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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
Price Cap Performance Review for Local Exchange Carriers	)	CC Docket No. 94-1
Access Charge Reform	)	CC Docket No. 96-262

FOURTH REPORT AND ORDER IN CC DOCKET NO. 94-1 AND SECOND REPORT AND ORDER IN CC DOCKET NO. 96-262

Adopted: May 7, 1997; Released: May 21, 1997

By the Commission: Commissioners Quello, Ness, and Chong issuing separate statements.

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I. INTRODUCTION

1. In this Order, we make significant revisions to our current price cap plan for regulating incumbent local exchange carriers (incumbent LECs) as part of our plan to construct a dynamic regulatory framework to further the new pro-competitive, deregulatory paradigm set out in the Telecommunications Act of 1996 (1996 Act).[1] In conjunction with the Access Reform First Report and Order[2] and the Universal Service Order,[3] this Order adopts reforms needed to set the stage for the progressive deregulation of incumbent LECs with the development of competition. We adopt a reasonable, challenging price cap plan that effectively requires price cap LECs to reduce inflation-adjusted prices for interstate access services by approximately 6.5 percent annually. This new price cap reflects a more reliable productivity estimate than in past Orders, one that is based on a careful analysis of the rate of growth of incumbent LEC total factor productivity (TFP) and the rate of change of LEC input prices. We also eliminate the sharing requirements of the current rules, which substantially undercut the efficiency incentives of price cap regulation and retained some of the cost-misallocation incentives inherent in rate-of-return regulation. These forward-looking reforms to our price cap plan for incumbent LECs will allow services to be more readily removed from price regulation as warranted by the development of a competitive marketplace.

II. BACKGROUND AND OVERVIEW

A. Background

2. Price cap regulation seeks to replicate the beneficial incentives of competition in the provision of interstate access services,[4] while striking a reasonable balance between the interests of ratepayers and stockholders. Price cap regulation is intended to encourage growth in productivity by permitting incumbent LECs that increase their productivity to earn

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[1] Telecommunications Act of 1996, Pub.L.No. 104-104, 110 Stat. 56 (1996) (to be codified at 47 U.S.C. §§ 151 et seq.). For clarity, we refer to provisions of the 1996 Act using the sections at which they will be codified.

[2] Access Charge Reform, First Report and Order, CC Docket No. 96-262, FCC 97-158 (rel. May 16, 1997) (Access Reform First Report and Order).

[3] Federal-State Board on Universal Service, First Report and Order, CC Docket No. 96-45, FCC 97-157 (rel. May 8, 1997) (Universal Service Order).

[4] Price Cap Performance Review for Local Exchange Carriers, CC Docket No. 94-1, First Report and Order, 10 FCC Rcd 8961, 9001-03 (paras. 90-96) (1995) (LEC Price Cap Performance Review), aff'd sub. nom. Bell Atlantic Telephone Companies v. FCC, 79 F.3d 1195 (D.C. Cir., 1996) (Bell Atlantic v. FCC).

higher profits,[5] while at the same time ensuring that interstate access customers share in the benefits of productivity growth in the form of lower rates.[6] The price cap formula was designed to ensure that "[b]oth carriers and customers will be better off" under price cap regulation.[7]

3. The Commission adopted LEC price cap regulation in 1990 because it found that rate-of-return regulation did not create adequate efficiency incentives for incumbent LECs, and required administratively burdensome cost allocation rules to enforce.[8] Rather than adjusting prices to allow LECs the opportunity to earn a pre-determined return on interstate investment, price cap regulation directly regulates prices and allows earnings to vary. Under price cap regulation, the ceiling or maximum price a LEC can charge for interstate access services is adjusted annually by a measure of inflation minus an "X-Factor." A separate adjustment is made for "exogenous" cost changes, which are changes outside the carrier's control and not otherwise reflected in the price cap formula.[9]

4. In the 1990 LEC Price Cap Order, the Commission scheduled a review of the performance of the price cap plan, to begin in 1994, to determine whether any revisions or modifications to the plan would be necessary.[10] In the first phase of that performance review, completed in 1995,[11] we made several revisions to the price cap plan.[12] We also concluded, however, that we required a more complete record to resolve several important issues, including how the X-Factor should be calculated in the future,[13] and whether it would

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[5] Policy and Rules Concerning Rates for Dominant Carriers, CC Docket No. 87-313, 5 FCC Rcd 6786, 6789 (para. 22) (1990) (LEC Price Cap Order), Erratum, 5 FCC Rcd 7664 (Com. Car. Bur. 1990), modified on recon., 6 FCC Rcd 2637 (1991) (LEC Price Cap Reconsideration Order); aff'd sub nom. National Rural Telecom Ass'n v. FCC, 988 F.2d 174 (D.C. Cir. 1993).

[6] LEC Price Cap Order, 5 FCC Rcd at 6790 (para. 30).

[7] LEC Price Cap Order, 5 FCC Rcd at 6790 (para. 30).

[8] LEC Price Cap Order, 5 FCC Rcd at 6789-91 (paras. 21-37).

[9] LEC Price Cap Order, 5 FCC Rcd at 6792 (paras. 47-48). For a complete summary of the original price cap plan, see LEC Price Cap Order, 5 FCC Rcd at 6787-89 (paras. 5-20).

[10] LEC Price Cap Order, 5 FCC Rcd at 6834-35 (paras. 385-94).

[11] LEC Price Cap Performance Review), 10 FCC Rcd 8961.

[12] For a summary of those revisions to the price cap plan, see LEC Price Cap Performance Review, 10 FCC Rcd at 8970-73 (paras. 19-26).

[13] See LEC Price Cap Performance Review, 10 FCC Rcd at 8967-69 (paras. 9-13).

be possible to develop a price cap plan that did not impose sharing obligations.[14] Accordingly, we adopted an "interim plan" in the LEC Price Cap Performance Review and sought comment on additional issues in the Price Cap Fourth Further Notice.[15]

5. In that Notice, we sought comment on methods for developing an X-Factor, the appropriate number of X-Factor options, and whether we should represcribe the X-Factor periodically or adopt a method for recalculating the X-Factor annually. We requested comment on sharing, the price cap common line formula, and our exogenous cost rules. We tentatively concluded that the X-Factor should have three characteristics. First, it should provide a reliable measure of the extent to which changes in LECs' unit costs have been less than the change in level of inflation.[16] Second, it should pass through ongoing unit cost reductions to consumers. Finally, the calculation of the X-Factor should be relatively simple and based on publicly available data.[17]

6. In the Access Reform Notice,[18] we invited further comment on whether and how we should revise our LEC price cap plan as part of access reform. We sought comment, inter alia, on whether we should adopt a higher X-Factor based on the record developed in response to the Price Cap Fourth Further Notice or on similar, more recent economic studies.[19]

B. Overview of Revised Price Cap Plan

7. In this Order, we make significant changes to our interim price cap plan and adopt the revised plan as our permanent price cap regulatory regime for incumbent LECs. Incumbent LECs have distributed their interstate services among four groups of access

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[14] See LEC Price Cap Performance Review, 10 FCC Rcd at 8969 (paras. 15-16).

[15] LEC Price Cap Performance Review, 10 FCC Rcd at 8967 (para. 7), 8968 (para. 14); Price Cap Performance Review for Local Exchange Carriers, Fourth Further Notice of Proposed Rulemaking, CC Docket No. 94-1, 10 FCC Rcd 13659 (1995) (Price Cap Fourth Further Notice).

[16] In the LEC Price Cap Performance Review, we explained that changes in a firm's unit costs come from two sources: (1) changes in productivity, and (2) changes in input prices. LEC Price Cap Performance Review, 10 FCC Rcd at 9033 (para. 160). See also Price Cap Fourth Further Notice, 10 FCC Rcd at 13668 (para. 54).

[17] Price Cap Fourth Further Notice, 10 FCC Rcd at 13662 (para. 16).

[18] Access Charge Reform, Notice of Proposed Rulemaking, CC Docket No. 96-262, Price Cap Performance Review for Local Exchange Carriers, Third Report and Order, CC Docket No. 94-1, FCC 96-488 (rel. Dec. 24, 1996) (Access Reform Notice).

[19] Access Reform Notice at paras. 231-35.

services, called baskets.[20] A price cap index (PCI) limits the weighted average of rate increases for each basket to the rate of inflation minus an "X-Factor."

8. In the original and the interim price cap plans, the baseline X-Factor was based on the average of the short-term and long-term trends in rate reductions prior to our adoption of the original price cap plan in 1990, plus a consumer productivity dividend (CPD) of 0.5 percent. We selected the X-Factor and the CPD so that, at minimum, rates would decline more quickly than they had declined before 1990, and thus would ensure that the first benefits of price cap regulation would flow to access customers in the form of lower rates. In the LEC Price Cap Performance Review, we tentatively concluded that an analysis that directly measured the growth of LEC productivity and input prices would provide a better basis for prescribing an X-Factor.[21] In the Price Cap Fourth Further Notice, we invited comment on the total factor productivity (TFP) methodology and other alternatives for calculating the X-Factor. We also tentatively concluded that we should base our X-Factor on a TFP-based measure of productivity and an input price differential.[22] We find below that the record supports prescribing a single X-Factor of 6.5 percent, based on our conclusions regarding a reasonable method of calculating LEC TFP and input prices, our findings regarding the input price differential, and our decision to retain the 0.5 percent CPD.

9. In its simplest form, total factor productivity is the ratio of a firm's (or industry's, or nation's) total output to its total input.[23] A firm can become more productive by producing greater output from the current level of inputs, by producing the same level of output from fewer inputs, or through a combination of both. In TFP calculations, output and input are represented by indices. The output index represents the quantities of goods or services produced, and the input index represents the quantities of capital, labor, and materials used in the production of those goods and services. TFP studies most often develop output and input price indices to adjust output and input quantities for the effects of inflation. The development of composite quantity and price indices, and the weighting of these indices in TFP calculations, raise important issues that we decide in Section III.C. of this Order. In addition to these TFP calculation issues, we also resolve issues about whether to adjust the X-Factor for the difference between LEC input prices and input prices for the

[20] Our companion Access Reform First Report and Order has added a new price cap basket for recovery of marketing expenses. Access Reform First Report and Order at paras. 317-25.

[21] LEC Price Cap Performance Review, 10 FCC Rcd at 9031-32 (para. 157).

[22] See Price Cap Fourth Further Notice, 10 FCC Rcd at 13664 (para. 25). See also LEC Price Cap Performance Review, 10 FCC Rcd at 9031 (para. 155). Price Cap Fourth Further Notice, 10 FCC Rcd at 13668 (paras. 54-55).

[23] LEC Price Cap Performance Review, 10 FCC Rcd at 9008-09 (para. 106).

national economy (an "input price differential"), and about whether to adjust for any difference between interstate and intrastate productivity growth.

10. Our interim price cap plan permits LECs to choose among three X-Factors, two of which include obligations to share certain earnings. Sharing requires incumbent LECs to "share" half or all earnings above specified rates of return with their access customers by lowering the maximum prices LECs may charge during the next year. We tentatively concluded in the LEC Price Cap Performance Review that we should move to a system of pure price caps, without sharing, because we found that sharing tends to blunt the efficiency incentives that we sought to create with price cap regulation.[24] We retained sharing in our interim plan, however, because we found that it served three beneficial functions: a "flow-through" function, a "matching" function, and a "backstop" function.[25] In the Price Cap Fourth Further Notice, we proposed to eliminate sharing if we found a way to replace these three beneficial functions or if we found these functions no longer necessary to the operation of our price cap regulatory regime.[26] The "backstop" and "flow-through" functions were necessary in part because we were not certain that the productivity targets established by our X-Factors were sufficiently challenging.

11. We conclude that, under the price cap plan we adopt today, the beneficial aspects of these functions are outweighed by the benefits of eliminating sharing. As explained in detail below, we consider the X-Factor we adopt today to be based on a much more reliable estimate of incumbent LEC potential productivity gains. Therefore, we have substantially more confidence that this X-Factor will flow through a reasonable portion of LEC productivity gains to access customers. We also find that, because we establish a price cap plan with only one X-Factor, a matching mechanism is no longer necessary. To guard against our new X-Factor requiring individual LECs to charge unreasonably low rates, we will retain our current low-end adjustment mechanism.

12. In the Price Cap Fourth Further Notice, we sought comment on updating the X-Factor annually using a moving average of TFP, or periodically during performance reviews. We decide, in light of the fundamental changes to the marketplace resulting from the new

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[24] LEC Price Cap Performance Review, 10 FCC Rcd at 9045-46, 9049 (paras. 187-89, 197).

[25] The "flow-through" function of sharing ensures that a reasonable portion of the productivity gains of incumbent LECs are flowed through to access customers. The "matching" function encourages incumbent LECs to select an X-Factor that most closely matches their reasonably expected productivity growth in a price cap plan with more than one X-Factor. The "backstop" function ensures that rates under price cap regulation do not become unreasonably high or low. LEC Price Cap Performance Review, 10 FCC Rcd at 9047-49 (paras. 191-96). See also Price Cap Fourth Further Notice, 10 FCC Rcd at 13676-77 (paras. 112-15). These three functions are discussed in more detail in Section IV. of this Order below.

[26] Price Cap Fourth Further Notice, 10 FCC Rcd at 13679 (para. 127).

competitive paradigm of the 1996 Act, that the better course is to select a new generally applicable X-Factor, based on the current record, that will remain in place until we change it in a new performance review.

13. We also sought comment on how to revise the common line PCI formula and the exogenous cost rules should we decide to adopt a TFP-based X-Factor. In our companion Access Reform First Report and Order, we are revising the PCI formula for the common line basket to reflect our revisions to common line recovery, and we therefore decline to discuss common line issues further here. We also conclude that our decision to adopt a fixed X-Factor precludes the revision of the exogenous cost rules that we contemplated in the Price Cap Fourth Further Notice.

C. Price Cap Regulation and Access Reform

14. The rules we adopt in this Order are an essential part of access reform. They are necessary to promote, and plan for, the growth of competition envisioned by the Telecommunications Act of 1996. An X-Factor based on TFP and an input price differential provides, with the Consumer Productivity Dividend, a reasonable, challenging target for LEC access prices. Importantly, eliminating the sharing requirement will increase the incentive of incumbent LECs to become more productive and will enable us to deregulate competitive services while noncompetitive services remain under regulation. In addition, eliminating the sharing requirement will remove the incentives that incumbent LECs now have to misallocate costs from services not subject to sharing, such as those no longer subject to price cap regulation, to services that are subject to sharing. A price cap plan without sharing should greatly facilitate our overarching goal of deregulating services that face sufficient competition by making it easier to remove from regulation those services subject to competition.

15. In the Access Reform Notice, we invited comment on increasing the X-Factor, either on the basis of the record submitted in response to the Price Cap Fourth Further Notice, or on more recent economic studies.[27] In response to the Access Reform Notice, a number of parties have argued that, in light of the 1996 Act, we should move forward to reform our current price cap plan.[28] In this Order, we consider all the comments filed in

[27] Access Reform Notice at para. 233.

[28] See, e.g., PacTel 1997 Comments at 41-42; Aliant 1997 Comments at 8; SNET 1997 Reply at 23-24; BA/NYNEX 1997 Reply at 32-33; CPI 1997 Comments at 23-25 (favoring new X-Factor). See also, e.g., USTA 1997 Comments at 18; BA/NYNEX 1997 Comments at 60; PacTel 1997 Comments at 43; GTE 1997 Comments at 56 (favoring elimination of sharing).

response to both the Price Cap Fourth Further Notice and the Access Reform Notice pertaining to calculation of the X-Factor and other price cap structure issues.[29]

III. X-FACTOR CALCULATION ISSUES

A. Background

16. Under price cap regulation, the weighted average of the prices for the services in a given price cap basket, or the actual price index (API), must be less than or equal to the price cap index (PCI). An incumbent LEC's PCIs are adjusted annually pursuant to formulae set forth in our rules.[30] The PCI formula consists of an inflation measure, in this case the Gross Domestic Product Price Index (GDP-PI),[31] minus the X-Factor, plus or minus any permitted exogenous cost changes.

17. In the Price Cap Fourth Further Notice, we proposed to adopt a total factor productivity (TFP) method for deriving the productivity component of the X-Factor, as advocated by USTA, but also sought comment on several other possible X-Factor calculation methods and invited parties to propose additional methods. For instance, we sought comment on AT&T's Historical Revenue Method, which would explicitly set the X-Factor to produce an industry-average rate of return of 11.25 percent.[32] In addition, we considered the Historical Price Method, which would set the X-Factor based on updated versions of the two studies relied upon in the LEC Price Cap Order. The first, the Spavins-Lande study, compared prices for LEC services to price levels for the U.S. national economy between 1929 and 1989; the second, the Frentrup-Uretsky study, examined the trend in LEC prices for switched access between 1984 and 1990.[33] Additionally, we sought comment on combining elements of the Historical Revenue Method and the Historical Price Method, or retaining the interim price cap plan on a long-term basis.

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[29] In Appendix A of this Order, we list all the pleadings filed in response to the Price Cap Fourth Further Notice in 1996. For purposes of this Order, we refer to these pleadings as "Comment" or "Reply." In Appendix A of our companion Access Reform First Report and Order, we list all the pleadings filed in response to the Access Reform Notice in 1997. For purposes of this Order, we refer to these pleadings as "1997 Comment" or "1997 Reply."

[30] See Section 61.45(b) of the Commission's Rules, 47 C.F.R. § 61.45(b).

[31] In the LEC Price Cap Performance Review, we adopted GDP-PI as the inflation measure, in place of the Gross National Product Price Index (GNP-PI) used in the original price cap plan. LEC Price Cap Performance Review, 10 FCC Rcd at 9116 (para. 351).

[32] Price Cap Fourth Further Notice, 10 FCC Rcd at 13671-72 (paras. 77-83).

[33] See LEC Price Cap Order, 5 FCC Rcd at 6885 (App. C).

18. In the next section of this Order, we find that the record provides compelling evidence in favor of adopting the TFP methodology. In Section III.C., we address the issues raised by TFP calculations. In Section III.D., we consider X-Factor calculation issues other than those raised by use of TFP, such as the input price differential. Finally, in Section III.E., we find that an X-Factor prescription of 6.5 percent, including a CPD of 0.5 percent, is a reasonable one.

B. X-Factor Approaches

1. Methods for Estimating the X-Factor

19. In the Price Cap Fourth Further Notice, we tentatively concluded that we should base our X-Factor on a TFP-based measure of productivity and an input price differential.[34] In line with a majority of the commenters, including Ad Hoc, AT&T, and USTA, who support TFP in some form, we base our X-Factor prescription on productivity growth and input price differential, derived on the basis of the TFP methodology.[35] For the reasons discussed below, we conclude that TFP measures productivity growth more accurately than the method we adopted in the LEC Price Cap Order and the LEC Price Cap Performance Review, and more accurately than any other method proposed in the record before us. In the LEC Price Cap Performance Review, we noted that we were forced to reject TFP-based productivity studies because they were not specific to the telephone industry, or because they were based on non-public information.[36] Pacific notes that the California Public Service Commission has based its intrastate price cap plan on a TFP model. Pacific cites a recent California Public Utilities Commission (California PUC) opinion finding that TFP lies between 1.8 percent and 2.6 percent.[37] We now have before us TFP studies that are specific to the telephone industry and rely on publicly available data. Finally, we note that the

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[34] See Price Cap Fourth Further Notice, 10 FCC Rcd at 13664 (para. 25). See also LEC Price Cap Performance Review, 10 FCC Rcd at 9031 (para. 155). Price Cap Fourth Further Notice, 10 FCC Rcd at 13668 (paras. 54-55).

[35] As explained further below, Ad Hoc, AT&T and USTA support using TFP to calculate the X-Factor, but Ad Hoc and AT&T disagree with USTA over the amount of the input price differential. USTA argues that the input price differential is zero, while Ad Hoc and AT&T contend that it is at least 2 percent. See Section III.D.1., infra.

[36] LEC Price Cap Performance Review, 10 FCC Rcd at 9031 (para. 157), citing Policy and Rules Concerning Rates for Dominant Carriers, CC Docket No. 87-313, 3 FCC Rcd 3195, 3406-07 (1988) (AT&T Price Cap Further Notice).

[37] Pacific Reply at 2-3, 14-16, citing Investigation on the Commission's Own Motion Into the Second Triennial Review of the Operations and Safeguards of the Incentive-Based Regulatory Framework for Local Exchange Carriers, I.95-05-047, Decision 95-12-052 (Dec. 20, 1995) (California PUC Opinion). Pacific attaches a copy of the California PUC Opinion to its reply.

Bureau of Labor Statistics (BLS) uses TFP to measure productivity growth in the national economy.[38]

20. Several parties oppose the use of TFP because they maintain that the X-Factor resulting from this method is lower than the X-Factors in the interim plan.[39] We interpret these arguments as opposing USTA's method of calculating TFP, not as objections to the principle of basing the X-Factor on TFP generally. Similarly, ICA opposes TFP because it anticipates that any TFP-based approach will inevitably raise data availability problems.[40] We find that the record demonstrates that publicly available data can now provide an adequate basis for TFP analysis. We address TFP calculation issues below.

21. We have considered but do not rely on alternatives to our TFP approach. In the Price Cap Fourth Further Notice, we sought comment on alternative methods of calculating TFP, including an econometric estimation method.[41] The only parties commenting in the record on the econometric estimation method opposed it. USTA and NYNEX assert that an econometric estimation of productivity growth sophisticated enough to be economically meaningful would not meet the goal we established in the Price Cap Fourth Further Notice of being relatively simple.[42] No party to this proceeding has placed an econometric TFP model in the record. Therefore, we have no basis at this time on which to adopt an econometric estimation of productivity growth to measure TFP.

22. We also decline to adopt the Historical Revenue Method discussed in the Price Cap Fourth Further Notice and supported by GSA and TRA.[43] The Historical Revenue Method would set the X-Factor prospectively at the level that would have, in retrospect,

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[38] BLS Handbook of Methods, Bulletin 2285, Productivity Measures: Business Economy and Major Subsectors, Chapter 10.

[39] LDDS Comments at 3-4; Ad Hoc Reply at 2 and Att. at 39; MCI Reply at 5-6; NCTA Reply at 6; API Reply at 1-2; TRA Reply at 4-5.

[40] ICA Comments at 6-7.

[41] Under this method, we would develop a "production function," or an equation explaining the mathematical relationship between inputs and outputs, and price cap LECs would then derive TFP from this equation. Price Cap Fourth Further Notice, 10 FCC Rcd at 13671 (para. 75).

[42] USTA Comments at 6-8; NYNEX Comments at 27. See Price Cap Fourth Further Notice, 10 FCC Rcd at 13662 (para. 16).

[43] Price Cap Fourth Further Notice, 10 FCC Rcd at 13671-72 (paras. 77-83).

produced an industry-wide average rate of return of 11.25 percent under price cap regulation.[44] Adopting the Historical Revenue Method on a moving-average basis, as GSA recommends, would create substantially similar incentives to those under rate-of-return regulation, because the X-Factor would be explicitly linked to earnings. The Historical Revenue Approach also would re-create many of the administrative burdens of rate-of-return regulation, including a substantial reliance on accurate demand and cost forecasts. In addition, in the Price Cap Fourth Further Notice, we expressed concerns that the Historical Revenue Approach might not provide sufficient incentives for productivity growth, to the extent that increases in industry-wide earnings would increase the X-Factor.[45] No one has adequately responded to this concern. GSA recommends using a moving average to update an X-Factor developed pursuant to the Historical Revenue Method.[46] For the reasons set out below, however, we decline to adopt a moving average. TRA supports the Historical Revenue Method because it believes that it would help reduce rates to economic cost levels,[47] but presents no reasons why a "historical" revenue method better achieves that end than a TFP methodology. In addition, in our companion Access Reform First Report and Order, we reject proposals to adopt prescriptive measures at this time to drive access rates to economic cost-based levels.[48]

23. We also decline to continue using the Historical Price Method developed in the LEC Price Cap Order. None of the commenters supports this approach.[49] Furthermore, the Historical Price Method bases the X-Factor on historical trends in prices of telecommunications prices relative to the economy as a whole, and thus uses price changes as a surrogate for productivity growth. We find that TFP is a more accurate measure of LEC productivity because it is based on incumbent LECs' actual outputs and inputs.

24. We also reject MCI's alternative to our TFP approach. MCI asserts that LECs electing the 5.3 percent X-Factor, which entails no obligation to share, must have believed that their unit costs (productivity growth plus decrease in input prices) would decrease by at least 8.54 percent. MCI claims that, otherwise, these incumbent LECs would have earned greater profits by selecting a lower X-Factor, notwithstanding the accompanying sharing

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[44] LEC Price Cap Performance Review, 10 FCC Rcd at 9019 (para. 127), Price Cap Fourth Further Notice, 10 FCC Rcd at 13672 (para. 81).

[45] Price Cap Fourth Further Notice, 10 FCC Rcd at 13672 (para. 81).

[46] GSA Reply at 8.

[47] TRA Comments at 6-7.

[48] Access Reform First Report and Order, Section IV.B.2.

[49] See API Comments at 2-3; Bell Atlantic Comments at 7-8.

obligations. Therefore, MCI recommends a fixed X-Factor of at least 8.54 percent.[50] In response, USTA criticizes MCI's calculations, in part because MCI implicitly assumes that all price cap LECs earned an 11.25 percent rate of return at the time of their 1995 annual access filings. According to USTA, correcting this error results in an X-Factor of 2.85 percent.[51] In reply, MCI filed an ex parte statement agreeing with USTA's methodological point, but arguing that USTA erred in basing its analysis on a 13.78 percent return, the incumbent LECs' rate of return in 1994.[52] According to MCI, the price cap LECs' 1994 rates of return are not the correct starting point because the LECs' expected earnings were depressed by two exogenous cost decreases required in the LEC Price Cap Performance Review in 1995.[53] MCI contends that, after adjusting the LECs' rates of return to remove the effects of these two exogenous cost decreases, its alternative X-Factor approach produces an X-Factor of 7.9 percent.

25. We conclude that MCI's method is inherently ill-suited for prescribing an X-Factor, regardless of whether MCI's calculation can be perfected. Fundamentally, MCI's alternative does not estimate expected productivity growth, but instead derives an X-Factor based on LEC X-Factor choices that depend critically on the LECs' earnings for a single tariff year. It would not be reasonable to base a long-term X-Factor prescription, as MCI suggests, on short-term LEC expectations. Furthermore, the results of MCI's alternative methodology rely heavily on LEC interstate earnings. For example, LECs choosing the 4.0 percent X-Factor under the interim plan are required to share half of their earnings in excess of 12.25 percent, and all of their interstate earnings in excess of 13.25 percent. As a LEC's sharing obligations increase, its gains from increases in productivity decrease. Thus, if an incumbent LEC expects its interstate earnings to exceed 12.25 percent, and also anticipates that it will increase its productivity, it is more likely to choose the no-sharing 5.3 percent X-Factor than a LEC that expects the same increases in productivity, but forecasts that its interstate rate of return will be 11.25 percent. As we have said consistently in our discussions of price cap regulation over the years,[54] we achieve beneficial incentives by

[50] MCI Reply at 9-11.

[51] USTA 1997 Comments, Att. 7 at 7-8.

[52] Ex Parte Letter from Chris Frentrup, Senior Regulatory Analyst, MCI to William F. Caton, Secretary, FCC, April 18, 1997.

[53] MCI refers to our decisions to reinitialize PCIs to the levels at which they would have been had we adopted a 4.0 percent minimum X-Factor in the LEC Price Cap Order, and to remove OPEB costs from the PCIs. See LEC Price Cap Performance Review, 10 FCC Rcd at 9069-70 (paras. 245-50); 9095-97 (paras. 307-09).

[54] See LEC Price Cap Order, 5 FCC Rcd at 6791 (para. 34); LEC Price Cap Performance Review, 10 FCC Rcd at 8973-74 (paras. 27-29).

placing less rather than more importance on LEC interstate earnings. For these reasons, we reject that alternative as a means for prescribing an X-Factor.

26. US West suggests setting the X-Factor equal to the GDP-PI, and thereby freezing the PCIs at their current levels as a means of simplifying the price cap plan.[55] We reject US West's proposal, because it would not provide access customers with any benefits from productivity growth, and so would not strike a reasonable balance between stockholders and ratepayers.[56]

2. Direct Approach

27. In the Price Cap Fourth Further Notice, we invited comment on replacing the PCI formula completely with a formula based on what we called the "direct approach."[57] Under the direct approach, the PCI would change by the percentage change in LEC input prices minus the percentage change in LEC TFP. The direct approach eliminates the GDP-PI (or any other measure of economy-wide inflation), nation-wide TFP indices, and nation-wide input price indices needed to calculate the X-Factor in our current PCI formula.

28. We decide not to modify our PCI formula so that the X-Factor can be calculated under the "direct approach," as suggested by Sprint and GTE, among other parties. First, for reasons discussed in Section V. below, we adopt in this Order a fixed X-Factor until the next scheduled performance review. Adopting a direct approach without also adopting a moving average-based method of updating the X-Factor on an annual basis would result in a PCI formula that reduces PCIs by a certain percentage every year. By definition, a direct approach without a moving average would require prices to decrease by the same nominal percentage regardless of whether the national economy is experiencing high or low inflation. Under a direct approach, with the PCI formula updated only in periodic performance reviews, there is no possible mechanism to incorporate an unexpected increase or decrease in inflation that occurs between performance reviews. Retaining a PCI formula that reflects changes in overall prices is more consistent with our decision to prescribe a fixed X-Factor rather than updating the X-Factor on a moving average basis. Second, we agree with AT&T that the direct approach does not simplify the PCI formula nearly as much as Sprint claims, because the approach eliminates only non-controversial terms from the PCI formula, or terms that can be based on publicly available data.

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[55] US West Comments at 3-5; US West Reply 4-5.

[56] Price Cap Fourth Further Notice, 10 FCC Rcd at 13673 (para. 93).

[57] LEC Price Cap Performance Review, 10 FCC Rcd at 9216 (App. F, equation 7); Price Cap Fourth Further Notice, 10 FCC Rcd at 13668-69 (para. 61).

C. TFP Calculation Issues

1. Background

29. In the LEC Price Cap Performance Review, we noted that changes in a firm's costs of producing a unit of output are the product of both changes in the quantity of resources used, i.e., changes in productivity, and changes in the prices paid for those resources, i.e., changes in input prices.[58] We tentatively concluded that the X-Factor should include both a measure of productivity growth and a measure of input price changes.[59] In this Section, we consider methods to estimate changes in productivity. In Section D. below, we consider methods to estimate changes in LEC input prices.

30. In general, TFP models measure productivity as the ratio of an index of the outputs of a firm (or industry, or nation) to an index of its inputs over a given period of time.[60] The growth in productivity is simply the amount by which this ratio changes over time. In these calculations, every effort is made to isolate the real change in productivity from the effects of simple price changes. This is why, in a subsequent section, we consider separately the matter of changes in input prices.

31. A LEC's outputs are the services it provides, and the output index represents the quantities of services provided. For purposes of constructing the output index, quantities of services can be measured directly, based on such measures as minutes of use or number of access lines, or indirectly, by dividing revenues by an index of output prices. Output indices can be developed to represent changes in the quantity of each individual LEC service over time, or services can be aggregated into one or more categories. The categories are weighted, either on the basis of costs or revenues, to make the output index.

32. LEC inputs consist of three major factors of production: labor, materials, and capital services (services provided by plant and equipment). As explained further below,

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[58] LEC Price Cap Performance Review, 10 FCC Rcd at 9033 (paras. 160-61) and 9213-40 (App. F). See also Price Cap Fourth Further Notice, 10 FCC Rcd at 13668 (para. 54).

[59] LEC Price Cap Performance Review, 10 FCC Rcd at 9033 (para. 160); Price Cap Fourth Further Notice, 10 FCC Rcd at 13668 (para. 54).

[60] We also provide overviews of the TFP method in the LEC Price Cap Performance Review, 10 FCC Rcd at 9008-10 (paras. 106-07), and the Price Cap Fourth Further Notice, 10 FCC Rcd at 13663-64 (paras. 23-24), and Att. A.

TFP analysis assumes capital services are a fixed proportion of the capital stock.[61] TFP theory and practice estimates the growth in capital services using the assumption that the level of capital services is some fixed proportion of the capital stock available at the beginning of the year. Capital services can be measured as changes in the level of capital stock. Although these factors can be disaggregated further, all the parties presenting TFP models limited themselves to these three input factors. The growth rate of total input index is determined by the growth rates of the capital, labor, and materials input indices, and by their relative by the relative weight given each input index. As discussed below, measuring the growth rate of capital input is a particularly complicated procedure, requiring, among other things, a determination of capital stock and the flow of capital services from capital stock.

33. We have reviewed the TFP models submitted by Ad Hoc, AT&T, and USTA in response to the Price Cap Fourth Further Notice, the comments received in response to the Access Reform Notice, the numerous ex parte filings in both dockets providing additional or updated data or critiques, and the various estimates of TFP and input price differentials. On the basis of our review, we have determined the most reasonable method of performing each step of a TFP calculation. We discuss our conclusions on each of these TFP calculation issues below. We find that no study in the record embodies all the best TFP calculation practices. We then calculate TFP using the most reasonable parts of each TFP study as it was presented by the record. As explained in detail below, we rely primarily, but not exclusively, on the results of that analysis for our X-Factor prescription.[62]

34. In Section 2., we summarize the results of USTA's, AT&T's, and Ad Hoc's models. In Section 3., we address output index issues. We address issues regarding the capital, labor, and materials input indices in Section 4. Subsequently, in Section D, we analyze other X-Factor calculation issues, such as how to calculate the input price differential, whether to adjust for claimed differences in interstate and intrastate productivity growth, whether to include a CPD, and whether to make adjustments at this time for the access charge reforms we adopt in the Access Reform First Report and Order. In Section E. below, we prescribe an X-Factor of 6.5 percent, based on our analysis of these issues.

[61] Capital stock in the base year of a TFP study period is the book value of plant. For the second year, the capital stock is derived by reducing the first period's capital stock for depreciation, and increasing it by the second period's plant additions that have been deflated by the change in capital stock prices. See Section III.C.4.a.(2).

[62] See Section III.E., infra.

2. TFP Models Placed in Current Record

35. USTA has submitted its simplified TFP model. That model is a revision of its original TFP model,[63] which was addressed in our LEC Price Cap Performance Review.[64] USTA supports updating the X-Factor annually on the basis of a five-year moving average. For the nine LECs included in its original TFP study, USTA claims its simplified TFP model results in average difference between LEC and U.S. national productivity growth of 2.9 percent from 1988 to 1993, 3.1 percent from 1989 to 1994,[65] and 2.7 percent from 1990-95.[66] USTA asserts that the input price differential is zero, and makes no adjustment for a consumer productivity dividend.[67]

36. AT&T maintains that its TFP-based model corrects errors in USTA's original TFP model.[68] In response to the Price Cap Fourth Further Notice, AT&T recommends a baseline X-Factor of 7.8 percent, based on estimates of interstate-only TFP and an input price differential, and including a Consumer Productivity Dividend (CPD).[69] We discuss

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[63] While the LEC Price Cap Performance Review was pending, USTA made two price cap proposals. The first, submitted in USTA's 1994 comments, based the X-Factor on TFP. LEC Price Cap Performance Review, 10 FCC Rcd at 9008 (paras. 104-11). In a January 18, 1995, ex parte statement, USTA submitted its second proposal, basing the X-Factor on a moving average of industry-wide TFP data, but did not make any significant revisions to its TFP calculations. In the Price Cap Fourth Further Notice, we often referred to USTA's original TFP study to illustrate the TFP issues on which we were seeking comment. Price Cap Fourth Further Notice, 10 FCC Rcd at 13663 (para. 22). For the purposes of this Order, we will refer to USTA's 1994 TFP calculations as the "Original TFP Model."

[64] Because USTA has made revisions to the original TFP model, we will not discuss that model in detail here, nor will we discuss in detail whether the data in USTA's original model met the general criteria discussed in the Price Cap Fourth Further Notice. See Ad Hoc Comments, Att. at 5-14, 60-61; AT&T Comments at 9-11, and App. A at 3-6; USTA Comments at 32-33 and App. A; MCI Comments at 9-11; TRA Comments at 2-3; LDDS Reply at 5.

[65] USTA Comments, App. A at 30-32.

[66] USTA 1997 Comments, Att. 5 at 1-4.

[67] USTA Comments at 26 and App. C at 3-6; USTA Reply, Att. A at 23-25. See also US West Comments at 7, 16; Southwestern Bell Comments at 11; NYNEX Comments at 21; BellSouth Comments at 14-16; Bell Atlantic Comments at 11-12; Lincoln Comments at 4; Ameritech Comments at 4-5; GTE Comments at 11 and App. B, App. F; NYNEX Reply at 5; Pacific Reply at 4, citing California PUC Opinion at 68-69.

[68] AT&T Comments at 24-26; AT&T Reply at 35-37.

[69] AT&T Reply at 38 n.78. For purposes of comparison, AT&T would recommend setting the X-Factor at 5.42 percent, based on total company TFP and an input price differential, and excluding a CPD. AT&T Reply at 38-40. AT&T updated its results to include data BLS released between the time AT&T filed its reply and its comments. Compare AT&T Reply at 38-40 with AT&T Comments at 29.

AT&T's interstate TFP adjustment in Section D.2. below. Later, in its 1997 pleadings, AT&T updated its study with 1995 data, and found an interstate-only TFP-based X-Factor of 9.0 percent from 1985 to 1995, including a CPD.[70]

37. Ad Hoc also adjusts USTA's original TFP model to correct for alleged methodological errors. Specifically, Ad Hoc recommends adjusting TFP to estimate interstate-only productivity, and including an input price differential in the X-Factor. Ad Hoc proposes an X-Factor of 9.4 percent, which is composed of an estimated TFP growth of 6.0 percent for interstate services, and an input price differential of 3.4 percent.[71] Ad Hoc states that adopting all its recommendations except its interstate/intrastate adjustment results in an X-Factor of 6.6 percent.[72]

38. Ad Hoc submitted its models in the proprietary format of a commercial software program to which we do not have access. The format makes it quite difficult for us to validate its results or to compare them with those of other models in a manner similar to that shown in Section III.E. below. To the extent that Ad Hoc reveals its intermediate results, its input price index appears to suffer some of the same infirmities as USTA's original model, and to exhibit erratic fluctuations. Furthermore, as discussed further below, we find that the revisions Ad Hoc does make to USTA's original TFP model do not improve the model. Specifically, Ad Hoc makes an interstate-only TFP adjustment, recommends making a hedonic adjustment, and does not weight the capital input index on a residual earnings basis. Therefore, we do not give any weight to Ad Hoc's X-Factor estimates. We discuss AT&T's and USTA's models below in greater detail, and we resolve TFP calculation issues on the basis of that analysis.

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[70] AT&T 1997 Reply, App. G at 31-32. AT&T's calculations would yield a total company TFP-based X-Factor, including the input price differential but excluding a CPD, of 6.20 percent. Id.

[71] Ad Hoc Comments, Att. at 53-56. Ad Hoc's recommended adjustments are discussed in more detail below.

[72] Specifically, Ad Hoc proposed an X-Factor of 7.1 percent, including a CPD of 0.5 percent. Ad Hoc Comments, Att. at 56. For purposes of comparison, Ad Hoc in its reply based its calculations on data submitted in USTA's comments. Ad Hoc claims that the X-Factor would be 7.9 percent, excluding a consumer productivity dividend, from 1989 to 1993; 5.9 percent from 1990 to 1994; and 7.3 percent from 1989 to 1994. Ad Hoc Reply, Att. at 36.

3. Output Index Issues

a. Mathematical Construction of Output Indices

39. Background. In the Price Cap Fourth Further Notice, we invited parties to recommend appropriate methods for calculating output price indices for TFP studies.[73] As noted earlier, output quantities can be measured directly based on such measures as minutes of use or number of access lines, or indirectly, by deriving quantities by dividing output revenues by a price index. In the Price Cap Fourth Further Notice, we identified various potentially relevant mathematical techniques for constructing indices: the Laspeyres Price Index, the Chained Laspeyres Index, the Paasche Price Index, and the Fisher Ideal Index.[74]

40. Discussion. USTA and AT&T both use physical output measurements for certain access service categories.[75] While AT&T's TFP study measures all output directly[76] using the Fisher Ideal Index method,[77] USTA advocates indirect measures for certain outputs. For example, USTA uses deflated revenue to measure special access output, arguing that using special access line counts is too simplistic.[78] When it measures output indirectly, USTA divides total revenues by output price indices that are based on an approximation of a chain-linked Paasche method, and then creates output quantity indices using the Tornquist index method.[79] USTA also contends that using physical measures of output in its local service and toll service categories is inaccurate because it treats each local call identically, and does not capture differences such as the time of day of toll calls, or the effects of vertical services. USTA claims this causes AT&T's study to overstate TFP growth by 0.9 percent.[80]

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[73] Price Cap Fourth Further Notice, 10 FCC Rcd at 13994 (para. 26).

[74] Price Cap Fourth Further Notice, 10 FCC Rcd at 13994 n.52. In Appendix D to this Order, we describe the Fisher Ideal Index in more detail. We discussed the Laspeyres and Paasche index forms in the AT&T Price Cap Further Notice, 3 FCC Rcd at 3435-36 (paras. 444-45).

[75] In its 1996 pleadings, USTA identifies its "end user access" and "interstate switched access" categories. USTA Reply, Att. at 10. In its 1997 pleadings, USTA identifies its "local service" and "LEC toll" categories. USTA 1997 Comments, Att. 6 at 9-10.

[76] AT&T Comments, Att. A at 72-73.

[77] AT&T Comments, App. B at 5-6.

[78] USTA Reply, Att. A at 9-12.

[79] USTA Comments at 14-15.

[80] USTA 1997 Comments, Att. 6 at 9-10.

41. We find that, although both methods can be reasonable for calculating TFP growth in most contexts, use of physical output measures is better suited to calculating TFP for purposes of prescribing an X-Factor. Use of physical output measures simplifies the analysis, and USTA has not shown that that method yields results less accurate than use of deflated revenues. Specifically, USTA has not explained why a toll call made during the day should count more than a night or weekend call for purposes of determining output in a TFP study. Furthermore, we disagree with USTA's contention that using physical measures overstates TFP growth because they do not adequately reflect vertical services. We expect that the quantities of vertical services will increase faster than the inputs used to provide those services in the future, because the price cap LECs have only relatively recently deployed the SS7 facilities necessary to provide vertical services widely in their networks. Thus, increased output of vertical services reasonably could occur as a result of such recent investment rather than directly requiring further inputs through new investment. To the extent that new investment does occur, we believe it likely would result in further or additional increases in output beyond the output increases generated by the prior investment. At the same time, since the LECs have begun marketing vertical services only relatively recently, demand for these services is likely to grow. Thus, physical measures of services should produce conservative measures of productivity and productivity growth.

42. In its 1997 comments, USTA claims that AT&T overstates output growth because it measures common line output by minutes of use rather than number of access lines.[81] USTA also criticizes AT&T's model because it derives common line minutes of use for the period from 1984 to 1985 on the basis of an extrapolation of data for the period from 1986 to 1992.[82] AT&T replies that its extrapolation is necessary in order to create a consistent series from divestiture to the present, because common line data were not recorded separately from switched access before 1988.[83] We find that where both line and minute data are available, converting all common line output to a per-minute basis is not desirable. Therefore, in our staff analysis, we measure end user common line growth on a per-line basis, and carrier common line growth on a per-minute basis. For the period before 1988, switched access minutes provide a reasonable surrogate for carrier common line minutes. Thus, in our staff analysis in Appendix D, we measure output quantities directly on the basis of switched access lines,[84] special access lines, and switched access minutes of use.

[81] USTA 1997 Comments, Att. 6 at 10-11.

[82] USTA 1997 Comments, Att. 6 at 25-26.

[83] AT&T 1997 Reply, App. G at 29-30.

[84] For the purposes of our TFP calculation, we define "access lines" as business lines, residential lines, and public access lines.

43. As a technical matter, our review of the relevant economic literature indicates that the Fisher Ideal Index is superior to the approximated Paasche chain index and Tornquist Index used by USTA for the construction of deflated revenue quantity indices.[85] For example, Diewert states that the Fisher Ideal Index is the only index that satisfies twenty well-defined mathematical tests.[86] We therefore use the Fisher Ideal Index form in our analysis.

b. Number of Output Categories

44. Background. In the Price Cap Fourth Further Notice, we noted that USTA developed output indices for seven categories in its original TFP study. We sought comment generally on whether USTA's output categorization was reasonable, or whether any of USTA's categories should be combined or subdivided.[87]

45. Discussion. Both USTA and AT&T base their output categories on ARMIS 43-02 reporting groups. USTA uses seven categories, while AT&T uses three. We include three output categories in our analysis of the record: local, intrastate toll plus intrastate access, and interstate access. We find that this categorization is sufficiently disaggregated to provide an accurate measure of output growth, and is easy to implement because we have collected data in ARMIS on this basis.

46. USTA, in effect, holds that both we and AT&T should have retained miscellaneous services as a fourth category. The three output categories that both we and AT&T use include the services in six of USTA's seven output categories, but exclude those in USTA's miscellaneous services category. USTA claims that, by excluding these miscellaneous services, AT&T's model overestimates TFP growth by 0.4 percent from 1988-94, and 0.5 percent from 1989-94, because miscellaneous services output has grown more slowly than other LEC outputs.[88] This apparently slower growth, however, is a direct result of USTA's use of GDP-PI when it calculates output quantities by deflating revenues by a price index. USTA used the GDP-PI because it did not have a specific measure of miscellaneous service prices. Because GDP-PI rose substantially over the period while the prices of LEC services other than miscellaneous services fell sharply, it is obvious that miscellaneous output estimated in this manner would grow more slowly. It is not at all obvious, however, that GDP-PI is an appropriate price index for miscellaneous services.

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[85] Diewert, Fisher Ideal Output, Input and Productivity Indexes Revisited, 3 J. Productivity Analysis 211 (1992).

[86] Diewert, id.

[87] Price Cap Fourth Further Notice, 10 FCC Rcd at 13994 (para. 27).

[88] USTA 1997 Comments, Att. 6 at 8.

Furthermore, examining the major components of this category reveals that it is a collection of highly diverse activities. Many of these, such as White and Yellow Pages operations,[89] are at best ancillary to telecommunications services. We also note that the composition of this category varies widely from year to year. Because of these characteristics, we do not believe it is feasible to construct a valid quantity measure for this category. Accordingly, we exclude USTA's miscellaneous services category from our analysis. Moreover, because most of the services in this category appear to be produced using a separate production function from that used to produce telecommunications services, it is not unreasonable to exclude miscellaneous services. For these reasons, we exclude the miscellaneous services output category completely from our output index.

c. Weighting of Output Categories

47. Background. Regardless of whether output quantity growth rates are based on physical measures or deflated revenues, TFP studies with more than one output category must adopt some weighting scheme to combine the categories into a single index. In the Price Cap Fourth Further Notice, we sought comment on the proper weights for aggregating output quantity categories. We observed that USTA's original TFP study used revenue weights for the output index, and we found that this weighting implicitly assumes that the revenue of a service is a reasonable measure of its value. We questioned whether it is reasonable to make this assumption in an industry where incumbent LECs face different levels of competition for their services, and rates diverge to varying degrees from the costs of producing those services. Therefore, we sought comment on alternative weighting schemes for output categories.[90]

48. Discussion. We conclude that, despite the doubts we expressed in the Price Cap Fourth Further Notice,[91] revenue weights are the best weighting method available. In its comments in response to the Price Cap Fourth Further Notice, AT&T recommends weighting the output indices on a marginal cost basis, arguing that revenue weights will not approximate more economically meaningful marginal cost weights until competition has developed further.[92] Neither AT&T nor any other party in this proceeding, however, has provided estimates of marginal cost weights. Instead, AT&T uses booked costs as a surrogate for marginal cost weights. BellSouth asserts that using fully distributed costs, such as booked costs, as a surrogate for marginal costs would be unreasonable except in cases

[89] See 47 C.F.R. § 32.5230.

[90] Price Cap Fourth Further Notice, 10 FCC Rcd at 13994 (para. 28).

[91] Price Cap Fourth Further Notice, 10 FCC Rcd at 13994 (para. 28).

[92] AT&T Comments at 23-24 and App. A at 60-63; AT&T Reply at 34.

where there are no economies of scale, and therefore booked cost weights are inappropriate for calculating LEC TFP.[93] In its TFP model, the Interstate Commerce Commission (ICC) concluded that use of revenue weights was unlikely to bias its output index seriously over time.[94] Finally, we note that AT&T has switched its recommendation from cost-based weights to revenue weights.[95] Accordingly, we agree with the parties that revenue weights are the most reasonable basis of aggregating output indices.

4. Input Index Issues

a. Capital

(1) Background

49. The capital input index measures the amount of capital services used by the LEC to produce output. "Capital services" represent the contribution capital makes to the production of output. Capital input quantities generally assume that the capital services in a time period are proportional to the stock of capital available in that period. Capital input quantities are constructed for a number of asset categories of plant and equipment.[96] The development of the aggregate capital input index requires three determinations: (1) the capital stock for each asset category, (2) the capital input quantities from these capital stocks, and (3) the relative weight that each asset category should have in the final aggregate capital input index.

50. Typically, the "perpetual inventory method" is used to develop a constant dollar capital stock. The nominal dollar level of capital stock in the first period, called the benchmark capital stock, is generally derived by adjusting gross booked investment, either by subtracting the associated accumulated depreciation and amortization reserves, or multiplying by a ratio of market to book value of investment derived from another source. The capital stock for the next period is derived by reducing the first period's capital stock for depreciation, and increasing it by the second period's plant additions that have been

[93] BellSouth Reply. Att. at 29-30.

[94] Railroad Cost Recovery Procedures - Productivity Adjustment, Ex Parte No. 290 (Sub-No. 4), 5 ICC 2d 434, 462 (1989) (ICC TFP Order), aff'd sub nom. Edison Electric Institute v. FCC, 969 F.2d 1221 (D.C. Cir. 1989).

[95] See Ex Parte Letter from Brian W. Masterson, Government Affairs Director, AT&T, to William F. Caton, Secretary, FCC, April 16, 1997.

[96] For example, USTA based its capital input index on six asset types in its original TFP study. Fourth Further Notice, 10 FCC Rcd at 13664 (para. 29).

deflated by an asset price index.[97] We discuss this process in detail in subsections (2) and (3) below.

51. Once we have calculated constant dollar capital stocks, we need to measure the capital services that these stocks generated. In the Price Cap Fourth Further Notice, we sought comment on two measures. One measure assumes capital services are a constant proportion of capital stock, and that the growth of capital services is measured by the growth in capital stock. A second measure focuses on "capital consumption," i.e., changes in the level of efficiency in the capital stock over time.[98] We discuss this issue further in subsection (5).

52. The aggregate capital input quantity is a weighted average of the input quantity of all the capital input categories.[99] The weights are based on the price, or "rental value" of the capital services provided by each asset category, or in other words, an estimate of what the rental value of those assets would be in an competitive market, if one existed. We stated in the Price Cap Fourth Further Notice that this "implicit rental price" includes the rate of return, the depreciation rate, and tax rates.[100] Below in subsection (2), we decide to have only one capital input index. Nonetheless, issues relating to weighting asset categories are still relevant because the method used to develop weights for aggregating asset categories into a single index are also used to aggregate capital, labor, and materials into the final, single input index. We discuss the weighting of the capital input index relative to the labor and materials indices in subsection (6).

(2) Capital Stock

53. Background. The capital input index for a TFP study requires the calculation of capital stock -- the real (or constant dollar) value of LEC net investment. In the Price Cap Fourth Further Notice, we invited comment on several issues related to the calculation of capital stock. We asked generally whether the perpetual inventory model in USTA's original model was the best method to derive capital stock quantity indices, and if not, what other method would be preferable.[101] In particular, we asked whether the benchmark capital stock,

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[97] The perpetual inventory method is also discussed briefly in the Price Cap Fourth Further Notice, 10 FCC Rcd at 13666 (para. 41). A more detailed description can be found in Christensen and Jorgenson, The Measure of U.S. Real Capital Input, 1929-1967, 15 Rev. of Income and Wealth 294 (December 1969).

[98] Price Cap Fourth Further Notice, 10 FCC Rcd at 13667 (para. 47).

[99] In subsection (4) below, we address the issue of how many asset classes should be used in a TFP study.

[100] Price Cap Fourth Further Notice, 10 FCC Rcd at 13664-65 (para. 31).

[101] Price Cap Fourth Further Notice, 10 FCC Rcd at 13666 (para. 46).