

**Figure 1. Telecommunications Output Growth in California has Converged With the National Average<sup>26</sup>**

averaged only 3.8 percent per year. After 1990, Pacific's output growth rate has declined and the respective growth rates have converged, as shown in Figure 1.<sup>25</sup>

Output growth is a basic driver of productivity growth—higher output growth tends to generate higher productivity, and vice versa. For example, Dr. Crandall's study that was cited in D.94-06-011 showed that a one percent increase in output growth would produce a 0.37 percent gain in total factor productivity (on average).<sup>27</sup> Christensen, et al. reached a similar conclusion—

<sup>25</sup> Although we agree with the Commission that the productivity level itself should be based on an industry-wide study, the comparison between California and the industry (which is too company-specific for setting a target) is entirely appropriate for the purpose of ruling out the need to adjust the national average.

<sup>26</sup> U.S. telecommunications industry output is from Dr. Christensen's testimony and Pacific's output growth is based on 1-1-94 rate adjusted revenue.

<sup>27</sup> Robert W. Crandall, *After the Breakup: U.S. Telecommunications in a More Competitive Era* (Washington D.C.: Brookings Institution, 1991), p. 70.

each one percent increase in output growth would produce a 0.3 percent to 0.5 percent gain in TFP.<sup>28</sup> Staranczak, et al. concluded that "a one percent increase in telecommunications output leads to about a 0.7% increase in TFP."<sup>29</sup> These studies establish a range of 0.3 to 0.7 for the impact of output growth on TFP. For example, at the mid-point of this range, a drop in annual output growth from six percent to three percent would carry with it a decline in TFP growth of 1.5 percent (0.5 x (6 - 3) percent). Consequently, any particular productivity target will tend to be easier when the LEC experiences high output growth and more difficult when output growth is weaker. Because (1) the convergence of California and U.S. output growth and (2) increased competition in major markets will limit the LECs' future output growth potential, it will be exceedingly difficult to meet and exceed the current productivity target of five percent on a sustained basis. Based on the examination of output growth and the other factors discussed in the following sections, we conclude that the national average productivity differential of two percent *is* a reasonable target.<sup>30</sup>

The impact of output growth on productivity growth is dramatically illustrated by comparing two telecommunications productivity studies performed by Laurits Christensen. Dr. Christensen's most recent study covered the post-divestiture (1984 to 1993) period for U.S. local exchange carriers. Earlier, Dr. Christensen had performed a study of the U.S. telecommunications industry for 1951 to 1987.<sup>31</sup> In the period covered by Dr. Christensen's most recent study, 1984-1993, output grew at an annual rate of 3.4 percent while TFP grew at 2.4 percent. Over a comparable period, 1974-1983, output and TFP grew at 6.5 percent and 3.4 percent, respectively. The 1974-1983 period had larger values for both the output growth and TFP growth, although the

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<sup>28</sup>Laurits R. Christensen, Philip E. Schoech, and Mark E. Meitzen, "Productivity of the Local Operating Companies Subject to Price Cap Regulation," May 1994, p. 23.

<sup>29</sup>G.A. Staranczak, E.R. Sepulveda, P.A. Dilworth, and S.A. Shaikh, "Industry Structure, Productivity, and International Competitiveness: The Case of Telecommunications," *Information Economics and Policy*, Vol. 6, No. 2, July 1994, pp. 121-142.

<sup>30</sup> In fact, because the LECs, in general, are experiencing competition that will erode output growth, the long-run historical average itself is becoming an increasingly challenging target.

<sup>31</sup> Testimony of L.R. Christensen, "Total Factor Productivity Growth in the U.S. Telecommunications Industry and the U.S. Economy: 1951-1987," filed in North Dakota Public Service Commission Case No. PU-2320-90-149, October 1, 1990.

annual rate of growth in the economy was about the same in the comparable eight year periods. Output growth was 3.1 percent higher and TFP growth was 1.0 percent higher in the earlier period, which is consistent with the finding that each percentage point change in output growth is associated with a change in TFP of 0.3 to 0.7 percentage points.

The amount by which the current productivity target is unreasonably high can be determined by the drop in output during the 1990s. Based upon the finding that each percentage point decline in output lowers TFP by 0.3 - 0.7 percent, the 3.1 percent drop in output implies that expected productivity has dropped by 0.9 percent ( $3.1 \times 0.3$ ) to 2.2 percent ( $3.1 \times 0.7$ ).<sup>32</sup>

### **3. Firm-wide Average Productivity Gains Are Likely to Decline With Competition**

In addition to the overall decline in California telecommunications output growth, which by itself has rendered the current target of five percent unrealistic, the combination of the IRD rate rebalancing and competitive entry have made the current productivity target even more onerous for two reasons. First, the productivity target is designed to track the expected reduction in average real telephone prices, calculated with *revenue* weights.<sup>33</sup> Accordingly, when fast growing services such as toll experience price decreases, their contribution to measured output growth diminishes and, as a result, overall output growth decreases. And, by definition, the reduction in measured output growth reduces TFP by the same amount. For example, recalculating rate-adjusted revenue—the output quantity index used in our previous TFP study<sup>34</sup>—using post-IRD prices in place of pre-IRD prices lowers measured output (and therefore TFP) by 0.4 percent.

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<sup>32</sup> The productivity target in the price cap plan is the difference between telecommunications industry and U.S. economy productivity. Therefore, changes in U.S. productivity should also be considered. However, over the post-divestiture period, there has been very little change in U.S. productivity—the annual average was 0.3 percent for 1984 to 1993. The 1984-1989 annual average was 0.4 percent, while the 1990s annual average has been 0.2 percent.

<sup>33</sup> Taylor and Tardiff, *op. cit.*, Appendix 1, pp. 18-19.

<sup>34</sup> Taylor and Tardiff, *op. cit.*, Appendix 3.

Second, competition itself reduces the rate of output growth of the incumbent company (because the LECs' market shares will erode). For example, based upon the findings of Taylor and Taylor, we estimate that loss of market share since 1984 has reduced AT&T's annual volume growth to about two-thirds of what it would have been without the loss in share.<sup>35</sup> In turn, a reduction in output growth of one percent reduces productivity growth, by 0.3 - 0.7 percent, as shown earlier. For example, if competition causes the LEC's toll volume growth rate to fall by 40 percent, productivity growth would fall by about 0.1 - 0.3 percent as a result.

#### **4. Overall Reduction in Expected Productivity**

The unusually high telecommunications output growth in California during the late 1980's may have justified the addition of a large "stretch" to expected national productivity growth, but current conditions are much different and such a stretch is no longer reasonable. Replacement of the formula with selected price protection will remedy this problem. However, if the Commission chooses to maintain the price cap formula, the use of a smaller productivity target no greater than the average industry productivity differential in the price cap index would be an alternative, albeit less preferred, remedy.

If the Commission chooses to change the productivity target, the combination of (1) lower industry output, (2) smaller revenue weights for the fast-growing toll services, and (3) the reduction in output growth caused by competition reduces expected annual productivity growth by 1.4 percent to 2.9 percent, relative to what might have been reasonable when California's incentive regulation began in 1990. This reduction supposes a productivity target that (1) is consistent with prevailing economic and industry conditions and (2) is close to the historical U.S. differential. That is, although unique conditions might have made a large stretch component in the current target reasonable in the past, conditions have changed so that California's telecommunications industry is no longer uniquely productive and a uniquely large stretch component for future years is not reasonable. The results are summarized in Table 1.

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<sup>35</sup>William E. Taylor and Lester D. Taylor, "Postdivestiture Long-Distance Competition in the United States," *American Economic Review*, Vol. 83, 1993, pp. 185-190.

**Table 1. Today's Expected Productivity is Lower Than at the Beginning of Incentive Regulation**

<b>Due To:</b>	<b>Amount</b>
California Industry Output Reduction	0.9% - 2.2%
Changed Revenue Weights	0.4%
Market Share Losses	0.1% - 0.3%
<b>Total</b>	<b>1.4% - 2.9%</b>

### **5. The Rate of Productivity Growth Is *Not* Increasing**

We have just concluded that because of changes in California's telecommunications industry and the increase in competition, a "stretch" component beyond the national average is not justified for the future. It is also important to recognize the fact that the national average itself is not changing, a fact that we demonstrate in this section.<sup>36</sup>

#### **a. Trends in TFP from the Previous Review of Incentive Regulation**

During the last review, California TFP studies were presented by DRA, Dr. Roddy, and NERA. All studies covered the post-divestiture period. In addition, DRA cited a TFP study by Dr. Robert Crandall of the Brookings Institution.<sup>37</sup> While the productivity studies offered in the last review are not appropriate for setting the *level* of X, they do provide some useful information on the *trend* in TFP growth.

To examine the productivity trends in the three California studies, we divide the post-divestiture period in half and calculated average TFP for the earlier and later years.<sup>38</sup> The results

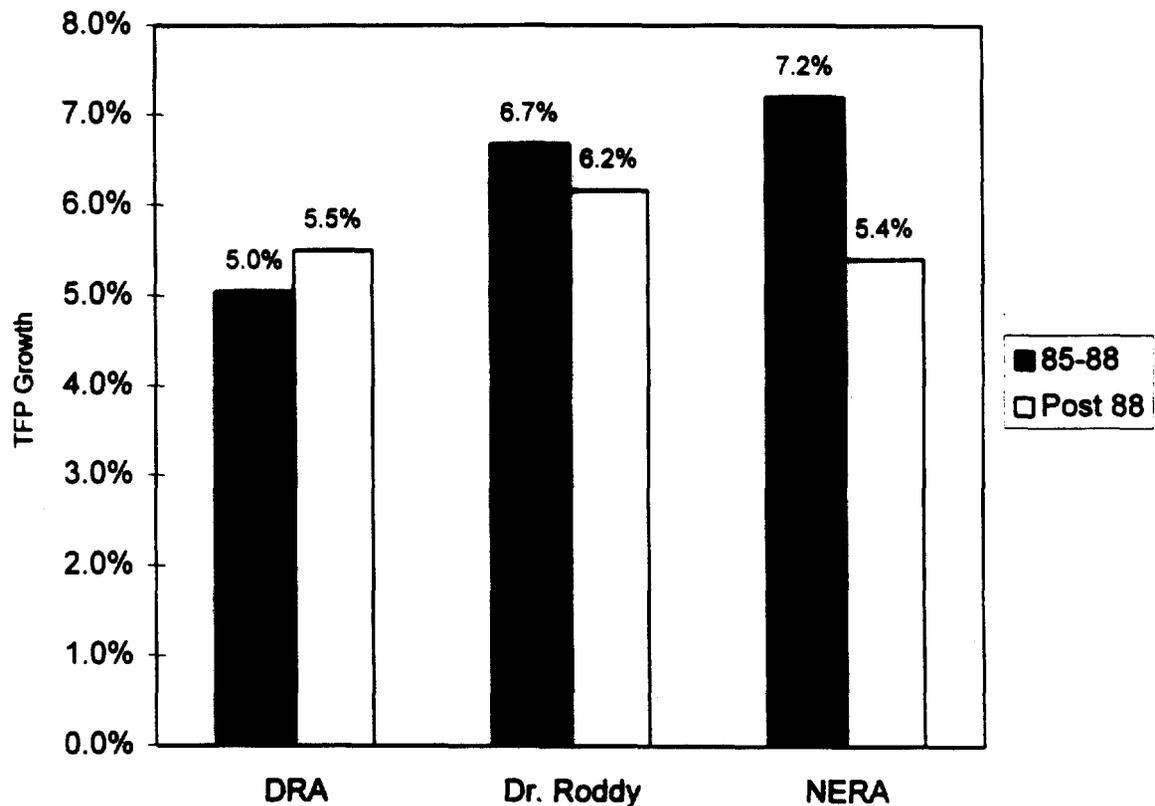
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<sup>36</sup>D.94-06-011 increased the productivity (X) factor from 4.5 percent to 5.0 percent. This increase appeared to be based on a belief that productivity growth rates are increasing over time (D.94-06-011, pp. 41-42).

<sup>37</sup>Crandall, op. cit.

<sup>38</sup>The actual periods are 1985 to 1988 and post-1988. The DRA and Dr. Roddy's study had three latter years (1989, 1990, and 1991), while NERA's study had four years (1989 to 1992). Because only a few years of data were available, we limited the analysis to two periods in order to have sufficient observations to calculate reasonably stable averages (we concluded in our 1993 analysis—Taylor and Tardiff, op. cit.—that several years are needed to obtain stable average TFP). In addition, formal statistical analysis of the annual data also showed no trend for Dr. Roddy's and DRA's studies and a significant *negative* trend for the NERA study.

appear in Figure 2. For example, Figure 2 shows that Dr. Roddy's study produced an average TFP growth of 6.7 percent during the first half of the post-divestiture period and an average TFP of 6.2 percent during the second half of the period.



**Figure 2. The First Review of Incentive Regulation Revealed *No* Trend of Increasing Productivity<sup>39</sup>**

<sup>39</sup> DRA, *Report on the 1992 Review of the New Regulatory Framework*, Section 2. (Exhibit 50 in A.92-05-004); D.J. Roddy, Direct Testimony, April 8, 1993. (Exhibit 61 in A.92-05-004); W. Taylor and T. Tardiff, *Pacific's Performance Under the New Regulatory Framework: An Economic Evaluation for the First Three Years*. April 8, 1993, Appendix A. (Exhibit 1 in A.92-05-004).

In each study, the early and late period averages are close to the overall average, indicating no increasing trend. In fact, in two of the three studies (Dr. Roddy and NERA), TFP in the later period is somewhat lower than earlier TFP.

In addition, the decision cites Dr. Crandall's results. Dr. Crandall's study showed that post divestiture (1984-1988) TFP of 3.8 percent was virtually identical to average TFP for the period from 1971 to 1983 (3.9 percent), i.e., no trend of increasing productivity improvements is readily apparent from Dr. Crandall's data. Dr. Crandall did estimate a *partial* trend of increasing TFP growth over the period 1971 to 1988. However, this trend assumes output is held constant. In fact, output has been decreasing in recent years. Because TFP growth tends to be higher with greater output growth, the overall impact is that TFP has remained roughly equal over long periods of time, as we discuss in greater detail below.

#### **b. National Telecommunications Productivity Growth is not Accelerating**

Dr. Christensen reviews numerous studies of telecommunications productivity growth over time periods spanning 1947 to the present. The average difference in telecommunications productivity and U.S. industry productivity in all of these studies is remarkably close to two percent per year.<sup>40</sup> When the annual changes in this productivity differential are statistically analyzed, the data reveal no trend of increasing productivity over time.

Dr. Christensen also examines studies of the differences in telecommunications and economy-wide output prices—indirect productivity studies. Again, statistical analysis of the annual changes in these price differences revealed no trend of increasing productivity over time.

The significance of the lack of a trend in productivity growth is that there is no reason to believe that real telecommunications prices will fall any faster than they have in the past. Consequently, these historical studies form a solid basis for eliminating the price cap formula.

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<sup>40</sup> Studies that compare telecommunications and U.S. industry productivity are often called direct TFP studies.

## 6. The California Economy and Telecommunications Output Growth are Unlikely to Bounce Back to Late 1980s Growth

Although California's economy has improved somewhat from recent years, it is nowhere near as robust as it was during the mid to late 1980's, the period immediately preceding the establishment of the current regulatory plan. A strong state economy is conducive to high telecommunications output and productivity growth: Conversely, weaker economic growth makes productivity growth more difficult to achieve. The growth rates for indicators likely to be related to telecommunications output—population, employment, and personal income—that have been forecast for the future, while generally higher than in the early 1990s, are considerably smaller than those that prevailed in the early and late 1980s. Table 2 compares the late 1980s to the late 1990s, based on data and forecasts provided by UCLA.<sup>41</sup>

**Table 2. Future Economic Growth in California Will Be Slower Than it was in the Late 1980s**

	1984-1989	1990-1994	1995-2000
Personal Income	7.6%	3.7%	5.8%
Employment	3.3%	-0.4%	2.2%
Population	2.5%	1.8%	1.2%

In addition, Dr. Christensen shows that the U.S. economy has caught up to the California economy on the key personal income indicator. Therefore, the historical national telecommunications productivity differential of two percent remains the best indicator for the near future.

## IV. ECONOMIC EVALUATION OF PACIFIC'S PROPOSAL

Phase I of this investigation addresses three questions:

1. Should GDP-PI minus X (inflation minus productivity factor) in the price cap formula be modified or eliminated?

<sup>41</sup> The UCLA Business Forecast for the Nation and California, Conference Edition, June 1995.

2. Should the price cap formula be applied to all above the line services or Category I services alone?
3. Should implementation of regulatory modifications be ordered in stages, contingent on achieving milestones?

Phase I is necessarily focused, because the schedule calls for answers to these questions and any necessary modifications to incentive regulation by the end of 1995. Nevertheless, successfully addressing and answering these questions will produce changes that will serve the California telecommunications industry well during 1996 and beyond.

In the previous sections, we have established that (1) competition requires that regulation be limited to those services requiring price protection (competition provides the necessary protection for other services) and (2) current price protection—uniform application of the price index formula—no longer fits the requirements of the competitive environment and, in fact, will cause greater price reductions than reasonable productivity expectations justify. Consequently, a new, more selective form of price regulation is necessary.

Incentive regulation reform should address three concerns. First, regulation must still provide sufficient safeguards for selected services like residential and small business basic access in areas where competition has not sufficiently developed. However, with increasing competition, the base of services for which such protection is required will shrink continuously. Conversely, the ever-increasing competition itself provides the price protection for other services. That is, competition where it is feasible by itself will provide the benefits and price protection that regulation can only imperfectly emulate. Regulatory price protection should be confined only to where it is needed, not superimposed on competitive services. Second, because of the tremendous changes currently underway, e.g., intraLATA toll competition and the imminent authorization of local competition, new mechanisms for ensuring universal service, etc., the price regulation plan that results from this review should be viewed as part of a comprehensive, sustainable package. In order to preserve appropriate incentives and reduce uncertainty, while at the same time ensuring that consumers benefit from increasing competition, the plan must provide sufficient financial stability for the LECs and adequate safeguards for those services still in need of regulatory protection.

Third, to align the economic incentives of price regulation to those prevailing in competitive markets, the vestiges of rate of return regulation that remain in the current plan should be eliminated.<sup>42</sup> The most significant component of Pacific's recommendation involves eliminating the price cap formula. This proposal protects basic subscribers since low rates (well below the national average) cannot be adjusted without approval by the Commission. Customers are also protected by other ongoing regulatory safeguards, such as service quality standards and the lifeline program.

#### **A. Pacific's Response to the Three Phase I Questions**

Pacific's proposal for regulatory reform has the following elements of economic significance.

- Eliminate price cap index (GDP-PI - X) for automatic annual price adjustments.
- Recognize that if instead the Commission decides simply to modify the formula, the productivity factor should not exceed two percent.
- If the formula is simply modified, then consistent with sound economic principles, the formula should be applied solely to those services that require regulatory protection.
- Because Phase I is narrowly focused, issues such as elimination of earnings caps and sharing as well as future application of Z factors<sup>43</sup> should be resolved in Phase II early next year.

Pacific's plan implicitly recognizes parallel proceedings on universal service funding reform and local competition. Presently, basic residential access is well below cost. To require that productivity gains be used to reduce these rates more not only further erodes pricing efficiency (one of the components of the second regulatory goal stated in D.89-10-031), but it is at odds with

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<sup>42</sup> Because Phase I is limited to the three questions listed above, other necessary changes to the regulatory framework must wait until Phase II in 1996. Nevertheless, we believe that the elimination of the last ties to cost-base regulation is an important component of the necessary reforms and we recommend that it be a major Phase II issue.

<sup>43</sup> Excluding PBOPs, USOAR, and property tax issues, which are pending in other proceedings.

the workings of a competitive market.<sup>44</sup> Competitive firms simply would not reduce prices below cost.

## **B. Economic Evaluation of Proposal**

### **1. Eliminate Price Index Formula**

Elimination of the price cap formula does *not* mean that services still in need of price protection are effectively deregulated. For those services for which LECs maintain market power, protection will continue in the form of the requirement that the Commission approve price changes and other regulatory safeguards.

In an environment of increasing competition, the change to targeted price protection has several theoretical and practical advantages over the current price index approach. First, as competition replaces regulation as the means of controlling prices for an ever expanding range of services, the need for regulation to control prices (and provide other safeguards) will be limited to certain services, such as basic access. Commission-protected prices guarantee stable rates for these services for an extended period of time. For the other services, market forces will establish efficient prices.

This focusing of price protection on services that truly need the protection is supported by both sound economics—regulation at best emulates some aspects of competition and should be substantially limited when competition is feasible—and consistent with the rapidly changing California competitive environment that has been described by Professor Harris. In this environment, customers receive the benefits that competition inevitably brings in dynamic markets such as telecommunications. By giving the LECs the flexibility to compete efficiently in these markets, the benefits from competition are enhanced, while at the same time, the Commission continues to control any vestiges of market power.

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<sup>44</sup>The theoretical development of the price cap model assumes that *average* price equals *average* cost. In this way, the price cap provides productive efficiency incentives (the firm must reduce its costs in order to meet the target). When individual prices are inefficient, e.g., below cost, the productive efficiency gains may be eroded by continuing and/or further pricing efficiency losses.

The services for which Commission-sanctioned price protection is proposed cover all Category I services, including residential basic access, which by Commission mandate is priced at only 50 percent of (direct embedded) cost, and small business basic access. Given recent trends in inflation, maintaining the current price cap index will force these prices downward, both in real and nominal terms. In contrast, not changing these prices (unless authorized by the Commission) would ameliorate the problem of reducing below-cost prices—a step that would produce greater pricing efficiency. This outcome would advance the Commission goal of economic efficiency. More efficient pricing of local services also would promote the development of efficient local competition, because efficient entrants would be encouraged to compete. Of course, in an environment of increasing competition, the support of universal service must shift from inefficient pricing to more targeted subsidies.

In general, incentive regulation must address the trade-off between preserving efficiency incentives (which long-term regulatory commitment accomplishes) with the need to maintain cost based rates. Before competition is well established, as was the case in the early 1990s, regulation was needed to keep rates (on average) close to cost. With expanding competition, much of the price discipline will come from the market. Accordingly, greater weight can be given to maintaining efficiency incentives through a regulatory commitment of stable prices.

Finally, it is important not to overlook the fact that a constant price over an extended period guarantees that real prices will fall at the rate of inflation. In contrast, the current price index guarantees that real prices fall at a rate equal to the productivity factor (ignoring exogenous adjustments). Therefore, not changing prices is equivalent to an indexed price cap where the productivity factor equals the rate of inflation.

To see why this is the case, recall that the price cap formula (ignoring exogenous cost changes (Z-factors)) is the following.

$$P_t = P_{t-1} (1 + \Delta GDP - PI - X)$$

In order for the price index to stay the same ( $P_t = P_{t-1}$ ), the productivity target (X) would have to be the same as the inflation rate (GDP-PI).

Since the beginning of the current plan, the inflation factor has been required for six annual filings (including the startup revenue requirement). During this time period, inflation has averaged about 3.7 percent. Accordingly, had prices remained constant, the implied X would have been 3.7 percent. This rate is considerably higher than both the long-term and recent productivity trends for the U.S. telecommunications industry.

Put in another light, the choice between constant and indexed prices is a choice of where the risk of inflation lies. Because the future rate of inflation is expected to exceed the rate of productivity growth, Pacific has assumed the risk of inflation (because a price increase would actually be produced by the index).

## **2. If the Formula is Maintained, the Productivity Factor Should be Two Percent**

Dr. Christensen discusses in detail the findings on long-term national telecommunications productivity trends. Based on these trends and the fact that we do not believe that California's telecommunications productivity is likely to exceed the national average, Pacific's recommendation that if a productivity factor is retained then it should be two percent (the long-term national average) is reasonable. We further note that the same analysis that supports a productivity factor of two percent for a price cap index also justifies stable prices for protected services, because future annual inflation is expected to be at least as high as three percent.

## **3. Application of Price Cap Formula to Category I**

With the elimination of the formula that Pacific recommends, the question of which services are adjusted annually becomes moot. In contrast, if the Commission chooses to modify the productivity factor, the question would remain to be answered. The economic reasoning that supports our endorsement of Pacific's recommendation would lead to a recommendation that a modified price cap index be applied only to those services in need of price protection. A definitive determination of the specific services that fit this description would require a service-by-service evaluation. However, if the current service classification remains a valid indicator of competitive conditions, then price protection should be limited to Category I. In terms of economic efficiency,

application of the formula with the national average productivity factor would be an improvement over the current situation because the prices of services that are now below cost would no longer be reduced.

#### **4. Regulatory Reform Stages: Eliminate Sharing and Other Links to Rate of Return in Phase II**

Both the decision instituting the current form of regulation (D.89-10-031) and the review decision (D.94-06-011) clearly recognized that sharing was primarily instituted as a safeguard against excessive earnings by the LECs. Elimination of all links to rate of return as an outcome of Phase II appears to be consistent with Commission's direction and with the substantial changes in the marketplace.

#### **V. SUMMARY AND CONCLUSIONS**

The Commission's Infrastructure Report charts a course that anticipates open competition in all markets by 1997. California's telecommunications markets are well into this course. This report has focused on the changes to the incentive regulation that can be addressed in Phase I and that are required to meet the Commission's bold objective. In particular, we have evaluated Pacific's proposed changes conclude that they are consistent with the direction indicated by the Commission's competition objective. Specifically, Pacific's proposal

- Provides realistic efficiency incentives by eliminating annual price indexing based on a productivity factor that is no longer reasonable;
- Provides price protection for those services that need it. Open competition in other markets provides price protection and related consumer benefits for other services;
- Improves pricing efficiency and better promotes efficient local competition by eliminating the reduction of below-cost rates that the current plan causes.

**PREPARED TESTIMONY**  
**OF**  
**DR. RICHARD L. SCHMALENSEE**

**ATTACHMENT 2**  
**CURRICULUM VITAE**

**RICHARD L. SCHMALENSSEE**

**BUSINESS ADDRESS:**

Massachusetts Institute of Technology  
Room E52-456  
50 Memorial Drive  
Cambridge, Massachusetts 02139  
(617) 253-2957 tel. (617) 258-6855 fax

National Economic Research Associates, Inc.  
One Main Street  
Cambridge, Massachusetts 02142  
(617) 621-0444 tel. (617) 621-0336 fax

**EDUCATION:**

MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
S.B., Economics, Politics and Science, 1965  
Ph.D., Economics, 1970

**EMPLOYMENT:**

1991-           **MASSACHUSETTS INSTITUTE OF TECHNOLOGY**  
1988-           **Director, Center for Energy and Environmental Policy Research**  
1986-           **Gordon Y Billard Professor of Economics and Management**  
1979-           **Professor, Department of Economics**  
1977-79       **Professor, School of Management**  
1970           **Associate Professor, School of Management**  
1967-69       **Assistant Professor, School of Management (Spring)**  
                  **Instructor, School of Management**

1989-91       **PRESIDENT'S COUNCIL OF ECONOMIC ADVISERS**  
1967           **Member**  
                  **Junior Staff Economist (Summer)**

1991-           **NATIONAL ECONOMIC RESEARCH ASSOCIATES, INC.**  
1981-1989     **Special Consultant**  
                  **Special Consultant**

1974-77       **UNIVERSITY OF CALIFORNIA, SAN DIEGO**  
1970-74       **Associate Professor, Department of Economics**  
                  **Assistant Professor, Department of Economics**

**VISITING APPOINTMENTS:**

1985-86       **Visiting Professor, Harvard Business School**  
1985           **Visiting Professor, CORE, University of Louvain, Belgium (Spring)**  
1980-81       **Visiting Scholar, Department of Economics, Harvard University**  
1973-74       **Visiting Associate Professor and Research Fellow, Department of Economics, University of Louvain, Belgium**

**EDITORIAL SERVICE:**

Editorial Board: *Journal of Economics and Management Strategy* (1992-)  
Associate Editor: *Journal of Economic Perspectives* (1992-)

Associate Editor: *Zeitschrift für Nationalökonomie* (1987-89)  
Associate Editor: *International Journal of Industrial Organization* (1982-89)  
Board of Editors: *American Economic Review* (1982-86)  
Associate Editor: *Recherches Economiques de Louvain* (1979-89)  
Editor (1978-89); Co-Editor (1989-): MIT Press Monograph Series, *Regulation of Economic Activity*  
Associate Editor (1977-81); Board of Editors (1981-89): *Journal of Industrial Economics*

**PROFESSIONAL ASSOCIATIONS:**

American Economic Association:

Executive Committee, 1993-  
Budget Committee, 1993-  
Nominating Committee, 1987  
Advisory Committee on Meetings Program, 1986, 1989, 1994

Econometric Society:

Chairman: Local Arrangements Committee, 1985 World Congress  
Fellow, 1982-  
Chairman: Program Committee, 1980 North American Fall Meeting  
Program Committee, 1980 World Congress

**SLOAN SCHOOL ADMINISTRATION:**

Area Head: Economics, Finance, and Accounting; Sloan School of Management (1987-89)  
Coordinator: Applied Economics Group, Sloan School of Management (1986-87)  
Chairman: Doctoral Program Committee, Sloan School of Management (1982-85)

**CONSULTATION AND GOVERNMENT SERVICE (SELECTED):**

*Revista de Analisis Económico* Lecture, Econometric Society Latin American Meeting, 1994  
Special Consultant: National Economic Research Associates, Inc., 1981-89, 1991-  
Federal Reserve Board of Governors, 1993 (Bank Merger Policy)  
Russian State Committee for Management of State Property (GKI), 1992- (Competition Policy)  
Environmental Economics Advisory Board, U.S. EPA, 1992-  
Chairman: Clean Air Act Compliance Analysis Council, U.S. EPA, 1992-  
Antitrust Division, U.S. Department of Justice, 1991-92 (1992 Merger Guidelines)  
Bureau of Economics, U.S. Federal Trade Commission, 1972-81 (Antitrust Policy)

**OTHER PROFESSIONAL ACTIVITIES:**

Research Associate, National Bureau of Economic Research (1992-)  
Board of Directors, Long Island Lighting Company (1992-)  
Board of Directors, American Council for Capital Formation Center for Policy Research (1991-)

**BOOKS:**

The Economics of Advertising (Vol. 80, Contributions to Economic Analysis), Amsterdam: North-Holland, 1972.

Applied Microeconomics: Problems in Estimation, Forecasting and Decision-Making, San Francisco: Holden-Day, 1973.

An Introduction to Applied Macroeconomics (with E. Kuh), Amsterdam: North-Holland, 1973. Japanese Edition, Tokyo: McGraw-Hill Kogakusha, 1975.

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**BOOKS EDITED:**

The Empirical Renaissance in Industrial Economics (co-editor, with T. F. Bresnahan), Oxford: Basil Blackwell, 1987.

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