.651	8.396	11.344	-2.948	-0.297
2000	5.202	10.884	7.448	3.436	-1.766	13.491	4.134	9.357	7.591
2001	3.445	1.027	-3.840	4.867	1.422	9.629	-5.369	14.999	16.421
Avg. (97 - 01)					**2.94**			**7.16**	**10.10**

Sources: U.S. Nonfarm Business Sector TFP Growth Rate: BLS's Multifactor Productivity, Table 2, "Private Nonfarm Business: Productivity and Related Indexes, 1948-00"; U.S. Nonfarm Business Sector Input Price Growth Rate, BLS's Net Input Price, Table NFB 4b "Net Multifactor Productivity and Costs , 1948 to 2000: Private Nonfarm Business Sector (excluding Government Enterprises)"; 2001 U.S. Nonfarm Business Sector TFP Growth Rate and U.S. Nonfarm Business Sector Input Price Growth Rate, based upon 1996-2000 average growth.

Results for Small ILECs by Economic Definition

Table 1 Summary Table of Annual Company Productivity Growth			
Year	**Total Factor Productivity Differential** **A = Table 2**	**Input Price Differential** **B = Table 2**	**Annual Productivity Growth** **C = A+B**
1996			
1997	10.4	-0.4	10.0
1998	20.9	4.7	25.6
1999	-1.9	-9.5	-11.4
2000	-8.2	-8.6	-16.8
2001	19.8	-1.5	18.3
Avg. (97 - 01)	**8.20**	**-3.05**	**5.14** **(X-Factor)**

Results for Small ILECs by Economic Definition

Table 2

Annual Total Company Productivity Growth

Year	U.S. Nonfarm Business Sector TFP Growth Rate	LECs' Output Growth Rate	LECs' Input Growth Rate	LECs' TFP Growth Rate	LECs' TFP Differential	U.S. Nonfarm Business Sector Input Price Growth Rate	LECs' Input Price Growth Rate	Input Price Differential	Total Company Productivity Growth
	A	**B = Table 3**	**C = Table 7**	**D = +B-C**	**E = +D-A**	**F**	**G = Table 8**	**H = +F-G**	**I = +E+H**
1996									
1997	0.995	5.287	-6.096	11.383	10.388	2.567	2.950	-0.383	10.005
1998	1.181	10.244	-11.848	22.092	20.911	2.977	-1.759	4.736	25.647
1999	0.683	4.124	5.344	-1.221	-1.903	2.799	12.336	-9.538	-11.441
2000	1.734	-3.328	3.122	-6.449	-8.183	4.497	13.116	-8.619	-16.803
2001	1.148	8.525	-12.388	20.913	19.765	3.210	4.673	-1.463	18.302
Avg. (97 - 01)					**8.20**			**-3.05**	**5.14**

Sources: U.S. Nonfarm Business Sector TFP Growth Rate: BLS's Multifactor Productivity, Table 2, "Private Nonfarm Business: Productivity and Related Indexes, 1948-00"; U.S. Nonfarm Business Sector Input Price Growth Rate, BLS's Net Input Price, Table NFB 4b "Net Multifactor Productivity and Costs , 1948 to 2000: Private Nonfarm Business Sector (excluding Government Enterprises)"; 2001 U.S. Nonfarm Business Sector TFP Growth Rate and U.S. Nonfarm Business Sector Input Price Growth Rate, based upon 1996-2000 average growth.

Results for Large ILECs by Economic Definition ("Big Four")

Table 1

Summary Table of Annual Company Productivity Growth

Year	Total Factor Productivity Differential A = Table 2	Input Price Differential B = Table 2	Annual Productivity Growth C = A+B
1996			
1997	5.5	-2.4	3.1
1998	7.5	6.0	13.5
1999	5.2	0.5	5.7
2000	5.8	7.1	13.0
2001	-2.0	8.6	6.6
Avg. (97 - 01)	**4.39**	**3.97**	**8.36 (X-Factor)**

Results for Large ILECs by Economic Definition ("Big Four")

Table 2

Annual Total Company Productivity Growth

Year	U.S. Nonfarm Business Sector TFP Growth Rate	LECs' Output Growth Rate	LECs' Input Growth Rate	LECs' TFP Growth Rate	LECs' TFP Differential	U.S. Nonfarm Business Sector Input Price Growth Rate	LECs' Input Price Growth Rate	Input Price Differential	Total Company Productivity Growth
	A	B = Table 3	C = Table 7	D = +B-C	E = +D-A	F	G = Table 8	H = +F-G	I = +E+H
1996									
1997	0.995	7.834	1.334	6.500	5.505	2.567	4.976	-2.409	3.097
1998	1.181	11.857	3.216	8.641	7.460	2.977	-3.024	6.001	13.461
1999	0.683	11.700	5.846	5.853	5.171	2.799	2.278	0.520	5.691
2000	1.734	11.124	3.585	7.539	5.805	4.497	-2.651	7.148	12.953
2001	1.148	-1.545	-0.712	-0.833	-1.981	3.210	-5.387	8.597	6.616
Avg. (97 - 01)					**4.39**			**3.97**	**8.36**

Sources: U.S. Nonfarm Business Sector TFP Growth Rate: BLS's Multifactor Productivity, Table 2, "Private Nonfarm Business: Productivity and Related Indexes, 1948-00"; U.S. Nonfarm Business Sector Input Price Growth Rate, BLS's Net Input Price, Table NFB 4b "Net Multifactor Productivity and Costs , 1948 to 2000: Private Nonfarm Business Sector (excluding Government Enterprises)"; 2001 U.S. Nonfarm Business Sector TFP Growth Rate and U.S. Nonfarm Business Sector Input Price Growth Rate, based upon 1996-2000 average growth.

Appendix 4 | LIST OF SENSITIVITY TEST RESULTS PRESENTED

Run #	Model Input Tested	Location of Model Input
1	Local Revenues	Table 5, Column A
2	Intrastate Toll/Access Revenues	Table 5, Column B
3	Interstate Revenues – End User	Table 6, Column A
4	Interstate Revenues – Switched Access	Table 6, Column B
5	Interstate Revenues – Special Access	Table 6, Column C
6	Local DEMs	Table 3, Column D
7	Intrastate DEMs	Table 3, Column E
8	Switched Access Lines	Table 4, Column D
9	Interstate Switched Access Minutes	Table 4, Column E
10	Interstate Special Access Lines	Table 4, Column F
11	Labor Compensation	Table 10, Column A
12	Number of Employees	Table 10, Column B
13	Operating Expense	Table 11, Column B
14	Capital Stock Benchmark	Table 12, Column A
15	BEA Composite Asset Price Index	Table 12, Column C
16	Imputed Cost of Capital	Table 12, Column K

Sensitivity Test Results

Model Input Tested: **Local Revenues**
Location of Input: Table 5, Column A

	Model Output Result				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	-5.56	-6.70	-4.93	8.14	1.44
-10%	-3.17	-4.31	-5.00	8.21	3.90
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	1.86	0.71	-5.16	8.37	9.09
20%	4.50	3.35	-5.25	8.46	11.81

	% Change in Indicated Model Output (vs. Base Value Shown)				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	700%	264%	-3%	-2%	-78%
-10%	356%	134%	-2%	-1%	-40%
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-368%	-139%	2%	1%	41%
20%	-748%	-282%	3%	2%	83%

Note: This shows the change in the model results for 2001 when the year 2001 value of the indicated model input is increased/decreased by the adjustment factor shown.

Sensitivity Test Results

Model Input Tested: **Intrastate Toll and Access Revenues**
Location of Input: Table 5, Column B

	Model Output Result				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	-2.00	-3.14	-5.05	8.26	5.11
-10%	-1.35	-2.49	-5.06	8.27	5.78
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-0.04	-1.19	-5.10	8.31	7.12
20%	0.62	-0.53	-5.12	8.33	7.80

	% Change in Indicated Model Output (vs. Base Value Shown)				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	188%	71%	-1%	0%	-21%
-10%	94%	35%	0%	0%	-10%
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-94%	-36%	0%	0%	10%
20%	-189%	-71%	1%	0%	21%

Note: This shows the change in the model results for 2001 when the year 2001 value of the indicated model input is increased/decreased by the adjustment factor shown.

Sensitivity Test Results

Model Input Tested: **Interstate Revenues -- End User**
Location of Input: Table 6, Column A

	Model Output Result				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	-1.47	-2.61	-5.06	8.27	5.65
-10%	-1.08	-2.23	-5.07	8.28	6.05
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-0.30	-1.45	-5.09	8.30	6.85
20%	0.09	-1.06	-5.11	8.32	7.26

	% Change in Indicated Model Output (vs. Base Value Shown)				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	111%	42%	0%	0%	-12%
-10%	56%	21%	0%	0%	-6%
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-56%	-21%	0%	0%	6%
20%	-113%	-43%	0%	0%	13%

Note: This shows the change in the model results for 2001 when the year 2001 value of the indicated model input is increased/decreased by the adjustment factor shown.

Sensitivity Test Results

Model Input Tested: **Interstate Revenues -- Switched Access**
Location of Input: Table 6, Column B

	Model Output Result				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	-1.33	-2.48	-5.06	8.27	5.79
-10%	-1.01	-2.16	-5.07	8.28	6.12
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-0.37	-1.52	-5.09	8.30	6.78
20%	-0.05	-1.20	-5.10	8.31	7.11

	% Change in Indicated Model Output (vs. Base Value Shown)				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	92%	35%	0%	0%	-10%
-10%	46%	17%	0%	0%	-5%
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-46%	-17%	0%	0%	5%
20%	-93%	-35%	0%	0%	10%

Note: This shows the change in the model results for 2001 when the year 2001 value of the indicated model input is increased/decreased by the adjustment factor shown.

Sensitivity Test Results

Model Input Tested: **Interstate Revenues -- Special Access**
Location of Input: Table 6, Column C

	Model Output Result				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	-1.73	-2.87	-5.06	8.27	5.39
-10%	-1.21	-2.36	-5.07	8.28	5.92
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-0.18	-1.33	-5.09	8.30	6.98
20%	0.33	-0.82	-5.11	8.32	7.50

	% Change in Indicated Model Output (vs. Base Value Shown)				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	149%	56%	-1%	0%	-16%
-10%	74%	28%	0%	0%	-8%
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-74%	-28%	0%	0%	8%
20%	-148%	-56%	1%	0%	16%

Note: This shows the change in the model results for 2001 when the year 2001 value of the indicated model input is increased/decreased by the adjustment factor shown.

Sensitivity Test Results

Model Input Tested: **Local DEMs**
Location of Input: Table 3, Column D

	Model Output Result				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	-13.89	-15.04	-5.08	8.29	-6.75
-10%	-6.93	-8.08	-5.08	8.29	0.21
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	4.95	3.81	-5.08	8.29	12.10
20%	10.11	8.96	-5.08	8.29	17.25

	% Change in Indicated Model Output (vs. Base Value Shown)				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	1901%	716%	0%	0%	-205%
-10%	898%	339%	0%	0%	-97%
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-813%	-307%	0%	0%	88%
20%	-1556%	-586%	0%	0%	168%

Note: This shows the change in the model results for 2001 when the year 2001 value of the indicated model input is increased/decreased by the adjustment factor shown.

Sensitivity Test Results

Model Input Tested: **Intrastate DEMs**
Location of Input: Table 3, Column E

	Model Output Result				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	-3.94	-5.09	-5.08	8.29	3.20
-10%	-2.23	-3.38	-5.08	8.29	4.91
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	0.71	-0.44	-5.08	8.29	7.85
20%	2.00	0.85	-5.08	8.29	9.15

	% Change in Indicated Model Output (vs. Base Value Shown)				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	468%	176%	0%	0%	-50%
-10%	221%	83%	0%	0%	-24%
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-202%	-76%	0%	0%	22%
20%	-388%	-146%	0%	0%	42%

Note: This shows the change in the model results for 2001 when the year 2001 value of the indicated model input is increased/decreased by the adjustment factor shown.

Sensitivity Test Results

Model Input Tested: **Switched Access Lines**
Location of Input: Table 4, Column D
Note: this input is used in the interstate quantity index only.

	Model Output Result				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	-2.73	-3.88	-5.08	8.29	4.41
-10%	-1.65	-2.80	-5.08	8.29	5.49
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	0.17	-0.98	-5.08	8.29	7.31
20%	0.96	-0.19	-5.08	8.29	8.10

	% Change in Indicated Model Output (vs. Base Value Shown)				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	293%	110%	0%	0%	-32%
-10%	138%	52%	0%	0%	-15%
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-124%	-47%	0%	0%	13%
20%	-238%	-90%	0%	0%	26%

Note: This shows the change in the model results for 2001 when the year 2001 value of the indicated model input is increased/decreased by the adjustment factor shown.

Sensitivity Test Results

Model Input Tested: **Interstate Switched Access Minutes**
Location of Input: Table 4, Column E

	Model Output Result				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	-2.51	-3.66	-5.08	8.29	4.63
-10%	-1.55	-2.70	-5.08	8.29	5.59
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	0.08	-1.06	-5.08	8.29	7.23
20%	0.80	-0.35	-5.08	8.29	7.94

	% Change in Indicated Model Output (vs. Base Value Shown)				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	262%	99%	0%	0%	-28%
-10%	124%	47%	0%	0%	-13%
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-112%	-42%	0%	0%	12%
20%	-215%	-81%	0%	0%	23%

Note: This shows the change in the model results for 2001 when the year 2001 value of the indicated model input is increased/decreased by the adjustment factor shown.

Sensitivity Test Results

Model Input Tested: **Interstate Special Access Lines**
Location of Input: Table 4, Column E

	Model Output Result				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	-2.68	-3.83	-5.08	8.29	4.46
-10%	-1.63	-2.78	-5.08	8.29	5.51
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	0.15	-0.99	-5.08	8.29	7.30
20%	0.93	-0.21	-5.08	8.29	8.08

	% Change in Indicated Model Output (vs. Base Value Shown)				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	286%	108%	0%	0%	-31%
-10%	135%	51%	0%	0%	-15%
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-122%	-46%	0%	0%	13%
20%	-234%	-88%	0%	0%	25%

Note: This shows the change in the model results for 2001 when the year 2001 value of the indicated model input is increased/decreased by the adjustment factor shown.

Sensitivity Test Results

Model Input Tested: **Labor Compensation**
Location of Input: Table 10, Column A

	Model Output Result				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	-3.98	-5.13	-8.37	11.58	6.45
-10%	-2.34	-3.49	-6.73	9.94	6.45
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	0.95	-0.20	-3.44	6.65	6.45
20%	2.59	1.44	-1.80	5.01	6.45

	% Change in Indicated Model Output (vs. Base Value Shown)				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	474%	179%	65%	40%	0%
-10%	237%	89%	32%	20%	0%
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-237%	-89%	-32%	-20%	0%
20%	-473%	-178%	-65%	-40%	0%

Note: This shows the change in the model results for 2001 when the year 2001 value of the indicated model input is increased/decreased by the adjustment factor shown.

Sensitivity Test Results

Model Input Tested: **Number of Employees**
Location of Input: Table 10, Column B

	Model Output Result				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	2.88	1.73	-1.51	4.72	6.45
-10%	0.98	-0.17	-3.40	6.61	6.45
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-2.20	-3.35	-6.59	9.80	6.45
20%	-3.59	-4.73	-7.97	11.18	6.45

	% Change in Indicated Model Output (vs. Base Value Shown)				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	-515%	-194%	-70%	-43%	0%
-10%	-242%	-91%	-33%	-20%	0%
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	218%	82%	30%	18%	0%
20%	416%	157%	57%	35%	0%

Note: This shows the change in the model results for 2001 when the year 2001 value of the indicated model input is increased/decreased by the adjustment factor shown.

Sensitivity Test Results

Model Input Tested: **Operating Expense**
Location of Input: Table 11, Column B

	Model Output Result				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	25.19	24.04	-5.97	9.18	33.22
-10%	11.41	10.26	-5.47	8.68	18.94
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-11.49	-12.64	-4.77	7.98	-4.65
20%	-21.23	-22.38	-4.52	7.73	-14.65

	% Change in Indicated Model Output (vs. Base Value Shown)				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	-3728%	-1405%	17%	11%	415%
-10%	-1744%	-657%	8%	5%	194%
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	1555%	586%	-6%	-4%	-172%
20%	2958%	1115%	-11%	-7%	-327%

Note: This shows the change in the model results for 2001 when the year 2001 value of the indicated model input is increased/decreased by the adjustment factor shown.

Sensitivity Test Results

Model Input Tested: **Capital Stock Benchmark**
Location of Input: Table 12, Column A

	Model Output Result				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	-1.22	-2.36	-5.55	8.76	6.39
-10%	-0.95	-2.10	-5.31	8.52	6.42
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-0.45	-1.60	-4.87	8.08	6.48
20%	-0.22	-1.37	-4.67	7.88	6.51

	% Change in Indicated Model Output (vs. Base Value Shown)				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	75%	28%	9%	6%	-1%
-10%	37%	14%	4%	3%	0%
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-35%	-13%	-4%	-3%	0%
20%	-68%	-26%	-8%	-5%	1%

Note: This shows the change in the model results for 2001 when the year 2001 value of the indicated model input is increased/decreased by the adjustment factor shown.

Sensitivity Test Results

Model Input Tested: **BEA Composite Asset Price Index**
Location of Input: Table 12, Column C

	Model Output Result				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	-2.91	-4.06	-7.10	10.31	6.25
-10%	-1.69	-2.84	-5.99	9.20	6.36
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	0.13	-1.01	-4.32	7.53	6.52
20%	0.83	-0.31	-3.68	6.89	6.58

	% Change in Indicated Model Output (vs. Base Value Shown)				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	319%	120%	40%	24%	-3%
-10%	144%	54%	18%	11%	-1%
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-119%	-45%	-15%	-9%	1%
20%	-220%	-83%	-28%	-17%	2%

Note: This shows the change in the model results for 2001 when the year 2001 value of the indicated model input is increased/decreased by the adjustment factor shown.

Sensitivity Test Results

Model Input Tested: **Imputed Cost of Capital**
Location of Input: Table 12, Column K

	Model Output Result				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	-0.59	-1.74	-5.13	8.34	6.60
-10%	-0.64	-1.79	-5.10	8.31	6.52
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	-0.74	-1.89	-5.06	8.27	6.38
20%	-0.79	-1.94	-5.04	8.25	6.31

	% Change in Indicated Model Output (vs. Base Value Shown)				
Factor Applied	LEC TFP	TFP Differential	LEC Input Price Growth	Input Price Differential	X-Factor
-20%	-15%	-5%	1%	1%	2%
-10%	-7%	-3%	0%	0%	1%
0%	-0.69	-1.84	-5.08	8.29	6.45
10%	7%	3%	0%	0%	-1%
20%	14%	5%	-1%	-1%	-2%

Note: This shows the change in the model results for 2001 when the year 2001 value of the indicated model input is increased/decreased by the adjustment factor shown.

ECONOMICS AND
TECHNOLOGY, INC.

TWO CENTER PLAZA, SUITE 400
BOSTON, MASSACHUSETTS 02108-2617