access market is biased downwards." *Further Notice*, App. B at 26. This conclusion is confirmed by the results of the Commission's imputed X study (*Further Notice*, App. C), in which X-factors based on interstate data range from 6.61% to 7.71% -- significantly higher than the total company X-factors obtained from the TFP study.

Despite these findings, the staff has continued to use total company data in its recent TFP study "because of the difficulty of separating interstate and intrastate costs for the TFP calculations" (*Further Notice* at 37). Indeed, the Commission has long maintained that the difficulty in calculating an X-factor based on interstate-only TFP growth is quantifying the amount of inputs used to provide interstate services. As shown below, the "direct" method of calculating the X-factor eliminates this problem. Under the direct method, the X-factor is calculated on the basis of output and revenue growth, without separately calculating the TFP and input price components of the X-factor.[2]

This approach has many advantages. It makes calculating an interstate-only X-factor a simple matter, because measurement of LEC interstate outputs and LEC interstate revenues is easy. It properly focuses attention on those variables that actually determine the historical X-factor and eliminates the complex calculations needed to develop indices that have no real bearing on the results. Moreover, limiting the analysis to interstate services produces an X-Factor that is more appropriate for regulating these interstate services. It also has the virtue of avoiding the complications inherent in measuring output of other, non-interstate LEC services. Most of the LECs' interstate output consists of wholesale access services provided to other carriers, which are more conducive to measurement in terms of relatively simple physical units.

Derivation of the Direct Method

We can derive a formula for calculating X-factors directly by examining the components of the Commission's X-factor model. In the Commission's TFP studies, the historically justified X-factor is calculated according to the following formula (*Further Notice*, App. B at 44):

(1) $X = (\%\Delta TFP_{LEC} - \%\Delta TFP_{US}) + (\%\Delta IP_{US} - \%\Delta IP_{LEC})$,

where the X-factor is expressed in terms of two components: the historical growth in LEC productivity ($\%\Delta TFP_{LEC}$) relative to that of the entire U.S. economy ($\%\Delta TFP_{US}$), and the historical trend in LEC input prices ($\%\Delta IP_{LEC}$) relative to input prices for the entire economy ($\%\Delta IP_{US}$). Growth in TFP is defined as growth in an index of total outputs (Q) minus growth in an index of total inputs (N), so that equation (1) can be written as:

(2) $X = (\%\Delta Q_{LEC} - \%\Delta N_{LEC} - \%\Delta TFP_{US}) + (\%\Delta IP_{US} - \%\Delta IP_{LEC})$

[2] This analysis was first presented in the paper "The Use of Productivity Studies in Price Cap Regulation: What do the FCC's X-factor Calculations Really Measure?" Stephen Friedlander, 18th Annual Conference of the Center for Research in Regulated Industries, Rutgers University, May 27.1999.

$$X = \%\Delta Q_{LEC} - (\%\Delta N_{LEC} + \%\Delta IP_{LEC}) - \%\Delta TFP_{US} + \%\Delta IP_{US}.$$

The term in parentheses ($\%\Delta N_{LEC} + \%\Delta IP_{LEC}$) represents growth in LEC input costs or growth in factor payments. In the Commission's 1997 TFP study, this term is exactly equal to growth in total revenues. In the 1999 TFP study, it is approximately equal to growth in revenues adjusted for excess LEC earnings and excess employee benefits. This can be shown by examining how the input price and quantity indexes are developed.

The input quantity index (N) consists of a chained Fisher Ideal Index comprised of three factors: labor measured in terms of number of employees; materials measured in terms of materials expense deflated by a materials price index; and a capital stock based on the Perpetual Inventory Model. The growth in this index can be expressed as:

$$(3) \qquad \%\Delta N_{LEC} = W1*(\%\Delta NEM) + W2*(\%\Delta(MAT/MATP)) + W3*(\%\Delta K),$$

where:

N_{LEC} = index of total LEC inputs
NEM = number of employees
MAT = materials expense
MATP = materials price index
K = capital stock
W1, W2, W3 = payments to each factor as a fraction of total factor payments.

The input price index is also a chained Fisher Ideal Index, with the price of labor measured in terms of average compensation per employee, the price of materials measured by the materials price index, and the price of a unit of capital measured as "property income" divided by the capital stock. Growth in the input price index is given by:

$$(4) \qquad \%\Delta IP_{LEC} = W1*[\%\Delta(TCOMP/NEM)] + W2*[\%\Delta MATP] + W3*[\%\Delta(PINC/K)],$$

where:

TCOMP = total compensation
PINC = property income
K = capital stock.

Note that several items that appear in the denominators of the terms in one index appear in the numerators of the other index. When equations (3) and (4) are added together, these terms effectively "cancel out":

$$\%\Delta N_{LEC} + \%\Delta IP_{LEC} = W1*(\%\Delta NEM + \%\Delta TCOMP - \%\Delta NEM)$$
$$+ W2*(\%\Delta MAT - \%\Delta MATP + \%\Delta MATP) + W3*(\%\Delta K + \%\Delta PINC - \%\Delta K).$$ [3]

[3] With growth rates expressed in terms of logarithmic first differences, the growth rate of a ratio (A/B) is equal to growth in the numerator (A) minus growth in the denominator (B).

(5) $\%\Delta N_{LEC} + \%\Delta IP_{LEC} = W1*(\%\Delta TCOMP) + W2*(\%\Delta MAT) + W3*(\%\Delta PINC)$.

The growth in LEC inputs plus growth in input prices can thus be expressed as a weighted average of the growth rates of the payments to each factor. Similarly, the growth in total factor payments (TCOMP+MAT+PINC) can be expressed as a weighted average of the growth rates for each of its components, using the same revenue weights as above:

$$\%\Delta(TCOMP+MAT+PINC) = W1*(\%\Delta TCOMP) + W2*(\%\Delta MAT) + W3*(\%\Delta PINC).$$

The growth in LEC inputs plus growth in input prices is thus equal to the growth in total factor payments.

In the 1997 TFP study, total factor payments equal total revenues because of the way property income is defined -- as total revenue *minus* compensation *minus* materials expense. In the 1999 TFP study, excess earnings are removed from property income, while excess benefits are removed from employee compensation. Total factor payments are thus equal to total revenues minus these adjustments, and the following equality holds:

(6) $\%\Delta REV_{LEC} = \%\Delta N_{LEC} + \%\Delta IP_{LEC}$,

where REV refers to LEC revenue and reflects whatever adjustments are made in the analysis. Substituting (6) into (2) shows that the X-factor can be calculated as:

(7) $X = \%\Delta Q_{LEC} - \%\Delta REV_{LEC} - \%\Delta TFP_{US} + \%\Delta IP_{US}$.

The 1999 TFP study differs slightly from the 1997 study in its measurement of the capital quantity index. The capital quantity index in the 1997 study is based on the computed capital stock as of the end of the prior year. Since the capital price index - based on property income divided by the capital stock - is also calculated with respect to the prior year's capital stock, the capital stock numbers cancel out when the capital price and quantity indexes are combined. In the 1999 study, on the other hand, the capital quantity index is based on the computed capital stock for the current year, while the capital price index is calculated with respect to the prior year's capital stock. (It is not clear from Appendix B in the *Further Notice* whether this difference is intentional.) When the two indexes are combined, the capital stock numbers do not cancel out. That is,

(5') $\%\Delta N_{LEC} + \%\Delta IP_{LEC} = W1*(\%\Delta TCOMP) + W2*(\%\Delta MAT)$
$+ W3*[\%\Delta PINC + \%\Delta K(t) - \%\Delta K(t-1)]$,

and the X-factor is calculated as:

(8) $X = \%\Delta Q_{LEC} - \%\Delta REV_{LEC} - W3*[\%\Delta K(t) - \%\Delta K(t-1)] - \%\Delta TFP_{US} + \%\Delta IP_{US}$

As a result, direct calculation of the X-factor based on equation (7), yields numbers that differ slightly from the Commission's calculation, which is equivalent to equation (8). The differences can be fairly significant for individual years, but tend to average out over longer periods. For the 1991-98 period, for instance, the two calculations yield very similar results for total company X-factors: 6.336% using the direct calculation versus 6.334% with the FCC's calculation.

The implications of this analysis are clear. X-factors applicable to the LECs' interstate access services can be calculated directly on the basis of interstate output and interstate revenue using equation (7). There is no need to measure explicitly interstate inputs or interstate productivity. The principal difficulty in calculating an interstate-only X-factor dissolves away.

Indeed, the Commission staff has all but acknowledged these facts, by finding that "most measurement errors associated with the prices of the inputs will tend to cancel out so that the impact on the productivity offset will, in general, be minimal" (*Further Notice*, App. B at 27) and that "increasing (decreasing) the price of one of the factor inputs will lower (raise) TFP_{LEC} but it will reduce (raise) the input price differential resulting in little net change in X" (*Further Notice*, App. B at 31).[4] Equation (5) shows that input prices and input quantities both "cancel out" when calculating the X-factor. The X-factor can thus be calculated directly without developing input price and quantity indexes.

Measurement of Inflation in the Commission's Study

AT&T also sets forth here an alternative method for accounting for inflation in the Commission's TFP methodology. A major objective in the TFP study is to determine "the expected amount that national output prices grow faster than industry input prices" (p. 42). In the Commission's X-factor equation (equation (26) or (27) in Appendix B), the change in output prices in the economy as a whole is represented by the change in U.S. input prices ($\%\Delta IP_{US}$) minus the change in U.S. productivity ($\%\Delta TFP_{US}$). That is, changes in economy-wide input prices and productivity act as a surrogate for economy-wide inflation in the X-factor equation.

There is no reason, however, why economy-wide inflation cannot be measured directly by using the GDP price index in place of the terms ($-\%\Delta TFP_{US} + \%\Delta IP_{US}$) in equations (26) and (27).[5] Although output prices in the economy tend to be a function of input prices and productivity (at least in theory), it turns out that historical growth in the GDP price index has been somewhat greater than growth in U.S. input prices minus growth in U.S. productivity, particularly in recent years since 1995. Since the price cap rules utilize changes in the GDP price index (GDP-PI) to adjust rate levels, it is more

[4] The Commission staff apparently intended to say "raise (lower) TFP" rather than "lower (raise) TFP."
[5] Data on U.S. input prices and productivity may be useful for comparing the trends in LEC input prices and productivity to economy-wide trends, but these data are not needed for the purpose of calculating the X-factor.

appropriate to compare the trend in LEC input costs to the trend in GDP-PI. Equation (7) then becomes:

(9) $X = \%\Delta Q_{LEC} - \%\Delta REV_{LEC} + \%\Delta GDP\text{-}PI,$

which can also be written as:

(9') $X = \%\Delta GDP\text{-}PI - \%\Delta(REV_{LEC}/Q_{LEC}).$

With excess earnings removed from LEC revenues, REV_{LEC} represents total LEC costs (i.e., factor payments) and the term (REV_{LEC}/Q_{LEC}) represents costs per unit of output. The X-factor is thus equal to the difference between the inflation rate and the trend in unit costs. Use of equation (9) to calculate the historically justified X-factor is fully consistent with the criteria established by the Commission in this proceeding:

> "First, the X–Factor should be economically meaningful. That is, it should provide a reliable measure of the extent to which changes in the LECs' unit costs have been less than the level of inflation. Second, the X-Factor should ensure that ongoing gains by the LECs in reducing unit costs are passed through to consumers. Third, calculation of the productivity offset should be reasonably simple and based on accessible and verifiable data."[6]

By measuring the extent to which changes in the LECs' unit costs have been less than the level of inflation, use of equation (9) or (9') clearly promotes the Commission's objective of ensuring "that ongoing gains by the LECs in reducing unit costs are passed through to consumers." It also satisfies the criterion of using "accessible and verifiable data," since use of the GDP price index as a benchmark avoids the need to forecast the last year of U.S. productivity growth, for which 1998 data is not yet available.

Cost of Capital Adjustment

In order to use equations (7) or (9) to calculate interstate X-factors, the revenue data needs to be adjusted to remove earnings in excess of the LECs' cost of capital. The accompanying charts set forth AT&T's calculations based on the Commission staff's proposed cost of capital adjustment, as well as separate calculations based on AT&T's alternative cost of capital adjustment.

The first approach uses the Commission's adjustments for excess earnings and excess employee benefits. As shown on the right-hand side of Table A-1, "Adjusted total factor payments," as calculated by the Commission in Table B-10, are divided by total revenue in Table A-1. (Table A-1 is a modified version of staff's Table B-2.) The resulting ratio is then applied to interstate service revenue to obtain interstate revenue adjusted for excess earnings and employee benefits. These calculations have the effect of

[6] FCC, *Fourth Further Notice of Proposed Rulemaking in CC Docket No. 94-1*, Sept. 27, 1995, Paragraph 16.

reducing interstate revenue by the same percentage as total revenue is reduced by the Commission's adjustments.

In order to confirm the reasonableness of these calculations, AT&T constructed an alternative methodology. The second approach removes excess earnings from interstate revenues for 1991 through 1998, based on AT&T's estimate of the LECs' cost of capital.

For 1998, an 8.63% rate of return on average net investment is used to represent the LECs' cost of capital. This figure represents the mid-point estimate of the RBOCs' weighted average cost of capital as of December 1997, as reported in AT&T's recent submission in Docket 98-166.[7] The 8.63% figure is very close to the competitive rates of return for 1998 used by the Commission in its imputed X study (*Further Notice*, Appendix C), which consist of 8.68% for all LECs and 8.66% for the RBOCs.

The 11.25% rate of return prescribed by the Commission in 1990 is used as the cost of capital in 1990 and 1991. Competitive rates of return for the years between 1991 and 1998 are based on a straight-line interpolation of 11.25% in 1991 and 8.63% in 1998. The resulting downward trend from 1991 to 1998 is similar to the trend in corporate bond rates used by the Commission to develop its cost of capital index. For the years prior to 1990, it is assumed that interstate earnings were commensurate with the cost of capital, and no adjustment is made to interstate revenue. Although this assumption is made purely for the sake of simplicity, the assumption is reasonable because interstate access services were under rate of return regulation prior to 1991.

Adjustments to interstate revenue for the years 1991 to 1998 are shown on the right-hand side of Table A-2. Revenues are reduced by an *earnings adjustment* that represents the change in earnings needed to provide the *competitive ROR* and a *tax adjustment* equal to 39% of the earnings adjustment.[8] No adjustment is made for excess employee benefits.[9]

Correction Of A Minor Error In The Staff's Calculations

Finally, the Commission's spreadsheets contained a minor error, whereby the growth rates in LEC input prices for 1986 through 1989 were incorrectly copied from Table B-13 to Table B-12. As shown in the corrected version of Table B-12 included here (Table A-3), this reduces the average 1986-1998 X-factor from 6.02% to 5.95%, but has no effect on the average 1991-98 X-factor.

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[7] Responsive Submission of AT&T Corp. to Prescription Proceeding Direct Case Submissions and Reply Comments on the Notice of Proposed Rulemaking (CC Docket No. 98-166), March 16, 1999. Attachment 10.

[8] The Commission used a 39% marginal tax rate in its imputed X study.

[9] An adjustment similar to that of the Commission could easily be made, but the adjustment has little effect on the X-factor for multi-year periods.

Results

X-factors for each year from 1986 through 1998 were calculated based on the modifications to the Commission's Option 2 methodology described above. These are presented in Table A-4, which uses the staff's capital cost index. Rolling averages, similar to those that the Commission relied on in the *1997 Price Cap Order*, were then calculated for the periods ending in 1995 and 1998.

Estimates utilizing the Commission's adjustments for excess earnings and excess employee benefits are presented in Table A-6. The first column shows Interstate X-factors based on equation (7) above, for which the median value is 10.1% for the 1986-1995 period and 9.5% for the 1986-1998 period. X-factors obtained using equation (9), in which growth rates for U.S. input prices and total factor productivity are replaced with growth in the GDP-PI, are shown in the second column, with median values of 10.1% for the 1986-1995 period and 9.9% for the 1986-1998 period. Because growth in the GDP price index has been somewhat greater than growth in U.S. input prices minus growth in U.S. productivity in the years since 1995, the use of GDP-PI causes the X-factors to be about 0.3 percentage points higher for the periods ending in 1998. For periods ending in 1995, there is little difference between the two measures of inflation.

Annual X-factor calculations based on AT&T capital cost index are presented in Table A-6, and rolling averages based on this approach are shown in Table A-7. Estimated X-factors are generally in the same range as those shown in Table A-5. The calculation of X-factors for individual years, from which the averages in Tables A-5 and A-7 are obtained, is shown in Tables A-4 and A-6 respectively. Column H shows interstate X-factors based on equation (7), while X-factors obtained using equation (9) are shown in Column J. Also shown in Tables A-4 and A-6 are total company X-factors based on direct calculation.

Comparison With Results Under the Staff's Option 2 Study

X-factors calculated in this manner, moreover, are very similar to those obtained under the Commission's Option 2 methodology, using interstate outputs rather than total-company outputs. This is essentially the approach previously used by AT&T in its "Performance-Based Model" to estimate interstate X-factors, based on the assumption that inputs grow at the same rates for interstate access as for the LECs' other regulated telephone services.[10] Calculations are shown on Table A-8, which is basically the same as the Commission's Table B-12, except that growth rates for interstate output rather than total company output are used in Column B. The average X-factors are strikingly similar to those reported on Table A-5, with median values of 10.0% for the 1986-95 period and 9.5% for the 1986-98 period. Table A-9 reports average TFP growth rates for specified periods, based on the results from Table A-8.

Table A-1. LEC Revenue ($) by Type of Service[1] - 1985-1998

Year	Local Service Revenue	Intrastate Toll and Intrastate Access Service Revenue	Interstate Service Revenue (A)	Total Revenue (B)	Adjusted Total Factor Payments (C)	Adjusted Interstate Service Revenue (A*C/B)	Growth Rate (%)
					Adjusted Interstate Service Revenue based on FCC adjustments		
1985	$26,960,554,164	$13,047,095,682	$14,366,305,727	$54,373,955,573	$53,150,159,615	$14,042,962,930	
1986	$28,626,174,049	$13,538,946,795	$15,459,541,700	$57,624,662,544	$49,919,483,458	$13,392,396,625	-4.74343
1987	$29,150,842,991	$14,166,723,124	$15,360,313,555	$58,677,879,670	$51,370,103,970	$13,447,331,580	0.40936
1988	$29,226,988,000	$14,994,975,000	$15,806,448,000	$60,028,411,000	$55,341,418,635	$14,572,287,377	8.03409
1989	$29,973,157,000	$14,868,219,000	$15,745,189,000	$60,586,565,000	$57,636,166,697	$14,978,441,803	2.74904
1990	$30,699,085,000	$15,014,729,000	$15,483,956,000	$61,197,770,000	$59,829,528,203	$15,137,770,252	1.05810
1991	$32,059,008,000	$14,522,276,000	$15,461,344,000	$62,042,628,000	$61,420,175,153	$15,306,225,529	1.10667
1992	$33,359,990,000	$14,225,181,000	$15,767,707,000	$63,352,878,000	$59,267,469,536	$14,750,901,992	-3.69554
1993	$34,598,957,000	$14,496,831,000	$16,341,156,000	$65,436,944,000	$58,867,197,742	$14,700,534,633	-0.34204
1994	$35,758,637,000	$14,355,983,000	$17,100,570,000	$67,215,190,000	$62,959,202,419	$16,017,781,816	8.58156
1995	$37,684,860,000	$13,123,225,000	$17,632,821,000	$68,440,906,000	$63,619,966,130	$16,390,774,763	2.30192
1996	$40,523,387,000	$12,987,476,000	$18,411,197,000	$71,922,060,000	$63,537,350,717	$16,264,810,559	-0.77147
1997	$42,460,592,000	$12,308,613,000	$18,882,869,000	$73,652,074,000	$66,361,588,503	$17,013,739,251	4.50173
1998	$45,643,024,000	$12,236,469,000	$20,270,078,000	$78,149,571,000	$66,379,832,287	$17,217,297,048	1.18933

[1]This excludes miscellaneous services

Source: Federal Communications Commission, *Statistics of Communication Common Carriers* [various years]

Table A-2. LEC Revenue ($) by Type of Service[1] - 1985-1998

Year	Local Service Revenue	Intrastate Toll and Intrastate Access Service Revenue	Interstate Service Revenue (A)	Total Revenue
1985	$26,960,554,164	$13,047,095,682	$14,366,305,727	$54,373,955,573
1986	$28,626,174,049	$13,538,946,795	$15,459,541,700	$57,624,662,544
1987	$29,150,842,991	$14,166,723,124	$15,360,313,555	$58,677,879,670
1988	$29,226,988,000	$14,994,975,000	$15,806,448,000	$60,028,411,000
1989	$29,973,157,000	$14,868,219,000	$15,745,189,000	$60,586,565,000
1990	$30,699,085,000	$15,014,729,000	$15,483,956,000	$61,197,770,000
1991	$32,059,008,000	$14,522,276,000	$15,461,344,000	$62,042,628,000
1992	$33,359,990,000	$14,225,181,000	$15,767,707,000	$63,352,878,000
1993	$34,598,957,000	$14,496,831,000	$16,341,156,000	$65,436,944,000
1994	$35,758,637,000	$14,355,983,000	$17,100,570,000	$67,215,190,000
1995	$37,684,860,000	$13,123,225,000	$17,632,821,000	$68,440,906,000
1996	$40,523,387,000	$12,987,476,000	$18,411,197,000	$71,922,060,000
1997	$42,460,592,000	$12,308,613,000	$18,882,869,000	$73,652,074,000
1998	$45,643,024,000	$12,236,469,000	$20,270,078,000	$78,149,571,000

[1]This excludes miscellaneous services

Source: Federal Communications Commission, *Statistics of Communication Common Carriers* [various years]

Adjusted Interstate Service Revenue based on AT&T's capital cost index

Interstate Earnings (B)	Interstate ANI (C)	Interstate ROR (B/C)	Competitive ROR (D)	Competitive Earnings (E=C*D)	Earnings Adjustment (F=E-B)	Tax Adjustment (G=0.39*F)	Adjusted Interstate Revenue (A-F-G)	Growth Rate (%)
							$14,366,305,727	
							$15,459,541,700	7.33408
							$15,360,313,555	-0.64393
							$15,806,448,000	2.86308
							$15,745,189,000	-0.38831
$3,252,800	$25,752,912	12.63%	11.25%	$2,897,203	-$355,597	-$138,683	$14,989,675,614	-4.91732
$3,065,010	$25,191,906	12.17%	11.25%	$2,834,089	-$230,921	-$90,059	$15,140,364,401	1.00026
$3,290,715	$24,875,599	13.23%	10.88%	$2,705,399	-$585,316	-$228,273	$14,954,117,863	-1.23776
$3,467,862	$24,759,133	14.01%	10.50%	$2,600,063	-$867,799	-$338,442	$15,134,914,927	1.20176
$3,446,525	$24,779,745	13.91%	10.13%	$2,509,480	-$937,045	-$365,447	$15,798,077,694	4.28839
$3,506,389	$25,461,013	13.77%	9.75%	$2,483,176	-$1,023,213	-$399,053	$16,210,555,243	2.57743
$3,756,542	$26,132,272	14.38%	9.38%	$2,450,834	-$1,305,708	-$509,226	$16,596,262,596	2.35149
$3,761,899	$25,890,407	14.53%	9.00%	$2,331,246	-$1,430,653	-$557,955	$16,894,261,634	1.77965
$3,731,385	$25,229,123	14.79%	8.63%	$2,177,273	-$1,554,112	-$606,104	$18,109,862,758	6.94827

Source: *ARMIS 43-01*

Table A-3. Summary of the Components of the LECs' Price Cap X-Factor (excluding the Consumer Productivity Dividend) - 1985-1998
Based on FCC Cost of Capital Index

Year	U.S. Nonfarm Business Sector TFP Growth Rate (%) A	LECs' Output Growth Rate (%) B	LECs' Input Growth Rate (%) C	LECs' TFP Growth Rate (%) D=B-C	TFP Differential (%) E=D-A	U.S. Nonfarm Business Sector Input Price Growth Rate (%) F	LECs' Input Price Growth Rate (%) G	Input Price Differential (%) H=F-G	X-factor (%) I=E+H	Previous X-factor[1] (%) J
1986	1.10166	3.20079	-3.47804	6.67883	5.57716	2.80830	-3.15211	5.96041	11.53757	-0.5
1987	-0.39920	3.76640	0.58715	3.17925	3.57845	2.53178	1.76258	0.76920	4.34765	5
1988	0.29955	6.51199	5.73029	0.78170	0.48215	3.72958	2.14711	1.58246	2.06461	5
1989	0.19920	4.38736	3.61531	0.77205	0.57285	3.03629	-0.22468	3.26096	3.83381	7.9
1990	-0.69895	4.76136	0.01899	4.74237	5.44133	3.30913	3.88344	-0.57432	4.86701	8.8
1991	-1.41274	2.61222	2.60077	0.01145	1.42418	2.05824	-0.13437	2.19261	3.61680	5.8
1992	1.61294	3.51156	-2.30554	5.81711	4.20417	2.88104	-1.36727	4.24830	8.45247	3.4
1993	0.09995	5.83136	-0.05132	5.88267	5.78272	3.71664	-0.66966	4.38631	10.16903	4.7
1994	0.39880	5.41556	4.36237	1.05319	0.65439	3.50341	2.21830	1.28511	1.93950	5.4
1995	0.29806	5.98474	0.29912	5.68562	5.38756	1.96268	0.84015	1.12253	6.51009	6.8
1996	1.47713	8.22067	-5.26234	13.48301	12.00588	1.38258	5.65415	-4.27157	7.73431	
1997	0.39024	9.46129	4.48479	4.97650	4.58626	1.89887	-0.22680	2.12567	6.71193	
1998	0.59259	5.37564	-0.22988	5.60552	5.01293	0.71810	0.18976	0.52834	5.54127	
				avg[2](86-98)	4.20846			1.73969	5.94816	
				var[3](86-98)	8.97963			6.02245	8.02857	
				avg(91-98)	4.88226			1.45216	6.33442	
				var(91-98)	10.27623			6.39758	6.08167	
				avg(86-95)	3.31050			2.42336	5.73385	5.23
				var(86-95)	4.70821			3.58663	9.99729	5.93
				avg(91-95)	3.49060			2.64697	6.13758	5.22
				var(91-95)	4.33513			1.99491	9.14567	1.29

[1] X-factor reported in the 1997 Price Cap Review Order

[2] avg denotes the arithmetic mean of the series

[3] var denotes the variance of the series.

Source: Bureau of Labor Statistics' Multifactor Productivity Table 2: Private Nonfarm Business: Productivity and Related Indexes (annual and quarterly tables), Table B-4, Table B-11, and Table B-13.

Table A-4. Direct Calculation of the LECs' Price Cap X-Factor (excluding the Consumer Productivity Dividend) - 1985-1998
Based on FCC Cost of Capital Index

Year	U.S. Nonfarm Business Sector TFP Growth Rate (%) A	U.S. Nonfarm Business Sector Input Price Growth Rate (%) B	LECs' Output Growth Rate (%) C	LECs' Adjusted Revenue Growth Rate (%) D	Total Company X-factor (%) E=C-D-A+B	LECs' Interstate Output Growth Rate (%) F	LECs' Adjusted Interstate Revenue Growth Rate (%) G	Interstate X-factor (%) H=F-G-A+B	GDPPI Growth (new series) I	Interstate X-factor (%) based on new GDPPI J=F-G+I	Interstate X-factor with CPD removed for 1996-98 K=H-1.5
1986	1.10166	2.80830	3.20079	-6.27097	11.17839	5.14068	-4.74343	11.59074	2.2	12.08411	11.59074
1987	-0.39920	2.53178	3.76640	2.86450	3.83288	7.78433	0.409356	10.30596	2.9	10.27497	10.30596
1988	0.29955	3.72958	6.51199	7.44652	2.49549	12.18682	8.034091	7.58276	3.4	7.55273	7.58276
1989	0.19920	3.03629	4.38736	4.06287	3.16158	6.04719	2.749035	6.13524	3.9	7.19816	6.13524
1990	-0.69895	3.30913	4.76136	3.73491	5.03453	11.49069	1.058101	14.44067	3.9	14.33259	14.44067
1991	-1.41274	2.05824	2.61222	2.62390	3.45929	9.83068	1.106668	12.19498	3.4	12.12401	12.19498
1992	1.61294	2.88104	3.51156	-3.56778	8.34744	5.95758	-3.69554	10.92122	2.2	11.85312	10.92122
1993	0.09995	3.71664	5.83136	-0.67766	10.12571	11.26657	-0.34204	15.22530	2.7	14.30861	15.22530
1994	0.39880	3.50341	5.41556	6.72029	1.79988	8.70504	8.581561	3.22809	2.1	2.22348	3.22809
1995	0.29806	1.96268	5.98474	1.04404	6.60532	9.58520	2.301919	8.94790	2.1	9.38328	8.94790
1996	1.47713	1.38258	8.22067	-0.12994	8.25606	9.62733	-0.77147	10.30426	1.8	12.19881	8.80426
1997	0.39024	1.89887	9.46129	4.34905	6.62087	10.28931	4.50173	7.29620	1.7	7.48758	5.79620
1998	0.59259	0.71810	5.37564	0.02749	5.47366	8.33142	1.189331	7.26759	1.2	8.34208	5.76759
				avg[2](86-98)	5.87624			9.64930		9.95104	9.30315
				var[3](86-98)	8.10233			10.48687		10.63527	11.82778
				avg(91-98)	6.33603			9.42319		9.74012	8.86069
				var(91-98)	6.48045			11.51794		12.58994	13.32086
				avg(86-95)	5.60405			10.05729		10.13351	10.05729
				var(86-95)	9.82093			12.30262		12.42157	12.30262
				avg(91-95)	6.06753			10.10350		9.97850	10.10350
				var(91-95)	9.39435			15.97649		17.47236	15.97649

[2] avg denotes the arithmetic mean of the series

[3] var denotes the variance of the series.

Source: Bureau of Labor Statistics' Multifactor Productivity Table 2: Private Nonfarm Business: Productivity and Related Indexes (annual and quarterly tables); U.S. Department of Commerce, *Survey of Current Business*, Table 6 (GDP-PI); Table B-4, Table B-11, and Table B-13.

Table A-5. Average Interstate X-Factors

Based on Direct Calculation and FCC Cost of Capital Index

(From Table A-4)

	Interstate X-factor (%)	Interstate X-factor (%) based on GDPPI
1986 to 1995	10.057	10.134
1987 to 1995	9.887	9.917
1988 to 1995	9.835	9.872
1989 to 1995	10.156	10.203
1990 to 1995	10.826	10.704
1991 to 1995	10.103	9.979
Mean:	10.144	10.135
Median:	**10.080**	**10.056**
1986 to 1998	9.649	9.951
1987 to 1998	9.488	9.773
1988 to 1998	9.413	9.728
1989 to 1998	9.596	9.945
1990 to 1998	9.981	10.250
1991 to 1998	9.423	9.740
Mean:	9.592	9.898
Median:	**9.542**	**9.859**

Table A-6. Direct Calculation of the LECs' Price Cap X-Factor (excluding the Consumer Productivity Dividend) - 1985-1998
Based on AT&T Cost of Capital Index

Year	U.S. Nonfarm Business Sector TFP Growth Rate (%) A	U.S. Nonfarm Business Sector Input Price Growth Rate (%) B	LECs' Output Growth Rate (%) C	LECs' Adjusted Revenue Growth Rate (%) D	Total Company X-factor (%) E=C-D-A+B	LECs' Interstate Output Growth Rate (%) F	LECs' Adjusted Interstate Revenue Growth Rate (%) G	Interstate X-factor (%) H=F-G-A+B	GDPPI Growth (new series) I	Interstate X-factor (%) based on GDPPI J=F-G+I	Interstate X-factor with CPD removed for 1996-98 K=H-1.5
1986	1.10166	2.80830	3.20079	5.80654	-0.89912	5.14068	7.334081	-0.48677	2.2	0.00660	-0.48677
1987	-0.39920	2.53178	3.76640	1.81122	4.88616	7.78433	-0.64393	11.35924	2.9	11.32826	11.35924
1988	0.29955	3.72958	6.51199	2.27551	7.66650	12.18682	2.863082	12.75377	3.4	12.72374	12.75377
1989	0.19920	3.03629	4.38736	0.92552	6.29892	6.04719	-0.38831	9.27259	3.9	10.33550	9.27259
1990	-0.69895	3.30913	4.76136	3.13619	5.63325	11.49069	-4.91732	20.41609	3.9	20.30801	20.41609
1991	-1.41274	2.05824	2.61222	0.69286	5.39033	9.83068	1.000264	12.30139	3.4	12.23041	12.30139
1992	1.61294	2.88104	3.51156	-1.54638	6.32604	5.95758	-1.23776	8.46344	2.2	9.39534	8.46344
1993	0.09995	3.71664	5.83136	3.74194	5.70611	11.26657	1.201762	13.68150	2.7	12.76481	13.68150
1994	0.39880	3.50341	5.41556	-0.44480	8.96497	8.70504	4.288395	7.52126	2.1	6.51665	7.52126
1995	0.29806	1.96268	5.98474	2.10969	5.53966	9.58520	2.577432	8.67239	2.1	9.10777	8.67239
1996	1.47713	1.38258	8.22067	1.90626	6.21986	9.62733	2.351494	7.18129	1.8	9.07584	5.68129
1997	0.39024	1.89887	9.46129	0.74811	10.22181	10.28931	1.779649	10.01828	1.7	10.20966	8.51828
1998	0.59259	0.71810	5.37564	3.07893	2.42222	8.33142	6.948268	1.50866	1.2	2.58315	0.00866
				avg[2](86-98)	5.72129			9.43562		9.73736	9.08947
				var[3](86-98)	7.00535			25.65017		22.79569	28.26465
				avg(91-98)	6.34888			8.66853		8.98545	8.10603
				var(91-98)	4.90827			11.87292		9.19845	15.13677
				avg(86-95)	5.55128			10.39549		10.47171	10.39549
				var(86-95)	5.93934			25.59805		23.91079	25.59805
				avg(91-95)	6.38542			10.12800		10.00300	10.12800
				var(91-95)	1.76492			5.80713		5.18285	5.80713

[2] avg denotes the arithmetic mean of the series

[3] var denotes the variance of the series.

Source: Bureau of Labor Statistics' Multifactor Productivity Table 2: Private Nonfarm Business: Productivity and Related Indexes (annual and quarterly tables); U.S. Department of Commerce, *Survey of Current Business*, Table 6 (GDP-PI); Table B-4, Table B-11, and Table B-13.

Table A-7. Average Interstate X-Factors

Based on Direct Calculation and AT&T Cost of Capital Index

(From Table A-6)

	Interstate X-factor (%)	Interstate X-factor (%) based on GDPPI
1986 to 1995	10.395	10.472
1987 to 1995	11.605	11.634
1988 to 1995	11.635	11.673
1989 to 1995	11.476	11.523
1990 to 1995	11.843	11.720
1991 to 1995	10.128	10.003
Mean:	11.180	11.171
Median:	**11.540**	**11.579**
1986 to 1998	9.436	9.737
1987 to 1998	10.262	10.548
1988 to 1998	10.163	10.477
1989 to 1998	9.904	10.253
1990 to 1998	9.974	10.244
1991 to 1998	8.669	8.985
Mean:	9.734	10.041
Median:	**9.939**	**10.248**

Table A-8. Summary of the Components of the LECs' Price Cap Interstate X-Factor - 1985-1998
Based on FCC Cost of Capital Index

Year	U.S. Nonfarm Business Sector TFP Growth Rate (%) A	LECs' Interstate Output Growth Rate (%) B	LECs' Input Growth Rate (%) C	LECs' TFP Growth Rate (%) D=B-C	TFP Differential (%) E=D-A	U.S. Nonfarm Business Sector Input Price Growth Rate (%) F	LECs' Input Price Growth Rate (%) G	Input Price Differential (%) H=F-G	X-factor (%) I=E+H
1986	1.10166	5.14068	-3.47804	8.61872	7.51706	2.80830	-3.15211	5.96041	13.47746
1987	-0.39920	7.78433	0.58715	7.19718	7.59638	2.53178	1.76258	0.76920	8.36558
1988	0.29955	12.18682	5.73029	6.45653	6.15698	3.72958	2.14711	1.58246	7.73944
1989	0.19920	6.04719	3.61531	2.43189	2.23268	3.03629	-0.22468	3.26096	5.49365
1990	-0.69895	11.49069	0.01899	11.47170	12.17065	3.30913	3.88344	-0.57432	11.59634
1991	-1.41274	9.83068	2.60077	7.22990	8.64264	2.05824	-0.13437	2.19261	10.83525
1992	1.61294	5.95758	-2.30554	8.26313	6.65019	2.88104	-1.36727	4.24830	10.89849
1993	0.09995	11.26657	-0.05132	11.31789	11.21794	3.71664	-0.66966	4.38631	15.60425
1994	0.39880	8.70504	4.36237	4.34267	3.94387	3.50341	2.21830	1.28511	5.22898
1995	0.29806	9.58520	0.29912	9.28608	8.98802	1.96268	0.84015	1.12253	10.11055
1996	1.47713	9.62733	-5.26234	14.88968	13.41255	1.38258	5.65415	-4.27157	9.14098
1997	0.39024	10.28931	4.48479	5.80452	5.41427	1.89887	-0.22680	2.12567	7.53994
1998	0.59259	8.33142	-0.22988	8.56130	7.96871	0.71810	0.18976	0.52834	8.49705

Average X-factors:		
	1986 to 1995	9.93500
	1987 to 1995	9.54139
	1988 to 1995	9.68837
	1989 to 1995	9.96679
	1990 to 1995	10.71231
	1991 to 1995	10.53550
	Mean:	10.06323
	Median:	9.95089
	1986 to 1998	9.57907
	1987 to 1998	9.25421
	1988 to 1998	9.33499
	1989 to 1998	9.49455
	1990 to 1998	9.93909
	1991 to 1998	9.73194
	Mean:	9.55564
	Median:	9.53681

Table A-9. Results for Specified Periods

Total company results(from Table A-3):

	TFP growth	TFP differential	X-factor
1986-90	3.23	3.13	5.33
1991-95	3.69	3.49	6.14
1996-98	8.02	7.20	6.66

Interstate-only results (from Table A-8):

	TFP growth	TFP differential	X-factor
1986-90	7.24	7.13	9.33
1991-95	8.09	7.89	10.54
1996-98	9.75	8.93	8.39

Appendix B
TECHNICAL CORRECTION TO THE STAFF IMPUTED X STUDY (OPTION 3)
Stephen Friedlander, AT&T

The Staff's imputed X study (Option 3) attempts to simulate the impact of alternative X-factors on interstate revenues and earnings with the purpose of determining the X-factors that result in local exchange carriers ("LECs") earning a "competitive" interstate rate of return in either 1995 or 1998. The purpose of this appendix is to identify and correct a minor flaw in the imputed X study that causes the imputed X-factor for the 1991 to 1998 period to be slightly understated.

The calculations in Table C-1 of the study improperly fail to account for the price cap "reinitialization" that occurred in July 1997. As a result of this reinitialization, price cap indexes as of July 1997 and thereafter were calculated based on an X-factor of 6.5%. Thus, the imputed X study's X-factor for 1996 (shown in the column labeled "Actual X-factor" in Table C-1) should be 6.5% rather than 5.3%.

The study's failure to account for the 1997 reinitialization has the effect of overstating the differential between revenues under existing X-factors and the revenues that would result under higher X-factors. As a result, the earnings associated with higher X-factors are understated, and the X-factors needed to produce a given level of earnings are understated.

This minor flaw is corrected in Table B-1 (attached hereto), which replicates the Commission's Table C-1 in Appendix C of the *Further Notice*, except that the "Actual X-Factor" for 1996 has been changed from 5.3% to 6.5%.

Once this correction is made, the X-factor that causes the LECs to earn a "competitive" interstate rate of return (*i.e.*, 8.68%) in 1998 increases from 7.71% to 7.87%. The impact of a 7.87% X-factor on LEC revenues, LEC rates of return, and consumer benefits is shown in Table B-2 (attached hereto).

Table B-1
Historic Price, Output, and Revenue Changes
Resulting form Hypothetical X-factor

Hypothetical X Factor	7.87%
End user price elasticity	-0.5
Access price elasticity*	-0.2

YEAR	Actual X Factor**	New X Factor**	X Factor Change	Cumulative Price Index	Price Change	Calendar Year Output Change	Calendar Year Revenue Change
Ameritech, Bell Atlantic, NYNEX, SBC, GTE, others							
1991	4.00%	7.87%	3.87%	0.961	-3.87%	0.39%	-1.75%
1992	4.00%	7.87%	3.87%	0.924	-7.58%	1.15%	-4.65%
1993	4.00%	7.87%	3.87%	0.888	-11.16%	1.87%	-7.67%
1994	4.00%	7.87%	3.87%	0.854	-14.59%	2.58%	-10.63%
1995	5.30%	7.87%	2.57%	0.832	-16.79%	3.14%	-13.04%
1996	6.50%	7.87%	1.37%	0.821	-17.92%	3.47%	-14.49%
1997	6.50%	7.87%	1.37%	0.810	-19.05%	3.70%	-15.47%
1998	6.50%	7.87%	1.37%	0.798	-20.15%	3.92%	-16.45%
BellSouth							
1991	4.00%	7.87%	3.87%	0.961	-3.87%	0.39%	-1.75%
1992	4.30%	7.87%	3.57%	0.927	-7.30%	1.12%	-4.53%
1993	4.00%	7.87%	3.87%	0.891	-10.88%	1.82%	-7.44%
1994	4.00%	7.87%	3.87%	0.857	-14.33%	2.52%	-10.40%
1995	5.30%	7.87%	2.57%	0.835	-16.53%	3.09%	-12.82%
1996	6.50%	7.87%	1.37%	0.823	-17.67%	3.42%	-14.26%
1997	6.50%	7.87%	1.37%	0.812	-18.79%	3.65%	-15.25%
1998	6.50%	7.87%	1.37%	0.801	-19.90%	3.87%	-16.23%
Pacific Telesis							
1991	4.30%	7.87%	3.57%	0.964	-3.57%	0.36%	-1.61%
1992	4.30%	7.87%	3.57%	0.930	-7.01%	1.06%	-4.29%
1993	4.00%	7.87%	3.87%	0.894	-10.60%	1.76%	-7.20%
1994	4.00%	7.87%	3.87%	0.859	-14.06%	2.47%	-10.17%
1995	5.30%	7.87%	2.57%	0.837	-16.27%	3.03%	-12.59%
1996	6.50%	7.87%	1.37%	0.826	-17.41%	3.37%	-14.04%
1997	6.50%	7.87%	1.37%	0.815	-18.54%	3.59%	-15.03%
1998	6.50%	7.87%	1.37%	0.803	-19.65%	3.82%	-16.01%
U S West							
1991	4.30%	7.87%	3.57%	0.964	-3.57%	0.36%	-1.61%
1992	4.30%	7.87%	3.57%	0.930	-7.01%	1.06%	-4.29%
1993	4.30%	7.87%	3.57%	0.897	-10.32%	1.73%	-7.08%
1994	4.30%	7.87%	3.57%	0.865	-13.52%	2.38%	-9.82%
1995	5.30%	7.87%	2.57%	0.843	-15.74%	2.93%	-12.13%
1996	6.50%	7.87%	1.37%	0.831	-16.89%	3.26%	-13.59%
1997	6.50%	7.87%	1.37%	0.820	-18.03%	3.49%	-14.58%
1998	6.50%	7.87%	1.37%	0.808	-19.15%	3.72%	-15.56%
Sprint							
1991	4.00%	7.87%	3.87%	0.961	-3.87%	0.39%	-1.75%
1992	4.00%	7.87%	3.87%	0.924	-7.58%	1.15%	-4.65%
1993	4.00%	7.87%	3.87%	0.888	-11.16%	1.87%	-7.67%
1994	4.07%	7.87%	3.79%	0.855	-14.53%	2.57%	-10.60%
1995	5.30%	7.87%	2.57%	0.833	-16.72%	3.13%	-12.99%
1996	6.50%	7.87%	1.37%	0.821	-17.86%	3.46%	-14.43%
1997	6.50%	7.87%	1.37%	0.810	-18.98%	3.68%	-15.42%
1998	6.50%	7.87%	1.37%	0.799	-20.09%	3.91%	-16.39%

* Assumes access = 40% of IXC costs and all price reductions passed on to end user customers.
** In effect 7/1 of each year.
*** Assumes "others" chose lowest X factor 1991-1994.

Table B-2
X Factor Required for Competitive Return
Calendar Year 1998
With Demand Stimulation

Modifications to FCC study:
Set 1996 X at 6.5% to reflect reinitialization in 1997.
X factor since 1991 7.87%

Revenue, Rate of Return, and Consumer Benefits

Price Cap Company	Actual Operating Revenue* (000)	Adjusted Operating Revenue (000)	Actual Operating Expense (000)	Adjusted Operating Expense* (000)	Actual Operating Income (000)	Adjusted Operating Income (000)	Average Net Investment (000)	Actual Rate of Return	Adjusted Rate of Return	Change in Consumer Surplus* (000)
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
Ameritech	$2,553,594	$2,133,602	$1,918,674	$1,754,877	$634,920	$378,725	$2,794,765	22.72%	13.55%	$510,278
Bell Atlantic	$6,453,096	$5,391,748	$5,378,333	$4,964,407	$1,074,763	$427,341	$8,380,851	12.82%	5.10%	$1,289,505
BellSouth	$3,794,553	$3,178,817	$2,842,101	$2,601,964	$952,452	$576,853	$4,578,390	20.80%	12.60%	$748,364
PacTel	$2,027,231	$1,702,750	$1,639,515	$1,512,967	$387,716	$189,782	$2,645,273	14.66%	7.17%	$394,513
SBC	$2,359,902	$1,971,766	$2,022,258	$1,870,885	$337,644	$100,881	$3,407,300	9.91%	2.96%	$471,573
U S West	$2,670,048	$2,254,497	$2,089,034	$1,926,969	$581,015	$327,528	$3,513,985	16.53%	9.32%	$505,597
GTE	$3,222,880	$2,692,809	$2,354,224	$2,147,496	$868,656	$545,313	$4,432,509	19.60%	12.30%	$644,019
Sprint	$1,130,092	$944,827	$857,222	$784,969	$272,870	$159,858	$1,400,433	19.48%	11.41%	$225,110
Others *	$939,899	$785,313	$739,759	$679,470	$200,140	$105,842	$1,241,895	16.12%	8.52%	$187,817
All	$25,151,295	$21,056,129			$5,310,176	$2,812,124	$32,395,401	16.39%	8.68%	$4,976,776
Difference		-$4,095,166				-$2,498,052				
% change		-16.3%				47.0%				

Source: Columns B, D, H. Form 492-A

* Column Notes:
(A) Assumes all chose lowest X factor 1991-94.
(B) Interstate revenue.
(E) Assumes fed + state tax rate = 39%.
(K) Assumes all price reductions passed through to end user customers.

** Depends on X factor chosen by carrier 1991-1994.

Appendix C
CALCULATION OF A NEW CONSUMER PRODUCTIVITY DIVIDEND
Stephen Friedlander, AT&T

The D.C. Circuit remanded the FCC's 1997 decision retaining the Consumer Productivity Dividend ("CPD") on the ground that the Commission had failed to explain its "choice of the amount -- 0.5%." 188 F.3d at 527. As the Court observed, the LEC petitioners did not dispute the FCC's rationale that retention of the CPD in some amount was appropriate because the FCC's newly adopted rule eliminating all sharing requirements would increase the price cap LECs' productivity in the future. Id. Because there is no dispute about the Commission's *reason* for retaining the CPD, the only question on remand is the level at which the CPD should be set to reflect the likely impact of the elimination of sharing on the LECs' productivity.

To put the matter in mathematical terms, our task is to find a reasonable estimate of the difference, all else being equal, between the LECs' potential productivity gains in a sharing regime (which we will denote X_S) and the LECs' potential productivity gains in a no-sharing regime (X_{NS}). The CPD would then be calculated as the estimated difference between these two quantities, *i.e.*, $X_{NS} - X_S$, and this quantity would then be added to the historical component of the X-factor. This is consistent with the Commission's rationale in adopting the original CPD, namely, that it "assure[s] that the first benefits of price caps flow to customers in the form of reduced rates." 5 FCC Rcd. at 6799.

There are a number of possible approaches to calculating this difference. All of them point in the same direction -- toward a CPD of at least 1.5 percent.

1. One approach is suggested by the FNPRM's references to two studies in the record -- one performed by Strategic Policy Research ("SPR") on behalf of Southwestern Bell and the other sponsored by the Ad Hoc Telecommunications Users Committee ("Ad Hoc").[1] These studies show that the imposition of sharing suppresses the LECs' incentives for productivity growth and, conversely, that the complete elimination of sharing would substantially increase the LECs' productivity.

Neither study attempts to measure directly the impact on productivity of the elimination of sharing. But a rough estimate of that impact can be derived from the SPR study, when combined with other data regarding the impact on productivity of the Commission's move from rate-of-return regulation to a price cap system with sharing.

a. Both studies derive a measure of the efficiency incentives faced by a LEC under different regulatory regimes. If we denote this incentive as I, then I_C is the efficiency incentive faced in a fully competitive market, and is equal to unity.

SPR calculates that the efficiency incentive in a no-sharing regime is only about 35% of that prevailing in a competitive market; thus I_{NS} is 0.35. SPR further calculates that the incentive

[1] *See* Comments of Southwestern Bell Telephone Company, CC Docket No. 94-1, App. SPR (May 9, 1994) ("SPR study"); Reply Comments of Ad Hoc, CC Docket No. 94-1, 14-18 (June 30, 1994).

in a sharing scenario (I_S), where firms are required to share 50% of their additional earnings above a certain threshold, is 0.18. Thus, the efficiency incentive in a no-sharing regime is about twice what it is in a sharing regime. Moreover, the efficiency incentive in a rate-of-return regime (with a one-year lag) (I_{ROR}) is only slightly smaller, at 0.14, than the efficiency incentive in a sharing regime.

In this model, then, the adoption of a price cap system with sharing would be expected to increase a LEC's incentives for efficiency by about 29 percent (.4/.14) as compared with a ROR regime. And the move from a price cap system with sharing to one without sharing would increase a LEC's efficiency incentives by about 94 percent ((.35-.18)/.18).

If we further assume that the LEC's potential productivity gain, X, is a linear function of the incentive for efficiency, I, then these same relationships should hold among X_{NS}, X_S, and X_{ROR}. And if that is so, the change from a price cap system with sharing to one without sharing should ultimately produce a much larger productivity increase -- about three times as much (94/29) -- as the change from the old ROR system to price caps with sharing.[2]

b. By itself, this analysis does not give us an estimate of $X_{NS} - X_S$. To generate such an estimate based on the SPR study, we must first find an estimate of $X_S - X_{ROR}$. Fortunately, there are a number of potential sources for such an estimate.

The most obvious is the Commission's original choice of a 0.5 percent CPD when it first adopted the price cap plan for the LECs. That number was chosen because the Commission believed the change from ROR to price cap regulation (even with sharing) would produce a productivity increase of at least that amount, and the Commission wanted to "assure that the *first* benefits of price caps flow to customers . . ." 5 FCC Rcd. at 6799. Because no one challenged that judgment on appeal, we can assume that this decision represented a reasonable judgment about the likely effects on productivity of moving from ROR to price caps with sharing (*i.e.*, $X_S - X_{ROR} = 0.5$). Accordingly, applying the SPR model, we would expect to see the LECs' potential X-factor increased by an additional 1.5 percent (approximately) based on the elimination of sharing. In other words, if $X_S - X_{ROR}$ is at least 0.5, as the Commission has long maintained, the SPR model predicts that X_{NS} - X_S would be at least 1.5.

[2]Although the revision of the SPR model suggested by Ad Hoc (and alluded to in the *Further Notice*) does not permit a similar calculation of the effect of eliminating sharing, that revision appears consistent with this conclusion. Indeed, the Ad Hoc study is quite similar to the SPA study, except that it assumes that, even without price regulation, the gains from efficiency enhancements are more transitory (as a result of competition) than is assumed in the SPR study. As a result of this assumption, Ad Hoc calculates that a price cap plan with 50/50 sharing would produce 45 percent of the efficiency incentives that full competition would produce (so that I_S is .45 rather than .18 as in the SPA study), and that a pure price cap plan would produce about 86 percent of the efficiency incentives (*i.e.*, I_{NS} is .86 rather than .35 as in the SPA study). *See* Reply Comments of The Ad Hoc Telecommunications Users Committee, CC Docket No. 94-1 (June 29, 1994) at 16. Although the predicted incentives are higher in absolute terms, the relationship between them is approximately the same as in the SPR study, so the impact of moving from one system to the other should be about the same as well.

Other sources generate somewhat higher values for X_{NS} - X_S, but are generally consistent with these results. For example, in the Commission's TFP study (based on total company data), the average X-factor for 1986-1990 -- prior to price caps -- is approximately 5.5 percent, whereas the average X-factor for 1991-95 -- after price caps were implemented -- is approximately 6.1 percent. By itself, this analysis suggests that the move from ROR to price caps with a sharing mechanism increased the LECs' *potential* productivity by 0.6 percent (*i.e.*, $X_S - X_{ROR} = .6$). Under the SPR model, then, the move from price caps with sharing to price caps without sharing would be expected to increase potential productivity by an additional 1.8 percent (*i.e.*, X_{NS} - X_S = 1.8).

This analysis, however, can be refined in two respects to give a more accurate picture of the impact of the change in regulatory systems on X_{NS} - X_S. First, as shown in Table [B-14] of Appendix A, we can adjust the data in the staff's TFP study to reflect only interstate inputs and outputs. Second, we can hold constant all of the elements of the X-factor other than LEC productivity. Obviously, the change in the regulatory system for the LECs would not be expected to have an impact on input prices, either for the LECs or for other industries. Nor would it be expected to have an immediate impact on productivity in other industries, or on the economic forces that are affecting the productivity of *both* the LECs and the economy as a whole. Thus, to obtain a first-order approximation of the impact of the regulatory system on LEC productivity, we can simply look at trends in interstate LEC TFP growth.

As shown in Table A-9 of Appendix A, LEC TFP growth increased from 7.24 percent for the period 1986-1990, to 8.09 percent for the period 1991-95, a difference of 0.85 percent. Applying the SPR model thus suggests that X_{NS} - X_S would be 2.55 percent.[3] The Commission staff's results based on total company data, also shown on Table A-9, exhibit a similar pattern.

2. Further corroborating evidence of the impact that the elimination of sharing had on the LECs' productivity is provided by the staff's imputed X Study (*Further Notice*, Appendix C). That study calculates the X-factors required in each year to maintain the LECs' average rate of return at the level of the previous year (as shown in Table C-4). These calculations show an average X factor of 7.66 for the years 1996 to 1998 – more than two percentage points higher than the 5.59 average computed for 1992 to 1995.[4]

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[3]Indeed, the average differential TFP growth for 1996-1998, after the LECs were given the option of accepting a higher X in exchange for the elimination of sharing, was 8.93 percent – slightly more than one full percentage point above the 1991-95 level. This suggests that the Commission's limited efforts to move from price caps with sharing to price caps with sharing produced a further, *actual* increase in productivity of 1 percent. The latter figure, however, understates the *potential* increase from that change in regulatory regimes. Sharing was not eliminated for all LECs as of 1996 -- only those that thought they could profit substantially from the alternative regime. Thus, the complete elimination of sharing should produce an even larger efficiency gain. Moreover, the elimination of sharing was subject to legal challenge during that entire period, further dampening its impact on efficiency. And in all events, we have only three years of data since the LECs were given the option of avoiding sharing, as compared with five years' experience during the ROR period and the period in which sharing was mandatory.

[4] The 7.66 figure is a simple average of the X-factors calculated for 1996-1998: 7.90, 6.57, and 8.51. 5.95 is a simple average of the X-factors calculated for 1992-95: 5.50, 5.94, 5.51, and 6.83.

3. Another alternative is to rely on the LECs' own apparent valuations of the efficiency impact of the sharing mechanism. Indeed, although it is not mentioned in the *Further Notice*, one of the most obvious indicators of the likely impact of the elimination of sharing is the actions taken by the price cap LECs in response to the option they were given in 1995 to increase their X-factor in return for the complete elimination of the sharing requirement.

The Commission's 1995 Price Cap Review Order gave the price cap LECs three alternatives for selecting the X-factor: a minimum X-factor of 4.0 percent with full sharing requirements, a 4.7 percent factor with a less restrictive sharing mechanism, and a 5.3 percent factor with no sharing requirement. These alternatives were available to the LECs for their tariff filings on July 1, 1995. Significantly, the vast majority of the price cap LECs chose the 5.3 percent X-factor with its no-sharing condition: eventually, five of the seven RBOCs elected the highest (5.3 percent) X-factor in return for the elimination of sharing.[5] And most of the non-RBOC price cap LECs also chose the 5.3 percent/no sharing alternative.[6] Thus, the bulk of the price cap LECS were willing to pay for the elimination of sharing by increasing their individual X-factor by 130 basis points.

This valuation by the price cap LECs themselves is strong evidence of the *minimum* increase in productivity that could be expected from the elimination of sharing. In other words, the LECs' own "revealed preferences" show that $X_{NS} - X_S$ is at least 1.3. And given that the actual value is probably much higher (as indicated by the LECs' persistent profitability), it would be reasonable for the FCC to adopt a CPD of approximately that amount.

To be sure, not all of the LECs have been willing to make this bargain. But, as the Commission has emphasized many times, the X-factor is designed, not to reflect the LECs' actual productivity experience, but the potential productivity gains that a LEC might reasonably expect. Even if some LECs did not believe they could increase their productivity by more than enough to make up for the 1.3 reduction in their X-factors, that does not prove that they could not do so. And it certainly does not prove that LECs in general could not do so. Indeed, the record shows that the vast majority of them were willing and able, in exchange for the elimination of sharing, to increase their productivity by *at least* 1.3 percentage points. This provides strong support for the conclusion that they could have increased their productivity slightly more – by 1.5 percentage points.

4. The final step is to combine the CPD with the historical component of the X-factor. For the period through 2000, this is straightforward: a 1.5 percent CPD could simply be added to the 10.1 percent historical X-factor, which is based entirely on data through 1995,

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[5] The five RBOCs selecting the 5.3 percent X-factor were Ameritech, Bell Atlantic, BellSouth, PacTel, and Southwestern Bell. See Fourth Further Notice of Proposed Rulemaking, CC Dkt. No. 94-1, Sep. 27, 1995, FCC 95-406, ¶ 8 n.17.

[6] The non-RBOC carriers selecting the 5.3 percent X-factor were United, Rochester, Lincoln, and GTE (38 out of 46 study areas). Id.

before the LECs had the option to eliminate sharing.

For the future, however, the analysis is arguably more complicated. While 1.5% represents the additional productivity growth that results from going from a sharing regime to a no-sharing regime, the historical X-factor (for 2000 forward) is based on periods characterized by both sharing and no-sharing options. Arguably, it may thus already reflect some of the additional productivity associated with the elimination of sharing.

However, the CPD can easily be adjusted to eliminate any risk of double-counting. If we assume, conservatively, that fully 1.5 percentage points of the X-factors for 1996, 1997, and 1998 are attributable to the (partial) elimination of sharing during that period, we get adjusted X-factors for those years of 8.8, 5.8, and 5.8, respectively. Using these values to calculate the rolling average X-factors as in Table A-5 yields an average X of 9.14 percent rather than 9.54 percent, suggesting that the X-factor during that period would have been 9.1 percent (after rounding) without the elimination of sharing. Because this is 0.4 percent less than the X-factor of 9.5 percent calculated in Table A-5 for future periods, we can eliminate any potential double-counting simply by reducing the CPD from 1.5 percent to 1.1 percent.

CERTIFICATE OF SERVICE

I hereby certify that on this 7th day of January, 2000, I caused true and correct copies of the foregoing Comments of AT&T Corp. to be served on all parties by mailing, postage prepaid to their addresses listed on the attached service list.

Dated: Washington, D.C.
January 7, 2000

/ s / Peter M. Andros

Peter M. Andros

Robert J. Aamoth
KELLEY, DRYE & WARREN, LLP
1200 19th Street, N.W., Suite 500
Washington, DC 20036

Danny E. Adams
Steven A. Augustino
KELLEY, DRYE & WARREN
1200 19th Street, N.W., Suite 500
Washington, DC 20036

William P. Barr
M. Edward Whelan
Ward D. Wueste
GTE SERVICE CORPORATION
1850 M Street, N.W., Suite 1200
Washington, DC 20036

Debra R. Berlyn
Ronald J. Bink
John Windhausen, Jr.
COMPETITION POLICY INSTITUTE
1156 15th Street, N.W., Suite 310
Washington, DC 20005

Mark L. Evans
Michael K. Kellogg
KELLOGG, HUBER, HANSEN, TODD & EVANS
1300 K Street, N.W., Suite 1000 West
Washington, DC 20006

Anne K. Bingaman
Douglas W. Kinkoph
LCI INTERNATIONAL TELECOM CORP.
8180 Greensboro Drive, Suite 800
McLean, VA 22102

Wayne V. Black
Susan M. Hafeli
C. Douglas Jarrett
KELLER & HECKMAN
1001 G Street, N.W., Suite 500 West
Washington, DC 20001

James S. Blaszak
LEVINE, BLASZAK, BLOCK & BOOTHBY
2001 L Street, N.W., Suite 900
Washington, DC 20036

James S. Blaszak
Kevin S. DiLallo
Mark G. Johnston
LEVINE, BLASZAK, BLOCK & BOOTHBY
2001 L Street, N.W., Suite 900
Washington, DC 20036

Sue D. Blumenfeld
WILLKIE, FARR & GALLAGHER
1155 21st Street, N.W., Suite 600
Washington, DC 20036

Richard P. Bress
LATHAM & WATKINS
1001 Pennsylvania Avenue, N.W., Suite 1300
Washington, DC 20004

Robert J. Butler
R. Michael Senkowski
Bryan N. Tramont
Daniel E. Troy
WILEY, REIN & FIELDING
1776 K Street, N.W.
Washington, DC 20006

Chris Frentrup
MCI TELECOMMUNICATIONS CORP.
Regulatory Analyst
1801 Pennsylvania Avenue, N.W.
Washington, DC 20006

Liam S. Coonan
Patricia Diaz Dennis
James D. Ellis
Robert M. Lynch
SBC COMMUNICATIONS
175 E. Houston, Room 4-C-90
San Antonio, TX 78205

David Cosson
L. Marie Guillory
NATIONAL TELEPHONE COOPERATIVE ASSOCIATION
2626 Pennsylvania Avenue, N.W.
Washington, DC 20037

Joseph DiBella
Michael E. Glover
Betsy L. Roe
Edward D. Young, III
BELL ATLANTIC TELEPHONE COS.
1320 North Courthouse Road, 8th Floor
Arlington, VA 22201

Durward D. Dupre
Robert M. Lynch
Thomas A. Pajda
Michael J. Zpevak
SOUTHWESTERN BELL TEL. CO., NEVADA BELL, PACIFIC BELL
One Bell Plaza, Room 2403
Dallas, TX 75202

Aimee M. Cook
James U. Troup
ARTER & HADDEN
1801 K Street, N.W., Suite 400K
Washington, DC 20036-1301

Mark Cooper
CONSUMER FEDERATION OF AMERICA
1424 16th Street, N.W. - Suite 604
Washington, DC 20036

Madelyn M. DeMatteo
SOUTHERN NEW ENGLAND TELEPHONE
227 Church Street, 10th Street
New Haven, CT 01610

Kenneth Dunmore
Michael S. Pabian
AMERITECH
2000 West Ameritech Center Drive, Room 4H82
Hoffman Estates, IL 60196-1025

Anthony C. Epstein
Carl S. Nadler
Jon M. Shepard
Donald B. Verrilli, Jr.
JENNER & BLOCK
601 13th Street, N.W.
Washington, DC 20005

James W. Erwin
Stephen M. Higgins
THOMPSON COBURN
One Mercantile Center, Suite 3300
St. Louis, MO 63101

Dana Frix
Tamar Haverty
SWIDLER & BERLIN
3000 K Street, N.W., Suite 300
Washington, DC 20007

Honorable Harold Furchtgott-Roth
Commissioner
FEDERAL COMMUNICATIONS COMMISSION
1919 M Street, N.W.
Washington, DC 20554

Hance Haney
Linda Kent
Mary McDermott
Keith Townsend
UNITED STATES TELEPHONE ASSOCIATION
1401 H Street, N.W., Suite 600
Washington, DC 20005

Douglas E. Hart
Robert D. Shank
Christopher J. Wilson
FROST & JACOBS
201 East 5th Street
2500 PNC Center
Cincinnati, OH 45202

Thomas P. Hester
MAYER, BROWN & PLATT
190 South LaSalle Street
Chicago, IL 60603

Donald M. Falk
Kenneth S. Geller
MAYER, BROWN & PLATT
2000 Pennsylvania Avenue, N.W., Suite 6500
Washington, DC 20006

Richard L. Fruchterman, III
David N. Porter
Catherine R. Sloan
Richard S. Whitt
WORLDCOM, INC.
1120 Connecticut Avenue, N.W., Suite 400
Washington, DC 20036

David A. Gross
AIRTOUCH COMMUNICATIONS
1818 N Street, N.W., Suite 800
Washington, DC 20036

Catherine M. Hannan
Charles C. Hunter
HUNTER COMMUNICATIONS LAW GROUP
1620 I Street, N.W., Suite 701
Washington, DC 20006

John H. Harwood, II
William T. Lake
David M. Sohn
WILMER, CUTLER & PICKERING
2445 M Street, N.W.
Washington, DC 20037

Cathy Hotka
NATIONAL RETAIL FEDERATION
325 7th Street, N.W.
Washington, DC 20004

H. Richard Juhnke
Jay C. Keithley
Leon M. Kestenbaum
SPRINT CORPORATION
1850 M Street, N.W., 11th Floor
Washington, DC 20036

Richard A. Karre
Robert B. McKenna
US WEST, INC.
1020 19th Street, N.W., Suite 700
Washington, DC 20036

Honorable William E. Kennard
Chairman
FEDERAL COMMUNICATIONS COMMISSION
1919 M Street, N.W.
Washington, DC 20554

Linda L. Kent
Mary McDermott
Lawrence E. Sarjeant
UNITED STATES TELEPHONE ASSOCIATION
1401 H Street, N.W., Suite 600
Washington, DC 20005

Douglas W. Kinkoph
LCI INTERNATIONAL
TELECOMMUNICATIONS
8180 Greensboro Drive, Suite 800
McLean, VA 22102

Christy C. Kunin
Glenn B. Manishin
BLUMENFELD & COHEN
1615 M Street, N.W., Suite 700
Washington, DC 20005

Rebecca M. Lough
Richard M. Sbaratta
M. Robert Sutherland
BELLSOUTH CORPORATION
1155 Peachtree Street, N.E., Suite 1700
Atlanta, GA 30306-3610

Robert M. McDowell
c/o HELEIN & ASSOCIATES, PC
8180 Greensboro Drive, Suite 700
McLean, VA 22102

Richard J. Metzger
ASSOCIATION FOR LOCAL
TELECOMMUNICATIONS SERVICES
888 17th Street, N.W., Suite 900
Washington, DC 20006

Brian R. Moir
MOIR & HARDMAN
2000 L Street, N.W., Suite 512
Washington, DC 20036-9852

Genevieve Morelli
COMPETITIVE TELECOMMUNICATIONS
ASSOCIATION
1900 M Street, N.W., Suite 800
Washington, DC 20036

Honorable Susan Ness
Commissioner
FEDERAL COMMUNICATIONS COMMISSION
1919 M Street, N.W.
Washington, DC 20554

Catherine G. O'Sullivan
Robert J. Wiggers
UNITED STATES DEPARTMENT OF JUSTICE
Antitrust Division
Patrick Henry Building, Room 10535
601 D Street, N.W.
Washington, DC 20530

Gail L. Polivy
GTE SERVICE CORPORATION
1850 M Street, N.W., Suite 1200
Washington, DC 20036

Michael J. Shortley
ROCHESTER TELEPHONE CORPORATION
180 South Clinton Avenue
Rochester, NY 14646

Richard M. Teitelbaum
CITIZENS UTILITIES COMPANY
1400 16th Street, N.W., Suite 500
Washington, DC 20036

Rocky N. Unruh
MORGENSTEIN & JUBELIRER
One Market
Spear Street Tower, 32nd Floor
San Francisco, CA 94105

Nancy C. Woolf
PACIFIC BELL TELEPHONE COMPANY
140 New Montgomery Street, Room 1523
San Francisco, CA 94105

Thomas F. O'Neill, III
Maria L. Woodbridge
MCI TELECOMMUNICATIONS CORP.
1133 19th Street, N.W.
Washington, DC 20036

Honorable Michael Powell
Commissioner
FEDERAL COMMUNICATIONS COMMISSION
1919 M Street, N.W.
Washington, DC 20554

Donald Russell
UNITED STATES DEPARTMENT OF JUSTICE
Antitrust Division
1401 H Street, N.W., Suite 8000
Washington, DC 20530

James M. Smith
EXCEL TELECOMMUNICATIONS, INC.
3000 K Street, N.W., Suite 300
Washington, DC 20007

Honorable Gloria Tristani
Commissioner
FEDERAL COMMUNICATIONS COMMISSION
1919 M Street, N.W.
Washington, DC 20554

Curtis T. White
ALLIED ASSOCIATED PARTNERS
4201 Connecticut Avenue, N.W., Suite 402
Washington, DC 20008

ITS, Inc.
1231 20th Street, N.W.
Washington, DC 20036