

#### 14. ECI: Comparison of 5-Year Compound Annual Average Growth Rates

Year	Wages & Salaries		Total Compensation	
	Economy	Trans. & Public Utility	Economy	Trans. & Public Utility
1984	83.10	88.20	82.20	
1985	86.70	90.80	85.70	88.40
1986	89.90	93.60	88.90	91.40
1987	92.60	95.60	91.60	93.90
1988	96.10	97.90	95.70	96.80
1989	100.00	100.00	100.00	100.00
1990	104.50	103.20	105.20	103.30
1991	108.40	106.60	109.80	107.70
1992	111.60	110.60	113.90	111.90
1993	114.60	114.00	118.00	116.00

Description: Total compensation and wages and salaries indexes for private industry workers, June values. These indexes measure the changes in labor costs holding the distribution of employment among occupations fixed over time.

Source: *Employment Cost Indexes and Levels, 1975-93*, United States Department of Labor, Bureau of Labor Statistics, September 1993, Table 8, pages 38, 44-45, 62, and 71.

#### 15. Annual Growth Rates: Average Hourly Earnings United States Private Industry versus Telecommunications

Source: *Employment and Earnings*, United States Department of Labor, Bureau of Labor Statistics, annual August issues, Tables C-2 and B-15, June values.

#### 16. Production Workers Average Hourly Earnings: Comparison of 5-Year Compound Annual Growth Rates

Year	Economy	Telecommunications
1984	8.30	11.72
1985	8.54	12.27
1986	8.71	12.85
1987	8.92	13.07
1988	9.23	13.30
1989	9.58	13.70
1990	9.97	14.10
1991	10.31	14.54
1992	10.52	14.91
1993	10.76	15.52

Description: June dollar values of average hourly earnings of production or nonsupervisory workers' on private nonagricultural payrolls by detailed industry, not seasonally adjusted.

Source: *Employment and Earnings*, Department of Labor, Bureau of Labor Statistics, annual August issues, Tables C-2 and B-15, June values.

### 17. Net Effect of Accounting for the Differential Between Economy-Wide and Telecommunications Input Price Indices

	Economy-Wide	Telecommunications
Year	Input Price Index	Input Price Index
1984	0.94	NA
1985	0.97	0.97
1986	0.97	0.99
1987	1.00	1.00
1988	1.05	1.02
1989	1.08	1.04
1990	1.13	1.07
1991	1.16	1.09
1992	1.20	1.12
1993	1.23	1.15

Description: 1987 fixed weight index of inputs: materials, labor, and capital.

Source: Author calculations based on data from the United States Department of Commerce, Bureau of Economic Analysis (*Benchmark Input-Output Accounts of the United States: 1987*, November 1994; *Survey of Current Business*, Tables 6.4b and 6.2C, various issues; and the *Detailed Industry Wealth Data Diskette*, September 13, 1994), the Federal Communications Commission (*Statistics of Communications Common Carriers*, Table 2.9, 1988-89 edition); the United States Department of Labor, Bureau of Labor Statistics, Office of Employment Projections' input/output time series data; and *Employment Cost Indexes and Levels, 1975-93*, United States Department of Labor, Bureau of Labor Statistics, September 1993, Table 7, pages 38, 44-45.

### 18. Comparison of Economy-Wide TFP Measures: Current Analyses versus the BLS

Source: TFP: Current Study Author calculations, based on the previously calculated economy-wide input price index and the economy-wide output price index. See exhibits 2 and 17, above.  
TFP: BLS *Monthly Labor Review*, United States Department of Labor, Bureau of Labor Statistics, September 1995, page 129.

### 19. 5-Year Average Growth Rates Economy-Wide TFP Measures: Current Analyses versus the BLS

Source: Current Analyses: Author calculations based on the previously calculated economy-wide input price index and the economy-wide output price index. See exhibits 2 and 17, above.  
BLS: *Monthly Labor Review*, United States Department of Labor, Bureau of Labor Statistics, September 1995, page 129.

**20. Biases in the Modified Differential Approach Relative to the Full Differential Approach to Price Cap Calculations**

Year	Output Price Indexes		Input Price Indexes	
	GDP-PI	EWOPI	Economy-Wide	Telecommunications
1984	0.91	0.95	0.94	NA
1985	0.94	0.97	0.97	0.97
1986	0.97	0.97	0.97	0.99
1987	1.00	1.00	1.00	1.00
1988	1.04	1.04	1.04	1.02
1989	1.09	1.09	1.09	1.04
1990	1.14	1.13	1.13	1.07
1991	1.18	1.16	1.17	1.09
1992	1.22	1.19	1.20	1.12
1993	1.25	1.21	1.23	1.15

Source: GDP-PI: see Exhibit 3.  
 EWOPI: see Exhibit 3.  
 Input Price Indexes: see Exhibit 17.

**21. Biases in the Modified Differential Approach Relative to the Full Differential Approach to Price Cap Calculations**

Year	GDP-PI	Telco Input Price Index
1984	0.91	NA
1985	0.94	0.97
1986	0.97	0.99
1987	1.00	1.00
1988	1.04	1.02
1989	1.09	1.04
1990	1.14	1.07
1991	1.18	1.09
1992	1.22	1.12
1993	1.25	1.15

Source: GDP-PI: see Exhibit 3.  
 Telecommunications Input Index: see Exhibit 17.  
 Aggregate TFP: *Monthly Labor Review*, Department of Labor, Bureau of Labor Statistics, September 1995, page 129.

## Appendix B

### FRANCIS J. CRONIN, Ph.D.

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#### EDUCATION

1977 Ph.D., Economics, Georgetown University  
1975 M.A., Economics, Georgetown University  
1972 B.S., Foreign Service, Georgetown University

#### PROFESSIONAL SOCIETIES

American Economic Association  
National Association of Business Economists  
Western Economic Association

#### HONORS AND AWARDS

1992 McGraw-Hill Distinguished Achievement in New Product Development  
1990, 1991 and 1992 DRI Consulting Group Awards  
1988 Standard & Poor's Business Success Award, 1987 and 1986 S & P's Business Innovation Awards  
1988 McGraw-Hill Senior Management School  
Phi Beta Kappa, Phi Alpha Theta, University Fellow, Departmental Fellow, Distinction in Ph.D.  
Comprehensive (all areas), University Merit Scholarship

#### PROFESSIONAL BACKGROUND

1995- Managing Director, A. T. Kearney, Inc.  
1994 Managing Director, EDS Management Consulting Services  
1993 Group Director, DRI/McGraw-Hill  
1990 Managing Director, DRI/McGraw-Hill  
1988-1994 Sr. Vice President, McGraw-Hill  
1987 Vice President, McGraw-Hill  
1985 Director, DRI/McGraw-Hill  
1982-1984 Manager, Washington Operations, Battelle Northwest  
1981-1984 Senior Research Economist, Battelle Northwest  
1977-1981 Senior Research Associate, The Urban Institute  
1980-Present Referee, *Review of Economics and Statistics*, *Southern Economic Journal*, *Empirica*,  
*Telecommunications Policy*  
1978-1979 Adjunct Assistant Professor, Georgetown  
1976-1977 Research Economist, Science Applications, Inc.  
1973-1975 Economist and Consultant, U.S. Environmental Protection Agency

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## PROFESSIONAL EXPERIENCE

Francis J. Cronin is a Principal with A. T. Kearney and directs the Economics, Policy & Planning Service (EPPS). Dr. Cronin specializes in policy analysis, business and market planning, integration of business development plans and policy objectives, and comprehensive analyses at the industry, regional and national levels. Dr. Cronin specializes in project concept, design, and management in the areas of quantitative analysis, interpretation and application within the planning process at corporate, business unit or functional level. Applying his expertise in microeconomics and econometric analysis, interindustry economics, and urban-regional economics, Dr. Cronin has lead engagements for multinational corporations and government agencies in the areas of policy/regulatory analysis, market planning and strategic and tactical business development. He has over 20 years of consulting and management experience.

In his current position, and in previous positions at DRI/McGraw-Hill, Battelle Northwest, and The Urban Institute, Dr. Cronin has specialized in complex project management in the areas of economic impact analysis and market planning. He has performed studies for a wide variety of clients in the private and public sectors. Dr. Cronin has undertaken consulting assignments for clients in the accounting, computer, manufacturing, publishing, software, utility, pipeline, telecommunications, insurance, banking, temporary services, entertainment, energy, airline, chemical, furniture, instrument, construction, automotive, aircraft and information technology industries. His public sector clients include HUD, DOD, JCS, EPA, NRC, DOE, CIA, DOT, NASA, EPRI, API, MPAA and Bellcore. Many of these reports have been filed with regulatory agencies, including the NTIA, the U.S. Congress, and state legislatures; Dr. Cronin frequently presents results to these agencies and at regional economic conferences.

## POLICY-RELATED/REGULATORY ENGAGEMENTS

- Dr. Cronin is currently directing a study to be filed with the Canadian Radio–Television and Telecommunications Commission (CRTC) to assess the impact on the Canadian economy of various proposed interconnection and pricing arrangements for telecommunications network access. The incumbents' proposed pricing arrangements would seek to recover the embedded costs of past business decisions in three parts: causally related incremental costs (Phase II costs), a 25% mark up, and a charge for local contribution, the latter gauged to produce whatever revenues are required to cover embedded costs. The report directly measures the implications of these proposed charges for various stakeholders, including: businesses, residential customers by income type, and the Competitive Local Exchange Carriers ("CLECs"), relative to long-run incremental cost (LRIC)-based pricing for access. The analysis also addresses several substantive issues concerning the underlying role of telecommunications in economic development as well as the importance of appropriate interconnection policy in fostering competition.
- Dr. Cronin directed a study in support of a Canadian telecommunications company's PCS license application to Industry Canada. The analysis examined such issues as (1) the social rate of return from telecommunications research and development; (2) the stakeholder benefits from competition; and (3) the role of interconnection arrangements in infrastructure development. This report has been filed as part of the client's Phase II Detailed Submission to Industry Canada's Policy and Call for (PCS) License Applications.

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- Prepared for South Carolina Pipeline Corporation a report assessing the validity of current regulatory rate-making methodology governing Pipeline's sales to direct industrials, and determining the appropriate mechanism to ensure 'just and reasonable' rates on industrial sales in the future. Using monthly contract information on individual customers, conducted an econometric examination of price determinants. Also examined the extent of margin attainment and contract retention. The utility's risk was determined to be much greater from the industrial customers than from the resale customers. Presented analyses on critical background issues such as Pipeline's market environment for industrial sales, precedents in applying alternative regulatory frameworks, and the historical role of natural gas in the economic welfare of South Carolina. This report and related testimony have been filed with the South Carolina Public Utilities Commission.
  - Analyzed the impact of local competition in telecommunications in Michigan by developing a quantitative analysis of competition and rate rebalancing on specific Michigan stakeholder groups (the business sector, low and high income groups, rural/urban consumers and the elderly). The analysis determined that increased competition will result in benefits for most ratepayer groups. In all cases, benefits will be transmitted to other stakeholders in the form of lower prices on commodities, due to the widespread impact of telecommunications pricing on the economy. However, the results indicated that if competition is to maximize benefits for all ratepayers in Michigan, traditional LEC rate designs must be modified to reduce economic distortions. Results will be presented to the Michigan legislature as part of its review of the Michigan Telecommunications Act of 1991.
  - Prepared for Pacific Bell an analysis of the myriad interrelated issues (e.g. competition, rate rebalancing, universal service and infrastructure) facing the telecommunications industry. This report was filed with the California Public Utility Commission.
  - Provided policy-makers with estimates of the quantifiable macro- and microeconomic benefits to society of accelerating electric utility deployment of Energy Information Services (EIS) and telecommunications technologies. Study findings focused on such factors as deferred capital investment, reduced energy costs for consumers and businesses, increased employment levels, price competitiveness of the telco industry, and household income. Dr. Cronin was invited to present these findings at a National Economic Council/DOE/EPRI Conference. This report was filed with the Florida Public Utility Commission.
  - Led a team of researchers in an analysis of the benefits of telecommunications network improvements on aggregate and industry-specific efficiency. The study presented 1) an analysis of the causal relationship between telecommunications network development and economic growth; 2) an analysis of the substitution of telecommunications for other inputs based on econometrically estimated production functions for each U.S. industry; and, 3) an analysis of the resources saved by each industry as a result of enhanced telecommunications usage. The study was filed with the NTIA (National Telecommunications and Information Administration Industry Association) as part of its hearings on network infrastructure modernization. Results of the research have been published in *Telecommunications Policy and Information Economics & Policy*. Additional papers are under review at the *Review of Economics and Statistics*, *Contemporary Economic Policy* and *Economic Systems Research*.
  - Directed a comprehensive study of the impacts of telecommunications infrastructure investment on the state of Pennsylvania. This study linked potential infrastructure systems with desirable economic development, taking into consideration different geographical, economic, and demographic characteristics of the Commonwealth. This extensive analysis addressed the costs and the benefits of the investment to the economy including an analysis of quantitative and qualitative improvements in

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health care, education, government, and business. Dr. Cronin's work supported the Pennsylvania Public Utility Commission and state legislature in developing an appropriate regulatory framework to promote infrastructure investment programs. Direct and indirect employment, tax-revenues, and income are all calculated as a requirement for the analysis of potential infrastructure investment. An important step in the analysis of Pennsylvania's telecommunications systems is the development of a set of state-specific telecommunications price indexes. The study also addresses the issues of state and sub-state causality and the direction of economic benefits, and a complete funding analysis addressing the fiscal responsibility for the costs associated with the range of possible telecommunications infrastructure investments. Included in this analysis is a discussion of the benefits of telecommunications network modernization on educational and medical services as well as specific stakeholder groups; e.g., the elderly, the disabled, and the low-income population. Results of this research were presented to the Pennsylvania legislature and published in *Telecommunications Policy, Information Economics and Policy*, and the *Southern Economic Journal*.

- Conducted quantitative studies analyzing the benefits to the New York, Virginia, California, Maryland, New Jersey, Illinois, Ohio, Arkansas, and Massachusetts economies of telecommunications' network modernization. The analyses included application of the comprehensive telecommunications input substitution model, which relates individual industries' usage of capital, labor, materials, and telecommunications to the prices of each input, the advancement in each input 's technology, and the industry 's production level . The studies analyzed the historical and/or prospective impacts of telecommunications' network development, under various scenarios, on each state's employment, tax revenues, prices, and per-capita income, increasing state competitiveness. The research prepared for New Jersey Bell was instrumental in shaping the 1992 Utility Reform Act and in assisting the company to obtain alternative regulation under the provisions of the Act (see *Fortune*, March 1993). The reports prepared for major LECs in Maryland, Illinois , Ohio and Arkansas were filed with the Public Utility Commissions. The findings for California and Massachusetts were presented to top aides of the Governors. In New York, the report was undertaken for the Governor's Telecommunications Exchange Commission.
- On behalf of Ohio Bell, Dr. Cronin prepared testimony and presentations for the Ohio Tax Commission, the state Department of Economic Development and the Ohio State Senate. This tax research gained national attention and was presented as an invited paper to the Symposium on Taxation and Telecommunications at Georgia State's Center for Economic and Management Research. This research was instrumental in winning the Ohio Legislature support for correcting biases in the tax code.
- Submitted a study to the New Jersey Senate which analyzed the economic implications of relaxing the manufacturing ban placed on local exchange carriers under the Modified Final Judgment decree (MFJ) to aid legislatures in drafting legislation for the telecommunications industry.
- Dr. Cronin directed a study examining the state of trade in telecommunications equipment. The analysis rectified the discrepancy in the size and direction of the deficit across various reporting agencies by developing a historically consistent series of data on trade in telecommunications equipment. The study also analyzed the economic and regulatory factors that have shaped the deficit and drew conclusions for the future changes in the trade balance and the competitiveness of domestic telecommunications manufacturers. The study was submitted to the International Trade Commission to assist policy makers in drafting the *Telecommunications Equipment Research and Manufacturing Competition Act of 1991*. The results of this work were published in *Telephony*.

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- Assisted policy-makers at the Department of Transportation in selecting the appropriate level, mix, and timing for transportation investments by conducting a team of researchers in path breaking productivity analysis in which each transportation sector was analyzed in terms of: (1) its own productivity performance over the 1963-91 period; (2) the sources of productivity change; (3) the rate of successful technology absorption; (4) the contribution to comprehensive total economy productivity growth; and, (5) the sectors contributing to indirect productivity growth in the transportation sectors. Results from this research have been submitted to the *Southern Economic Journal*, *The Review of Economics and Statistics* and *Economic Systems Research*.
  - As part of the National Aerospace Plane (NASP) and NASP Derived Vehicles (NDV) programs, Dr. Cronin directed a team that worked with program engineers from the Joint Program Office (U.S. Air Force and NASA) to identify the likely areas of innovations spin-offs within the economy. Under Dr. Cronin's direction, his staff then developed an approach that quantified the economic and technological benefits to the U.S. economy resulting from NASP/NDV research, development, production, operations, and maintenance over a twenty-year forecast horizon. The analysis provided detailed projections of the impact on employment, industrial structure and trade competitiveness.
  - Dr. Cronin directed a research project for the Motion Picture Association of America, Inc. to determine the extent and type of recording and copying by households with VCRs in 1982 and 1990 and the economic harm to copyright owners from such activities. The project also examined the value households place on these activities, and their likely reactions to royalties on VCRs or blank tapes. The analysis employed two econometric models, one industry and one household (i.e., a simultaneous equations model of the demand for prerecorded, rental and blank tapes), specified and estimated by Dr. Cronin. Findings were instrumental in changing the client's position on the First Sales Doctrine and in restructuring the prices charged for videocassettes. Results were presented to the Senate Judiciary Committee as well as to the House and Senate staffs. Policy results and analytical underpinnings of the research have been published in *Contemporary Policy Issues*.
  - Dr. Cronin directed a project to examine the level and mix of U.S. defense-related energy requirements during periods of mobilization and energy supply disruptions for the Department of Energy. The research employed new interindustry modeling frameworks developed by Dr. Cronin, together with mathematical programming techniques. Dr. Cronin examined the application of interindustry modeling to situations involving constraints on the supply of primary factors of production. Both the standard Leontief production function assumption, as well as the Eastern European allocation mechanism, were examined. Results from this research were published in the *Southern Economic Journal*.
  - At the request of the Department of Energy and the U.S. intelligence community, Dr. Cronin directed an examination of the economic justifications for selecting reprocessing rather than a conventional once-through nuclear fuel cycle in the Republic of Korea. Employing macroeconomic and energy demand models for Korea as well as a nuclear fuel cycle model, the project examined the conditions which could make reprocessing economic.
  - Dr. Cronin contributed to a study for the Joint Chiefs of Staff which enhanced their analytical capabilities to conduct attainability assessments employing interindustry models.
  - Dr. Cronin directed an analysis of the impacts to the Taiwanese economy resulting from the proposed joint US-ROC venture to invest in aircraft parts manufacturing in Taiwan. The analysis involved developing two alternative scenarios, based on different levels of investment and production, and comparing the results with the baseline forecast for the Taiwanese economy. The

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results were used by the Taiwanese legislature in its debates concerning approval of the proposed investment.

#### PRIVATE SECTOR ENGAGEMENTS

- For a major international computer giant, Dr. Cronin developed a customized market assessment to provide relevant sales targets for 270 domestic branch offices, for four key product segments. After a major corporate restructuring transferred sales planning responsibility to the local region level, Dr. Cronin directed a team which was retained by one regional office to provide relevant forecast analyses. Over a three year period, Dr. Cronin's team significantly expanded the number of regional offices relying on our tailored planning capabilities such that the regions requested that this staff be adopted as the objective source for external planning information by the corporate headquarters. Recently, the client signed a five-year, multi-million dollar agreement to provide on-going planning support for their domestic businesses.
- For a publisher of a leading national business magazine, Dr. Cronin provided strategic direction and decision support assistance to help guide the publication out of a position of declining market share. Dr. Cronin was instrumental in reversing many of the long-held views and objectives within the magazine's operations, and recommended changes which were considered radical by many within the organization. The analysis of the magazine's markets identified two major strategic actions to grow revenues: a significant increase in subscription rates and an unprecedented decrease in advertising rates. These factors have contributed to the magazine's strong growth, which was projected by Dr. Cronin's analysis. EDS staff also developed a PC-based decision support planning system which allows senior management to evaluate alternative strategies regarding pricing, competitor actions and external market conditions.
- For each of the "Big 6" accounting firms, Dr. Cronin directed the development of detailed market planning assessments to guide office location, staffing and goal setting activities. These engagements developed region-specific forecasts for key lines of business (tax, audit, consulting), which were exhibiting radically different growth trends. For one firm, Dr. Cronin's analysis supported the establishment of two separate operating divisions. For a second firm, the quick turnaround was invaluable as the accounting firm evaluated the benefits of a potential merger, which was ultimately consummated. Many of these projects required acceptance by the firm's partners, and Dr. Cronin supported the consensus-building process by presenting key elements of the project at partner's meetings.
- Dr. Cronin assisted one of the largest temporary help service companies to develop market potential and market share estimates for major metropolitan area markets in the United States. Using Dr. Cronin's detailed industry and regional analytical capabilities, his staff developed proprietary factors for temporary services utilization to assist the firm evaluate markets which are under or over-performing. As a result of his high quality and objective analysis, Dr. Cronin was asked by the national trade association for temporary services to design, implement and analyze an on-going survey of member activity.
- For a major accounting firm, Dr. Cronin directed the development of an integrated modelling system to perform "what-if" analyses across the company's lines of business. Specifically, the system econometrically evaluated company-provided data by office and line of business. The system was installed as an on-going framework for evaluating such operational issues as near-term (cyclical) and long-term (cohort) staffing levels, resource allocation across lines of business, and mergers and acquisitions.

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- For the private placement division of a major insurance company, Dr. Cronin developed a comprehensive industry-based analytical system to assess portfolio risk by assisting in the identification of possible areas of growth or decline across industry segments. The system was also used to gauge over-exposure in industry groups, and provided management with the ability to evaluate their portfolio on an on-going basis.
  - Dr. Cronin assisted a major utility seeking to improve load factor planning (i.e., generating capacity used) through analytically-based and structured area economic development and forecasting efforts. This involved developing a profile of companies that met client and project-developed criteria. This analysis included identifying and econometrically quantifying the load impacts of attracting and retaining companies that met specific energy usage criteria. Parameters investigated included: (1) companies with constant or non-peak (either day, season, or annual) demands, (2) companies with a greater degree of geographic mobility, and (3) companies which best fit the capital and labor resources of the region. This report received a national award for excellence in research.

#### **OTHER EXPERIENCE**

- Dr. Cronin directed a study for the Association of Data Processing Service Organizations (ADAPSO) to determine the contributions computer software has made to the U.S. economy and its individual sectors. Results were presented at the Association's 25th Anniversary Meeting.
- Dr. Cronin examined the implications for the residential housing market of the preponderance of owner-operated construction firms. Specifically, Dr. Cronin specified and estimated a model of the supply of new residential construction based on a utility maximizing theory of firm behavior. This model is able to theoretically explain the "counter-intuitive" results found by earlier researchers. Results from this research have been submitted for publication.
- Dr. Cronin directed a research project for the American Petroleum Institute to determine the historical and prospective economic resource requirements and consequences associated with developing the petroleum and natural gas reserves of the OCS. The analysis examined these topics at both the national and state level as well as by industry. Results were presented to Senate and House committees.
- Dr. Cronin directed and was lead author of an invited paper presented at a symposium sponsored by the Electric Power Research Institute. Aggregate, sectoral, and industrial electricity demands were forecast to 1990; potential impacts from changing demands and technologies were analyzed. Results indicate a potential for a national shortfall in electric generating capacity may occur in the 1990s.
- Dr. Cronin conducted a study for the Economic Regulatory Administration on the residual fuel oil market and, in particular, the impacts of government regulations on this market.
- Dr. Cronin conducted a study for the U.S. Environmental Protection Agency to estimate households' willingness to pay for improved water quality using a contingent market sample of 2,000 households. Issues addressed included the choice of estimation techniques (e.g., covariance, random coefficients) and the significance and magnitude of strategic bias, information bias, and interview bias. Results will aid the EPA in selecting the appropriate methodology to gauge the value of "nonmarket" goods and in determining the optimal level of environmental improvements.
- Dr. Cronin has provided background research on various litigation cases. For example, he provided information on the economic costs and impacts (e.g., noise) on residences bordering metropolitan airports.

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- Dr. Cronin directed a planning study for the Nuclear Regulatory Commission which involved the identification of NRC-induced nonmarket impacts and the appropriate methodologies for estimating their value. Results were published as a Nuclear Regulatory Report by the NRC.
  - Dr. Cronin assisted the Department of Energy in analyzing the economic impacts of proposed energy legislation. Topics included residential, commercial, and industrial energy tax credits and the general application of benefit-cost analysis.
  - While at the Urban Institute, Dr. Cronin completed a project for the City of Detroit and the State of Michigan which investigated the behavior of households in six comparable urban areas in terms of: (1) the consumption of housing services by homeowners and renters, (2) the intraurban residential location decision of homeowners and renters, (3) the tenure choice decision, and (4) the impact of the federal income tax treatment of homeownership on these decisions. The results were used by the City of Detroit in their urban revitalization efforts. Research results were published in *Land Economics*.
  - While at the Urban Institute, Dr. Cronin also undertook a series of studies for the Department of Housing and Urban Development using a consistent and unified microeconomic framework. The studies assessed the results of the Experimental Housing Allowance Program, the nation's largest social experiment (30,000 households). Topics investigated by Dr. Cronin include: (1) the causes and efficiency of households' intraurban residential search and mobility decision, (2) the impacts of racial differences in the demand-oriented housing programs, (3) the household's decision to join a constrained subsidy program and (4) the consumption of housing services. Results from this research were published in the *Review of Economics and Statistics*, the *Southern Economic Journal*, the *Journal of Human Resources*, and in two books. In addition, Dr. Cronin presented two invited papers at major national conferences.
  - While at Science Applications, Dr. Cronin participated in evaluations of both the Industrial Petroleum Reserve and the Strategic Petroleum Reserve for the Federal Energy Administration. In addition, Dr. Cronin helped to develop and apply a methodology to investigate the impacts of a petroleum shortfall on the U.S. economy. This analysis covered national econometric and input-output models, regional models, and energy models.
  - On two occasions Dr. Cronin was employed at the Environmental Protection Agency. During his first tour of duty in the Assistant Administrator's Office of Policy Analysis, Dr. Cronin estimated an econometric market shares model of the automotive market, which allowed the Office of Policy Analysis to investigate the relative effectiveness of gasoline excise tax vis-a-vis a "gas guzzler" tax in increasing the fuel efficiency of the U.S. automotive fleet. He also participated in the development of a project designed to measure the value of improved water quality. The technique employed a contingent market approach.
  - During Dr. Cronin's second tour of duty, he undertook a cost-effectiveness study for the Office of Land Use and Transportation Planning of the Transportation Control Plans being proposed by the Environmental Protection Agency.
  - Dr. Cronin investigated the degree and impact of concentration of ownership or control of rental housing within the northern Virginia suburbs of Washington D.C. He found a high degree of concentration by neighborhood; furthermore, his findings indicated that the price of rental housing services was higher in those areas of higher concentration. Results were published in *Urban Studies*.

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**JOURNAL ARTICLES**

- Cronin, F. J. and Gold, M., in preparation. "Estimating and Decomposing the System-Wide Effects of Sectoral Technical Change."
- Cronin, F.J. et al., in preparation. "Economic System Implications of Sectoral Productivity Advances."
- Cronin, F.J., et al., October 1995. "Telecommunications and Rural Economic Development." *Telecommunications Policy*.
- Cronin, F.J., et al., April 1995. "The Calculation and Application of Composite Telecommunications Service Price Indexes." *Information Economics and Policy*.
- Cronin, F.J., et al., "Slutsky Substitution and Sectoral Growth: Telecommunications and a Test of the de la Grandville Hypothesis." Invited submission to *Contemporary Economic Policy*. Prepared for presentation at the Western Economic Association Meeting, San Diego, CA, July 1995.
- Cronin, F.J., et al., June 1994. "Inequities in the Costs and Benefits of Telecommunications Across Stakeholder Groups." *Telecommunications Policy*.
- Cronin, F.J., et al., October 1994. "Telecommunications and Cost Savings in Health Care Services." *Southern Economic Journal*.
- Cronin, F. J., et al., 1994, No. 1. "Telecommunications and Cost Savings in Educational Services." *Information Economics and Policy*.
- Cronin, F.J. et al., November 1993. "Telecommunications Infrastructure Investment and Productivity." *Telecommunications Policy*.
- Cronin, F.J. and E. Parker, November 1993. "A Review of Telecommunications and Geography," by A. Kellerman. *Telecommunications Policy*.
- Cronin, F.J. et al., August 1993. "Telecommunications Infrastructure Investment and Economic Development." *Telecommunications Policy*.
- Cronin, F.J., et al., 1993, No. 5. "Factor Prices, Factor Substitution and the Relative Demand for Telecommunications Across U.S. Industries." *Information Economics and Policy*.
- Cronin, F.J., et al., October 1992. "Telecommunications Technology, Sectoral Prices, and International Competitiveness." *Telecommunications Policy*.
- Cronin, F.J., et al., September 1992. "Linking Telecommunications and Economic Competitiveness." *Global Telephony*.
- Cronin, F.J., et al., December 1991. "Telecommunications Infrastructure and Economic Growth: An Analysis of Causality." *Telecommunications Policy*.
- Cronin, F.J., et al., March 1992. "Confusion Clouds U.S. Telecommunications Equipment Trade." *Telephony*.
- Cronin, F.J., et al., submitted for publication. "The Social Rate of Return from Telecommunications Infrastructure Investment." Under revision, *Review of Economics and Statistics*.

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- Brown, D. M. and F. J. Cronin, work in process. "Estimating the Supply of Housing within a Utility Maximizing Model of the Owner-Operator."
  - Cronin, F.J., et al., work in process. "Competition in Telecommunications, Universal Service and Stakeholders."
  - Cronin, F.J., et al., submitted for publication. "Sectoral Productivity in the American Economy: 1963-91."
  - Cronin, F.J., et al., work in process. "Analyzing the Production of Telecommunications Services."
  - Cronin, F.J., et al., work in process. "The Productivity Performance of Regulated Industries."
  - Cronin, F.J., et al., work in process. "Temporal and Spatial Variation in LEC Productivity Performance."
  - Cronin, F.J., et al., work in process. "The Productivity Performance of Technology Sectors in the American Economy."
  - Cronin, F. J., et al., work in process. "Telecommunications and the Derived Demand for Transportation by U.S. Sectors, 1963-1991."
  - Cronin, F.J., et al., work in process. "IXC Deregulation."
  - Cronin, F.J., et al., work in process. "Airline Deregulation."
  - Cronin, F.J., et al., work in process. "The Productivity Performance of U.S. Transportation Networks."
  - Cronin, F.J. and A.R. Wusterbarth, April 1986. "Economic Harm Ignored: Betamax Revisited." *Contemporary Policy Issues*
  - Cronin, F.J., October 1984. "Analytical Assumptions and Casual Ordering in Interindustry Modeling." *Southern Economic Journal*.
  - Cronin, F.J. and A.R. Wusterbarth, October 1983. "A Review of Cities and Firms," by B. Harrington, editor. *Southern Economic Journal*.
  - Cronin, F.J., October 1983. "Market Structure and the Price of Housing Services." *Urban Studies*.
  - Cronin, F.J., October 1983. "Federal Tax Regulations and the Housing Demand of Owner Occupants." *Land Economics*.
  - Cronin, F.J., Winter 1983. "The Efficiency of Demand-Oriented Housing Programs: Generalizing from Experimental Findings " *Journal of Human Resources*.
  - Cronin, F.J., July 1982. "The Household's Decision to Accept or Reject a Conditional Transfer Offer." *Southern Economic Journal*.
  - Cronin, F.J., April 1982. "The Efficiency of Housing Search." *Southern Economic Journal*.
  - Cronin, F.J., February 1982. "Estimation of Dynamic Linear Expenditure Functions for Housing." *Review of Economics and Statistics*.

---

**BOOK ARTICLES:**

- Cronin, F.J., June 1982. "Racial Differences in the Search for Housing." In W.A.V. Clark (ed.), *Housing Search*, Croom and Helm, London.
- Cronin, F.J., 1981. "Participation in the Experimental Housing Allowance Program." In R. Struyk and M. Bendick (eds.), *What Do Housing Allowances Buy? Answers from the Nation's Largest Social Experiment*, The Urban Institute Press, Washington, D.C.
- Cronin, F.J., 1981. "Consumption Responses to Constrained Programs." In R. Struyk and M. Bendick (eds.), *What Do Housing Allowances Buy? Answers from the Nation's Largest Social Experiment*, The Urban Institute Press, Washington, D.C.
- Cronin, F.J., 1981. "Consumption Responsiveness to Unconstrained Housing Allowances." In R. Struyk and M. Bendick (eds.), *What Do Housing Allowances Buy? Answers from the Nation's Largest Social Experiment*, The Urban Institute Press, Washington, D.C.
- Cronin, F.J., 1981. "Mobility." In R. Struyk and M. Bendick (eds.), *What Do Housing Allowances Buy? Answers from the Nation's Largest Social Experiment*, The Urban Institute Press, Washington, D.C.

**PROFESSIONAL REPORTS**

- Cronin, F. J. et al., January 1996. *The Impact of Alternative Local Interconnection Pricing on Stakeholder Groups in Canada*. Prepared for Microcell 1-2-1 by A. T. Kearney, Inc.
- Cronin, F. J. et al., August 1995. *Benefits of Telecommunications Research and Development, Competition and Interconnection*. Prepared for MicroCell 1-2-1 by EDS Management Consulting Services.
- Cronin, F. J. et al., May 1995. *Natural Gas Industrial Rate Cap Analysis*. Prepared for South Carolina Pipeline Corporation by EDS Management Consulting Services.
- Cronin, F.J. et al., May 1995. *Local Competition, Rate Rebalancing, and Stakeholder Groups in Michigan*. Prepared for Ameritech Michigan by EDS Management Consulting Services.
- Cronin, F. J. et al., May 1995. *The Importance of Comprehensive Local Exchange Competition Policy in California*. Prepared for Pacific Bell by EDS Management Consulting Services.
- Cronin, F.J., et al., May 1994. *The Contribution of Transportation to Aggregate and Sectoral Productivity*. Prepared for U S. Department of Transportation by DRI/McGraw-Hill, Lexington, MA.
- Cronin, F.J., et al., August 1993. *Telecommunications Network Modernization and the Arkansas Economy*. Prepared for Southwestern Bell Tel. by DRI/McGraw-Hill, Lexington, MA.
- Cronin, F.J., et al., November 1992. *Telecommunications Network Modernization and the Illinois Economy*. Prepared for Illinois Bell by DRI/McGraw-Hill, Lexington, MA.
- Cronin, F.J., et al., April 1993. *The Future Contributions of Telecommunications to the Ameritech Five-State Region*. Prepared for Ameritech by DRI/McGraw-Hill, Lexington, MA.
- Cronin, F.J., et al., October 1993. *Telecommunications Network Modernization and the Massachusetts Economy*. Prepared for NYNEX by DRI/McGraw-Hill, Lexington, MA.

- 
- Cronin, F.J., et al., April 1993. *Telecommunications Network Modernization and the Ohio Economy*. Prepared for Ameritech—Ohio by DRI/McGraw-Hill, Lexington, MA.
  - Cronin, F.J., et al., June 1993. *Telecommunications Network Modernization and the New York Economy*. Prepared for New York Telephone by DRI/McGraw-Hill, Lexington, MA.
  - Cronin, F.J., et al., June 1993. *Telecommunications Network Modernization and the Virginia Economy*. Prepared for C&P of Virginia by DRI/McGraw-Hill, Lexington, MA.
  - Cronin, F.J., et al., March 1993. *Pennsylvania Telecommunications Infrastructure Study*. Prepared for the Pennsylvania Public Utility Commission by DRI/McGraw-Hill, Lexington, MA.
  - Cronin, F.J., et al., November 1992. *Telecommunications Network Modernization and the California Economy*. Prepared for Pacific Telesis 11y DRI/McGraw-Hill, Lexington, MA.
  - Cronin, F.J., et al., October 1992. *The Impacts of Deregulation and the Subsequent Increase in Competition on Investment Activity*. Prepared by DRI/McGraw-Hill, Lexington, MA
  - Cronin, F.J., et al., March 1992. *An Economic Assessment of the Proposed McDonnell-Douglas and Republic of China Joint Venture*. Prepared by DRI/McGraw-Hill, Lexington, Massachusetts.
  - Cronin, F.J., et al., December 1991. *Telecommunications Network Modernization and the New Jersey Economy*. Prepared for New Jersey Bell by DRI/McGraw-Hill, Lexington, Massachusetts.
  - Cronin, F.J., et al., November 1991. *Telecommunications Network Modernization and the Maryland Economy*. Prepared for C&P of Maryland by DRI/McGraw-Hill, Lexington, Massachusetts
  - Cronin, F.J., et al., June 1991. *An Examination of U.S. Trade in Telecommunications Equipment, 1980-1990*. Prepared for Bell Atlantic by DRI/McGraw-Hill, Lexington, Massachusetts.
  - Cronin, F.J., et al., March 1991. *The Impact on the New Jersey Economy of Relaxing the MFJ Manufacturing Rules*. Prepared for New Jersey Bell by DRI/McGraw-Hill, Lexington, Massachusetts.
  - Cronin, F.J., et al., February, 1991. *The Impact on the New Jersey Economy of Telecommunications Network Modernization*. Prepared for New Jersey Bell by DRI/McGraw-Hill, Lexington, Massachusetts.
  - Cronin, F.J., et al., February 1991. *The Contributions of Telecommunications Infrastructure to Aggregate and Sectoral Efficiency*. Prepared for Ameritech, Bell Atlantic, BellSouth, Cincinnati Bell, GTE, NYNEX, Pacific Bell, SNET, Southwestern Bell, United Telephone, and U. S. West, by DRI/McGraw-Hill, Lexington, Massachusetts.
  - Cronin, F.J., et al., January 1990. *An Analysis of the National Benefit of NASP/NDV Expenditures: 1990 through 2010*. Prepared for NASA and the U.S. Air Force by DRI/McGraw-Hill, Lexington, Massachusetts.
  - Cronin, F.J., et al., Spring 1988. *The Facts on Foreign Direct Investment*. DRI/McGraw-Hill, Lexington, Massachusetts.
  - Cronin, F.J., et al., Spring 1988. *The Enduring Growth of Systems, Software, and Data Processing*. DRI/McGraw-Hill, Lexington, Massachusetts.
  - Cronin, F.J. and S. I. Barry, Spring 1986. *Examining the Effects of Increased Import Penetration on Corporate Performance and Forecasting*. DRI/McGraw-Hill, Lexington, Massachusetts.
-

- Cronin, F.J., et al., November 1985. *Total Contribution of Outer Continental Shelf Exploration, Development and Production to the U.S. Economy*. Prepared for the American Petroleum Institute by Data Resources Interindustry Service, Lexington, Massachusetts.
- Franke, J.C., et al., October 1985. *Case Study of the Research and Development and Commercialization of Two Energy Efficient Appliances*. Prepared for the Energy Conversion Equipment Program, Department of Energy by Battelle Pacific Northwest Laboratory, Washington, D.C.
- Feldman, S.J., et al., October 1985. *Florida Power Corporation Economic Development Study: Identifying Industries to Attract to Florida*. Prepared for Florida Power Corporation by Data Resources Interindustry Service, Lexington, Massachusetts.
- Cronin, F.J., et al., March 1985. *Economic Implications of Developing the Outer Continental Shelf*. Prepared for the American Petroleum Institute by Data Resources Interindustry Service, Lexington, Massachusetts.
- Cronin, F.J., et al., March 1985. *Outer Continental Shelf Development to the Year 2000: The Direct Factor Input and Financial Requirements*. Prepared for the American Petroleum Institute by Data Resources Inc., Lexington, Massachusetts.
- Cronin, F.J., et al., February 1985. *Recent Trends in Energy Research and Development Expenditures*. Prepared for the Office of Industrial Programs, Department of Energy by Battelle, Pacific Northwest Laboratory, Washington, D.C.
- Cronin, F.J., et al., July 1984. *Developing and Simulating Outer Continental Shelf Leasing Scenarios*. Prepared for the American Petroleum Institute by Battelle, Pacific Northwest Laboratory, Washington, D.C.
- Tawil, J.J. et al., June 1984. *Socioeconomic Consequences of Nuclear Reactor Accidents*. NUREG/CR-3566. Prepared for the Nuclear Regulatory Commission by Battelle, Pacific Northwest Laboratory, Richland, Washington.
- Cronin, F.J., et al., April 1984. *Optimizing the Allocation of Petroleum within the Defense Energy Requirements Analysis System*. Prepared for the Office of Energy Contingency Planning, Department of Energy by Battelle, Pacific Northwest Laboratory, Washington, D.C.
- Cronin, F.J., et al., March 1984. *Interindustry Modeling Frameworks Underlying the Defense Energy Requirements Analysis System*. Prepared for the Office of Energy Contingency Planning, Department of Energy by Battelle, Pacific Northwest Laboratory, Washington, D.C.
- Cronin, F.J., et al., December 1983. *Estimating and Testing a System of Demand Equations for VCR-Related Videocassettes*. Prepared for the Motion Picture Association of America, Inc. by Battelle, Pacific Northwest Laboratory, Washington, D.C.
- Cronin, F.J., et al., October 1983. *Changing Demands and Technologies: Their Potential Impacts on Electricity*. PNL-SA-11725. Prepared for the Electric Power Research Institute's symposium on "Forecasting Structural Change in U.S. Manufacturing and Its Impact on Electricity Use," Palo Alto, California, October 25, 1983. Battelle, Pacific Northwest Laboratory, Washington, D.C.
- Cronin, F.J., R.J. Moe, and A.R. Wusterbarth, October 1983. *An Economic Analysis of Once-Through Versus Reprocessing Nuclear Fuel Cycles in the Republic of Korea*. Battelle, Pacific Northwest Laboratory, Washington, D.C.

- Moe, R.J., et al., October 1983. *Changing Technologies and Shifting Demands: Forecasting Regional Electricity Use*. PNL-SA-11732. Prepared for the Electrical Power Research Institute's symposium on "Forecasting in an Era of Technological Change," Boston, Massachusetts, October 18, 1983. Battelle, Pacific Northwest Laboratory, Richland, Washington.
- Tawil, J.J., et al., September 1983. *The Contribution of Socioeconomic Consequences to Nuclear Reactor Accident Risk*. Prepared for the U.S. Nuclear Regulatory Commission by Battelle, Pacific Northwest Laboratory, Richland, Washington.
- Cronin, F.J., et al., August 1983. *An Analysis of the Economic Benefits and Harm from Videocassette Recorders and Related Products*. Prepared for the Motion Picture Association of America, Inc. by Battelle, Pacific Northwest Laboratory, Washington, D.C.
- Eisenhauer, J.L. and F.J. Cronin, July 1983. *Estimating the Private Cost of Delivered Electric Energy*. Prepared for the Western Economic Association Meetings, Seattle, Washington, July 1983 by Battelle, Pacific Northwest Laboratory, Washington D.C.
- Cronin, F.J., F.J. Nesse, M. Vaeth, and A.R. Wusterbarth, November 1982. *Improved Cost-Benefit Techniques in the U.S. Nuclear Regulatory Commission*. NUREG/R-3194 PNL-4653. Prepared for the Nuclear Regulatory Commission by Battelle, Pacific Northwest Laboratory, Washington, D.C.
- Cronin, F.J., September 1982. *Valuing Nonmarket Goods Through Contingent Markets*. PNL-4255. Prepared for the Environmental Protection Agency by Battelle, Pacific Northwest Laboratory, Washington, D.C.
- Callaway, J. M., F.J. Cronin, J.W. Carrie, and J.J. Tawil, August 1982. *An Analysis of Methods and Models for Assessing the Direct and Indirect Economic Impacts of CO<sub>2</sub>-Induced Environmental Changes in the Agricultural Sector of the U.S. Economy*. PNL-4384. Prepared for the Department of Energy by Battelle, Pacific Northwest Laboratory, Richland, Washington.
- Nieves, L.A., J.B. Scherer, and F.J. Cronin, June 1982. *Interim Technical Letter Report #2 on Socioeconomic Impacts of Alternatives for Processed TMI-2 Accident Water Disposal*. Prepared for the Nuclear Regulatory Commission by Battelle, Pacific Northwest Laboratory, Richland, Washington.
- Tawil, J.J., et al., November 1981. *Improving Socioeconomic Impact Assessments of Nuclear Power Plant Accidents*. (Draft) Prepared for the Nuclear Regulatory Commission by Battelle, Pacific Northwest Laboratory, Richland, Washington.
- Cronin, F.J., August 1981. *A Contingent Market Valuation of Improved Water Quality*. Prepared for the Environmental Protection Agency by Battelle, Pacific Northwest Laboratory, Washington, D.C.
- Cronin, F.J. et al., August 1980. *Shelter Allowances in Canada: Lessons for Program Design from the U.S. Experience*. No. 1440-1. Prepared for the Government of Canada by the Urban Institute, Washington, D.C.
- Cronin, F.J. and D.W. Rasmussen, July 1980. *Homeowner Investment in Detroit*. Working Paper 1375-1. Prepared for the State of Michigan and the City of Detroit by the Urban Institute, Washington, D.C.

- 
- Cronin, F.J., June 1980. *Search and Residential Mobility: Part 1. Economic Models of the Decisions to Search and to Move Among Low-Income Households*. No. 249-27. Prepared for the Department of Housing and Urban Development by the Urban Institute, Washington, D.C.
  - Cronin, F.J., 1979. *The Demand for Low-Income Households*. No. 249-25. Prepared for the Department of Housing and Urban Development by the Urban Institute, Washington, D.C.
  - Cronin, F.J., April 1979. *An Economic Analysis of Intraurban Search and Mobility Using Alternative Benefit Measures*. Working Paper 249-24. The Urban Institute, Washington, D.C.
  - Cronin, F.J., November 1978. *Intraurban Household Mobility: The Search Process*. Working Paper 249-16.
  - Cronin, F.J., October 1978. *Search, Mobility, and Locational Choice: Preliminary Findings from the Experimental Housing Allowance Program*. No. 249-11. Prepared for the Department of Housing and Urban Development by the Urban Institute, Washington, D.C.
  - Cronin, F.J., et al., 1977. *Integrated Economic Impact Assessment of Petroleum Supply Interruption Contingency Actions*. Prepared for the Federal Energy Administration by Science Applications, Inc., McLean, Virginia.
  - Cronin, F.J., 1977. *A Review of the Literature on Measuring the Impacts of Energy Price Changes and Petroleum Supply Interruptions*. Prepared for the Federal Energy Administration by Science Applications, Inc., McLean, Virginia.
  - Cronin, F.J. (with others), 1976. *Feasibility Study for Requiring Storage of Crude Oil, Residual Fuel Oil, and/or Refined Petroleum Products by Industry*. Prepared for the Federal Administration by JRB Associates, McLean, Virginia.
  - Cronin, F.J., *An Economic Analysis of Transportation Control Plan Measures*. Office of Land Use and Transportation Planning, Environmental Protection Agency, Washington, D.C.
  - Cronin, F.J., *Estimating the Economic Determinants of the Distribution of the Automotive Market by Size-Price Classes*. Office of Policy Analysis, Environmental Protection Agency, Washington, D.C.

**EXPERT TESTIMONY, CONFERENCE PRESENTATIONS, SEMINARS, AND MAJOR CLIENT BRIEFINGS:**

*Expert Testimony, Regulatory and Legislative Filings*

- Canadian Radio-Television and Telecommunications Commission, January, 1996.
- Canadian Radio-Television and Telecommunications Commission, December, 1995.
- South Carolina Public Utilities Commission, October 1995, Docket No. 90-588-G.
- Industry Canada, September 1995.
- Michigan Legislature, September 1995.
- California Public Utilities Commission, May 1995.
- Southern Company and EPRI, August 1994

- 
- Ohio Subcommittee on Taxation, July 1994
  - Ohio Commissioner of Revenue, July 1994
  - Public Utility Commission of Ohio, July 1994.
  - Florida Public Utility Commission, December 1994.
  - Public Utility Commission of Arkansas, September 1993.
  - Illinois Public Utility Commission, May 1993.
  - Pennsylvania Senate, May 1993.
  - New Jersey Public Utility Commission, September and October 1992.
  - New Jersey Public Utility Commission Staff, July 1992.
  - Maryland Public Utility Commission, 1991.
  - National Telecommunications and Information Administration, April 1991.
  - National Telecommunications and Information Administration, January 1991.
  - Senate and House Judiciary Staff, October 1983.

*Conference Presentations*

- Southern Economic Association, New Orleans, LA, November 1995.
- Western Economic Association, San Diego, CA, July 1995.
- NEC(Whitehouse)/DOE/EPRI Workshop on NII Benefits and Technology, December 1994.
- Center for Economic and Management Research, August 1994
- Pacific Telecommunications Conference, January 1994
- Society of Insurance Research, February 1989.
- Western Economic Association Meetings, July 1986.
- Atlantic Economic Society Meetings, October 1984.
- Western Economic Association Meetings, June 1984.
- Western Economic Association Meetings, July 1983.
- North American Regional Science Association Annual Meetings, November 1982.
- Western Economic Association Meetings, June 1981.
- University of California at Los Angeles, Institute for Social Science Research, May 1980.
- Allied Social Science Meetings, December 1979.
- Western Economic Association Meetings, June 1979.
- Eastern Economic Association Meetings, April 1979.

- Conference on the Housing Choices of Low Income Households, Washington, D.C., March 1979.
- North American Regional Science Association Annual Meetings, November 1978.
- Southern Economic Association Meetings, November 1977.
- Atlantic Economic Society Meetings, May 1976.

*Major Client Briefings*

- United States Department of Transportation, May 1994
- United States Department of Transportation, January 1993.
- Bellcore and Funding Companies, November 1990.
- Bellcore and Funding Companies, August 1990.
- American Petroleum Institute, Member Oil Companies, and Related Service Companies, April 1985.
- American Petroleum Institute, Member Oil Companies, and Related Service Companies, January 1985.
- American Petroleum Institute, Member Oil Companies, and Related Service Companies, July 1984.
- Office of Energy Emergencies, Department of Energy, May 1984.
- Motion Picture Association of America, Member Companies and Associated Organizations, June 1983.
- Motion Picture Association of America, Member Companies and Associated Organizations, March 1983.
- Office of Policy, U. S. Environmental Protection Agency, October 1982.
- Georgetown University, Seminar on Urban Economics, April 1980.
- National Bureau of Economic Research, Stanford University, May 1979.
- Georgetown University, Seminar on Urban Economics, October 1977.

# **ATTACHMENT B**

## **Analysis of AT&T/Norsworthy Model**

Attachment B

**Analysis of Norsworthy (AT&T) Model of TFP Methods**

In the performance review of the Local Exchange Carriers (LECs) in the Commission's CC Docket No 94-1 proceeding, AT&T presented comments and a model by Dr. John Norsworthy, known as the "Performance-Based Model", on the proper measurement of total factor productivity (TFP) for use in price cap regulation.. This analysis will replicate the Norsworthy model, check it for accuracy and make adjustments where improper data or technique are used.

The Fisher Ideal Price Index technique is used for aggregation throughout the Norsworthy model and will be utilized here as well. Data for this analysis is the same used in the Norsworthy model unless otherwise noted. Tables B1 and B2 include the replicated results from the Norsworthy model for the time periods 1985-1994 and 1990-1994, respectively.

**Norsworthy Unadjusted - Baseline**

**Table B1**

	<u>Interstate</u>	<u>Intrastate</u>	<u>Total</u>
<b>1985 - 1994</b>			
Output Growth	6.83%	4.22%	4.90%
Input Growth	<u>1.89%</u>	<u>1.89%</u>	<u>1.89%</u>
LEC TFP	4.94%	2.33%	3.01%
US TFP	<u>0.15%</u>	<u>0.15%</u>	<u>0.15%</u>
TFP Diff	4.79%	2.18%	2.86%
Input Price LEC	0.46%	0.46%	0.46%
Input PRICE US	<u>3.00%</u>	<u>3.00%</u>	<u>3.00%</u>
Input Price Diff	2.54%	2.54%	2.54%
<b>TFP Diff + IPD</b>	<b>7.33%</b>	<b>4.72%</b>	<b>6.40%</b>

**Table B2**

	<u>Interstate</u>	<u>Intrastate</u>	<u>Total</u>
<b>1990 - 1994</b>			
Output Growth	5.41%	4.45%	4.69%
Input Growth	<u>0.08%</u>	<u>0.08%</u>	<u>0.08%</u>
LEC TFP	5.33%	4.37%	4.61%
US TFP	<u>0.21%</u>	<u>0.21%</u>	<u>0.21%</u>
TFP Diff	5.12%	4.16%	4.40%
Input Price LEC	2.27%	2.27%	2.27%
Input PRICE US	<u>2.12%</u>	<u>2.12%</u>	<u>2.12%</u>
Input Price Diff	-0.15%	-0.15%	-0.15%
<b>TFP Diff + IPD</b>	<b>4.97%</b>	<b>4.01%</b>	<b>4.25%</b>

Attachment B

**Adjustments to Model**

*Scenario 1: Use Switched MOU for Interstate Traffic Sensitive Quantity Measure*

The Norsworthy model erroneously divides interstate switched TS revenue requirements by residential access lines instead of switched MOU to arrive at a price series used to weight the output of interstate TS services. The result of this error is that interstate switched MOU growth is significantly overweighted and results in a major overstatement of aggregate interstate output growth. The results of correcting this model error are shown in Tables 1a and 1b for the time periods 1985-1994 and 1990-1994, respectively. This adjustment will be maintained in the scenarios that follow in this analysis.

**Table 1a**

	<b>Interstate</b>	<b>Intrastate</b>	<b>Total</b>
<b>1985 - 1994</b>			
Output Growth	5.23%	4.22%	4.49%
Input Growth	<u>1.89%</u>	<u>1.89%</u>	<u>1.89%</u>
LEC TFP	3.34%	2.33%	2.80%
US TFP	<u>0.15%</u>	<u>0.15%</u>	<u>0.15%</u>
TFP Diff	3.19%	2.18%	2.45%
Input Price LEC	0.46%	0.46%	0.46%
Input PRICE US	<u>3.00%</u>	<u>3.00%</u>	<u>3.00%</u>
Input Price Diff	2.54%	2.54%	2.54%
<b>TFP Diff + IPD</b>	<b>6.73%</b>	<b>4.72%</b>	<b>4.99%</b>

**Table 1b**

	<b>Interstate</b>	<b>Intrastate</b>	<b>Total</b>
<b>1990 - 1994</b>			
Output Growth	4.32%	4.45%	4.42%
Input Growth	<u>0.08%</u>	<u>0.08%</u>	<u>0.08%</u>
LEC TFP	4.24%	4.37%	4.34%
US TFP	<u>0.21%</u>	<u>0.21%</u>	<u>0.21%</u>
TFP Diff	4.03%	4.16%	4.13%
Input Price LEC	2.27%	2.27%	2.27%
Input PRICE US	<u>2.12%</u>	<u>2.12%</u>	<u>2.12%</u>
Input Price Diff	-0.15%	-0.15%	-0.15%
<b>TFP Diff + IPD</b>	<b>3.88%</b>	<b>4.01%</b>	<b>3.98%</b>

Attachment B

*Scenario 2: Add IntraLATA usage to Intrastate InterLATA usage to correspond with Revenue*

The Norsworthy model uses total intrastate toll revenue but uses only interLATA MOU to compute intrastate toll output. The omission of intraLATA usage significantly overstates output. IntraLATA toll usage is growing at a much slower rate than interLATA access due largely to growth in 800 services and dial-around (10XXXX). Tables 2a and 2b contain the results for this adjustment for the time periods 1985-1994 and 1990-1994, respectively.

**Table 2a**

	<b>Interstate</b>	<b>Intrastate</b>	<b>Total</b>
<b>1985 - 1994</b>			
Output Growth	5.23%	<b>3.31%</b>	<b>3.81%</b>
Input Growth	<u>1.89%</u>	<u>1.89%</u>	<u>1.89%</u>
LEC TFP	3.34%	<b>1.42%</b>	<b>1.92%</b>
US TFP	<u>0.15%</u>	<u>0.15%</u>	<u>0.15%</u>
TFP Diff	<b>3.19%</b>	<b>1.27%</b>	<b>1.77%</b>
Input Price LEC	0.46%	0.46%	0.46%
Input PRICE US	<u>3.00%</u>	<u>3.00%</u>	<u>3.00%</u>
Input Price Diff	<b>2.54%</b>	<b>2.54%</b>	<b>2.54%</b>
<b>TFP Diff + IPD</b>	<b>6.73%</b>	<b>3.81%</b>	<b>4.31%</b>

**Table 2b**

	<b>Interstate</b>	<b>Intrastate</b>	<b>Total</b>
<b>1990 - 1994</b>			
Output Growth	4.32%	<b>3.62%</b>	<b>3.79%</b>
Input Growth	<u>0.08%</u>	<u>0.08%</u>	<u>0.08%</u>
LEC TFP	4.24%	<b>3.54%</b>	<b>3.71%</b>
US TFP	<u>0.21%</u>	<u>0.21%</u>	<u>0.21%</u>
TFP Diff	<b>4.03%</b>	<b>3.33%</b>	<b>3.50%</b>
Input Price LEC	2.27%	2.27%	2.27%
Input PRICE US	<u>2.12%</u>	<u>2.12%</u>	<u>2.12%</u>
Input Price Diff	<b>-0.15%</b>	<b>-0.15%</b>	<b>-0.15%</b>
<b>TFP Diff + IPD</b>	<b>3.88%</b>	<b>3.18%</b>	<b>3.35%</b>

Note: IntraLATA MOU calculated by multiplying IntraLATA calls from ARMIS 43-08 by average industry toll holding times.

Attachment B

*Scenario 3: Remove Hedonic adjustment from capital input price.*

Undoubtedly, improvements in technology have increased TFP in the LEC industry. However, the Norsworthy model attempts to capture these increases through the application of a hedonic price adjustment to capital input prices. Several problems arise with this approach. First, technology has improved for the economy as a whole but no adjustment has been made to reflect it. Second, technological advances have improved the productivity of labor but Norsworthy makes no adjustment to reflect this. Third, the entire exercise is meaningless in the context of this formula since any changes in LEC TFP caused by the hedonic adjustment are offset by an equal increase in LEC input prices, thus resulting in no change in the X-factor. Tables 3a and 3b show the result of removing the hedonic adjustment for the time periods 1985-1994 and 1990-1994, respectively.

Table 3a

	Interstate	Intrastate	Total
<b>1985 - 1994</b>			
Output Growth	5.23%	4.22%	4.49%
Input Growth	<u>0.86%</u>	<u>0.86%</u>	<u>0.86%</u>
LEC TFP	4.37%	3.36%	3.63%
US TFP	0.15%	0.15%	0.15%
TFP Diff	4.22%	3.21%	3.48%
Input Price LEC	1.49%	1.49%	1.49%
Input PRICE US	<u>3.00%</u>	<u>3.00%</u>	<u>3.00%</u>
Input Price Diff	1.51%	1.51%	1.51%
<b>TFP Diff + IPD</b>	<b>6.73%</b>	<b>4.72%</b>	<b>4.99%</b>

Table 3b

	Interstate	Intrastate	Total
<b>1990 - 1994</b>			
Output Growth	4.32%	4.45%	4.42%
Input Growth	<u>-0.63%</u>	<u>-0.63%</u>	<u>-0.63%</u>
LEC TFP	4.96%	5.09%	5.05%
US TFP	0.21%	0.21%	0.21%
TFP Diff	4.74%	4.88%	4.84%
Input Price LEC	2.98%	2.98%	2.98%
Input PRICE US	2.12%	2.12%	2.12%
Input Price Diff	-0.86%	-0.86%	-0.86%
<b>TFP Diff + IPD</b>	<b>3.89%</b>	<b>4.02%</b>	<b>3.99%</b>