(Table 2 Continued)

Telephone Company Input Prices and National Input Prices, 1949-1992			
Year	**Telephone**	**US**	**Difference: US - Tel**
1972	8.0	7.2	-0.8
1973	0.6	6.3	5.7
1974	5.9	4.2	-1.7
1975	14.2	9.4	-4.8
1976	10.7	9.1	-1.6
1977	6.1	8.6	2.5
1978	7.6	7.8	0.2
1979	7.2	8.2	1.0
1980	14.6	6.6	-8.0
1981	11.6	9.9	-1.7
1982	12.1	3.7	-8.4
1983	12.8	5.6	-7.2
1984	1.8	7.4	5.6
1985	0.1	4.0	3.9
1986	1.3	3.8	2.5
1987	1.7	3.1	1.4
1988	-3.2	4.4	7.6
1989	-3.7	4.1	7.8
1990	11.9	4.2	-7.7
1991	1.3	2.9	1.6
1992	4.4	5.1	0.7

Source: USTA Ex Parte Filling to the FCC in CC Docket 94-1, dated February 1, 1995, Christensen Affidavit, as reported in Bush and Uretsky, *op. cit.*

Table 3 below shows the values of the differences between the LEC and US input prices in the column labeled "Point Estimate". Also, Figures 1 and 2 graphically depict these differences over the period 1985-1992. The standard deviation can be used to construct a 95 percent confidence interval around the estimate of the average annual difference. In Table 3, this interval ranges from -7.28 percent to 11.78 percent (see Table 1, supra). The USTA position is that, because the zero value falls within the confidence interval, the difference of 2.2 percent is not significant. *But the USTA position is based on a curious argument, because the measured difference is not significantly different from any other value within the confidence interval.* Specifically, a value of 4.4 percent is just as likely as zero for the input price differential, and 4.3 percent is *more* likely. To deal with this uncertainty, statisticians and econometricians use the most likely value in the interval as the point estimate of the variable. In this case, the most likely value for the input price differential is the point estimate of 2.2 percent.

Table 3

LEC-US Annual Input Price Differences, 1985-92			
Year	**Lower Bound**	**Point Estimate**	**Upper Bound**
1985	- 5.61	3.90	13.41
1986	- 7.01	2.50	12.01
1987	- 8.11	1.40	10.91
1988	- 1.91	7.60	17.11
1989	- 1.71	7.80	17.31
1990	-17.21	-7.70	1.81
1991	- 7.91	1.60	11.11
1992	- 8.81	0.70	10.21
Source: Computed from data in Table 2.			

Moreover, the Commission proposes using the price cap index (PCI) formula based on a period of several years. As Table 4 shows, the uncertainty in the point estimate of the input price differential is reduced considerably when a three-year moving average is used. This reduction is evident when the ranges between the upper and lower bounds are compared between Tables 3 and 4. It is proposed that the Commission use the average X-Factor based on the period 1985 to 1994 in the PCI formula. This procedure would reduce the uncertainty associated with the input price differential even further. Comparison of the upper and lower bounds in Figures 1 and 2 show clearly the reduction in uncertainty associated with an average input price differential.

Table 4

3-Year Moving Average of LEC-US Annual Input Price Differences, 1985-92			
Year	**Lower Bound**	**Point Estimate**	**Upper Bound**
1985	-3.83	0.77	5.36
1986	-0.59	4.00	8.59
1987	-1.99	2.60	7.19
1988	-0.76	3.83	8.43
1989	1.01	5.60	10.19
1990	-2.03	2.57	7.16
1991	-4.03	0.57	5.16
1992	-6.39	-1.80	2.79
Source: Computed from data in Table 2.			

Figure 1.

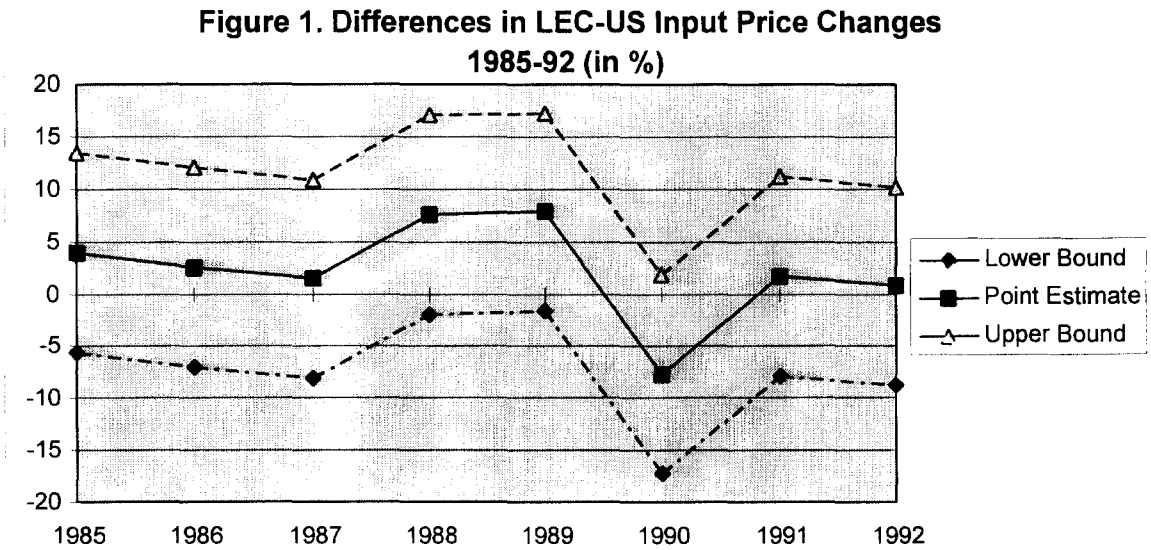
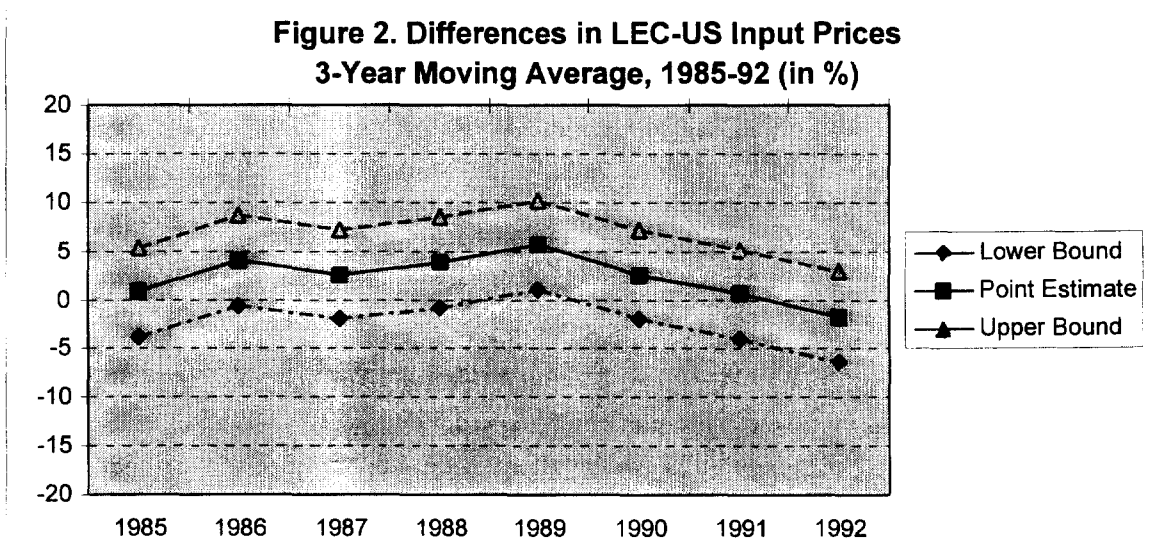


Figure 2.



On the basis of this examination of the USTA argument, it is concluded unequivocally that (a) an input price differential should be included in the X-Factor in the price cap index for regulation of the LECs, and (b) the best estimate of the input price differential consistent with the Bush-Uretsky study is 2.23 percent.

b. Direct measurement of the input price differential.

Bush and Uretsky measured the input price differential between the LECs and the national economy indirectly, in that they accepted the index of the input prices assigned by Christensen to capital, labor and materials, and then measured its difference from input prices in the national economy. Their study, together with the refutation of the USTA counter-arguments stated above, established the case for applying an input price differential in computing the X-Factor in the LEC price cap regulation. The magnitude of the differential, *given* the input price movements in the national economy, is a function of the input prices of the LECs. We have undertaken direct measurement of the input prices of the LECs from publicly available data, primarily those filed by the LECs, supplemented by nationally available economic statistics. The time period addressed is 1985-1994, which is the entire post-divestiture period with the 1984 data point omitted. Further, the input prices for the non-farm private business sector of the U.S. national economy have been revised and updated to 1993, subsequent to the Bush-Uretsky study. For these reasons, our results differ somewhat from those of Bush and Uretsky.

(i) Materials price index

The materials price index in our analysis is based on expenditure weights from the communications industry in the 1977, 1982, and 1993 input-output (I/O) tables for the United States, prepared by the U.S. Bureau of Labor Statistics (BLS). I obtained the Bureau of Labor Statistics 183-order interindustry accounts, which are available for the years 1977, 1987, and 1993. The corresponding 183-order industry deflators were available from BLS for the same periods.

The general procedure we applied in computing a materials price index for inputs purchased by the LECs is quite similar to that used by the BLS in constructing the **Consumer Price Index** and the **Producer Price Index**. **Input weights** are computed for each input for each year. Inputs, whether goods or services, are designated **commodities** for convenience. **Commodity prices** for each year are likewise taken from the BLS interindustry accounts, and so are consistent with the commodity and industry definitions. For each year, the input weights are computed so as to add to one. These weights are multiplied by the corresponding commodity prices and summed to a **materials input price index**.

This approach has limitations. The weights are based on the whole telecommunications industry, and may differ from the weights that would be derived from the expenditures of the LECs. The corresponding commodity prices represent the economy as a whole, which may differ from the prices paid by the LECs. However, despite these limitations, the input weights are a far superior representation of the purchases of the LECs than those in the price index for GDP (the GDP-PI), which is used to represent the price of materials in the USTA

model. Similarly, the prices we used are those of commodities used in telecommunications, rather than the value-added based prices for all of the goods and services produced in the private economy as a whole, as assumed by the USTA model.

(ii) Labor input price index

The method we used to create the labor input price index is to compute **average compensation per employee** for each of the LECs in each year. The compensation data are taken from ARMIS 43-01 Total Compensation for Employees. The data used for measuring the quantity of labor input are full-time-equivalent (FTE) employees derived from the same source. The total FTE number is the sum of reported full-time employment plus 0.5 times the reported number of part-time employees. (An additional discussion of the labor input prices is provided in Appendix B.)

(iii) Capital input price index

The treatment of capital in the alternative TFP measurement method we apply in the Performance-Based Model is described later in this Statement. The defining element of that method is to focus on the actual financial performance of the LECs, rather than on the theoretical performance erroneously assumed by the USTA model. When the actual performance of the LECs is taken as the basis of calculation, the **price of capital input** that is levied on the ratepayers is determined as the **gross return to capital** per unit of capital input. This gross return to capital is computed as the difference between total revenues and the cost of the labor and materials inputs. The gross return is divided by the **net capital stock**. Where the latter is measured by the **net book value of the stock**, that value of the capital stock is determined by the

regulatory decisions of the FCC. Among the desirable properties of this approach is that the resulting prices of capital, labor and materials, when multiplied by their associated input quantities, add up exactly to the total cost borne by the ratepayers.

In our analysis, the capital input price was adjusted for quality changes based on its technological characterics. This adjustment is based on a hedonic input price index derived from a variable cost function estimated for 11 large LECs for the period 1981-1990.[8] The technological characteristics of switching equipment recognized in the study are analog, digital and other switch types. The distinction between optical fiber and copper interoffice transmission cable is also accounted for. This procedure, which is also described below, was applied to the net book value of the capital stock for the LECs, the same measure of capital input used in the Performance-Based Model. In the way it is applied in the variable cost function model, the hedonic adjustment also incorporates correction of over- or under-depreciation of the capital stock, as well as a price correction. This hedonic adjustment was extended to the 1991-1994 period, and results in an average annual downward adjustment of 3.27 percent. This corresponds to an annual increase in the effective capital input of the same magnitude for the period 1985-1994.

(iv) Aggregate input price index for all RBOCs

Labor, materials and capital input prices are computed for the aggregate of all the RBOCs and combined into an aggregate input price index for the RBOCs. The price index

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[8] Norsworthy, Jang, et al. (1993).

method applied is the **Fisher Ideal Price Index** recommended by Diewart (1993) for application to productivity analysis. When this index is computed, the results are those shown in Table 5. The **Tornquist Index** (a discrete form of the continuous **Divisia Index**) used in the USTA study is a poor choice for exacting productivity measurement because its results vary according to whether TFP is computed from the price or quantity side. The Fisher Ideal Index also accommodates series that are zero during part of the period, while the Tornquist Index does not.

Table 5 shows the movements in the labor, materials and capital price indices for all RBOCs for the period 1985-1994. Also shown are the input price indices for the non-farm private business sector and the RBOCs. It is quite clear in Table 5 that input prices at the LECs, when estimated using publicly available data with hedonic adjustment for changes in capital quality, increase much more slowly than do input prices for the non-farm business sector of the national economy. The average rate of growth for input prices in the non-farm business sector is 3.00 percent per year for 1985-1994. (This rate of growth was extended to 1994, because data for that year have not yet been released by BLS.) The average rate of growth for input prices at the LECs is 0.46 percent per year for 1985-1994. **Thus, the best point estimate of the input price differential for 1985-1994 is 2.54 percent per year.**

Table 5. Input Price Indices for RBOCs

	ALL INPUTS NON-FARM BUSINESS 1985 = 1.000	LABOR ALL RBOCs 1985 = 1.000	MATERIALS ALL RBOCs 1985 = 1.000	CAPITAL ALL RBOCs 1985 = 1.000	ALL INPUTS ALL RBOCs 1985 = 1.000
1985	1.000	1.000	1.000	1.000	1.000
1986	1.030	1.025	1.021	1.112	1.056
1987	1.056	1.036	1.035	1.082	1.052
1988	1.096	1.064	1.059	0.862	0.986
1989	1.130	1.071	1.099	0.839	0.982
1990	1.168	1.158	1.143	0.832	0.952
1991	1.192	1.216	1.169	0.597	0.962
1992	1.228	1.223	1.194	0.612	0.979
1993	1.271	1.333	1.206	0.684	1.037
1994	1.310	1.373	1.234	0.651	1.043
Growth for Period	**3.00%**	**3.52%**	**2.34%**	**-4.77%**	**0.46%**

Note: Rate of growth for Nonfarm Business 1985-93 is extrapolated to 1994

Source: Computed in Performance-Based TFP Model from data in BOC reports to FCC.

3. The USTA Model Fails to Measure Productivity in Interstate Access Services.

Interstate access services provided by the LECs have grown more rapidly than local exchange services or intrastate toll services. Table 6 shows the rates of growth for three categories of the LECs' telephone service for the 1985-1994 period. As explained in the discussion in Part II below, these measures of activity better represent the services provided by the LECs than the output categories of deflated revenues in the USTA model. In summary, these three categories of LEC services are priced differently, sold to different customers, and regulated by different authorities. Minutes of use for interstate and intrastate toll services are traffic-sensitive, as are the charges assessed for these services.

The interstate access category of LEC services is developed in the Performance-Based Model as follows. Three types of physical measures are used to measure the outputs associated with interstate revenues: These outputs are aggregated using revenue requirements for three categories of activity: access lines (for end user common line activity), interstate access minutes, and special access lines. These revenue requirements[9] represent the long-term marginal costs of the respective services and are thus superior to revenues as a basis for aggregation. By contrast, the USTA model uses price indices of unknown origin to deflate three categories of interstate revenues -- end user charges, interstate access, and special access. Thus, while the Performance-Based Model uses physical units as interstate output measures, the USTA model uses deflated revenues.

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[9] As described in the Bush-Uretsky study.

In the Performance-Based Model, these outputs are aggregated to form a single index of interstate outputs using the Fisher Ideal Quantity Index method. The USTA model uses the Tornquist Index method to aggregate the deflated revenues that it uses for output measures. The Fisher Ideal Index is superior to the Tornquist Index for several reasons.[10] Most important, from the perspective of measuring productivity for price cap regulation, is the fact that the Fisher method allows for the introduction of new categories of output (e.g. video dial tone services) and the disappearance of existing categories of output. The Tornquist method cannot accommodate such changes, and thus is not appropriate for measurement in a dynamic setting such as interstate telecommunications. Moreover, when levels of output or prices are close to zero, the Tornquist Index exhibits erratic behavior.

The USTA model, while using these same three categories of interstate activity, does not separately report an output aggregate for interstate access. Instead, its overall company output index contains these output measures embedded. The USTA assertion that there is no basis for measuring interstate activity separately is therefore belied by its own model.

When the interstate access output measure is computed as described above, it can be placed in context with output measures for other LEC regulated services, as reflected in Table 6. As shown in Table 6 below, interstate access services have grown at an annual rate of 6.83 percent, while other LEC regulated services, local and intrastate, have grown at annual rates of 3.03 percent and 6.78 percent, respectively. When local and intrastate services are combined into

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10 Diewart (1993) ch. 13, Diewart and Nakamura (1993).

a single Fisher Ideal Quantity Index[11] based on their revenues, the rate of growth is 4.22 percent per year. Further, the output quantities that result from deflating revenues, as in the USTA model, may understate output because the price indices may not include discounts -- a major element of competition in long distance service -- while the revenues do. (This point cannot be assessed accurately unless and until the USTA methodology is fully disclosed.)

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11 Diewart (1993) ch. 13, Diewart and Nakamura (1993).

Table 6: Rates of Growth of Telephone Services
ALL RBOCs, 1985-1994

Year	Fisher Ideal Quantity Index: Interstate Access	Local Service: Number of Calls	Intrastate Toll: Minutes of Use	Fisher Ideal Quantity Index: Intrastate and Local
1985	1.000	1.000	1.000	1.000
1986	1.070	1.012	1.037	1.020
1987	1.152	1.019	1.094	1.043
1988	1.258	1.067	1.166	1.098
1989	1.374	1.105	1.267	1.156
1990	1.489	1.146	1.399	1.224
1991	1.573	1.182	1.500	1.278
1992	1.651	1.223	1.552	1.322
1993	1.741	1.262	1.683	1.385
1994	1.849	1.314	1.840	1.463
Growth for Period	**6.83%**	**3.03%**	**6.78%**	**4.22%**

1985 = 1.000
Source: Computed in Performance-Based TFP Model from data in BOC reports to FCC

Interstate access services rely more on fixed inputs, e.g. switches and transmission equipment, and less on labor and materials inputs, than do local services. Consequently, there should be greater economies of scale in the LECs' provision of interstate access than in their other telephone services. **Therefore, if we assume that inputs grow at the same rates for interstate access and other regulated telephone services provided by the LECs, the resulting implied allocation of costs is conservative**. It is important to note, however, that *no specific allocation* of costs is required by the assumption that inputs grow at the same rates for all classes of service, although that assumption is *consistent with the allocation of all costs in proportion to revenues*. Making this conservative assumption permits the computation of TFP separately for interstate access and the LECs' other services in a way that combines to overall company TFP measured directly. These results, together with the input price differential (IPD) and associated X-Factors, are set forth in Table 7.

As Table 7 shows, the X-Factor for the interstate access services is 7.33 percent, compared to 5.40 percent for all the LEC regulated services. This difference results entirely from much higher productivity growth in the LECs' interstate access services, 4.94 percent, than in all the LEC regulated services combined, 3.01 percent.

Table 7. TFP, Input Price Differential and X-Factor in Interstate and All LEC Regulated Services: Rates of Growth, 1985-1994		
	Interstate Access Services	All LEC Regulated Services
Output Growth	6.83%	4.90%
-Input Growth	1.89%	1.89%
=TFP Growth LECs	4.94%	3.01%
+IPD	2.54%	2.54%
- TFP Gr in NFB	0.15%	0.15%
= X-Factor	7.33%	5.40%

Note: TFP Gr in NFB is Total Factor Productivity Growth in Non-Farm Business

Source: Computed in Performance-Based Model

The computations underlying Table 7 reflect the rate of growth of aggregate inputs, labor, materials and capital, for the 1985-1994 period, which are aggregated using the Fisher Ideal Quantity Index. The computations and associated reasoning are discussed in Part II below describing the Performance-Based Model. The TFP index is the Fisher Productivity Index advocated by Diewart (1993), which is the ratio of the corresponding Fisher Ideal Quantity Indices for outputs and inputs. The input price differential is derived as described above, and is used with the TFP measures to compute the respective X-Factors for the LECs' interstate access, services and all LEC regulated services. Clearly, it is entirely feasible to calculate separate measures of TFP for interstate access services and other regulated telephone services for the RBOCs, based on conservative assumptions about costs and direct measurement of outputs in

the respective sectors, using only publicly available data. Furthermore, if more specific data concerning the LECs' expenditures and prices of materials were reported, improved estimates of the input prices and the input price differential could be achieved.

The conservatism of the cost allocation assumption in the Performance-Based Model is supported by the information in Table 7A below. To compute Table 7A, I used jurisdictional separations data for 1991-1994 to reallocate costs between interstate and other regulated services.[12] This procedure has the effect of raising measured interstate TFP growth by 0.91 percent for the 1985-1994 period, from 4.94 percent to 5.85 percent, and the interstate X-Factor is correspondingly raised from 7.33 percent to 8.24 percent. Consequently, it is concluded that the cost allocation assumptions underlying the Performance-Based Model are conservative, and are not biased to result in a higher X-Factor for the LECs' interstate services.

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[12] Data are from ARMIS 43-01 for 1991 to 1994.

Table 7A. TFP, Input Price Differential and X-Factor in Interstate and All LEC Regulated Services: Rates of Growth, 1985-1994 Adjusted for Separations, 1991-1994		
	Interstate Access Services	All LEC Regulated Services
Output Growth	6.83%	4.90%
-Input Growth	1.89%	1.89%
+ Separations Adj	0.91%	0.00%
= TFP Growth LECs	5.85%	3.01%
+ IPD	2.54%	2.54%
- TFP Gr in NFB	0.15%	0.15%
= X-Factor	8.24%	5.40%

Note: TFP Gr in NFB is Total Factor Productivity Growth in Non-Farm Business

Source: Computed in Performance-Based TFP Model

The TFP and X-Factor, shown for interstate access services separately, are consistent with the assertions of certain LECs before state regulatory agencies, claiming that price caps for intrastate services should be based only on TFP calculations that **exclude** interstate services. Further, it is consistent with the position of Dr. Lee Selwyn, who has advocated the separation of interstate from intrastate TFP and X-Factors for the LECs in his recent testimony before the California Public Utilities Commission.

4. The USTA Model Erroneously Measures Capital Input.

The fundamental difference between the USTA assumed rate of return model and the Performance-Based Model can be illustrated by examining the revenues and costs of the firm. The USTA model of total factor productivity does **not** allocate all of the revenues of the LECs to inputs. In particular, the allocation of revenues to capital in the USTA model may exceed or fall short of the actual return to capital realized by the LECs. Nor is there any reason to believe that the LECs' actual rate of return will equal the USTA's assumed rate of return on average over any time period. On the other hand, the Performance-Based Model computes the rate of return by allocating **all** revenues received by the LECs to some category of input: labor, materials or capital. This procedure in the Performance-Based Model conforms to the economic theory of the enterprise operating in the short or long run, and to the reality of the telecommunications industry: the enterprise is residual claimant to the revenues paid by its customers after all payments are made to its suppliers. What makes the inherent distortion in the USTA model so serious is that the **only point at which overall costs and capital costs of the LEC enter the regulatory process under the LEC price cap regime is through the TFP measure** embedded in the X-Factor in the Price Cap Index (PCI) formula.

a. Under the USTA model, capital stocks of the LECs are fully adjusted to cost-minimizing levels at all times.

A critical assumption in the USTA model is that capital inputs are adjusted at all times to cost-minimizing levels. This is an unsound assumption. The rapid pace of technological change in telecommunications, and the dynamic environment in which the LECs have operated since divestiture, including the change-over from rate of return to price cap regulation are well

recognized. There is no evidence that the capital stocks of the LECs are completely adjusted at all times to cost-minimizing levels. Other methods for measuring TFP are available that avoid USTA's questionable assumption. It is surprising that the USTA model depends on such weak methods.[13]

A refined appraisal of the proposition implicit in the USTA model would require an econometric model based on the variable cost function of the sort pioneered by Dr. Christensen and his colleague, Professor Randall Brown in a well-known paper in 1981.[14] In the absence of such a model, it is possible to examine suggestive evidence for the proposition. If the rate of return varies through time, we would expect to see the capital stock adjusting to that variation immediately in annual data, or at most with a short lag. Thus, if we plot the return to capital through time with the level of the capital stock, as shown in Figure 3, expect to see as much variation in the capital stock as in the return to capital. In order to adjust for possible biases introduced by regulatory changes in the depreciation reserve, we computed and plotted the return per unit of capital stock both on a gross basis and net of depreciation. When we did so, as in Figure 3, it is immediately clear that the gross return to capital varies considerably more than the capital stock which is strong evidence against the USTA assumption that the capital stock adjusts

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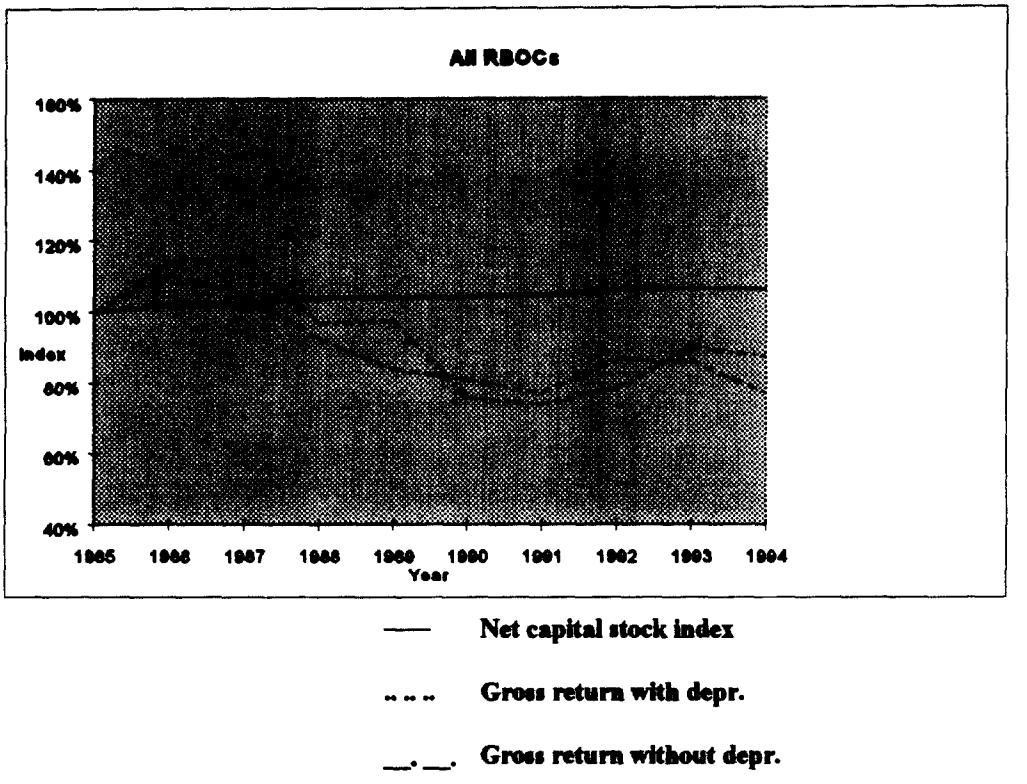
13 It is notable that in his earlier work, Dr. Christensen himself argued against the assumptions that underlie the USTA model: "An important assumption that underlies most cost function applications is that all inputs are in full statis equilibrium. In many instances, however, the assumption of full static equilibrium is suspect and hence so are the empirical results. . . . Furthermore departures from full static equilibrium may result from factors other than internal adjustment costs. For example, regulatory restrictions may hinder capital mobility." (Brown and Christensen, 1981, p. 208.)

14 Brown and Christensen, 1981.

fully in all time periods, or even nearly so. (The returns in Figure 3 are indexed to 100 percent in 1985 in order to show relative movements.) The variations of the returns computed both ways are considerably greater than the variation in the capital stock.

Figure 3



A very important consequence of adopting a performance-based approach in measuring the return to capital and computing TFP and the input price differential is that it reduces the sensitivity of the X-Factor to mismeasurement of capital input. When the total revenues and the labor and materials expenses are given for a sequence of years, the quantity of the capital stock, and hence the proportionate flow of capital services, acts to divide the capital

expense into price and quantity components. Under these circumstances, changes in the deflation of capital or in the rate of depreciation change the separation of capital input into price and quantity components, but the product of the price and quantity of capital input – the total capital expense – remains unchanged. Consequently, the weight assigned to the *capital input* in the *TFP calculation* remains unchanged, as does the weight assigned to the *price of capital* in the calculation of the *input price index*. Thus, for example, an increase in the computed capital stock that arises from a quality adjustment will be offset by a corresponding decrease in the price of that capital input that is assessed to the ratepayers. Measured TFP will decline because the capital input is greater than before the adjustment for quality. The measured index of input prices will also decline because the price of capital input is lower, thus increasing the input price differential. The change in TFP will thus tend to be offset by a change in the input price differential, resulting in a very small (or no) effect on the X-Factor.

The USTA model is more sensitive than is the Performance-Based Model to mismeasurement of quality change, because USTA's assumed long-run user cost of capital is fixed. That is, the price per unit of the capital input is fixed. Consequently, if the quantity of capital is increased by a quality adjustment, the cost of the capital input rises proportionately. Thus, in the USTA model the computed TFP will be lower for two reasons: the quantity of capital is higher, and the weight assigned to it in the computation of total input is larger. The effect on the input price index is to increase the weight of the price of capital input, but that price itself remains unchanged. There will be no direct offset in the measured input price differential to the lower TFP. The net effect under the USTA approach generally will be to reduce the calculated X-Factor, because the decline in TFP is not compensated by an increase in the input price

differential. The X-Factors in Tables 7 and 7A thus are not influenced by the hedonic adjustment of the capital input.

b. The USTA Model does not allocate all costs to the inputs.

It is important to note that the only point at which the costs of production enter the LECs' Price Cap Index formula is in the TFP calculation. Thus, costs that are omitted from TFP are not accounted for anywhere else, and thus are ignored in the regulatory process. The USTA model assigns an *assumed* cost to capital that depends on the assumption that the capital stock is fully adjusted to a cost-minimizing level as would tend to be true in a competitive industry. It *appears* that USTA's assumption understates the actual return to capital; it is *certain* that it results in substantial year-to-year deviations between the actual cost of capital levied on the ratepayers and the cost of capital reflected in its TFP calculation.

This difference in calculation methods between the Performance-Based Model and the USTA model is illustrated in Table 8 below.

Table 8. COST SHARE WEIGHTS FOR CALCULATION OF TOTAL FACTOR INPUT BASED ON ACTUAL TOTAL COST

Performance-Based Rate of Return Model

Labor Wt.	Materials Wt.	Capital Wt.	Remainder	Sum of Wts.
E_H / TC	E_M / TC	E_K / TC	0	= 1

USTA Assumed Rate of Return Model

Define $TC_{Assumed}$ = TR - Remainder

Labor Wt.	Materials Wt.	Capital Wt.	Remainder	Sum of Wts.
E_H / TC	E_M / TC	AC_K / TC	$\neq 0$	$\neq 1$ (Total Cost Basis)
E_H / TC_A	E_M / TC_A	E_K / TC_A	0	= 1 (Assumed Cost Basis)

Wt. = Weight
E_H = Labor expense
E_M = Materials expense
E_K = Property income
AC_K = Assumed cost of capital
TC = Actual total cost
TC_A = Assumed total cost

The expenses allocated to labor and "materials" (i.e. all other purchased inputs) are the same for each model. The difference between these models lies in the respective assignments of costs to capital. The Performance-Based Model, like the regulatory process itself, treats the difference between total revenues (TR) and labor and materials expenses (E_H, E_M) as a **gross return to capital**. Thus, in the Performance-Based Model all revenues received by the