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August 10, 2001

EXECUTIVE SECRETARY

VIA HAND DELIVERY

David Waddell, Executive Secretary
Tennessee Regulatory Authority
460 James Robertson Parkway
Nashville, TN 37238

Re: *Docket to Establish Generic Performance Measurements, Benchmarks and Enforcement Mechanisms for BellSouth Telecommunications, Inc.*
Docket No. 01-00193

Dear Mr. Waddell:

Enclosed are the original and four paper copies along with CD Rom versions of Rebuttal Testimony on behalf of BellSouth from the following witnesses:

David Coon
Edward Mulrow
Ronald Pate
William Taylor

The testimony is being provided counsel of record by CD Rom.

Very truly yours,

Guy M. Hicks

GMH:ch
Enclosure

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8/10/01

BEFORE THE

TENNESSEE REGULATORY AUTHORITY

IN RE: DOCKET TO ESTABLISH GENERIC PERFORMANCE MEASUREMENTS, BENCHMARKS AND ENFORCEMENT MECHANISMS FOR BELLSOUTH TELECOMMUNICATIONS, INC.	**)** **)** **)** **)**	**DOCKET NO. 01-00193**

REBUTTAL TESTIMONY

OF

WILLIAM E. TAYLOR, Ph.D.

ON BEHALF OF

BELLSOUTH TELECOMMUNICATIONS, INC.

AUGUST 10, 2001

n/e/r/a

Consulting Economists

REBUTTAL TESTIMONY OF WILLIAM E. TAYLOR, Ph.D.

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BEFORE THE TENNESSEE REGULATORY AUTHORITY

DOCKET NO. 01-00193

AUGUST 10, 2001

I. INTRODUCTION AND SUMMARY

Q. PLEASE STATE YOUR NAME, BUSINESS ADDRESS, AND CURRENT POSITION.

A. My name is William E. Taylor. I am Senior Vice President of National Economic Research Associates, Inc. ("NERA"), head of its Communications Practice, and head of its Cambridge office located at One Main Street, Cambridge, Massachusetts 02142.

Q. PLEASE DESCRIBE YOUR EDUCATIONAL, PROFESSIONAL, AND BUSINESS EXPERIENCE.

A. I have been an economist for over twenty-five years. I graduated from Oak Ridge High School in 1964, earned a Bachelor of Arts degree from Harvard College in 1968, a Master of Arts degree in Statistics from the University of California at Berkeley in 1970, and a Ph.D. from Berkeley in 1974, specializing in Industrial Organization and Econometrics. For the past twenty-five years, I have taught and published research in the areas of microeconomics, theoretical and applied econometrics, which is the study of statistical methods applied to economic data, and telecommunications policy at academic and research institutions. Specifically, I have taught at the Economics Departments of Cornell University, the Catholic University of Louvain in Belgium, and the Massachusetts Institute

of Technology. I have also conducted research at Bell Laboratories and Bell Communications Research, Inc.

I have participated in telecommunications regulatory proceedings before several state public service commissions, including the erstwhile Tennessee Public Service Commission and the current Tennessee Regulatory Authority ("TRA"). I have also filed testimony before the Federal Communications Commission ("FCC") and the Canadian Radio-television Telecommunications Commission on matters concerning incentive regulation, price cap regulation, productivity, access charges, local competition, interLATA competition, interconnection and pricing for economic efficiency. I have also been chosen by the Mexican Federal Telecommunications Commission and Telefonos de Mexico ("Telmex") to arbitrate the renewal of the Telmex price cap plan in Mexico.

I have also testified on market power and antitrust issues in federal court. In recent years, I have studied—and testified on—the competitive effects of mergers among major telecommunications firms and of vertical integration and interconnection of telecommunications networks.

Finally, I have appeared as a telecommunications commentator on PBS Radio and on The News Hour with Jim Lehrer. My curriculum vita is attached as Exhibit WET-1.

Q. PLEASE DESCRIBE NERA, YOUR PLACE OF EMPLOYMENT.

A. Founded in 1961, National Economic Research Associates or NERA is an internationally known economic consulting firm. It specializes in devising economic solutions to problems involving competition, regulation, finance, and public policy. Currently, NERA has more than 275 professionals (mostly highly experienced and credentialed economists)

with 10 offices in the U.S. and overseas offices in Europe (London, Brussels, and Madrid) and Sydney, Australia. In addition, NERA has on staff several internationally renowned academic economists as Special Consultants who provide their professional expertise and testimony when called upon.

The Communications Practice, of which I am the head, is a major part of NERA. For over 30 years, it has advised a large number of communications firms both within and outside the U.S. Those include the regional Bell companies and their subsidiaries, independent telephone companies, long distance companies, cable companies, and telephone operations abroad (e.g., Canada, Mexico, Europe, Japan and East Asia, Australia, and South America). In addition, this practice has provided testimony or other input to governmental entities such as the FCC, the Department of Justice, the U.S. Congress, state regulatory commissions and legislatures, and courts of law. Other clients include industry forums like the United States Telephone Association. Last year, the NERA Communications Practice received the International Business Leadership Award from the Center for International Business Education and Research at the University of Florida, citing our work on incentive regulation, transfer pricing, technological convergence and opening new markets to competition.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. I have been asked by BellSouth Telecommunications, Inc. ("BellSouth")—an incumbent local exchange carrier ("ILEC")—to address economic issues raised in this proceeding to determine a performance assessment plan ("PAP") for BellSouth. Testimony has been filed thus far by BellSouth in support of its Service Quality Measurements and Self-

Effectuating Enforcement Mechanisms plan, and by a coalition of competitive local exchange carriers ("CLEC Coalition") in support of its Performance Incentive Plan ("PIP") Version 2.0. Specifically, I respond to testimony from witnesses Cheryl Bursh and Robert M. Bell (on behalf of the CLEC Coalition)

Q. PLEASE SUMMARIZE YOUR POSITION ON THE PERFORMANCE ASSESSMENT PLAN FOR BELLSOUTH.

A. The TRA has an important opportunity in this proceeding to establish a PAP that will ensure that BellSouth's competitors are not placed at an economic disadvantage because of BellSouth's actions, while also not creating an artificial competitive advantage for BellSouth's competitors. For that purpose, the TRA is using as a starting point the Order it issued on February 23, 2001, in Docket No. 99-00430 (arbitration of ITC^DeltaCom Communications, Inc.'s of interconnection agreement with BellSouth).

The design of a PAP requires clear identification of the central goal: to provide a balanced set of incentives that would (1) enable BellSouth to provide wholesale services to CLECs on par with the services it provides to its own retail operations and (2) provide appropriate remedies to CLECs who have been denied wholesale services at parity. The PAP that is most likely to achieve this goal is one based on deterrence and automatic compliance, rather than contentious processes intended to lead to payment of damages.

BellSouth and the CLEC Coalition have submitted two competing PAP proposals for the TRA's consideration. Although the proposed PAPs agree on some matters, they also differ in some significant respects.

First, although the TRA's starting point does not include it, the CLEC Coalition

proposes to measure and remedy performance disparities at the level of sub-measures (the most elemental performance metrics). In contrast, BellSouth proposes to do so at a more aggregated transaction level.

Second, although the CLEC Coalition accepts the statistical methodology for detecting performance disparities that the TRA has adopted (and BellSouth has advocated in all of its states), it proposes to use the same methodology to set remedies as well. In contrast, BellSouth intends to determine appropriate penalties for specific disparities based on business judgment (subject to periodic review) rather than on arbitrary and mechanical mathematical formulas unrelated to likely gains or losses.

Third, the CLEC Coalition proposes to set a much lower threshold within its statistical methodology for detecting performance disparities that are also material in an economic (not just statistical) sense. BellSouth's counter-proposal, which is more appropriate for a transaction-level view of things, is to set that threshold of materiality initially at a relatively higher level but make it subject to periodic review.

Fourth, in contrast to BellSouth's proposal to set a cap on its annual financial liability as a percentage of its net revenue from services sold in Tennessee, the CLEC Coalition supports a procedural cap that, in effect, amounts to no cap at all.

Finally, the CLEC Coalition proposes specific adjustments to remedies when the market share of CLECs is collectively "low" (between zero and 50 percent). BellSouth believes that adjustment is neither necessary nor prudent.

My testimony addresses at length these five specific areas of disagreement, particularly from an economic perspective. Specifically, it

1. Argues that performance measurement and payment of remedies at the transaction level is more meaningful and less likely to create a source of windfall payments to either individual CLECs or the state.
2. Explains the dangers of accepting a PAP in which a single statistical methodology (and simple-minded and arbitrary mathematical functions of test statistics) is relied upon to both detect performance disparities and pay remedies. I argue further that any system of remedies that is totally divorced from the likely economic gains or losses from performance disparities can generate perverse incentives for CLECs and force BellSouth to compromise its ability to utilize its resources efficiently in the service of both retail and wholesale customers.
3. Explains the relevance of the materiality threshold, and how selection of different such thresholds can change incentives for BellSouth and its competitors.
4. Argues for the need to reduce business risks by setting a cap on BellSouth's annual financial liability, rather than leave that risk open and subject to manipulation by CLECs.
5. Explains why the proposed market penetration adjustment is not economically justified and could lead to undesirable strategic behavior by CLECs.
6. Explains why any PAP ultimately approved by the TRA should go into effect only when BellSouth receives interLATA long distance authorization in Tennessee—even though the TRA's starting position calls for implementation immediately after plan approval—so that all competitors are able to operate on an even footing.

Q. HOW IS YOUR TESTIMONY ORGANIZED?

A. My testimony begins with the economic perspective on the design of a PAP for BellSouth in Tennessee and, against this backdrop, evaluates the two competing PAP proposals. Subsequently, my testimony explores in greater depth some specific proposals made by the CLEC Coalition in this regard.

II. ECONOMIC PERSPECTIVE ON DESIGN OF PERFORMANCE ASSESSMENT PLAN: GENERAL PRINCIPLES

Q. AS A GENERAL MATTER, WHAT FUNDAMENTAL ECONOMIC PRINCIPLE SHOULD GUIDE THE DESIGN OF A PERFORMANCE ASSESSMENT PLAN?

A. The purpose of a PAP should be to induce BellSouth to deliver wholesale service of the

desired quality to its competitors, the CLECs. For this, it should provide remedies to CLECs denied wholesale service of the desired quality by BellSouth. However, such a system of remedies should neither compensate CLECs excessively and become a means of their enrichment, nor fail to penalize BellSouth suitably for any economic benefit it derives by failing to deliver service of the desired quality. The fundamental economic principle described below is the basis for striking that balance in the design of a PAP.[1]

Before stating that economic principle, it is important to understand what would constitute a failure on BellSouth's part. A performance or service quality disparity would occur in the following two circumstances:

1. The quality of a wholesale service provided to a CLEC falls short of that provided by BellSouth to its own retail operations.
2. Where BellSouth does not use a wholesale service in its own retail operations, the quality of the service provided to a CLEC falls short of a predetermined benchmark level.

Whether BellSouth's non-compliance with service quality or performance standards is inadvertent (e.g., due to system malfunctions, breakdowns within the sequence of tasks and operations associated with wholesale services, or pure random variation) or a deliberate act of discrimination (intended to diminish a CLEC's ability to compete in retail service markets) should not be the central issue. Regardless of whether the disparity (or,

[1] This desired balance can be described by use of imagery. Suppose BellSouth has a big dial which, when it reads zero, indicates that a PAP has been set up just right, i.e., the wholesale service performance delivered by BellSouth is exactly on target. Now, suppose that, if the dial is turned to the right, then BellSouth is providing wholesale services to favor its own retail services and, if the dial is turned to the left, then BellSouth's wholesale service performance actually favors a CLEC's retail services over its own. Neither turn of the dial is desirable—CLECs cannot accept a rightward turn of the dial while BellSouth cannot accept a leftward turn of the dial. Given the tension between these two opposing incentives, the trick is to find a PAP that keeps the dial firmly at zero. This includes designing statistical tests, remedies, and enforcement mechanisms that do not turn the dial in one direction or another.

equivalently, discrimination or non-compliance) is a planned or unplanned outcome, the net financial consequences are likely to be the same. Rather, instead of attempting to assign a motive to BellSouth for an observed performance disparity, a well-designed PAP should focus squarely on distinguishing among performance disparities that are of some economic consequence to CLECs and those that are innocuous.

Accordingly, the fundamental economic principle for designing a PAP is that it should prevent BellSouth from securing any undue economic value or competitive advantage by violating wholesale service quality standards, either inadvertently or otherwise. The optimal PAP would provide the right incentives to BellSouth and protect its competitors without providing them a source of windfall payments. That is, the PAP's penalties would provide the right amount of *deterrence* for acts of discrimination, favoritism, or other unfair strategic acts. A PAP based on deterrence, rather than the payment of punitive damages, would leave BellSouth no better off economically—and the aggrieved CLEC no worse off—than before the performance disparity. Any departure from this principle, such as by setting penalties unrelated to the economic value of the disparity, could encourage either BellSouth or the CLEC, or both, to act in ways that compromise the PAP itself and reduce economic efficiency and social welfare.

III. OVERALL COMPARISON OF THE COMPETING PERFORMANCE PLANS

Q. BASED ON THE TESTIMONIES OF WITNESSES REPRESENTING BELLSOUTH AND THE CLEC COALITION, WHAT DO THE TWO PERFORMANCE ASSESSMENT PLANS PROPOSED BY THEM HAVE IN COMMON?

A. Both parties agree on the broad design issues for any such plan, particularly in light of the starting point that emerged from the TRA's Order in the ITC^DeltaCom-BellSouth arbitration proceeding earlier this year. First, in accordance with precedents set by FCC rulings and opinions and similar proceedings in other states (most notably, New York), both parties agree on a two-tiered structure of remedies for BellSouth's failure to meet pre-specified service quality standards (parity and benchmarks) when providing wholesale services to CLECs with which it competes at the retail level.

Second, both parties agree on the statistical methodology to detect compliance with, or violation of, pre-specified performance standards, although they do differ on the level of measurement at which to apply the methodology. BellSouth has proposed transaction-level measurement, while the CLEC Coalition prefers greater disaggregation and measurement at the level of sub-measures (even beyond that anticipated in the TRA's starting point).

Third, both parties agree on several operational and implementation details, including (1) identifying a set of performance metrics, (2) determining to whom penalty payments should be made, (3) and adopting self-effectuating remedies.

Q. ARE THERE ISSUES OF DISAGREEMENT BETWEEN THE TWO PARTIES THAT YOU ADDRESS IN YOUR TESTIMONY?

A. Yes. While there are a number of issues on which the parties differ, my purpose in this testimony is to address only the issues of economic significance. These include the following proposals by the CLEC Coalition:

1. Select a comprehensive set of performance measurements based on sub-measures, rather than transactions. Thus, the CLEC Coalition supports measurement at a more disaggregated level than BellSouth. [Bursh, at 7–8 and 11-13]

2. Use a statistical decision rule to determine both whether a performance disparity has occurred and the size of the penalty if disparity is proved. While the test of performance disparity requires comparing a z-statistic with a critical value, the penalty is computed as a function of the ratio of that z-statistic and the critical value. An escalating scale of penalty payments is based solely on that ratio. [Bursh, at 15-18]
3. Measure the severity of a performance disparity (and set the appropriate penalty) by choosing a value of 0.25 or less for the "delta" parameter (an item discussed later in my testimony). [Bell, at 14]
4. Impose a procedural cap on BellSouth's annual financial liability for proven performance disparities in Tennessee. [Bursh, at 21-23]
5. Employ an adjustment for market penetration by CLECs. [Bursh, at 19]

The rest of my testimony addresses each of these proposals.

IV. EVALUATION OF SPECIFIC PROPOSALS BY THE CLEC COALITION

1. There is no economic justification for measuring performance at the sub-measure level.

Q. WHY IS IT APPROPRIATE, AS BELLSOUTH BELIEVES, TO TEST FOR AND REMEDY PERFORMANCE DISPARITIES AT THE MORE AGGREGATED TRANSACTION LEVEL, RATHER THAN AT THE MORE DISAGGREGATED SUB-MEASURE LEVEL?

A. Ultimately, the answer to this question depends on what a PAP is designed to achieve. If a PAP's purpose is to hold BellSouth accountable for every "failure" to provide a sub-measure at the desired quality level, regardless of the larger consequences of that failure, then the more disaggregated approach of the CLEC Coalition would appear to have merit. Indeed, the manner in which the CLEC Coalition has structured its proposed remedies, there is the potential for BellSouth to have to make very large remedy payments even with relatively few CLEC transactions. The CLEC Coalition proposes a maximum penalty of

$25,000 for every "severe failure." [Bursh, at 15] Hypothetically, if BellSouth were to register "severe failure" on several sub-measures, then it could find its remedy payments balloon quickly even when those sub-measures make up only a handful of actual CLEC transactions. If enrichment of the CLECs at BellSouth's expense is not the goal of a PAP—as it should surely not be—then the more measured approach to remedies proposed by BellSouth is appropriate.

Instead, if—as I believe it should be—the PAP's purpose is to ensure that BellSouth provides wholesale *services*, not just individual *functionalities*, at parity so that CLECs can compete for customers and provide matching services, then BellSouth's proposed more aggregated approach makes more economic sense. Whether BellSouth falls short or exceeds the quality standard for each and every sub-measure or functionality is less important than whether the wholesale services—which those sub-measures and functionalities collectively make up—meet quality standards set for them. Only if a performance failure for a single sub-measure were likely to cause a performance failure for the CLEC transaction as a whole, would it make sense to conduct tests and pay remedies at the sub-measure level.

2. There is no economic justification for applying a statistical decision rule used to detect performance disparities to the purpose of setting remedies as well.

Q. DO YOU ACCEPT THE STATISTICAL METHODOLOGY (BASED ON THE Z-SCORE) PROPOSED BY BOTH PARTIES TO DETECT PERFORMANCE DISPARITIES OR ACTS OF DISCRIMINATION?

A. Yes. Both BellSouth and the CLEC Coalition agree that, because of inherent randomness,

it is preferable to identify violations of standards for performance measures with retail analogs using a statistical decision rule. To this end, the CLEC Coalition has proposed elsewhere a version of the z-statistic called the "modified z-score." In Tennessee, however, the CLEC Coalition has indicated that it accepts, with some qualifications, the TRA's own selection of BellSouth's proposed version of that statistic, namely, the "truncated z-score." [Bell, at 3-4, Bursh, at 20] BellSouth's reasons for using the truncated z-score are explained in the direct testimonies of David A. Coon [at 81-82] and Edward Mulrow [at 5]. These statistics are fairly similar and the differences between them are explained in the testimonies of Dr. Bell and Dr. Mulrow. Dr. Mulrow's rebuttal testimony also responds to the caveat offered by Dr. Bell that the truncated z-score be used only when data from homogeneous cells are aggregated.

Q. IS THIS METHODOLOGY THE SAME AS USED IN CONVENTIONAL TESTS OF STATISTICAL SIGNIFICANCE?

A. No, this methodology differs from conventional tests in several important ways. The most important difference is that, unlike a conventional test that fixes the probability of Type I error but not that of Type II error, the proposed methodology first selects a critical value for the test that equalizes or "balances" the two probabilities of error. The probability of Type I error is the probability of rejecting a null hypothesis that is true (roughly, the return of a "guilty" verdict when, in fact, the accused is innocent), and the probability of Type II error is the probability of failing to reject a false null hypothesis (roughly, the return of a "not guilty" verdict when, in fact, the accused is not innocent). In this context, Type I error favors a CLEC but punishes BellSouth in error, while Type II error favors BellSouth and

denies a CLEC just compensation in error.

In a conventional test, it is customary to first "fix" the probability of Type I error at an "acceptable" level, e.g., 5 percent, and then conduct the test without making any attempt to control for the probability of Type II error. The most useful technique available at that point to minimize the probability of Type II error is to make the sample size as large as possible. A less useful technique is to exploit the trade-off between the probabilities of the two types of error and to tolerate a higher probability of Type I error in return for a lower probability of Type II error. As far as I know, the proposed truncated z-statistic makes the first attempt to conduct a test of statistical significance in a manner that equalizes (balances) the probabilities of the two types of error. The motivation for this comes from the desire to hold the risk of Type I error (which would favor the CLEC at BellSouth's expense) at exactly the same level as the risk of Type II error (which would favor BellSouth at the CLEC's expense).

The second difference is that the proposed test of statistical significance also builds in the added element of materiality. It does so by requiring that the disparity not only be statistically significant but also exceed a certain predetermined level to be considered material. This introduction of materiality necessarily comes about because Type I and Type II error rates must be balanced for a particular deviation from the null hypothesis of non-discrimination (i.e., no performance disparity). If the alternative hypothesis is far from the null (corresponding to a high degree of disparity or discrimination), the corresponding balanced Type I and II error rates will be small. If the alternative hypothesis is close to the null (corresponding to a small amount of disparity or discrimination), the associated

balanced Type I and II error rates will be large. Materiality must be used to determine the degree of discrimination or performance disparity at which it is appropriate to balance Type I and II error probabilities.

In effect, the proposed statistical test is a joint test of statistical significance and materiality. For example, suppose the average response time for a certain function provided to a CLEC is *x* minutes while it is *y* minutes when BellSouth provides that function to its own retail operations. Now, suppose that *y* is less than *x*, i.e., there is at least prima facie evidence of a performance disparity favoring BellSouth's retail operations at the CLEC's expense. The purpose of the statistical test using the truncated z-statistic would then be two-fold:

1. Determine whether the difference $y - x$ is *statistically significant*, i.e., whether that difference is genuine in the sense that it may be expected to happen overwhelmingly often in repeated trials (say, 95 times out of 100) or is simply a random and infrequent event.
2. Determine whether the difference $y - x$ is *material*, i.e., whether that difference is large enough to have real or significant financial consequences for both BellSouth (which gains) and the CLEC (which loses).

To accomplish the latter, BellSouth proposes that *y* and *x* be separated by a pre-set amount before that difference is considered material. The separation amount in question is a parameter delta multiplied by the standard deviation of response times when BellSouth serves its own retail operations. In conventional tests of statistical significance, materiality is not a factor. Therefore, a parameter like delta is not needed in such tests. But, in tests employing the truncated z-score and a balancing critical value, delta becomes an important choice, one (as I explain later) to be made with a judicious blend of economic and business judgment. The testimonies (and attachments thereto) of Mr. Coon, Dr. Mulrow, Dr. Bell,

and Ms. Bursh all explain how the choice of delta affects the statistical tests, thus making it unnecessary for me to dwell any further on that matter.

Finally, a statistical test based on the truncated z-statistic differs by having a built-in asymmetry that is not present in a test based on the conventional z-statistic. To understand this point, refer again to the example above of response times on a specified function when BellSouth serves a CLEC as opposed to when it serves its own retail operations. There are likely to be occasions when the quality of service BellSouth provides the CLEC exceeds the quality it provides its own retail operations. Conversely, there are likely to be other occasions when just the opposite is true. The *average* performance by BellSouth in this regard would ordinarily account for both better-than-expected performance as well as worse-than-expected performance. However, BellSouth's proposed truncated z-statistic is asymmetric in that it only considers worse-than-expected performance; all instances of better-than-expected performance are, in essence, set to zero. The final outcome is a measure of performance disparity whose severity depends on the size of each individual worse-than-expected performance. In effect, this type of truncated accounting of BellSouth's performance gives it no credit for delivering better-than-expected performance but holds it accountable for all instances of worse-than-expected performance. In contrast, a statistical test using the conventional z-statistic—which neither party has proposed to use here—would account for both types of performance.

Q. DOES AT&T'S MODIFIED Z-STATISTIC GIVE BELLSOUTH CREDIT FOR BETTER-THAN-EXPECTED PERFORMANCE?

A. No. Although the CLEC Coalition's witnesses in this proceeding do not offer testimony on

this point, AT&T (a member of the CLEC Coalition) claimed in a recent Florida proceeding that giving BellSouth credit for better-than-expected performance would enable BellSouth to "game the system." [Direct Testimony of Cheryl Bursh, Exhibit CLB-1, at 39-40, Florida Public Service Commission Docket No. 000121-TP] Apparently, BellSouth would do this by balancing worse-than-expected performance for some functions against better-than-expected performance for other functions and thus escaping penalties for performance disparities or discriminatory acts, regardless of the harm caused to the CLEC's ability to compete. In instances in which BellSouth provides better-than-expected service, the benefit to the CLEC may not be ephemeral as AT&T and the CLEC Coalition seem to suggest. If such service helps an CLEC to win over a customer from BellSouth, then it may take several mis-steps by the CLEC for that customer to consider switching back to BellSouth or some other CLEC. It is important to remember the central underlying economic issue in this proceeding: the more meaningful service quality-based competition is for the customer, rather than for any individual service.

Q. SHOULD A STATISTICAL DECISION RULE BE EMPLOYED TO BOTH DETECT PERFORMANCE VIOLATIONS *AND* DETERMINE THE SEVERITY OF THOSE VIOLATIONS FOR THE PURPOSES OF SETTING REMEDIES?

A. No. A statistical decision rule may only be used for the first purpose, i.e., to *detect* performance disparities that are material in some sense. It may not be used for determining the severity of those violations because the z-score and similar test statistics are designed only to indicate whether a particular statistical hypothesis is true or false, not how true or how false or what the economic significance of a given deviation from the null hypothesis

might be. In other words, a statistical decision rule like the z-score can only provide an absolute diagnosis, not a relative one and, therefore, may not be used for setting remedies. As I explain below, setting the remedy for each performance disparity should depend on both the type and the severity of only that disparity.

Q. CAN YOU EXPLAIN WITH AN EXAMPLE THE LIMITATION OF THE Z-SCORE FOR DETERMINING SEVERITY AND SETTING REMEDIES?

A. Yes. Suppose a z-score is computed for the same performance metric in two successive months, and in both months the outcome (an observed departure from parity) is found to be statistically significant. Next, suppose the z-score in the second month is twice as distant from a pre-specified critical value than that in the first month. Can it be inferred that the economic significance of the observed departure from parity is twice as great in the second month as in the first month, or that the penalty should be twice as large in the second month? The answer, in general, is "no." The reason is that the z-score has several ingredients (e.g., the mean performance when BellSouth serves itself, the mean performance when BellSouth serves the CLEC, the standard deviations for both, and the number of measurements made in each case). Changes in any of these ingredients can influence the realized value of the z-score. Therefore, a z-score that is twice as distant from a critical value than another could easily be so for reasons other than simply that one of the performance means is twice as large as the other. For these reasons, it is improper to use the same statistical decision rule that determines whether or not an outcome is statistically significant to also compare the economic significance of a *specific* disparity or to set a remedy for that disparity.

Q. DOESN'T THE DELTA PARAMETER ALREADY FACTOR MATERIALITY OR ECONOMIC SIGNIFICANCE INTO THE Z-SCORE? IF IT DOES, SHOULDN'T THIS THEN PERMIT SETTING REMEDIES BASED ON THAT Z-SCORE (OR SOME FUNCTION OF IT)?

A. Yes, the chosen value of delta reflects what level of observed disparity would be considered material or economically significant. However, that is *not* sufficient, in and of itself, to determine the penalty that should be paid *per transaction* for every disparity. In other words, the use of delta draws a dividing line between an observed disparity that is material and one that is not. That says nothing, however, about how severe a particular material performance disparity is, or what level of penalty ought to apply to it on a per-transaction basis. Once that materiality threshold is crossed, the disparity can be thought of as generating economic value for BellSouth that it would not otherwise receive. Correspondingly, there is an economic opportunity cost to the CLEC that receives disparate service from BellSouth. However, whether that economic value would be considered relatively small, moderate, or large depends entirely on the function performed by BellSouth for the CLEC. Not all functions or performance metrics have the same economic value; nor does that economic value change with time for all functions or performance metrics. Therefore, the severity of a disparity is not simply a matter of how long that disparity lasts. Moreover, the level of severity associated with disparities for different performance metrics may itself vary. That is why BellSouth has proposed a transaction-level fee schedule for different performance metrics, for both Tier 1 and Tier 2 penalties. [Coon direct, Exhibit DAC-2]

3. There is no economic justification for setting remedies and penalty payments in the manner proposed by the CLEC Coalition.

Q. DO YOU AGREE WITH THE CLEC COALITION'S PROPOSAL [BURSH, AT 15-16] TO CALIBRATE THE SEVERITY OF PERFORMANCE DISPARITIES BY USE OF THE Z-SCORE?

A. No, for the reasons explained above, a statistical decision rule based on the z-score may *not* be applied to the task of determining the severity of any observed performance disparity or to set a transaction-level remedy for it. This fact has been recognized elsewhere as well. For example, Administrative Law Judges in Pennsylvania evaluating competing PAP proposals from Bell Atlantic-Pennsylvania and other parties including AT&T and MCI WorldCom, rejected the idea of using the z-score for both purposes.[2]

Besides representing an improper use of statistics, the CLEC Coalition's proposed methodology also attempts to equate the degree to which a z-score differs from a critical value with the economic importance of an observed performance disparity. By using labels such as "Basic Failure," "Intermediate Failure," and "Severe Failure," the CLEC Coalition obviously wishes to convey a sense of how economically or financially important an observed "failure" is. The best that the statistical decision rule proposed in this proceeding can do, however, is only indicate whether an outcome is—from a statistical standpoint only— a "success" (i.e., compliance) or a "material failure." Such a rule may indicate that

[2] Before the Pennsylvania Public Utility Commission, Joint Petition of Nextlink Pennsylvania, Inc., RCN Telecommunications Services of Pennsylvania, Inc., Hyperion Telecommunications, Inc., ATX Telecommunications, Focal Communications Corporation of Pennsylvania, Inc., CSTI, Inc., MCI Worldcom, E. Spire Communications, and AT&T Communications of Pennsylvania, Inc. for an Order Establishing a Formal Investigation of Performance Standards, Remedies and Operations Support Systems Testing for Bell Atlantic-

(continued...)

a particular failure crosses some pre-specified level of materiality, but it *cannot per se* determine the relative severity of that failure, i.e., just how material it really is. Ultimately, the question that must be answered is: what economic value does BellSouth stand to gain from a specific performance disparity or act of discrimination on a specific performance metric? The statistics-based rule proposed by the CLEC Coalition does not answer this question.

Q. DO YOU ACCEPT THE CLEC COALITION'S PROPOSAL OF AN ESCALATING SCALE OF PENALTY PAYMENTS TO MATCH ITS CHOICE OF AN ESCALATING SCALE OF PERFORMANCE DISPARITIES?

A. No. The remedies or penalty payments proposed by the CLEC Coalition are arbitrary and capricious. First, they are suggested without regard to specific characteristics of the underlying performance metrics or transactions. That is, they are "one size fits all," suggested without any regard to what functions the different performance metrics perform or whether they contribute equally to a CLEC's ability to provide service or compete. For example, suppose that the "parity gap" (expressed as a difference between the z-score and the balancing critical value) is the same for two different performance metrics. Should we then conclude that the economic value to BellSouth of the two performance disparities is *identical*? While the rules proposed by the CLEC Coalition would imply that to be the case, such an implication is clearly absurd. The parity gap simply cannot be compared in

(...continued)

Pennsylvania, Inc., Docket No. P-009991643, Recommended Decision, August 6, 1999, at 206.

any meaningful way across different performance metrics.

Second, the proposed penalty rules (e.g., the CLEC Coalition's quadratic penalty function) are clearly designed to produce penalties that themselves escalate to match an escalating scale of performance disparities. In its eagerness to generate that match, however, the CLEC Coalition has neglected to explain why such a system of remedies makes economic sense. Does the economic value to BellSouth of a performance disparity in its favor change in the manner implied by the mathematical rules proposed by the CLEC Coalition? If the purpose of a well-designed, deterrence-focused PAP is to provide incentives to BellSouth to meet pre-set performance standards, then why is the proposed set of penalty rules the right way to go about dissuading BellSouth from providing service of lower quality to CLECs? Will the penalties, as calculated according to the CLEC Coalition's proposed rules, exactly offset any economic gain from discrimination or could they provide unwarranted revenues to the CLECs themselves? The CLEC Coalition has not given us reasons to believe that its proposed penalty rules can answer these questions. Besides emphasizing that penalties ought to be "great enough" [Bursh, at 5], Ms. Bursh provides no insight into how the remedies proposed by the CLEC Coalition would provide BellSouth the motivation to which she refers.

Q. IDEALLY, HOW SHOULD VARIOUS LEVELS OF PENALTY PAYMENTS BE SET?

A. Assuming that the public policy goal is to provide BellSouth a greater economic incentive to comply with performance standards than not to comply, the size of the penalty payments should vary directly and proportionally with the economic severity of the performance

disparity. Equating more serious performance disparities with more severe economic consequences (i.e., greater economic value or competitive advantage for BellSouth and the opposite for CLECs), the ideal system of penalties should be calibrated to the economic seriousness of the performance disparities. However, just as a statistical decision rule is not appropriate for creating such a system, it is also not always possible to determine accurately the economic importance of every performance disparity. This is a problem arising from the lack of the necessary information and experience, not from any infirmity in the use of economic principles for setting penalties. Therefore, the estimates of the economic value in question are initially based mostly on business judgment; subsequently, those estimates are revised as warranted by experience with the effectiveness of penalties in deterring performance disparities.

For this reason, BellSouth's multi-pronged approach is, in my opinion, both practical and reasonable for the current environment. In this approach, the first step is to design the statistical test for detecting performance disparities to catch only the disparities that meet at least a minimum materiality threshold. On this point, there is general agreement among all parties, except that the delta parameter—needed to implement the materiality threshold—is still a matter of contention among those parties.

The second step is to determine what proportion of transactions (in serving CLECs) is likely to have suffered from statistically significant and material performance disparities and is, therefore, eligible for compensatory penalty payments. Among all the parties, only BellSouth makes an attempt to determine that. The procedure for this is explained and demonstrated in the testimonies of Dr. Mulrow and Mr. Coon. It was also accepted

conditionally for a trial period of six months by the Staff of the Louisiana Public Service Commission during a similar proceeding in Louisiana.

The final step is to multiply the number of affected transactions by a per-transaction penalty or "fee" from a fee schedule. [Coon direct, Exhibit DAC-2] Thus, the remedy that applies in any given instance depends in part on an estimate of the affected volume of transactions and in part on a penalty level chosen to reflect the likely economic value to BellSouth of the performance disparity on a particular performance metric.

Q. HOW IS BELLSOUTH'S PROPOSED PENALTY SYSTEM SUPERIOR TO THAT PROPOSED BY THE CLEC COALITION?

A. Unlike the CLEC Coalition, BellSouth does not—correctly, in my opinion—propose a set of penalty payments that escalate according to a pre-specified mathematical function of the statistical decision rule used to detect performance disparities. This avoids the false correspondence between the statistical decision rule statistic and the economic significance of—and penalties for—observed performance disparities. Moreover, BellSouth proposes penalties that are specific to each performance metric and transaction. In contrast, the CLEC Coalition's proposal is arbitrary, unrelated to performance metrics or transactions, and unrelated to the economic importance of observed performance disparities.

Q. CAN THE CLEC COALITION CLAIM THAT BELLSOUTH'S OWN PROPOSED PENALTIES ARE ARBITRARY?

A. No. The BellSouth plan proposes penalty payments based on (1) the type of underlying transaction, (2) the estimated economic seriousness of the violation, and (3) the duration of

the violation. While there may be room for revision of the specific levels of the proposed penalties—by transaction—over time as carriers and regulators gain more experience in this regard, there is no denying that the CLEC Coalition's plan makes no attempt to match the comprehensive detail that is in BellSouth's proposed plan. In contrast, the CLEC Coalition's plan is arbitrary in two essential respects: (1) it relies on statistical, rather than on economic, criteria for determining the severity of a performance disparity, and (2) it treats all transactions or performance metrics alike by failing to link the size of the penalty to the likely economic harm resulting from a disparity.

Q. PLEASE INDICATE WHERE OPPORTUNITIES WOULD ARISE FOR REVISION WITH MORE EXPERIENCE.

A. Two important areas in which revision may be needed—and would be possible—as the chosen PAP is reviewed in the future include (1) the choice of delta and (2) the schedule of fees or penalty payments. Because of a lack of historical precedents or analogs from other areas of BellSouth's operations or regulatory obligations, current choices made with respect to both must necessarily be tentative and subject to review. To this end, BellSouth has already proposed to conditionally use a delta of 1.0 for Tier 1 remedies and 0.5 for Tier 2 remedies for a period of six months from the point a PAP is adopted in Tennessee. [Coon direct, at 32] Similarly, BellSouth has proposed two tables of penalty payments (corresponding to Tier 1 and Tier 2 remedies) to be used to calculate actual compensation for CLECs that receive disparate service. The proposed payments reflect BellSouth's best business judgment at this time of the economic value, for each performance metric, of disparities that last for one month or more. With experience of how each type of

performance disparity unduly contributes economic value to BellSouth, the opportunity may arise to fine-tune those proposed penalties as well.

Q. IN WHAT SENSE WOULD YOU CONSIDER BELLSOUTH'S CONDITIONAL CHOICES OF DELTA FOR TIER 1 AND TIER 2 REMEDIES TO BE REASONABLE?

A. While delta is itself a statistical parameter, the value that is chosen for it should be based on business knowledge and telephony considerations. [Mulrow direct, at 18] In choosing delta, we must also consider the reasonableness of the statistical implications of that choice. This suggests that whatever delta is chosen for now must necessarily be an educated guess, whose statistical and business implications need to be followed closely.

BellSouth's proposal for a delta of 1.0 for Tier 1 remedies and 0.5 for Tier 2 remedies is countered by the CLEC Coalition's proposal that delta be 0.25 or lower.[3] Whether or not these proposed values make sense from a business (or telephony) standpoint is hard to determine currently. Obviously, the lower the value of delta, the quicker the materiality threshold will be reached and a performance disparity that crosses that threshold will become a reason for the payment of penalties. Framing the debate over delta in this light, Dr. Bell [at 11-12] suggests that BellSouth may have a natural interest in asking for a "high" value while CLECs may have a natural interest in asking for a lower value.

The problem with this explanation, as I see it, is threefold. First, it presents the issue

[3] Although the TRA may have opted for a delta of 0.25 as a starting point, this proceeding provides an opportunity (continued...)

as a matter of knowing with perfect certainty that BellSouth's sole purpose is to exploit every opportunity to discriminate, including by selecting a "high" delta and, therefore, the TRA's role is essentially one of playing policeman by siding with the CLEC Coalition's demand for a "low" delta. If the TRA must play policeman in this matter, then it must also recognize the opposite economic incentive that exists, i.e., that of CLECs receiving unwarranted penalty payments from BellSouth as delta is selected low enough to make even small performance disparities appear material.

Second, Dr. Bell disregards the fact that what happens to the statistical test of performance disparity depends at least as much on the sample size (i.e., the number of CLEC transactions) as it does on the chosen value of delta. True, the balancing critical value is higher as delta gets larger (implying that the materiality threshold becomes more distant), and the implied Type I and Type II error rates get smaller. However, for any *fixed* value of delta, the same phenomenon occurs as sample size increases, i.e., more and more CLEC transactions are included in the test for disparity. CLEC witnesses are concerned about this effect because the approach they advocate for determining remedies—based on sub-measures rather than transactions—will naturally cause the number of sub-measures recorded to be quite large even for CLECs of small or moderate size. Conversely, since BellSouth proposes to determine remedies at the transaction—rather than the sub-measure—level, the number of transactions recorded may naturally be quite small even for CLECs of moderate or large size. Therefore, a "small" delta in these circumstances could

(...continued)

to seriously examine alternatives to that value, particularly those proposed by BellSouth.

cause even fairly small observed disparities to be found material and subject to penalty payments, and for Type I and Type II error rates to be quite high. Under these circumstances, it is perfectly reasonable for BellSouth—within its proposed scheme of things—to opt for a higher delta than would be acceptable to the CLEC Coalition.

Third, this explanation appears to ignore the salient characteristic of testing with balancing—that Type I and Type II error probabilities are not only equalized (so neither BellSouth nor the CLEC is better or worse off relative to each other) but they also go up and down together. So, if a large delta, particularly with large samples, seems to lower the Type I error rate almost to zero (which favors BellSouth), then so does it lower the Type II error rate almost to zero (which favors CLECs).

In sum, as explained more fully by Dr. Mulrow, the choice of delta is more than simply a matter of preventing BellSouth from discriminating. A number of factors besides delta affects the quality of the statistical test of detection or the calculation of remedies. The TRA should see the full picture in this regard, rather than be distracted by alarmist claims about the damage that BellSouth could do CLECs if granted a "high" value of delta. Instead, as accepted by the Louisiana Public Service Commission, the TRA should accept conditionally the range for delta proposed by BellSouth, and make suitable revisions following a review of results after a suitable period like six months. From that standpoint, BellSouth's proposed course of action looks eminently reasonable.

Q. SHOULD DELTA PLAY A LEADING ROLE IN DETERMINING TIER 1 AND TIER 2 REMEDIES?

A. No. In the CLEC Coalition's proposed rules for setting remedies, delta plays a prominent

if somewhat hidden-from-view role.[4] The choice of delta determines in part the balancing critical value; in turn, that balancing critical value is an important part of the statistical decision rule that determines the level of penalties. For reasons explained above, that approach to setting remedies is flawed. Instead, BellSouth relies more on its proposed fee schedule (which putatively measures the economic value of different performance disparities) to determine the final penalty payments. To the extent BellSouth uses the parity gap (which, in itself, depends on delta) to determine the number of transactions eligible for penalty payments, there is an unavoidable connection to delta. However, that connection is nowhere nearly as pervasive as it is in the CLEC Coalition's approach to setting remedies.

Q. DR. BELL PROVIDES AN EXAMPLE [AT 11-14] OF THE CONSEQUENCES OF CHOOSING DIFFERENT VALUES OF DELTA FOR THE LEVEL OF DISPARITY AND ITS MATERIAL IMPACT ON COMPETITION. WHAT DOES THAT EXAMPLE ADD TO THE DISCUSSION ABOUT HOW DELTA SHOULD BE CHOSEN?

A. Not much. Dr. Bell's obvious point is that associated with every choice of the value of delta is a threshold level of departure from the level of performance that BellSouth's own customers enjoy, and that any specific value of delta should be considered acceptable only if that threshold departure from BellSouth's performance is not considered a material threat

[4] The concern here is with the manner in which the penalty or fee is determined for each performance metric and each transaction, not the total penalty payment made over the overall volume of transactions affected by performance disparity.

to competition. Unfortunately, Dr. Bell's point is very much an artifact of the example (and the assumed values for the mean and the standard deviation) that he has chosen to provide.

Dr. Bell's Table 1 (based on an assumption of a mean of 5 days and a standard deviation of 5 days for the distribution of the Order Completion interval among BellSouth's own customers) is designed to show that the disparity level varies with the value of delta chosen. This is not surprising because that disparity level is constructed as the product of delta and the standard deviation. Thus, the disparity is higher for a higher delta, and lower for a lower delta. If, as constructed, the CLEC mean is the BellSouth mean plus the disparity, then obviously the CLEC mean would move further away from the BellSouth mean as delta increased in value. Dr. Bell then asks the TRA to judge whether that increasing disparity (as delta increases) would not be considered a material threat to competition:

> A value of delta equal to 0.50 would be justified only if any disparity of less than 2.5 days is judged *not* to pose a material impact on competition. A delta of 1.00 would be justified only if any disparity of less than 5.0 days is judged *not* to pose a material impact on competition—i.e., only if doubling the order completion interval was judged to be immaterial. [Bell, at 11; emphasis in original]

Dr. Bell fails, however, to point out two very important properties of the relationship between delta and the disparity level.

First, in judging whether any disparity of less than 5 days poses a material impact on competition, the TRA must take into account the fact that under Dr. Bell's hypothetical assumptions,

- about 16 percent of BellSouth's own retail customers would also experience installation intervals greater than 10 days, and

- about16 percent of the CLEC's customers would experience installation intervals shorter than 5 days.

This distribution assumes that interval data are normally distributed with mean 5 and standard deviation 5. The actual distribution would be truncated normal since the interval in question cannot be less than zero; the effect of truncation would be to increase the proportion of BellSouth customers who experience intervals greater than 1 standard deviation from the mean.

By assuming the standard deviation is large relative to the mean, Dr. Bell guarantees that any allowed disparity (delta times the standard deviation) is large relative to the mean and would appear to have competitive significance. However, assuming a large standard deviation implies that a large fraction of BellSouth customers would also experience substandard service intervals, which would offset the competitive significance of any assumed value of delta.

Second, Dr. Bell's claim of materiality is obviously as much an artifact of his assumed standard deviation as of the parameter delta. Suppose instead of 5 days, the standard deviation were 0.5 days. With an assumed standard deviation of 0.5 days, the disparity threshold would vary from 5.125 days at a delta of 0.25 to 5.5 at a delta of one. Re-asking Dr. Bell's question: is a disparity of 3 hours (i.e., 0.125 days) competitively significant when the average interval is 120 hours and when more than 16 percent of BellSouth's retail customers experience disparity greater than 12 hours? The point of Dr. Bell's example is, thus, equally an artifact of his assumptions about the standard deviation as about delta.

The overarching feature of the exercise in Dr. Bell's Table 1 is that it is entirely

statistical. No information regarding the competitive significance of discriminatory treatment is brought to the analysis, so nothing useful can be determined regarding appropriate values of delta. In Tables 1 and 2, Dr. Bell illustrates different aspects of the statistical measures of disparate treatment that would be a component of an analysis of competitive significance, but the illustrations (1) depend on parameters other than delta and can be misleading and (2) stop short of quantifying commercial significance.

Q. DR. BELL ALSO COMPARES [AT 12-14] HOW THE CHOICE OF DELTA AFFECTS THE PERCENT OF CLEC CUSTOMERS RECEIVING POOR SERVICE RELATIVE TO THE PERCENT OF BELLSOUTH CUSTOMERS THAT DO. HOW DOES THAT EXAMPLE INFORM THE DISCUSSION OF THE CHOICE OF DELTA?

A. That comparison distorts our perspective as well. Table 2 in Dr. Bell's testimony, in effect, compares the balanced Type I and Type II errors for the BellSouth distribution (under the null hypothesis) with the balanced Type I and Type II errors for the (re-centered) distribution under the alternative hypothesis. That is, the comparison is between a distribution centered at the BellSouth mean with another distribution centered at the likely CLEC mean, where the CLEC mean = BellSouth mean + delta. It can be shown that if the latter distribution is overlaid on the former distribution, then at the balancing critical value at which a certain percent of BellSouth customers receive poor service, a larger percent of CLEC customers could be expected to receive poor service as well. Table 2 shows that the relative size of those two groups (CLEC customers to BellSouth customers) increases as delta is increased in value. Thus, Dr. Bell claims that with delta=0.25, CLEC customers

would experience poor service at five times the rate that BellSouth's own customers would, and with a delta=0.5, that rate would be nearly twelve times.

While it is true that the disparity gap increases mechanically with the value of delta, Dr. Bell's example should be placed in the proper perspective. At delta=0.25, Table 2 shows that 1 percent of BellSouth's customers receive poor service compared with 5 percent of the CLEC's customers, which Dr. Bell characterizes [at 12] as "the CLEC rate is five times the BellSouth rate." While the ratio of the two is indeed five, an equivalent way to look at the competitive significance of this situation is to observe that 95 percent of the CLEC's customers receive satisfactory service, compared with BellSouth's 99 percent, i.e., the CLEC's satisfaction rate is 96 percent of BellSouth's satisfaction rate. While Dr. Bell's Table 2 is designed to suggest that a delta of 0.25 is reasonable because a five-fold difference in service rates would obviously be competitively significant, it is not so obvious that a 4 percentage point difference in service quality would be significant. However, both these pairs of numbers (1 percent BellSouth vs. 5 percent CLEC and 99 percent BellSouth vs. 95 percent CLEC) describe exactly the same situation. Table 2 is thus quite misleading if its intention is to help quantify the competitive significance of different values of delta.

More importantly, Dr. Bell's Table 2, like his Table 1, focuses exclusively on the effects of varying delta. His inferences about performance disparity are driven, therefore, purely by statistical measures; no effort is made to determine the economic or material significance of disparities. Accordingly, the approach embodied in Tables 1 and 2 is not helpful or sufficient for determining a value of delta for which the commercial gain to

BellSouth from unobserved discrimination equal to the product of delta and the standard deviation (a Type II error) is just outweighed by the cost to BellSouth of paying a penalty when it does not, in fact, discriminate (a Type I error).

Q. WHAT ARE THE LIKELY CONSEQUENCES OF SETTING REMEDIES, AS IN THE CLEC COALITION'S PLAN, WITHOUT ANY ACCOUNTING FOR THE LIKELY ECONOMIC SIGNIFICANCE OF PERFORMANCE DISPARITIES?

A. When a performance disparity is proved, the only way to establish the appropriate penalty is to investigate the nature of the disparity itself, specifically the functionality or service that suffered a lapse in performance or quality, and to determine the likely gain to the ILEC (corresponding to the likely loss to the CLEC). As I stated earlier, initial estimates of that gain or loss may need to be based on business judgment, with subsequent revisions being made as experience with the effects of performance disparities accumulates. To use only a blanket statistical decision rule for this purpose, e.g., by "how much" the quality of service provided to the CLEC misses the set standard or benchmark, would jeopardize the objective of measuring accurately the expected gain or loss from the disparity. Furthermore, because a statistical decision rule is often influenced by factors unrelated to either that expected gain or loss, and is beyond the control of one or the other party, it can become subject to abuse when applied to the determination of the appropriate penalty.

One example of the kind of gaming that can arise when the penalty set for a performance disparity is unrelated to the financial importance of that disparity is a class of actions that are described in economics as "moral hazard." Broadly defined, moral hazard is a form of gaming by which one party to a plan or contract may act in ways—within the

framework of the existing plan—that allow it to gain an unanticipated competitive or financial advantage at the expense of the other party. The PAP being formulated in this proceeding is by design asymmetric, i.e., all penalties are to be paid *by* BellSouth and *to* the CLECs. Therefore, without protections built into the PAP, there could be a strong incentive for the CLECs to act in ways that raise the risk of default—and loss—to BellSouth.

Q. PLEASE PROVIDE SOME EXAMPLES OF MORAL HAZARD.

A. The following are two examples of moral hazard:

1. A homeowner that insures his home against accidental fire damage may actually raise the risk of such damage by failing to take precautions or to maintain the pre-insurance level of vigilance against accidental fires.
2. A customer that purchases an appliance or automobile under a comprehensive warranty may actually raise the risk of needing repairs by failing to accord the level of care that would have been given without the warranty.

Q. PLEASE INDICATE THE DIFFERENT WAYS THIS MORAL HAZARD-BASED BEHAVIOR COULD MANIFEST ITSELF IN THE PRESENT CONTEXT.

A. The prospect—or promise—of payments in excess of amounts necessary for deterrence could trigger moral hazard-based behavior in at least the following ways:

1. *Reward lack of cooperation.* CLECs could have less incentive to report operational problems to BellSouth in a timely manner. The longer a problem goes uncorrected, the greater would be the compensation available.
2. *Maximize opportunities for unearned income to CLECs.* Reliance on arbitrary rules to set penalties could result in a PAP setting disproportionately severe penalties for relatively minor disparities. However, not every service failure would cause a CLEC customer to permanently change suppliers. Also, the proposed penalties would take effect regardless of whether the fault was BellSouth's, the CLEC's, the customer's, or of no one in particular.
3. *Discourage investment by CLECs.* The opportunities for unearned income could

discourage the CLECs from investing in their own facilities, especially if such investment were to cause those carriers to lose a lucrative source of income.

4. *Encourage inefficient entry.* Firms that are inefficient relative to BellSouth could nevertheless see an opportunity to enter the market in the expectation of receiving penalty payments from BellSouth. This would be precisely the same effect that providing a subsidy would have in inducing entry by inefficient firms.

5. *Entrapment by CLEC.* CLECs could have an incentive to force BellSouth into situations of non-compliance. For example, by choosing to provision hard-to-serve end-users, presenting service requests that are calculated to cause bottlenecks and delays in BellSouth's response, or basing service requests on deliberately underestimated service requirements (with a subsequent upward revision in those requests that BellSouth could not possibly fulfill quickly), those carriers could increase the risk of BellSouth's non-compliance.

Q. COULDN'T PROTECTIONS AGAINST SUCH GAMING BE BUILT INTO A PERFORMANCE ASSESSMENT PLAN?

A. Only partially. Certainly all parties would agree that remedies generated under the enforcement mechanisms should not be excessive or create an economic incentive for CLECs to be receptive to performance disparities on BellSouth's part. However, in most instances, those protections would not likely be automatic, i.e., moral hazard behavior would first have to be proved through litigation or some contested proceeding. Also, those protections would not suffice for all forms of moral hazard behavior. While the proposed protections are definitely worthwhile, the best protection would be to remove pre-emptively the very incentives that give rise to moral hazard behavior. Again, this means adopting a deterrence-based PAP which separates the use of statistical decision rules for establishing disparities from the use of economic or financial methodologies to determine the severity of disparities and the penalties appropriate for them. The efficient PAP must minimize the costs of proving alleged disparities and determining their appropriate penalties, and make the detection and remedying of disparities voluntary, self-effectuating,

and automatic.

The single best protection against gaming is to de-link the size of penalties for specific performance disparities from the statistical methodology used to test for those disparities. If the sole determinant of penalty payments by BellSouth is also the means by which BellSouth is determined to be non-compliant, then the incentive—and, conceivably, the opportunity—would exist for CLECs to engage in moral hazard behavior. Such behavior would simultaneously make it more probable for BellSouth to be found non-compliant and liable for penalty payments unrelated to the likely economic significance of that non-compliance.

4. The cap on BellSouth's financial liability should not be procedural, but a percent of its net revenue from services sold in Tennessee

Q. SHOULD BELLSOUTH'S FINANCIAL LIABILITY BE CAPPED AS A MATTER OF ECONOMIC PRINCIPLE?

A. Yes. A cap on BellSouth's financial liability will be an important signal to both BellSouth and CLECs to not employ tactics to secure any undue or extra-market financial advantage for themselves. In other words, a cap would prevent efforts by all parties to game the system. Knowing exactly what its financial liability is would limit the uncertainty under which BellSouth would have to operate. Without a cap on that liability, BellSouth would have to prepare for compensation claims almost without limit. This could affect BellSouth in at least one important way, namely, compromise BellSouth's ability to utilize its resources efficiently in all possible uses, including serving retail customers. BellSouth's resources to meet its various needs are not unlimited. While delivering retail services at

the desired level is both an obligation and a competitive necessity, BellSouth also has an obligation to provide wholesale services of the desired ability to its competitors. An excessive and unreasonable financial liability on one flank of its operations could clearly jeopardize BellSouth's ability to meet its goals elsewhere.

Q. SHOULD THE CAP ON ITS FINANCIAL LIABILITY BE PROCEDURAL OR RELATED TO ITS MARKET PERFORMANCE?

A. I endorse BellSouth's suggestion [Coon direct, at 91] that its financial liability be capped at 36 percent of its net revenue from all Tennessee operations. This is consistent with the percentage and the type of cap accepted by the FCC in other states that have recently received Section 271 authority.

The idea behind such a cap is straightforward. First, it reflects BellSouth's actual scale of operations and its profitability. As BellSouth loses market share over time, and its net revenue from services sold in Tennessee decreases, the proposed cap would allow a commensurate scaling down of its liability. This would guard against the prospect that, as its net revenue shrinks, any fixed amount of liability would become a larger and more crippling fraction of that net revenue. Also, the CLEC Coalition's procedural cap does not really cap BellSouth's financial liability with any degree of certainty. Thus, BellSouth's liability could escalate without any limit, and the only recourse available to BellSouth would be to persuade the TRA to impose a limit on its own. BellSouth's proposed approach would also guard against that prospect. Absent the protection of BellSouth's proposed cap, and sensing BellSouth's increased financial vulnerability in that circumstance, some CLECs could choose to compete with BellSouth not by attempting to

do better in the marketplace but by maximizing their claims for compensation from BellSouth. If the CLEC Coalition's proposed methodology for detecting and compensating performance failures were adopted, CLECs would have a strong incentive to compete in this perverse fashion.

Second, the TRA may find it easier to pick a fair percentage of BellSouth's net revenue for setting its financial liability than to implement and periodically modify a procedural cap amount. Once that percentage is picked, BellSouth's annual financial liability would automatically adjust in proportion to its net revenue from services sold in Tennessee. The TRA would spare itself the onerous—not to mention, contentious—task of determining and revising the liability cap as market circumstances changed. As Mr. Coon notes correctly in his rebuttal testimony [Coon rebuttal, at 42-43], a procedural cap would interfere with the self-effectuating nature of BellSouth's proposed PAP.

5. There should be no adjustments for market penetration

Q. WHAT IS THE 'N' FACTOR AS PROPOSED BY THE CLEC COALITION?

A. For Tier 2 remedies, the CLEC Coalition proposes a Market Penetration Adjustment that multiplies all levels of Tier 2 penalties by a factor *n* which takes on different values (from 1 to 10) as CLECs' collective market share of access lines varies from roughly half of the market to between zero and 5 percent. As that collective market share grows from its current level in Tennessee the applicable value of *n* would decline, but it is likely to be near the upper end of its proposed range if the PAP were implemented today and the CLEC Coalition's proposed Market Penetration Adjustment were accepted. In other words, under this adjustment, Tier 2 penalties today would be several multiples higher than at a time in

the future when the market becomes more evenly divided between BellSouth and the CLECs. This approach is not qualified in the least by focusing only on the wholesale services needed by a CLEC to provide retail service to new consumers.

Q. DO YOU ACCEPT THE PRINCIPLE OF SUCH AN ADJUSTMENT BASED ON MOVEMENTS IN MARKET SHARE?

A. No. The use of market share in isolation, as a predictor or estimate of the state of competition in a market, can be particularly misleading. The real issue is not market share *per se*; rather, it is whether the incumbent firm, here BellSouth, has either the incentive or the ability to exercise market power (e.g., restrict competitive entry and/or manipulate market prices). If other indicators confirm that BellSouth is unable, in any way, to exercise that market power, then adjusting Tier 2 remedies for BellSouth's current market share is both unnecessary and distortive. Indeed, the whole point of Tier 1 remedies is to prevent BellSouth from exercising market power, such as by raising barriers to entry for potential competitors. If Tier 1 remedies are successful at accomplishing this, then scaling Tier 2 penalties by a market penetration factor would be overkill and economically inefficient. For Tier 2 remedies, the real question is whether BellSouth's performance disparities are severe enough to cause damage to market competition. If competition is not harmed, i.e., market power is not exercised by BellSouth, then, even in a market in which CLECs have a relatively low combined market share, there can be no justification for scaling remedies according to a market penetration factor. It is important to keep in view that an observed "low" market penetration factor for CLECs could have other reasons as well, e.g., a strategic unwillingness on the part of CLECs (several of whom are large, well-financed

inter-exchange carriers that face potential competitive losses from BellSouth's entry into the interLATA long distance market) to take stronger positions in the local exchange market, or to provide residential local exchange service when their rates—particularly in rural areas—are below the incremental cost to provide the service.

Q. IS ANY MARKET PENETRATION ADJUSTMENT JUSTIFIABLE FROM AN ECONOMIC STANDPOINT?

A. On balance, no. Although the CLEC Coalition would tie the Market Penetration Adjustment to the current stage of local exchange competition, the arbitrarily high multiplier selected to scale up Tier 2 penalty payments could actually become a lucrative source of income for the state and a monumental drain on BellSouth's resources.

Although the motivation behind infant industry protections (such as that provided by the proposed adjustment) is usually commendable, the problem is that, by promoting a one-way stream of compensation (whether justified or not), those protections can also create certain perverse incentives. Even if the market share-scaled Tier 2 penalties are paid to the state and not to the CLECs themselves, there is no question that large payments would greatly reduce BellSouth's profitability and be a considerable drain on its resources. Although CLECs could benefit from BellSouth being financially weakened in this manner, ironically, CLECs would have a greater incentive to "remain small," i.e., not reduce BellSouth's market share too much. The more the status quo could be preserved, the more BellSouth would be in danger of making very large penalty payments.

Returning to the theme that any PAP should be based on deterrence, the essential point here is that compensation owed to CLECs for BellSouth's failure to comply with set

performance standards must be proportional to the financial or economic significance of the non-compliance. Any adjustment that creates arbitrary and excessive penalty payments also sows the seed for perverse behavior by the recipients of those payments.

6. BellSouth's performance assessment plan should become effective no earlier than the date it receives authorization to offer interLATA services

Q. FROM AN ECONOMIC STANDPOINT, WHEN WOULD BE THE PROPER TIME TO IMPLEMENT A PERFORMANCE ASSESSMENT PLAN FOR BELLSOUTH?

A. The introduction of a PAP for BellSouth should be timed to coincide with the creation of the conditions needed for competition among *all* carriers and unfettered access by those carriers to markets for *all* services. According to Section 271 of the 1996 Act, this will happen when BellSouth receives authorization from the FCC to offer interLATA long distance services. The purpose of the PAP should be to ensure that BellSouth's competitors are not placed at an economic disadvantage because of BellSouth's actions. It is appropriate, therefore, to require that any remaining restraints on BellSouth's ability to compete for all services be removed at the same time. Otherwise, the operation of the PAP alone would create an artificial competitive advantage for BellSouth's competitors for at least the period of time that BellSouth is held out of the interLATA long distance market, and that advantage—once created—may well endure even after BellSouth is authorized entry into that market. For example, as penalty payments get triggered, BellSouth could respond by shoring up the quality of wholesale services provided to CLECs, perhaps even exceeding the quality that BellSouth provides to its own retail operations. As a result, CLECs that are beneficiaries of this BellSouth response could develop competitive retail

services of a higher quality than BellSouth's and win over customers—perhaps even permanently—on the strength of those superior services.

Most customers of telecommunications services prefer stability in their choice of suppliers, particularly when they seek all of their services from a single source. Once customers have elected to receive all their services from its competitors, BellSouth could find it extremely difficult to woo those customers back even after it received interLATA long distance authorization and offered attractive prices and service packages. From an economic standpoint, the preferred outcome would be to put customers in a position to choose among suppliers only when all those suppliers are able to compete for all the services that customers may desire.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

AFFIDAVIT

COMMONWEALTH OF: Massachusetts
COUNTY OF: Middlesex

BEFORE ME, the undersigned authority, duly commissioned and qualified in and for the State and County aforesaid, personally came and appeared William E. Taylor –Senior Vice President – National Economic Research Associates, Inc. (NERA), who, being by me first duly sworn deposed and said that:

He is appearing as a witness before the Tennessee Regulatory Authority in Docket No. 01-00193 on behalf of BellSouth Telecommunications, Inc., and if present before the Authority and duly sworn, his testimony would be set forth in the annexed testimony consisting of 44 pages and 1 exhibit(s).

William E. Taylor

Sworn to and subscribed
before me on 7/30/01

NOTARY PUBLIC

WILLIAM E. TAYLOR

BUSINESS ADDRESS

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Dr. Taylor received a B.A. magna cum laude in Economics from Harvard College, an M.A. in Statistics and a Ph.D. in Economics from the University of California at Berkeley. He has taught economics, statistics, and econometrics at Cornell and the Massachusetts Institute of Technology and was a post doctoral Research Fellow at the Center for Operations Research and Econometrics at the University of Louvain, Belgium.

At NERA, Dr. Taylor is a Senior Vice President, heads the Cambridge office and is Director of the Telecommunications Practice. He has worked primarily in the field of telecommunications economics on problems of state and federal regulatory reform, competition policy, terms and conditions for competitive parity in local competition, quantitative analysis of state and federal price cap and incentive regulation proposals, and antitrust problems in telecommunications markets. He has testified on telecommunications economics before numerous state regulatory authorities, the Federal Communications Commission, the Canadian Radio-Television and Telecommunications Commission, federal and state congressional committees and courts. Recently, he was chosen by the Mexican Federal Telecommunications Commission and Telmex to arbitrate the renewal of the Telmex price cap plan in Mexico. Other recent work includes studies of the competitive effects of major mergers among telecommunications firms and analyses of vertical integration and interconnection of telecommunications networks. He has appeared as a telecommunications commentator on PBS Radio and on The News Hour with Jim Lehrer.

He has published extensively in the areas of telecommunications policy related to access and in theoretical and applied econometrics. His articles have appeared in numerous telecommunications industry publications as well as *Econometrica*, the *American Economic Review*, the International *Economic Review*, the *Journal of Econometrics*, *Econometric Reviews*, the *Antitrust Law Journal*, *The Review of Industrial Organization*, and *The Encyclopedia of Statistical Sciences*. He has served as a referee for these journals (and others)

and the National Science Foundation and has served as an Associate Editor of the *Journal of Econometrics*.

EDUCATION

UNIVERSITY OF CALIFORNIA, BERKELEY
Ph.D., Economics, 1974

UNIVERSITY OF CALIFORNIA, BERKELEY
M.A., Statistics, 1970

HARVARD COLLEGE
B.A., Economics, 1968
(Magna Cum Laude)

EMPLOYMENT

NATIONAL ECONOMIC RESEARCH ASSOCIATES, INC. (NERA)
1988- Senior Vice President, Office Head, Telecommunications Practice Director. Dr. Taylor has directed many studies applying economic and statistical reasoning to regulatory, antitrust and competitive issues in telecommunications markets. In the area of environmental regulation, he has studied statistical problems associated with measuring the level and rate of change of emissions.

BELL COMMUNICATIONS RESEARCH, INC. (Bellcore)
1983-1988 Division Manager, Economic Analysis, formerly Central Services Organization, formerly American Telephone and Telegraph Company. While at Bellcore, Dr. Taylor performed theoretical and quantitative research focusing on problems raised by the implementation of access charges. His work included design and implementation of demand response forecasting for interstate access demand, quantification of potential bypass liability, design of optimal nonlinear price schedules for access charges and theoretical and quantitative analysis of price cap regulation of access charges.

BELL TELEPHONE LABORATORIES
1975-1983 Member, Technical Staff, Economics Research Center. Performed basic research on theoretical and applied econometrics, focusing on small sample theory, panel data and simultaneous equations systems.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Fall 1977 Visiting Associate Professor, Department of Economics. Taught graduate courses in econometrics.

CENTER FOR OPERATIONS RESEARCH AND ECONOMETRICS
Université Catholique de Louvain, Belgium.
1974-1975 Research Associate. Performed post-doctoral research on finite sample econometric theory and on cost function estimation.

CORNELL UNIVERSITY
1972-1975 Assistant Professor, Department of Economics. (On leave 1974-1975.) Taught graduate and undergraduate courses on econometrics, microeconomic theory and principles.

MISCELLANEOUS

1985-1995	Associate Editor, *Journal of Econometrics*, North-Holland Publishing Company.
1990-	Board of Directors, National Economic Research Associates, Inc.
1995-	Board of Trustees, Treasurer, Episcopal Divinity School, Cambridge, Massachusetts.

PUBLICATIONS

"Smoothness Priors and Stochastic Prior Restrictions in Distributed Lag Estimation," *International Economic Review*, 15 (1974), pp. 803-804.
"Prior Information on the Coefficients When the Disturbance Covariance Matrix is Unknown," *Econometrica*, 44 (1976), pp. 725-739.
"Small Sample Properties of a Class of Two Stage Aitken Estimators," *Econometrica*, 45 (1977), pp. 497-508.
"The Heteroscedastic Linear Model: Exact Finite Sample Results," *Econometrica*, 46 (1978), pp. 663-676.
"Small Sample Considerations in Estimation from Panel Data," *Journal of Econometrics*, 13 (1980) pp. 203-223.
"Comparing Specification Tests and Classical Tests," Bell Laboratories Economics Discussion Paper, 1980 (with J.A. Hausman).
"Panel Data and Unobservable Individual Effects," *Econometrica*, 49 (1981), pp. 1377-1398 (with J.A. Hausman).
"On the Efficiency of the Cochrane-Orcutt Estimator," *Journal of Econometrics*, 17 (1981), pp. 67-82.
"A Generalized Specification Test," *Economics Letters*, 8 (1981), pp. 239-245 (with J.A. Hausman).
"Identification in Linear Simultaneous Equations Models with Covariance Restrictions: An Instrumental Variables Interpretation," *Econometrica*, 51 (1983), pp. 1527-1549 (with J.A. Hausman).
"On the Relevance of Finite Sample Distribution Theory," *Econometric Reviews*, 2 (1983), pp. 1-84.

"Universal Service and the Access Charge Debate: Comment," in P.C. Mann and H.M. Trebing (editors), *Changing Patterns in Regulation, Markets, and Technology: The Effect on Public Utility Pricing*. The Institute of Public Utilities, Michigan State University, 1984.

"Recovery of Local Telephone Plant Costs under the St. Louis Plan," in P.C. Mann and H.M. Trebing (editors), *Impact of Deregulation and Market Forces on Public Utilities*. The Institute of Public Utilities, Michigan State University, 1985.

"Access Charges and Bypass: Some Approximate Magnitudes," in W.R. Cooke (editor), *Proceedings of the Twelfth Annual Telecommunications Policy Research Conference*, 1985.

"Federal and State Issues in Non-Traffic Sensitive Cost Recovery," in *Proceedings from the Telecommunications Deregulation Forum*. Karl Eller Center, College of Business and Public Administration, University of Arizona, Tucson, Arizona, 1986.

"Panel Data" in N.L. Johnson and S. Kotz (editors), *Encyclopedia of Statistical Sciences*. John Wiley & Sons, New York, 1986.

"An Analysis of Tapered Access Charges for End Users," in P.C. Mann and H.M. Trebing (editors), *New Regulatory and Management Strategies in a Changing Market Environment*. The Institute of Public Utilities, Michigan State University, 1987 (with D.P. Heyman, J.M. Lazorchak, and D.S. Sibley).

"Efficient Estimation and Identification of Simultaneous Equation Models with Covariance Restrictions," *Econometrica*, 55 (1987), pp. 849-874 (with J.A. Hausman and W.K. Newey).

"Alternative NTS Recovery Mechanisms and Geographic Averaging of Toll Rates," in *Proceedings of the Thirteenth Annual Rate Symposium: Pricing Electric, Gas, and Telecommunications Services*. The Institute for the Study of Regulation, University of Missouri, Columbia, 1987.

"Price Cap Regulation: Contrasting Approaches Taken at the Federal and State Level," in W. Bolter (editor), *Federal/State Price-of-Service Regulation: Why, What and How?*, Proceedings of the George Washington University Policy Symposium, December, 1987.

"Local Exchange Pricing: Is There Any Hope?", in J. Alleman (editor), *Perspectives on the Telephone Industry: The Challenge of the Future*. Ballinger Publishing Company, Cambridge, Massachusetts, 1989.

"Generic Costing and Pricing Problems in the New Network: How Should Costs be Defined and Assessed," in P.C. Mann and H.M. Trebing (editors) *New Regulatory Concepts, Issues, and Controversies*. The Institute of Public Utilities, Michigan State University, 1989.

"Telephone Penetration and Universal Service in the 1980s," in B. Cole (editor), *Divestiture Five Years Later*. Columbia University Press, New York, New York, 1989 (with L.J. Perl).

"Regulating Competition for IntraLATA Services," in *Telecommunications in a Competitive Environment*, Proceedings of the Third Biennial NERA Telecommunications Conference, 1989, pp. 35-50.

"Costing Principles for Competitive Assessment," in *Telecommunications Costing in a Dynamic Environment*, Bellcore-Bell Canada Conference Proceedings, 1989 (with T.J. Tardiff).

"Optional Tariffs for Access in the FCC's Price Cap Proposal," in M. Einhorn (ed.), *Price Caps and Incentive Regulation in the Telecommunications Industry*. Kluwer, 1991 (with D.P. Heyman and D.S. Sibley).

"Alternative Measures of Cross-Subsidization," prepared for the Florida Workshop on Appropriate Methodologies for the Detection of Cross--Subsidies, June 8, 1991.

"Predation and Multiproduct Firms: An Economic Appraisal of the Sievers-Albery Results," *Antitrust Law Journal*, 30 (1992), pp. 785-795.

"Lessons for the Energy Industries from Deregulation in Telecommunications," *Proceedings of the 46th Annual Meeting of the Federal Energy Bar Association*, May 1992.

"Efficient Price of Telecommunications Services: The State of the Debate," *Review of Industrial Organization*, Vol. 8, pp. 21-37, 1993.

"Status and Results of Regulatory Reform in the U.S. Telecommunications Industry," in C.G. Stalon, *Regulatory Responses to Continuously Changing Industry Structures*. The Institute of Public Utilities, Michigan State University, 1992.

"Post-Divestiture Long-Distance Competition in the United States," *American Economic Review*, Vol. 83, No. 2, May 1993 (with Lester D. Taylor). Reprinted in E. Bailey, J. Hower, and J. Pack, *The Political Economy of Privatization and Deregulation*.London: Edward Elgar, 1994.

"Comment on 'Pricing of Inputs Sold to Competitors,' by W.J. Baumol and J.G. Sidak," *Yale Journal on Regulation*, Vol. 11, Issue 1, 1994, pp. 225-240 (with Alfred E. Kahn).

"Comments on Economic Efficiency and Incentive Regulation," Chapter 7 in S. Globerman, W. Stanbury and T. Wilson, *The Future of Telecommunications Policy in Canada*. Toronto: Institute for Policy Analysis, University of Toronto, April 1995.

"Revising Price Caps: The Next Generation of Incentive Regulation Plans," Chapter 2 in M.A. Crew (ed.) *Pricing and Regulatory Innovations under Increasing Competition*. Boston: Kluwer Academic Publishers, May 1996 (with T. Tardiff).

"An Analysis of the State of Competition in Long-Distance Telephone Markets," *Journal of Regulatory Economics*, May 1997, pp. 227-256 (with J.D. Zona).

"An Analysis of the Welfare Effects of Long Distance Market Entry by an Integrated Access and Long Distance Provider," *Journal of Regulatory Economics*, March 1998, pp. 183-196 (with Richard Schmalensee, J.D. Zona and Paul Hinton).

"Market Power and Mergers in Telecommunications," *Proceedings of the Institute of Public Utilities; 30th Annual Conference: Competition in Crisis: Where are Network Industries Heading?* The Institute of Public Utilities, Michigan State University, 1999.

"The Baby and the Bathwater: Utility Competition, But at What Price?," Public Utilities Fortnightly, Vol. 137, No.21, November 15, 1999, pp. 48-56 (with Anne S. Babineau and Matthew M. Weissman).

TESTIMONIES

Access Charges

Florida Public Service Commission (Docket No. 820537-TP), July 22, 1983.
Arkansas Public Service Commission (Docket No. 83-042-U), October 7, 1985.
Public Utility Commission of Texas (Docket No. 8585), December 18, 1989.
Mexican Secretariat of Communications and Transport, affidavit filed October 18, 1995 (with T. Tardiff).
Federal Communications Commission (CC Docket No. 96-98), affidavit July 8, 1996; *ex parte* letters filed July 22, 1996 and July 23, 1996.
Federal Communications Commission (CC Docket No. 96-262 et. al.) with Richard Schmalensee, January 29, 1997). Rebuttal February 14, 1997.
New York Public Service Commission (Case 94-C-0095 and 28425), Panel Testimony, May 8, 1997. Rebuttal Panel Testimony July 8, 1997.
Pennsylvania Public Utility Commission (Docket No. I-00960066), June 30, 1997. Rebuttal July 29, 1997. Surrebuttal August 27, 1997.
Connecticut Department of Public Utility Control (Docket No. 96-04-07), October 16, 1997.
Federal Communications Commission (*ex parte* CC Docket No. 96-262 *et. al.*), with Richard Schmalensee, January 21, 1998.
Federal Communications Commission (CCB/CPD 98-12), March 18, 1998.
Federal Communications Commission (CC Docket Nos. 96-262, 94-1, 97-250 and RM 9210), October 26, 1998. Reply November 9, 1998.
Federal Communications Commission (Docket No. 99-24), with Karl McDermott, January 20, 1999. Reply April 8, 1999.
Vermont Public Service Board (Docket No. 6167), May 20, 1999. Supplemental May 27, 1999.
Virginia State Corporation Commission, (Case No. PUC 000003), May 30, 2000.
Maryland Public Service Commission (Case No. 8745), March 23, 2001. Rebuttal May 21, 2001. Surrebuttal June 11, 2001.

Incentive and Price Cap Regulation

Federal Communications Commission (Docket No. 87-313), March 17, 1988.
Florida Public Service Commission (Docket No. 880069-TL), June 10, 1988.
Federal Communications Commission (Docket No. 87-313), August 18, 1988. Rebuttal November 18, 1988.
New Hampshire Public Service Commission (Docket 89-010), March 3, 1989.
Federal Communications Commission (Docket No. 87-313), June 9, 1989.
Federal Communications Commission (Docket No. 87-313), August 3, 1989. (2 filings)
New York State Public Service Commission (Case 28961 - Fifth Stage), September 15, 1989.
Georgia Public Service Commission (Docket No. 3882-U), September 29, 1989.

Federal Communications Commission (Docket 87-313), May 3, 1990.
Federal Communications Commission (Docket 87-313), June 8, 1990 (2 filings).
State of Maine Public Utilities Commission (Docket No. 89-397), June 15, 1990.
Montana Public Service Commission (Docket No. 90.8.46), October 4, 1990.
Federal Communications Commission (Docket 87-313), December 21, 1990.
Tennessee Public Service Commission, February 20, 1991.
Federal Communications Commission (Docket 87-313) with Alfred E. Kahn), June 12, 1991.
California Public Utilities Commission (Phase II of Case 90-07-037) with Timothy J. Tardiff, August 30, 1991. Supplemental testimony January 21, 1992.
Rhode Island Public Utilities Commission (Docket No. 1997), September 30, 1991.
Montana Public Service Commission (Docket No. 90.12.86), November 4, 1991. Additional testimony January 15, 1992.
Federal Communications Commission (Pacific Bell Tariff F.C.C. No. 128, Transmittal No. 1579) with T.J. Tardiff, April 15, 1992. Reply comments July 31, 1992.
California Public Utilities Commission (Docket No. I.87-11-033), with T.J. Tardiff, May 1, 1992.
Delaware Public Utilities Commission (Docket No. 33), June 22, 1992.
Florida Public Service Commission (Docket No. 920260-TL), December 18, 1992.
California Public Utilities Commission (Docket No. I.87-11-033), with T.J. Tardiff, April 8, 1993, reply testimony May 7, 1993.
Canadian Radio-Television and Telecommunications Commission (Docket No. 92-78), with T.J. Tardiff, April 13, 1993 (2 filings).
Federal Communications Commission (Petition for Declaratory Ruling and Related Waivers to Establish a New Regulatory Model for the Ameritech Region), April 16, 1993. Reply Comments, July 12, 1993.
Delaware Public Utilities Commission (Docket No. 33), June 1, 1993. Supplementary statement, June 7, 1993. Second supplementary statement," June 14, 1993.
Vermont Public Service Board (Dockets 5700/5702), September 30, 1993. Rebuttal testimony July 5, 1994.
Pennsylvania Public Utility Commission (Docket No. P-009350715), October 1, 1993. Rebuttal January 18, 1994.
Massachusetts Department of Public Utilities (Docket No. D.P.U. 94-50), April 14, 1994. Rebuttal October 26, 1994.
Federal Communications Commission (CC Docket 94-1), May 9, 1994. Reply June 29, 1994.
Federal Communications Commission (CC Docket 94-1) with R. Schmalensee, May 9, 1994. Reply June 29, 1994.
New York State Public Service Commission (Case 92-C-0665), panel testimony, October 3, 1994.
State of Maine Public Utilities Commission (Docket Nos. 94-123/94-254), December 13, 1994. Rebuttal January 13, 1995.
Canadian Radio-Television and Telecommunications Commission (Application of Teleglobe Canada for Review of the Regulatory Framework of Teleglobe Canada Inc.), December 21, 1994.

Kentucky Public Service Commission, testimony re concerning telecommunications productivity growth and price cap plans, April 18, 1995.
California Public Utilities Commission (U 1015 C), May 15, 1995. Rebuttal January 12, 1996.
State of Connecticut, Department of Public Utility Control (DPUC Docket No. 95-03-01), June 19, 1995.
Louisiana Public Service Commission (Docket No. U-17949, Subdocket E), July 24, 1995.
California Public Utilities Commission (Investigation No. I.95-05-047), with R.L. Schmalensee and T.J. Tardiff, September 8, 1995. Reply September 18, 1995.
Mississippi Public Service Commission (Docket No. 95-UA-313), October 13, 1995.
Louisiana Public Service Commission (Docket No. U-20883), November 21, 1995.
Federal Communications Commission (CC Docket No. 94-1), with T. Tardiff and C. Zarkadas, December 18, 1995. Reply March 1, 1996.
North Carolina Utilities Commission (Docket No. P-7, Sub 825; P-10, Sub 479), February 9, 1996.
Rhode Island Public Utilities Commission (Docket No. 2370), February 23, 1996. Rebuttal June 25, 1996.
Pennsylvania Public Utility Commission (Docket No. P-00961024), April 15, 1996. Rebuttal July 19, 1996.
Canadian Radio-Television and Telecommunications Commission, in response to CRTC Telecom Public Notice CRTC 96-8 (2 filings), June 10, 1996.
Federal Communications Commission (CC Docket 96-262 et al.), *ex parte* March 1997.
Federal Communications Commission (CC Docket Nos. 93-193, Phase 1, Part 2, 94-65), May 19, 1997.
Vermont Public Service Board (Docket no. 6000), January 19, 1998.
Colorado Public Utilities Commission (Docket No. 97A-540T, January 30, 1998. Rebuttal May 14, 1998.
California Public Utilities Commission, affidavit on economic principles for updating Pacific Bell's price cap plan. Filed February 2, 1998.
California Public Utilities Commission, reply comments on Pacific proposal to eliminate vestiges of ROR regulation and inflation minus productivity factor formula/index, filed June 19, 1998.
Pennsylvania Public Utility Commission (Docket No. P-00981410), October 16, 1998. Rebuttal February 4, 1999.
Comisión Federal de Telecomunicaciones de México ("Cofetel"), "Economic Parameter Values in the Telmex Price Cap Plan," arbitrator's report regarding the renewal of the price cap plan for Telmex, February 15, 1999.
Kentucky Public Service Commission (Docket No. 98-292), April 5, 1999.
Federal Communications Commission (Docket Nos. 94-1, 96-26), January 7, 2000. Reply comments filed January 24, 2000, Ex parte comments filed May 5, 2000.
New Mexico Public Regulation Commission, direct testimony filed December 10, 1999.
Arizona Corporation Commission (Docket No. T-01051B-99-105), rebuttal filed August 21, 2000; rejoinder filed September 19, 2000.
Connecticut Department of Public Utilities (Docket No. 00-07-17), filed November 21, 2000.

Pennsylvania Public Utility Commission (Docket No. P-00981449), filed October 31, 2000. Rebuttal testimony filed February 20, 2001.
NERA Report: Economic Assessment of the Consumer Choice and Fair Competition Telecommunications Amendment (Proposition 108) (with Aniruddha Banerjee and Charles Zarkadas), November 2000.
Canadian Radio-Television and Telecommunications Commission, in response to CRTC Telecom Public Notice CRTC 2000-108, oral panel testimony, January 11, 2001.
Maine Public Utilities Commission (Docket No. 99-851, January 8, 2001.
New York Public Service Commission, (Case 00-C-1945), May 15, 2001.
Canadian Radio-Television and Telecommunications Commission (Public Notice CRTC 2001-37), filed May 31, 2001.

Payphone

California Public Utilities Commission (Case 88-04-029), July 11, 1988.
Illinois Commerce Commission (Docket No. 88-0412), August 3, 1990. Surrebuttal December 9, 1991.
Michigan Public Service Commission (Case No. U-11756), October 9, 1998.
South Carolina Public Service Commission (Docket No. 97-124-C), December 7, 1998.
New Jersey Board of Public Utilities (OAL DOCKET Nos. PUCOT 11269-97N, PUCOT 11357-97N, PUCOT 01186-94N AND PUCOT 09917-98N), March 8, 1999. Surrebuttal June 21, 1999.
Louisiana Public Service Commission (Docket No. U-22632), July 17,2000.
Tennessee Regulatory Authority, Docket No. 97-00409, October 6, 2000.

Economic Costing and Pricing Principles

Florida Public Service Commission (Docket No. 820400-TP), June 25, 1986.
Delaware Public Service Commission (Docket No. 86-20, Phase II), March 31, 1989. Rebuttal November 17, 1989.
Delaware Public Service Commission (Docket No. 89-24T), August 17, 1990.
Florida Public Service Commission (Docket No. 900633-TL), May 9, 1991.
Maryland Public Service Commission (Case No. 8584, Phase II), December 15, 1994. Additional direct testimony May 5, 1995. Rebuttal testimony filed June 30, 1995.
Canadian Radio-Television and Telecommunications Commission, Response to Interrogatory SRCI(CRTC) 1Nov94-906, "Economies of Scope in Telecommunications," January 31, 1995.
Pennsylvania Public Utility Commission (Docket Nos. A-310203F0002, A-310213F0002, A-310236F0002 and A-310258F0002), March 21, 1996.
State of Connecticut, Department of Public Utility Control (DPUC Docket No. 95-06-17), July 23, 1996.

New Jersey Board of Public Utilities (Docket No. TX95120631), August 15, 1996. Rebuttal filed August 30, 1996.
Florida Public Service Commission (Docket No. 980000-SP), September 24, 1998.
Nebraska Public Service Commission, (Application No. C-1628), October 20, 1998. Reply November 20, 1998.
Florida Public Service Commission (Docket No. 980000-SP), November 13, 1998.
Wyoming Public Service Commission (Docket No. 70000-TR-99), April 26, 1999.
New Mexico Public Regulation Commission (Utility Case No. 3147), December 6, 1999, rebuttal testimony filed December 28, 1999.
New Mexico Public Regulation Commission (Case No. 3008, rebuttal testimony filed May 19, 2000.
North Dakota Public Service Commission, (Case No. PU-314-99-119), May 30, 2000.
New Mexico Public Regulation Commission (Case No. 3225, direct testimony filed August 18, 2000. Rebuttal filed September 13, 2000.
New Mexico Public Regulation Commission (Case No. 3300), rebuttal testimony filed October 19, 2000.

Statistics

Arizona State Air Pollution Control Hearing Board (Docket No. A-90-02), affidavit December 7, 1990.
Expert testimony: Michigan Circuit Court (Case No. 87-709234-CE and 87-709232-CE), *Her Majesty the Queen, et al., v. Greater Detroit Resource Recovery Authority, et al.*, February, 1992.
Expert testimony: United States District Court, Eastern District of New York, *Jancyn Manufacturing Corp. v. The County of Suffolk*, January 11, 1994.
New York Public Service Commission (Case Nos. 93-C-0451 and 91-C-1249), July 23, 1996.
New York Public Service Commission (Cases 95-C-0657, 94-C-0095, 91-C-1174 and 96-C-0036): panel testimony, March 18, 1998. Rebuttal June 3, 1998.

InterLATA Toll Competition

Canadian Radio-Television and Telecommunications Commission (Docket No. 1990-73), November 30, 1990.
Federal Communications Commission (Docket 91-141), August 6, 1991.
Federal Communications Commission (CC Docket 92-141), July 10, 1992.
Federal Communications Commission (In the Matter of Policy and Rules Concerning Rates for Competitive Common Carrier Services and Facilities Authorization Therefor) with A.E. Kahn, November 12, 1993.

U.S. District Court for the District of Columbia *United States of America v. Western Electric Company, Inc. and American Telephone and Telegraph Company*, Affidavit with A.E. Kahn, May 13, 1994.

U.S. Department of Justice, *United States of America v. Western Electric Company, Inc. and American Telephone and Telegraph Company*, August 25, 1994.

Federal Communications *ex parte* filing in CC Docket No. 94-1, March 16, 1995.

Federal Communications Commission (CC Docket No. 79-252) *ex parte* comments with J. Douglas Zona, April 1995.

U.S. Department of Justice in *United States of America v. Western Electric Company, Inc. and American Telephone and Telegraph Company*, regarding Telefonos de Mexico's provision of interexchange telecommunications services within the United States, affidavit May 22, 1995.

U.S. Department of Justice in *United States of America v. Western Electric Company, Inc. and American Telephone and Telegraph Company*, regarding provision of interexchange telecommunications services to customers with independent access to interexchange carriers, May 30, 1995.

Expert testimony: *US WATS v. AT&T*, Confidential Report, August 22, 1995. Testimony October 18-20, 25-27, 30, 1995. Rebuttal testimony December 4, December 11, 1995.

Expert testimony: United States District Court for the Northern District of Texas, Dallas Division, Civil Action 394CV-1088D, *Darren B. Swain, Inc. d/b/a U.S. Communications v. AT&T Corp.* Confidential Report, November 17, 1995.

U.S. District Court, Southern District of New York, *Multi Communications Media Inc., v. AT&T and Trevor Fischbach* (96 Civ. 2679 (MBM)), December 27, 1996.

Federal Communications Commission (CC Docket Nos. 96-262 and 96-45), March 18, 1998.

Subcommittee on Communications of the Senate Committee on Commerce, Science and Transportation, *Statement* and oral testimony regarding long distance competition and Section 271 of the Telecommunications Act of 1996, March 25, 1998.

Federal Communications Commission (CC Docket No. 96-262), with P.S. Brandon, October 16, 1998.

Federal Communications Commission (CC Docket No. 96-262) with P.S. Brandon, October 22, 1998.

IntraLATA Toll Competition

New Jersey Board of Public Utilities (Docket No. TX90050349), December 6, 1990.

New York Public Service Commission (Case No. 28425) with T.J. Tardiff, May 1, 1992.

New Jersey Board of Regulatory Commissioners (Docket No. TX93060259), Affidavit October 1, 1993.

New Jersey Board of Public Utilities (Docket Nos. TX90050349, TE92111047, TE93060211), April 7, 1994. Rebuttal April 25, 1994. Summary Affidavit and Technical Affidavit April 19, 1994.

Delaware Public Utilities Commission (Docket No. 42), October 21, 1994.

Pennsylvania Public Utility Commission (Docket No. I-940034), panel testimony, December 8, 1994. Reply February 23, 1995. Surrebuttal March 16, 1995.
Public Service Commission of West Virginia (Case No. 94-1103-T-GI), March 24, 1995.
New Jersey Board of Public Utilities (Docket No. TX94090388), April 17, 1995. Rebuttal May 31, 1995.
New York Public Service Commission (Case 94-C-0017), August 1, 1995.
Rhode Island Public Service Commission (Docket No. 2252), November 17, 1995.
Massachusetts Department of Telecommunications and Energy (Docket No. 98-85), October 20, 1998.

Local Competition

Massachusetts Department of Public Utilities (Docket No. D.P.U. 94-185), May 19, 1995. Rebuttal August 23, 1995.
The Public Utilities Commission of Ohio (Case No. 94-1695-TP-ACE), May 24, 1995.
Vermont Public Service Board (Open Network Architecture Docket No. 5713), June 7, 1995. Rebuttal July 12, 1995.
New Jersey Board of Public Utilities (with Kenneth Gordon and Alfred E. Kahn), paper filed in connection with arbitration proceedings, August 9, 1996.
Florida Public Service Commission, "Local Telecommunications Competition: An Evaluation of a Proposal by the Communications Staff of the Florida Public Service Commission," with A. Banerjee, filed November 21, 1997.
Rhode Island Public Utilities Commission (Docket No. 2681), January 15, 1999.
Connecticut Department of Public Utility Control (Docket No. 95-06-17RE02), June 8, 1999.

Interconnection

Federal Communications Commission (Docket 91-141), September 20, 1991.
Maryland Public Service Commission (Case No. 8584) with A.E. Kahn, November 19, 1993. Rebuttal January 10, 1994. Surrebuttal January 24, 1994.
Maryland Public Service Commission (Case No. 8659), November 9, 1994.
Federal Communications Commission (CC Docket No. 95-185), affidavit March 4, 1996.
Federal Communications Commission (CC Docket No. 96-98), videotaped presentation on economic costs for interconnection, FCC Economic Open Forum, May 20, 1996.

Imputation

New Hampshire Public Service Commission (Docket DE 90-002), May 1, 1992. Reply testimony July 10, 1992. Rebuttal testimony August 21, 1992.
Canadian Radio-Television and Telecommunications Commission (Telecom Public Notice CRTC 95-36), August 18, 1995.
Massachusetts Department of Public Utilities (Docket No. D.P.U./D.T.E. 94-185-C), Affidavit February 6, 1998. Reply Affidavit February 19, 1998.

New Jersey Board of Public Utilities (BPU Docket No. TO97100808, OAL Docket No. PUCOT 11326-97N), July 8, 1998. Rebuttal September 18, 1998.
Vermont Public Service Board (Docket No. 6077), November 4, 1998.

Economic Depreciation

Florida Public Service Commission (Docket No. 920385-TL), September 3, 1992.
Louisiana Public Service Commission (Docket No. U-17949, Subdocket E), November 17, 1995. Surrebuttal, December 13, 1995, Further Surrebuttal, January 12, 1996.
Federal Communications Commission (CC Docket No. 98-137), with A. Banerjee, November 23, 1998.

Spectrum

Federal Communications Commission (ET Docket 92-100) with Richard Schmalensee, November 9, 1992.
Federal Communications Commission (Amendment of Part 90 of the Commission's Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems, PR Docket No. 93-61), with R. Schmalensee, June 29, 1993.

Mergers

U.S. District Court for the District of Columbia, *United States of America v. Western Electric Company, Inc. and American Telephone and Telegraph Company*, with A.E. Kahn, January 14, 1994.
Vermont Public Service Board (Docket No. 5900), September 6, 1996.
Maine Public Utilities Commission (Docket No. 96-388), September 6, 1996. Rebuttal October 30, 1996.
New Hampshire Public Service Commission (Docket DE 96-220), October 10, 1996.
Federal Communications Commission (Tracking No. 96-0221), with Richard Schmalensee, October 23, 1996.
New York Public Service Commission (Case 96-C-0603), panel testimony, November 25, 1996. Reply December 12, 1996.
Federal Communications Commission (CC Docket No. 97-211), with R. Schmalensee, affidavit March 13, 1998. Reply affidavit May 26, 1998.
Connecticut Department of Public Utility Control, testimony regarding economic aspects of the SBC-SNET proposed change in control, filed June 1, 1998.
Federal Communications Commission (CC Docket No. 98-141), with R. Schmalensee, July 21, 1998. Reply November 11, 1998.
Alaskan Public Utilities Commission (Docket Nos. U-98-140/141/142 and U-98-173/174), February 2, 1999. Rebuttal March 24, 1999.
Pennsylvania Public Utility Commission (Docket Nos. A-310200F0002, A-311350F0002, A-310222F0002, A-310291F0003), April 22, 1999.

State Corporation Commission of Virginia, *In re: Joint Petition of Bell Atlantic Corporation and GTE Corporation for approval of agreement and plan of merger*, May 28, 1999.
Ohio Public Utility Commission (Docket No. 98-1398-TP-AMT), June 16, 1999.
Kentucky Public Service Commission (Docket No. 99-296), July 9, 1999.
Colorado Public Utilities Commission (Docket No. 99A-407T), December 7, 1999.
Iowa Utilities Board, rebuttal testimony, filed December 23, 1999.
Minnesota Public Utilities Commission (Docket No. P3009, 3052, 5096, 421, 3017/PA-99-1192), rebuttal affidavit regarding the effects of the proposed Qwest-U S WEST merger on economic welfare. Filed January 14, 2000.
Washington Utilities and Transportation Commission (Docket No. UT-991358), rebuttal testimony regarding the effects of the proposed Qwest-U S WEST merger on economic welfare. Filed February 22, 2000.
Montana Public Service Commission (Docket No. D99.8.200), rebuttal testimony regarding the effects of the proposed Qwest-U S WEST merger on economic welfare. Filed February 22, 2000.
Utah Public Service Commission (Docket No. 99-049-41), rebuttal testimony regarding the effects of the proposed Qwest-U S WEST merger on economic welfare. Filed February 28, 2000.
Minnesota Public Utilities Commission (Docket No. P3009, 3052, 5096, 421, 3017/PA-99-1192), rebuttal affidavit filed January 14, 2000.
Minnesota Public Utilities Commission (Docket No. P3009, 3052, 5096, 421, 3017/PA-99-1192), direct testimony filed March 29, 2000.
Arizona Corporation Commission (Docket No. T-01051B-99-0497), rebuttal testimony filed April 3, 2000.
Wyoming Public Service Commission (Docket Nos. 74142-TA-99-16, 70000-TA-99-503, 74037-TA-99-8, 70034-TA-99-4, 74089-TA-99-9, 74029-TA-99-43, 74337-TA-99-2, Record No. 5134), rebuttal testimony filed April 4, 2000.

Broadband Services

Federal Communications Commission (File Nos. W-P-C 6912 and 6966), August 5, 1994.
Federal Communications Commission (File Nos. W-P-C 6982 and 6983), September 21, 1994.
Federal Communications Commission, affidavit examining cost support for Asymmetric Digital Subscriber Loop (ADSL) video dialtone market trial, February 21, 1995.
Federal Communications Commission, affidavit examining cost support for Bell Atlantic's video dialtone tariff, March 6, 1995.
Federal Communications Commission (File Nos. W-P-C 7074), July 6, 1995.
U.S. District Court for the Eastern District of Virginia (Alexandria Division), *United States Telephone Association, et al., v. Federal Communications Commission, et al.* (Civil Action No. 95-533-A), with A.E. Kahn , affidavit October 30, 1995.
Federal Communications Commission (CC Docket No. 95-145), October 26, 1995. Supplemental Affidavit December 21, 1995.

Expert testimony: *FreBon International Corp. vs. BA Corp. Civil Action*, No. 94-324 (GK), regarding Defendants' Amended Expert Disclosure Statement, filed under seal February 15, 1996.

Federal Communications Commission (CC Docket No. 96-46), *ex parte* affidavit, April 26, 1996.

Federal Communications Commission (CC Docket No. 96-112), affidavit filed May 31, 1996.

Federal Communications Commission (CC Docket No. 96-112), affidavit June 12, 1996.

Federal Communications Commission (CC Docket No. 96-46), July 5, 1996.

Pennsylvania Public Utility Commission, "Promises Fulfilled; Bell Atlantic-Pennsylvania's Infrastructure Development," filed January 15, 1999 (with Charles J. Zarkadas, Agustin J. Ros, and Jaime C. d'Almeida).

Rate Rebalancing

Canadian Radio-Television and Telecommunications Commission, Implementation of Regulatory Framework and Related Issues, Telecom Public Notices CRTC 94-52, 94-56 and 94-58, February 20, 1995.

Pennsylvania Public Utility Commission (Docket No. R-00963550), April 26, 1996. Rebuttal July 5, 1996.

Pennsylvania Public Utility Commission (Docket No. R-963550 C0006), August 30, 1996.

Public Utilities Commission of Ohio (Case No. 96-899-TP-ALT), February 19, 1997.

The New Jersey Board of Public Utilities (Docket No. _____), February 15, 2001.

Universal Service

Louisiana Public Service Commission (Docket No. U-20883, Subdocket A), August 16, 1995.

Tennessee Public Service Commission (Docket No. 95-02499), October 20, 1995. Rebuttal October 25, 1995. Supplementary direct October 30, 1995. Supplementary rebuttal November 3, 1995.

Mississippi Public Service Commission (Docket No. 95-UA-358), January 17, 1996. Rebuttal February 28, 1996.

Federal Communications Commission (CC Docket No. 96-45) with Kenneth Gordon, April 12, 1996.

Federal Communications Commission (CC Docket No. 96-45) with Aniruddha Banerjee, August 9, 1996.

Federal-State Joint Board (CC Docket No. 96-45), *Remarks on Proxy Cost Models*, videotape filed January 14, 1997.

New Jersey Board of Public Utilities (Docket No. TX95120631), September 24, 1997. Rebuttal October 18, 1997.

Pennsylvania Public Utility Commission (Docket No. I-00940035), October 22, 1997.

Alabama Public Service Commission (Docket No. 25980), February 13, 1998.

North Carolina Utilities Commission (Docket No. P-100, SUB 133g), February 16, 1998. Rebuttal April 13, 1998.
Mississippi Public Service Commission (Docket No. 98-AD-035), February 23, 1998. Rebuttal March 6, 1998.
Tennessee Regulatory Authority (Docket No. 97-00888), April 3, 1998. Rebuttal April 9, 1998.
Florida Public Service Commission (Docket No. 980696-TP), September 2, 1998.
Georgia Public Service Commission (Docket No. 5825-U), September 8, 2000.

Classification of Services as Competitive

Maryland Public Service Commission (Case No. 8462), October 2, 1992.
State Corporation Commission of Virginia (Case No. PUC 950067), January 11, 1996.
Maryland Public Service Commission (Case No. 8715), March 14, 1996. Surrebuttal filed April 1, 1996.
Federal Communications Commission (File No. SCL-97-003), December 8, 1997.
Pennsylvania Public Utility Commission (Docket No. P-00971307, February 11, 1998. Rebuttal February 18, 1998.
State of Connecticut, Department of Public Utility Control (Docket No. 98-02-33), February 27, 1998.
The New Jersey Board of Public Utilities (Docket No. TO 99120934), May 18, 2000.
Washington Transportation and Utilities Commission, (Docket No. UT-000883). October 6, 2000.
New York Public Service Commission, (Case 00-C-1945), May 15, 2001.

Costing and Pricing Resold Services and Network Elements

Science, Technology and Energy Committee of the New Hampshire House of Representatives, "An Economic Perspective on New Hampshire Senate Bill 77," April 6, 1993.
Tennessee Public Service Commission (Docket No. 96-00067), May 24, 1996. Refiled with the Tennessee Regulatory Authority (Docket No. 96-00067), August 23, 1996.
New York Public Service Commission (Case Nos. 95-C-0657, 94-C-0095, 91-C-1174), May 31, 1996. Additional testimony June 4, 1996. Rebuttal July 15, 1996.
Louisiana Public Service Commission (Docket No. U-U-22020), August 30 1996. Rebuttal September 13, 1996.
Tennessee Regulatory Authority (Docket No. 96-01331), September 10, 1996. Rebuttal September 20, 1996.
New Jersey Board of Public Utilities (Docket No. TO96070519), September 18, 1996.
Pennsylvania Public Utility Commission (Docket No. A-310258F0002), September 23, 1996.
Massachusetts Department of Public Utilities (Docket Nos. D.P.U. 96-73/74, 96-75, 96-80/81, 96-83, 96-94), September 27, 1996. Rebuttal October 16, 1996.
New Jersey Board of Public Utilities (Docket No. TX95120631), September 27, 1996.
New Hampshire Public Service Commission (Docket DE 96-252), October 1, 1996.

Massachusetts Department of Public Utilities (Docket Nos. D.P.U. 96-73/74, 96-75, 96-80/81, 96-83, 96-94), October 11, 1996. Rebuttal October 30, 1996.
Federal Communications Commission (CC Docket No. 96-45), October 15, 1996.
New Hampshire Public Service Commission (Docket DE 96-252), October 23, 1996.
New Jersey Board of Public Utilities (Docket No. T096080621), November 7, 1996.
Alabama Public Service Commission (Docket No. 25677), November 26, 1996.
Delaware Public Utilities Commission, testimony re costs and pricing of interconnection and network elements, December 16,1996. Rebuttal February 11, 1997.
State Corporation Commission of Virginia, (Case No. PUC960), December 20,1996. Rebuttal June 10, 1997 (Case No. PUC970005).
Public Service Commission of Maryland (Case No. 8731-II), January 10, 1997. Rebuttal April 4, 1997.
Public Service Commission of the District of Columbia (Case No. 962), January 17, 1997. Rebuttal May 2, 1997.
Connecticut Department of Public Utilities (DPUC Docket No. 96-09-22), January 24, 1997.
Connecticut Department of Public Utilities (DPUC Docket No. 96-11-03), February 11, 1997.
Federal Communications Commission, response to FCC Staff Report on issues regarding Proxy Cost Models. Filed February 13, 1997.
Public Service Commission of West Virginia (Case Nos. 96-1516-T-PC, 96-1561-T-PC, 96-1009-T-PC, and 96-1533-T-T), February 13, 1997. Rebuttal February 20, 1997.
Public Utilities Commission of Ohio (Case No. 97-152-TP-ARB), April 2, 1997.
Maine Public Utilities Commission (Docket No. 97-505), April 21, 1997. Rebuttal October 21, 1997.
Vermont Public Service Board (Docket No. 5713), July 31, 1997. Rebuttal January 9, 1998. Surrebuttal February 26, 1998. Supplemental rebuttal March 4, 1998.
State of Connecticut, Department of Public Utility Control (Docket Nos. 95-03-01,95-06-17 and 96-09-22), August 29, 1997. Rebuttal December 17, 1998.
Alabama Public Service Commission (Docket No. 26029), September 12, 1997.
Tennessee Regulatory Authority (Docket No. 97-01262), October 17, 1997.
South Carolina Public Service Commission (Docket No. 97-374-C), November 25, 1997.
Rhode Island Public Utilities Commission, direct testimony re costing and pricing principles for interconnection and unbundled network elements filed November 25, 1997.
North Carolina Utilities Commission (Docket No. P-100, SUB 133d), December 15, 1997. Rebuttal March 9, 1998.
Massachusetts Department of Public Utilities (Docket No. DTE 98-15), January 16, 1998.
Mississippi Public Service Commission (Docket No. 97-AD-544, March 13, 1998.
New Hampshire Public Service Commission (Docket No. 97-171, Phase II), March 13, 1998. Rebuttal April 17, 1998.
Massachusetts Department of Telecommunications and Energy (D.P.U. 96-3/74, 96-75, 96-80/81, 96-83, & 96-94), April 29, 1998.
Massachusetts Department of Telecommunications and Energy (Docket No. 85-15, Phase III, Part 1), August 31, 1998.

Massachusetts Department of Telecommunications and Energy (Docket No. 98-15, Phase II), September 8, 1998.
Rhode Island Public Utilities Commission (Docket No. 2681), September 18, 1998.
Maryland Public Service Commission (Case No. 8786), November 16, 1998.
New Hampshire Public Utilities Commission (Docket No. 99-018), April 7, 1999. Rebuttal April 23, 1999.
Massachusetts Department of Telecommunications & Energy (Docket No. 94-185-E), July 26, 1999.
New York Public Service Commission, (Case 98-C-1357), February 7, 2000. Panel Rebuttal Testimony filed October 19, 2000.
The New Jersey Board of Public Utilities (Docket No. TO00060356), July 28, 2000.
The Public Service Commission of Maryland (Case No. 8879), May 25, 2001.
Public Service Commission of the District of Columbia (Case No. 962), July 16, 2001.

Bell Entry into InterLATA Markets

Federal Communications Commission (CC Docket No. 96-149), affidavit, August 15, 1996.
Federal Communications Commission (Docket No. 96-149) with Paul B. Vasington, November 14, 1996.
Georgia Public Service Commission (Docket No. 6863-U), January 3, 1997. Rebuttal February 24, 1997.
Pennsylvania Public Utility Commission, statement regarding costs and benefits from Bell Atlantic entry into interLATA telecommunications markets, February 10, 1997. Rebuttal March 21, 1997.
New York Public Service Commission, "Competitive Effects of Allowing NYNEX To Provide InterLATA Services Originating in New York State," with Harold Ware and Richard Schmalensee, February 18, 1997.
Delaware Public Utilities Commission, statement regarding costs and benefits from Bell Atlantic entry into interLATA telecommunications markets, filed February 26, 1997. Rebuttal April 28, 1997.
New Jersey Board of Public Utilities (Docket No. T097030166), March 3, 1997. Reply May 15, 1997.
Federal Communications Commission (CC Docket 96-262 *et al.*), with Richard Schmalensee, Doug Zona and Paul Hinton, *ex parte* March 7, 1997.
Public Service Commission of Maryland, statement regarding consumer benefits from Bell Atlantic's provision of interLATA service, filed March 14, 1997.
Louisiana Public Service Commission, (Docket No. U-22252), March 14, 1997. Rebuttal May 2, 1997. Supplemental testimony May 27, 1997.
Public Service Commission of West Virginia, economic analysis of issues regarding Bell Atlantic's entry into the interLATA long distance market. Filed March 31, 1997.
South Carolina Public Service Commission (Docket No. 97-101-C), April 1, 1997. Rebuttal June 30, 1997.

Kentucky Public Service Commission (Administrative Case No. 96-608), April 14, 1997. Rebuttal April 28, 1997. Supplemental rebuttal August 15, 1997.

Federal Communications Commission (CC Docket No. 96-149), April 17, 1997.

Maine Public Utilities Commission, affidavit regarding competitive effects of NYNEX entry into interLATA markets, with Kenneth Gordon, Richard Schmalensee and Harold Ware, filed May 27,1997.

Alabama Public Service Commission (Docket No. 25835), June 18, 1997. Rebuttal August 8, 1997.

North Carolina Utilities Commission (Docket No. P-55, Sub1022), August 5, 1997. Rebuttal September 15, 1997.

Mississippi Public Service Commission (Docket No. 97-AD-0321), July 1, 1997. Rebuttal September 29, 1997.

Federal Communications Commission, CC Docket No. 99-295. Filed September 29, 1999.

Federal Communications Commission, *In the Matter of Application by Verizon New England Inc., et. al. for Authorization to Provide In-Region, InterLATA Services in Massachusetts*, September 19, 2000, Reply Declaration filed November 3, 2000. Supplemental Reply Declaration filed February 28, 2001.

Pennsylvania Public Utility Commission, (Docket No. M-00001435), January 8, 2001.

Federal Communications Commission, *In the Matter of Application by Verizon New England Inc., et. al. for Authorization to Provide In-Region, InterLATA Services in Connecticut*, May 24, 2001.

Federal Communications Commission, *In the Matter of Application by Verizon Pennsylvania Inc., et. al. for Authorization to Provide In-Region, InterLATA Services in Pennsylvania*, June 21, 2001.

Alabama Public Service Commission (Docket No. 25835), June 19, 2001.

Louisiana Public Service Commission (Docket No. U-22252-E), reply affidavit filed June 25, 2001.

Regulatory Reform

Federal Communications Commission (CC Docket No. 80-286), December 10, 1997.

Federal Communications Commission, *In the Matter of United States Telephone Association Petition for Rulemaking—1998 Biennial Regulatory Review*, with Robert W. Hahn, filed September 30, 1998.

Reciprocal Compensation

Massachusetts Department of Telecommunications and Energy (Docket No. 98-67), September 25, 1998.

Washington Public Utilities Commission (Docket No. UT-990300), February 24, 1999. Rebuttal March 8, 1999.

Colorado Public Utilities Commission (Docket No. 99A-001T), March 15, 1999.

Massachusetts Department of Telecommunications and Energy (Docket No. D.T.E. 97-116-B), March 29, 1999.
North Carolina Utilities Commission (Docket No. P-500, Sub 10), July 9, 1999.
North Carolina Utilities Commission (Docket No. P-561, Sub 10), July 30, 1999.
Public Service Commission of South Carolina (Docket No. 1999-259-C), August 25, 1999.
Louisiana Public Service Commission (Docket No. U-24206), September 3, 1999.
Florida Public Service Commission (Docket No. 990750-TP), September 13, 1999.
New Mexico Public Regulation Commission (Case No. 3131), October 13, 1999.
Alabama Public Service Commission (Docket No. 27091), October 14, 1999.
Tennessee Regulatory Authority (Docket No. 99-00377), October 15, 1999.
Tennessee Regulatory Authority (Docket No. 99-00430), October 15, 1999.
Mississippi Arbitration Panel (Docket No. 99-AD421), October 20, 1999.
Kentucky Public Service Commission (Case No. 99-218), October 21, 1999.
Georgia Public Service Commission (Docket No. 10767-U), October 25, 1999.
Oregon Public Utility Commission (Arb. 154), November 5, 1999.
Federal Communications Commission (Docket No. 99-68), "An Economic and Policy Analysis of Efficient Intercarrier Compensation Mechanisms for Internet-Bound Traffic," *ex parte*, November 12, 1999 (with A. Banerjee and A. Ros). Reply Comments: "Efficient Inter-Carrier Compensation for Internet-Bound Traffic," (with A. Banerjee), October 23, 2000.
Georgia Public Service Commission (Docket No. 10854-U), November 15, 1999, rebuttal testimony filed November 22, 1999.
Idaho Public Utilities Commission (Docket No. GST-T-99-1), November 22, 1999, rebuttal testimony filed December 2, 1999.
Texas Public Utility Commission (Docket No. 21982), March 15, 2000, rebuttal testimony filed March 31, 2000.
Arizona Corporation Commission (Docket Nos. T-02432B-00-0026, T-01051B-00-0026), March 27, 2000, rebuttal testimony filed April 3, 2000.
Colorado Public Utilities Commission (Docket No. 00B-011T), direct testimony filed March 28, 2000.
Pennsylvania Public Utility Commission (Docket No. A-310620F0002), April 14, 2000, rebuttal testimony filed April 21, 2000.
Delaware Public Service Commission (PSC Docket No. 00-205), filed April 25, 2000.
Virginia State Corporation Commission, filed April 25, 2000.
The New Jersey Board of Public Utilities (Docket No. TO 00031063) Direct testimony filed April 28, 2000, rebuttal testimony filed May 5, 2000.
Washington Utilities and Transportation Commission (Docket No. UT-003006). Filed April 26, 2000. Rebuttal testimony filed May 10, 2000. Surrebuttal testimony filed May 26, 2000.
The New Jersey Board of Public Utilities (Docket No. TO 00031063). Filed April 28, 2000. Rebuttal testimony filed May 5, 2000.
Federal Communications Commission, (CC Docket Nos. 96-98, 95-185, WT Docket No. 97-207), "Reciprocal Compensation for CMRS Providers," June 13, 2000 (with Charles Jackson).
Colorado Public Utilities Commission (Docket No. 00B-103T), June 19, 2000.

Federal Communications Commission, *In the Matter the Remand of the Commission's Reciprocal Compensation Declaratory Ruling by the U.S. Court of Appeals for the D.C. Circuit* (CC Docket Nos. 96-98, 99-68), July 21, 2000. Reply August 4, 2000.
Montana Department of Public Service Regulation (Docket No. D2000.6.89), July 24, 2000. Rebuttal filed February 7, 2001.
Washington Utilities and Transportation Commission (Docket 003013 Part B), filed August 4, 2000. Rebuttal filed February 7, 2001.
Nebraska Public Service Commission, (Docket No. C-2328), September 25, 2000. Rebuttal testimony filed October 4, 2000.
Montana Department of Public Service Regulation (Docket No. D2000.8.124: TouchAmerica Arbitration), October 20, 2000. Rebuttal filed December 20, 2000.
Arizona Corporation Commission (Docket Nos. T-03654A-00-0882,T-01051B-00-0882), January 8, 2001.
Florida Public Service Commission (Docket No. 000075-TP), filed January 10, 2001.
Colorado Public Utilities Commission (Docket No. 00B-601T), filed January 16, 2001.
Utah Public Service Commission (Docket No. 00-999-05), filed February 2, 2001. Rebuttal testimony filed March 9, 2001.
Arizona Corporation Commission (Docket No. T-00000A-00-0194, Phase 2), March 15, 2001.

Contract Services

Superior Court Department of the Trial Court (Civil Action No. 95-6363F), affidavit, July 1996.
Connecticut Department of Public Utilities (Docket No. 99-03-17), June 18, 1999.
American Arbitration Association, New York, *MCI WorldCom Communications Inc. v.Electronic Data Systems, Corporation,* Expert Report June 25, 2001. Supplemental Expert Report July 13, 2001.

Service Quality Performance Plans

Georgia Public Service Commission (Docket No. 7892-U), June 27, 2000.
Florida Public Service Commission (Docket No. 000121-TP), March 1, 2001. Rebuttal filed March 21, 2001. Rebuttal in Phase II filed April 19, 2001.
North Carolina Utilities Commission (Docket No. P-100 Sub 133k), May 21, 2001.
South Carolina Public Service Commission (Docket No. 2001-209-C), July 16, 2001.
Kentucky Public Service Commission (Docket No. 2001-105), July 30, 2001.
Mississippi Public Service Commission (Docket No. 97-AD-321), August 2, 2001.

Miscellaneous

New Mexico Public Regulation Commission (Utility Case No. 3147), December 6, 1999.

New Mexico Public Regulation Commission (Utility Case No. 3008), May 19, 2000.
United States District Court, District of Nevada (Case No. CV-S-99-1796-KJD(RJJ), December 28, 2000.
Alabama Public Service Commission (Docket No. 15957), August 3, 2001.

August, 2001