In the *First Report and Order*, the Commission concluded that there "is an insufficient record to choose a long-term methodology for computing the X-Factor."[14] Thus, using the original method with an update[15] to the Frentrup/Uretsky study (now referred to as the Historical Price Method),[16] the Commission concluded that the mandated X-Factor should have been 4.0 percent.[17] Using this as a basis, the Commission established three X-Factor options: 4.0, 4.7, and 5.3 percent. The 4.0 and 4.7 percent options retained sharing. The 5.3 percent option relieves any LEC selecting this option from the sharing requirement.[18]

In addition, the Commission decided that the X-Factor "should be based on an industry-wide measure of performance, and it should incorporate productivity changes that have occurred since the institution of price cap regulation."[19] Having decided this, the Commission reached the tentative conclusions that: the X-Factor should not be fixed but recalculated routinely and automatically as a moving average; a TFP methodology should be adopted; and the long-term plan should have at least two X-

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[14] *First Report and Order,* 10 FCC Rcd at 9026.

[15] The 1984 data point was excluded from the Frentrup/Uretsky study. *See First Report and Order,* 10 FCC Rcd at 8970.

[16] *See Fourth Notice* at para. 86.

[17] *See First Report and Order* at 8970.

[18] *Id.* at 8971.

[19] *Id.* at 9026.

Factor options.[20] In the *Fourth Notice*, the Commission seeks to establish the long-term rules governing the X-Factor. Therefore, the Commission asks for comment on the appropriate methodology for calculating the X-Factor, the means of updating this factor, how many factors there should be, and the relationship of the X-Factor to sharing, the common line formula, and exogenous cost treatment.

Just as contentious as the X-Factor issue was the debate over the formula for the Common Line basket. The Commission, in the *First Report and Order*, tentatively concluded that LECs have little influence over growth in common line usage and that the formula should be changed to a per-line formula, rather than the current Balanced 50/50 formula.[21] The Commission's position is that a per-line formula would recognize that loop costs are not traffic sensitive and would encourage Interexchange Carriers ("IXCs") to increase common line usage. In the *Fourth Notice*, the Commission readdresses the common line formula in relation to X-Factor methodologies in order to determine if any X-Factor methodologies eliminate the need for a separate common line formula.

The last major issue addressed in the *Fourth Notice* is exogenous cost treatment. The Commission changed the definition of exogenous costs in the *First Report and Order* to "economic cost changes caused by administrative, legislative, or judicial requirements beyond the control of the carriers that are not reflected in the

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[20] *Id.* at 9027.

[21] *Id.* at 9078-9079.

[GDPPI]."[22] Therefore, only accounting rule changes that affect a LEC's discounted cash flow can be claimed as exogenous costs. The Commission now seeks to establish the relationship between the proposed X-Factor methodologies and exogenous costs to determine if any particular methodology would include costs classified as exogenous and exclude those not classified as exogenous.

DISCUSSION

I. THE COMMISSION NOW HAS AVAILABLE A LEC INPUT INFLATION INDEX AND AN ACCURATE MEASURE OF LEC TFP.

The goal of price cap regulation is to mimic the behavior of output prices in a competitive market. This is best accomplished by utilizing a direct measure of changes in LEC unit cost and LEC TFP to cap LEC output price changes. This method eliminates all economy-wide data from the price cap formula and concentrates purely on the price cap LECs. Further, the use of direct measures eliminates the controversy over the input inflation differential.[23] The Commission's previous reasons for not using a direct method are no longer valid; *i.e.*, an input inflation index for LECs did not exist or that, if one did, the LECs could manipulate it.[24] The tentative conclusion by the Commission that "it is appropriate to incorporate an input price differential into a TFP-

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22 *Id.* at 9090.

23 The input inflation differential is the difference between economy-wide inflation and LEC inflation.

24 *See LEC Price Cap Order,* 5 FCC Rcd at 6792-93.

based X-Factor"[25] demonstrates that the Commission has an input inflation index for the LECs and is no longer concerned with manipulation.[26] Otherwise, an input inflation index for LECs could not be used to calculate an input price differential.

Moreover, as an approximation to competition, the current price cap formula (*GDPPI-X+/-Z*) is valid only if there is no differential between the US input price growth series and the LEC input price growth series. Unlike the situation that existed at the time of the earlier decision, a LEC input price growth series exists and is available. Christensen provided a time series of LEC input inflation as part of the TFP study placed on the record by USTA.[27] GTE submits that establishing a price cap formula based on LEC direct measurements is simpler, more accurate, and less controversial than the adoption of an X-Factor methodology that contains an input price differential.[28]

GTE supports the TFP results submitted by Christensen in this proceeding[29] and further endorses those proposed changes that simplify the model and use publicly available and verifiable data.[30] TFP-based methods calculate a specific productivity

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25 *First Report and Order,* 10 FCC Rcd at 9033.

26 GTE supports the use of the input price data in the Christensen study as it is methodologically consistent.

27 This time series is listed in Appendix F of the *First Report and Order.*

28 Further, as GTE will demonstrate *infra*, the statistical evidence indicates that the input price differential is a random variable whose mean over the long-run is zero. Any attempt to select a non-zero value for this differential would mis-specify the formula.

29 *See Fourth Notice* at para. 23.

30 *See* USTA's Comments in the instant proceeding, Attachment A.

growth factor that forces the industry output price index to behave as it would under competition. Thus, GTE concurs with the Commission's tentative conclusion that a "TFP approach should be used to calculate the X-Factor in the future."[31]

In summary: GTE recommends that the Commission adopt a price cap formula that consists of the growth of the LEC input price minus the rate of LEC TFP growth adjusted for exogenous costs. This eliminates all economy-wide data from the price cap formula. GTE also recommends the use of Christensen's simplified TFP model, which is the appropriate measurement of LEC productivity. GTE urges the Commission to adopt a price cap formula consisting of LEC-specific measurements only, and to further adopt Christensen's simplified TFP model as the appropriate measure of LEC TFP growth.

II. THE THEORETICALLY ACCURATE MEASURE OF THE PCI ADJUSTMENT IS THE GROWTH OF THE LEC INPUT PRICE MINUS THE RATE OF LEC TFP GROWTH. (Issue 1i)

A. A return to first principles -- a direct measure -- is called for given that a LEC input price index exists.

The growth of LEC input prices minus the rate of LEC TFP growth is the appropriate measure of the PCI adjustment factor (*see* Appendix A).[32] As the Commission previously stated:

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[31] *Fourth Notice* at para. 25.

[32] This is the formula used by the Interstate Commerce Commission ("ICC") for regulating the railroads -- changes in railroads' costs reflect changes in railroad productivity as well as changes in railroad input prices. *See* Interstate

> [W]e believe it is important to clarify and refine what economic changes we seek to capture in the index we will select. While our Notice sought to identify an index that captured changes in the purchasing power of money, i.e., a general index of inflation, its purpose in identifying such an index was to capture inflationary changes that the carriers themselves face. Thus, the index we seek to adopt should capture changes in the purchasing power of money as a measure of the cost of factors of production. By selecting an index that will most closely mirror the inflationary pressures faced by carriers, our price cap formula will produce a result more equitable to both the carriers and ratepayers.[33]

The Commission now has the ability to return to first principles -- an index that reflects the inflationary pressures faced by the LECs. Further, using a LEC-specific inflation index eliminates any perceived need for an input price differential -- long- or short-term -- which GTE firmly believes has no place in the price cap formula. As explained *supra*, the Commission's previous reasons for not using a direct measure are no longer valid. Given that an input inflation index exists, it is now correct to return to first principles and directly measure changes in LEC unit cost and LEC TFP to cap output price changes.

In competitive markets, a revenue-share-weighted average of industry output price growth $(\%\Delta P_{LEC})$ will equal a cost-share-weighted average of the industry input price growth $(\%\Delta W_{LEC})$ minus the rate of change of industry total factor productivity $(\%\Delta TFP_{LEC})$, plus or minus exogenous factors that would ordinarily effect changes in

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Commerce Commission *Ex Parte* No. 290 (Sub-No.7) Productivity Adjustment-Implementation, decided October 26, 1993, at 1072.

33 *Policy and Rules Concerning Rates for Dominant Carriers*, Further Notice of Proposed Rulemaking, CC Docket No. 87-313, 3 FCC Rcd 3195, 3389-90 (1988) ("*D.87-313 FNPRM*")

output prices, such as changes in accounting rules, taxes, *etc.* (the so-called exogenous or Z-Factor). The economically valid PCI adjustment factor is:

$$\%\Delta P_{LEC}=\%\Delta W_{LEC}-\%\Delta TFP_{LEC}+/-Z$$

where $\%\Delta P_{LEC}$ is the PCI adjustment factor, $\%\Delta W_{LEC}$ is the cost-share-weighted average of percentage input price changes and $\%\Delta TFP_{LEC}$ is the industry growth rate in percentages.

GTE could support the formula:

$$\%\Delta P_{LEC}=\%\Delta GDPPI-(\%\Delta TFP_{LEC}-\%\Delta TFP_{US})+/-Z$$

because of its ease of computation. This support is contingent on the Commission recognizing that no adjustment for deviations between the US and LEC input price change series is necessary. (*See* Appendix B.) This formula is an approximation of the economically sound formula proposed by GTE, and has the advantages of being more stable and not requiring a LEC input price index.

GTE cannot support the formula:

$$\%\Delta P_{LEC}=\%\Delta GDPPI-(\%\Delta TFP_{LEC}-\%\Delta TFP_{US})+W+/-Z$$

where W is an estimate of the difference between the US input price change series and the LEC input price change series. As shown in Appendix C, this last formula, if properly applied, reverts to the formula recommended by GTE.[34] If this formula is

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[34] If the US and LEC TFP and input price series are not measured using the same method, this last formula would not produce the same result as the formula proposed by GTE. Different calculation methods employed for these series reinforces the need to simplify the formula.

improperly applied, it merely creates another area for dispute and could produce results that are not economically meaningful.

It is particularly important to realize that there is no evidence that W is anything but a random process bouncing around zero. A permanent fixed input price differential, other than zero, would not be economically valid as discussed *infra*. Further, as more components are added to the formula, it becomes increasingly subject to error and manipulation. If different time periods were assigned for averaging each of the components, the formula could result in significantly different results. For example, if GDPPI is set at an annual value and TFP is set at a five-year moving average while W is set at a three-year moving average – just to obtain a specific desired result – the formula loses its economic validity.

B. Economic analysis demonstrates that the input inflation differential is zero.

Both Christensen[35] and Duncan[36] have presented evidence that the input inflation differential should be zero in the price cap formula. NERA confirms these points: (i) the long-term trend is not significantly different from zero at conventional confidence levels;

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[35] *See Ex Parte* Affidavit of Dr. Laurits R. Christensen on Behalf of the United States Telephone Association, *D.94-1*, dated February 1, 1995.

[36] *See* Appendix F, GTE California Incorporated Testimony and Reply Testimony of Dr. Gregory M. Duncan, California Public Utilities Commission NRF Reform Proceeding - I. 95-05-047, dated September 8 and 18, 1995, respectively. ("*Duncan*")

and (ii) it has not changed since the divestiture of the RBOCs.[37] Appendix F of the *First Report and Order* concludes that the input price differential from the 1984-1990 time period is not zero and should be used in calculating the X-Factor.[38] Appendix F is flawed by a complete misuse of statistical methodology which leads to an erroneous conclusion that there is a differential between the growth of LEC input prices and the economy-wide growth in input prices. Most egregious in that Appendix is the introduction of a dummy variable without theoretical support. The authors of Appendix F test the statistical significance of the variable and conclude there is evidence of a structural break in the series – that is a permanent change in the relationship between the two input price series. They do this without sensitivity analysis; had they done so, they would have found their purported structural break is merely a statistical artifact. For example, moving the starting date of the dummy to 1983, when divestiture was ordered, eliminates their finding. Their errors arise from a misunderstanding of classical hypothesis testing, and a misapplication of indicator variable, or dummy variable, methodology.

Their first error was in determining the null hypothesis. The hypothesis that there is no difference between the series should have been the one to be tested because: (i) economic theory suggests that the two series move together; (ii) the Commission's reason for replacing the LEC input price growth index with the US input price growth

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[37] See USTA's Comments in the instant proceeding, Attachment C.

[38] *See First Report and Order,* Appendix F at 13-14.

index was that the series should be the same; and (iii) numerous outside witnesses testified that the series are the same. The authors of Appendix F, instead, propose to test the hypothesis that there is a difference, but do not specify in advance what that difference is. They assume there is a difference, find an estimation technique that exhibits a difference, and then test the hypothesis that the data exhibit exactly that difference. This is called data mining, and it is unacceptable statistical methodology.

Duncan takes a time-series approach. He shows first that the series made up of differences between the two input price series is a stationary Autoregressive Moving Average ("ARMA") process. Stationarity implies that there is no structural break. He then goes on to show that the mean of the series, that is the estimated difference in the series, is zero. Finally, he shows that the difference in the series is totally random. This means that any observed differences between the series are totally transitory -- pure noise that should be ignored. In his reply testimony, Duncan employs the methodology of Appendix F, *arguendo*, to show that the same argument used by the authors of Appendix F can be used to give any W-Factor desired.

In fact, an examination of the data would show that the sign of the W-Factor changed again between 1990 and 1991. Since that time, LEC input prices have been growing faster than the input prices for the economy as a whole. If, using the methodology of Appendix F, a dummy variable were inserted after 1991, it also would indicate a structural break. Thus, the Appendix F methodology would dictate an even lower X-Factor than anyone in these proceedings has suggested. Duncan goes on to point out a number of other flaws in the methodology invented by the authors of

Appendix F, any one of which would be fatal.[39] GTE submits that a formula using direct measures would incorporate all available information concerning LEC input prices, without imposing any judgment as to whether a differential exists. This approach would eliminate the controversy over the input price differential.

C. Incorporating an input price differential is inconsistent with emulating competition and will cause unnecessary pricing instability.

Addition of an input price differential to a formula that is already an approximation is not consistent with either economic or statistical theory. Moreover, since the method is *ad hoc* and not based on methods of statistical or economic validity, it cannot be optimal. Indeed, not only may it show too much instability, it will most likely be biased.

Use of a differential formula which incorporates an input price differential could introduce instability in two ways. First, the differential formula requires the use of two additional variables, the $\%\Delta P_{US}$ and $\%\Delta TFP_{US}$. These are measured by using GDPPI and the Bureau of Labor Statistics ("BLS") TFP series, respectively. Any inconsistency between these national measures and LEC industry measures will introduce error and instability into the PCI estimate.

Second, any difference in the way these variables are introduced into the formula will also create error and instability. For example, if a fixed value is chosen for

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[39] *See Duncan.*

the input price differential, while a five-year moving average is used for TFP, then the differential formula will no longer correspond to the direct measure.

In summary: An optimal forecast of the difference between the LEC input price growth index and the rate of LEC TFP growth is the appropriate measure of the PCI adjustment factor. To the extent the Commission now has available a LEC input inflation index and an accurate measure of LEC TFP, it should return to first principles and employ the proposed direct measure. To simply add an input inflation differential to the existing price cap formula adds unnecessary and unwarranted complications and is not supported by theory. Moreover, it flies in the face of the Commission's stated desire to reduce the complexity of the formula, not to further complicate it. Finally, GTE's recommendation is grounded firmly in economic and statistical methodology and theory, and as such is relatively safe from manipulation.

III. TFP SHOULD BE BASED ON CERTAIN CRITERIA.

A. The Christensen method is the most reasonable method to develop output price indexes for TFP calculation purposes. (Issue 1a)

The proper method for determining TFP changes appropriate for calculating the PCI is to use a revenue-share-weighted average of percentage output changes minus a cost-share-weighted average of percentage input changes. Categories of inputs can be aggregated up to the point where input price growth of the components to be aggregated begins to deviate substantially. That is, as long as the relative prices of two inputs, or a group of inputs, do not change -- as would be the case if their growth rates were roughly the same -- the inputs can be combined and no further disaggregation will

improve accuracy. Further, additional disaggregation would require burdensome data gathering and time-consuming computation.[40]

B. The most appropriate measure of the cost of capital for a TFP study incorporates both debt and equity components. (Issue 1b)

Both debt and equity components should be included in a measure of the cost of capital. Christensen used Moody's Yield on Public Utility Bonds in the development of the TFP as it: (i) was publicly available data that was updated annually; and (ii) the absence of equity in Moody's had a negligible effect on measured TFP growth – which was what Christensen was measuring. As suggested by Christensen, the US National Income and Products Accounts could be substituted for Moody's bond yield. This recommended change would treat LEC and economy-wide costs of capital symmetrically,[41] and would be more consistent with an economically meaningful measure of the changes in the cost of capital when analyzing both TFP and input prices. Also, these data are readily available and publicly verifiable.

GTE does not support the Commission's authorized rate of return for use in a TFP study. The Commission's rate of return is not calculated annually and, because of the timing interval for represcription proceedings, could increase the volatility of the input price index. Further, represcription proceedings have no place in a price cap

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[40] GTE supports the simplified model proposed by Christensen whereby all data can be obtained from publicly available and verifiable sources. *See* USTA's Comments in the instant proceeding, Attachment A.

[41] Again, *see* USTA's Attachment A.

environment. They perpetuate a link to rate of return regulation, as opposed to regulation by the competitive marketplace. If, as the Commission proposes, the new price cap plan does not include sharing, then the need for an authorized rate of return for price cap LECs would disappear. Adopting the Commission's authorized rate of return for use in a TFP study would be a step in the wrong direction.

C. Economic depreciation rates are the relevant rates for TFP. (Issue 1c)

The Commission's prescribed depreciation rates are not appropriate for a TFP study because they generally differ significantly from economic lives. Technological developments have made obsolete the depreciation lives prescribed by the Commission.[42] Further, the bands established by the Commission for streamlined treatment also are not based on economic theory. Only economic depreciation rates have meaningful value in a TFP study. As the Commission notes (*Fourth Notice* at para. 37), the economic rates used by Christensen were taken from Jorgensen, a productivity expert who recently updated the rates for expected lifetimes of the Bureau of Economic Analysis ("BEA"). As the BEA updates its lifetimes -- which is done approximately every five years -- the results should be incorporated into new economic depreciation rates used to develop TFP.

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[42] *See Simplification of the Depreciation Process*, CC Docket No. 92-296, Report and Order, 8 FCC Rcd 8025 (1993).

The Commission (*Fourth Notice* at para. 39) asks if the six classes of assets used by Christensen are the most appropriate.[43] The Commission appears to be concerned that, although depreciation rates are prescribed for over 30 capital accounts, Christensen aggregates the assets into six categories. In GTE's view: first, the six asset categories used by Christensen are sufficient to construct an economically meaningful capital input measure. Second, even the BEA uses broad categories of assets. Third, it would be impossible to gather the data required to construct a capital input measure based on more than thirty accounts, and in any event it would be contrary to the Commission's goal of simplification.

D. The perpetual inventory method is a reasonable method to estimate capital stock just as the use of capital stock is a reasonable representation of capital services. (Issues 1d and 1e)

The perpetual inventory method[44] used by Christensen is the generally accepted method for performing productivity studies. Further, it is consistent with the approach used by the BLS in its TFP studies. The only alternative that would produce more accurate results requires the collection of data by vintage on all LEC plant and equipment for each

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[43] The asset classes used by Christensen are buildings, general support equipment, central office equipment (including operator systems), transmission equipment, information origination/termination equipment, and cable and wire.

[44] The quantity of capital is based on the cost of plant and equipment added in previous years and adjusted for changes in the prices paid over time, and declines in efficiency as a result of aging.

year included in a study. This is not only a prohibitively laborious task, but contrary to the Commission's desire to simplify the Christensen methodology.

The use of capital stock to represent the quantity of capital input is also consistent with BLS practices and with standard productivity research practices. Capital consumption is not a valid substitute for capital stock. Capital consumption implies that an asset loses capital efficiency over time. Using capital consumption to measure capital services incorrectly implies that an asset has not provided service over time –'which is not the case with telephone plant and equipment.

E. Christensen's method of converting capital stock into capital cost is based on economic theory. (Issue 1f)

As the Commission notes (*Fourth Notice* at para. 48), "the value of capital services is assumed to be the rental value in a competitive market of the capital stock providing these services." The Commission then questions Christensen's "implicit rental price,"[45] which is the hypothetical price of renting telephone plant and equipment in a competitive market. Capital stock must be turned into capital cost using a rental price equation. Christensen's implicit rental price, which bases capital cost on taxes, economic depreciation, capital gains, and the cost of capital, is soundly based on economic theory and is consistent with the rental price equation used by BLS.[46] Christensen's implicit

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[45] Capital stock is multiplied by the implicit rental price to determine the value of capital services.

[46] *See* USTA's Comments in the instant proceeding, Attachment A.

rental price formula does introduce significant volatility in capital prices. This volatility has little impact on TFP, but has a significant impact on input prices. Therefore, it is particularly important that any PCI estimate which is based on LEC input prices should be optimally forecast using the method proposed by GTE.

F. Labor should not be further decomposed, and the GDPPI remains a valid approximation of a material price index. (Issues 1g and 1h)

Christensen used management and non-management hours in the development of the LEC TFP. The Commission now asks (*Fourth Notice* at para. 52) whether or not labor categories should be further subdivided based on education or vocational experience. First, if the Commission is really attempting to simplify the TFP methodology, then further disaggregation is not the solution. Second, even the management and non-management hours used by Christensen are not publicly available.[47] If the Commission wants publicly available data, then total employees, as reported on the ARMIS 4302 Report, is the only data available to be used in a TFP study.

Third, as noted above, categories of inputs can be aggregated up to the point where input price growth begins to deviate substantially. That is, as long as the relative prices of two inputs, or a group of inputs, do not change – as would be the case if their

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[47] Although non-management hours are reported, not all management hours are reported and, therefore, any numerical value assigned to management hours must be based on an estimate of the average hours worked by management employees.

growth rates were roughly the same -- the inputs can be combined and no further disaggregation will improve accuracy. Further, such disaggregation would require burdensome data-gathering and time-consuming computation. In the case of labor, wages within a corporation tend to move together. So do wages within an industry. Benchmarking the wages of jobs relative to other firms in the industry is a common practice of large corporations. This, among other things, reinforces the tendency for wages to grow at the same rate. This common growth means that the relative prices between the jobs stay fairly constant, thus allowing the aggregation of labor into a small number of categories

Christensen used the GDPPI as a proxy for a material index because it is virtually impossible to calculate one. Material purchases made by LECs would have to be categorized and indexes of the prices paid developed. The data involved makes it prohibitive to develop a material index, and certainly would complicate the calculation of TFP -- not simplify it. GDPPI is an acceptable proxy.

G. TFP should be based on TOTAL company productivity. (Issue 1j)

GTE does not support the calculation of a separate interstate TFP because it is not economically meaningful. A properly constructed productivity offset: (i) reflects the entire range of diverse factors that cause changes in the unit cost of production for the LECs; and (ii) should measure changes in the overall efficiency of production. Partial measures of productivity are inconsistent with the economics of price caps because they are confined to particular inputs or outputs.

Further, unless the technology of the industry is separable between inter- and intrastate production, there is no economically meaningful method of separating production. The appropriate PCI will contain the effects of all inputs and outputs used by the firm. It will not be distorted by artificial jurisdictional separations that have no basis in production and have no significance in market terms. Separability requires that the production of the separable activities be most efficiently done independently. If there are common facilities or shared resources, the activities are not separable. Since all services eventually use a loop, switch, processor or port, interstate and intrastate telecommunications services are not separable and cannot be treated separately.

The difference in demand between intra- and interstate services is not an issue with TFP. There is a direct relationship between output growth, whether it is intra- or interstate, and TFP growth. As discussed by NERA, faster output growth in usage leads to faster replacement of the switches and trunks that produce both intra- and interstate usage services. Therefore, more rapid interstate usage growth leads to more rapid TFP growth, and vice versa for intrastate. TFP growth rates would be the same, independently of which service was growing faster over any historical period.[48] It clearly would be inappropriate to attempt to separate TFP into intra- and interstate.

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[48] *See* USTA's Comments in the instant proceeding, Attachment C.

H. Other firms should not be included in the TFP calculation. (Issue 1m)

GTE does not support the inclusion of firms other than price cap LECs in the calculation of TFP. As a matter of precedent as well as logic, price cap regulation establishes productivity factors based only on those firms being regulated. This conclusion is demonstrated by the following: First, the Commission based the productivity factor in AT&T's price cap formula only on AT&T's expected productivity. Second, although the productivity factor for the cable industry was set at zero, the Commission did not consider the inclusion of other industry segments in establishing this factor. Third, the Rail Cost Adjustment Factor ("RCAF") used by the ICC reflects only railroad productivity.[49]

Even if a precedent had not been established for developing productivity factors based on the industry segment being regulated, it would be improper to include other than price cap LECs in a measurement of TFP for the LEC price cap formula. Inclusion of other industry segments could distort the estimate of actual achieved productivity growth of price cap LECs.

For example, LECs operating under rate of return regulation do not have the same incentive to achieve productivity gains as price cap LECs. Therefore, inclusion of

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[49] "[T]he RCAF calculation was modified so that changes in railroad costs would reflect changes in railroad productivity as well as changes in input prices." *(footnote omitted)* Interstate Commerce Commission Reports, *Ex Parte* No. 290 (Sub-No. 7), Productivity Adjustment-Implementation, decided October 26, 1993, at 1072.

rate of return LECs could have the effect of lowering the productivity factor because their growth in productivity year-to-year would be lower than that of the price cap LECs. Although this would definitely benefit the price cap LECs, GTE does not support this action. Even if the Commission wanted to include firms other than price cap LECs, the reality of the situation is that it would be impossible to obtain the data required to produce a TFP study for multiple industry segments without imposing burdensome reporting regulations on these other industry segments. As the Commission strives to eliminate unnecessary and burdensome regulation,[50] the imposition of reporting requirements necessary to develop a TFP study would be a major step backward.

Given that the price cap methodology attempts to mimic competition among LECs, the TFP should be developed using only the price cap LECs' inputs and outputs. To introduce other industry segments into the study would distort the accuracy of the price cap in replicating the discipline of the market that dictates LECs' performance, in the same way that introducing the orange-producing segment of the fruit industry would distort the picture of price changes applicable to apple producers.

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50 "[W]e propose to eliminate unnecessary regulatory burdens ...." *Streamlining the International Section 214 Authorization Process and Tariff Requirements*, Notice of Proposed Rulemaking, IB Docket No. 95-118 (released July 17, 1995) at para. 2. Also, "existing tariff filing requirements are unnecessary and overly burdensome ...." *Tariff Filing Requirements for Nondominant Common Carriers*, Memorandum Opinion and Order, CC Docket No. 93-36, 8 FCC Rcd 6752 (1993).

I. Universal Service and other subsidy programs do not require an adjustment to the TFP calculation. (Issue 1l)

TFP captures all outputs including the increased usage resulting from Universal Service and other subsidy programs. Further, calculation of a total company productivity factor, which is the only correct way to calculate TFP, encompasses subsidy programs instituted by the states.

In summary: The simplified TFP method proposed by Christensen in the instant proceeding meets all the criteria established by the Commission as it is: economically meaningful; reasonably simple; and based on accessible and verifiable data. Further, it is correct in its use of total company productivity as opposed to partial measures (*i.e.*, interstate only); and contains only information relative to the industry segment being regulated.

IV. GTE WOULD SUPPORT A PCI ADJUSTMENT FACTOR BASED ON A FIVE-YEAR ROLLING AVERAGE, BUT RECOMMENDS IT BE FORMALLY FORECAST. (Issues 3a, 3b, 3c, 3d)

To emulate the working of a competitive market, the PCI adjustment factor should be a forward looking estimate, based on past history. GTE will propose *infra* an optimal method for arriving at this estimate.

Competitive markets act as though they optimally forecast prices. Specifically, the market uses the available information to predict the likely output and input prices. Since inputs are purchased in competitive markets, all the information on a going forward basis is contained in the prices and past prices. This is because the price

summarizes all the impacts from all the different forces that affect markets. For example, using data on droughts might explain why the price of wheat behaved as it did, but it would give no new information about the price of wheat for next period unless a drought could be predicted in advance. If such a prediction could be done, the market would use this information. The forecasted drought would immediately enter into the price in the futures markets and, through arbitrage, have an immediate effect now -- thus eliminating any further usefulness of knowing there was going to be a drought. The price series would now incorporate all the information.

Thus, competitive markets behave as though the best predictions are based solely on current and past prices. Specifically, the market acts as though it forms a forecast that used all the predictable price variation but discarded the unpredictable, or totally random variation. This is the essence of the rational expectations hypothesis that may be found in many textbooks.[51]

GTE suggests that the Commission should estimate the PCI in exactly the same way. It should form an estimate based solely on current and past values of the PCI. The price cap model substitutes a PCI -- derived from the difference between the cost-share-weighted input price change index and a total factor productivity measure -- for

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[51] *See* for example, A. C. Harvey, *Forecasting, structural time series models and the Kalman filter*, Cambridge University Press: New York, 1989. The theory of rational expectations is widely accepted by economic and business planners throughout much of the modern world. Robert E. Lucas Jr. formed this theory which shows how future expectations influence economic decisions. Based on his work in this area, Professor Lucas won the 1995 Nobel Memorial Prize in Economic Science. *See The Wall Street Journal*, October 11, 1995, p. A2.

the prices participants observe in a competitive market. To emulate the workings of a competitive market, the Commission also should forecast the PCI change based on historical experience, and use the resulting forecast as the adjustment to the PCI cap. Only in such a way can the Commission force the LECs to behave as if they faced a completely competitive market.

GTE will support a five-year rolling average of PCI adjustments, or any other averaging method, provided it can be shown that the selected method accurately forecasts the PCI adjustment. Ideally, PCI adjustments would be calculated for years since 1960. Then, the series would be analyzed as a time series and used to forecast one-year ahead changes in the PCI, which would become the PCI adjustment for that year.

What must be avoided at all costs is a piecemeal forecast of the components of the formula. For example, if the GDPPI is not averaged, the X-Factor is subject to a five-year moving average, and the W-factor is subject to a seven- or ten-year moving average, then the methods will not yield identical results. Concerns about the possibility of gaming the averaging process lead GTE to endorse the simplest method, which is an ARIMA (*i.e.*, Autoregressive Integrated Moving Average) process forecasting method. This method eliminates GTE's concerns about the ability to game the averaging process, and provides the Commission with the ability to estimate the next-year-ahead PCI adjustment factor based on past history.

A. GTE suggests a formal prediction of the price change in place of a five-year moving average.

The goal is to predict what would happen in a competitive market, and have the price cap behave accordingly. Using a five-year moving average of past data to serve as the basis of the price cap is arbitrary. Its only purpose is to smooth a volatile series. Such smoothing can be justified, but misses the point that the goal is to forecast the PCI adjustment factor that best mimics competition. GTE believes the appropriate smoothing should come from an analysis of the data as a consequence of trying to forecast the output price change. An averaging procedure should be adopted only if it can be shown to give optimal and statistically valid predictions of the PCI adjustment factor.

The Commission chose to use the current year GNPPI as "the best predictor of next year's [GNPPI]" because "[t]hose two series of data exhibit a simple correlation of .85, indicating very close similarity."[52] Since the same correlation does not hold true for year-to-year LEC inflation, the Commission needs to employ some method of attaining a smooth series. Thus, GTE recommends an ARIMA forecasting method *infra*.

B. For a formal prediction process, GTE suggests an ARIMA forecasting method for forecasting the PCI adjustment factor.

Time series are referred to by their structure. Many time series are found to be ARIMAs. Simply, this means that these processes are easily forecast on the basis of

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[52] *D.87-313 FNPRM*, 3 FCC Rcd at 3393.