

PUC DOCKET NO. 31540

DIRECT TESTIMONY OF

DR. FRANK WOLAK

**ON BEHALF OF
DENTON MUNICIPAL ELECTRIC**

NOVEMBER 2005

DIRECT TESTIMONY OF DR. FRANK WOLAK

TABLE OF CONTENTS

I. STATEMENT OF QUALIFICATIONS3

II. SCOPE OF TESTIMONY4

III. CONCLUSIONS AND RECOMMENDATIONS5

IV. ANALYSIS OF CRR ISSUES7

V. SUMMARY10

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22

I. STATEMENT OF QUALIFICATIONS

Q. PLEASE STATE YOUR NAME, OCCUPATION AND BUSINESS ADDRESS.

A. My name is Frank A. Wolak. I am a Professor of Economics at Stanford University. My business address is Department of Economics, Stanford University, Stanford, CA 94305-6072.

Q. PLEASE BRIEFLY OUTLINE YOUR EDUCATIONAL AND PROFESSIONAL BACKGROUND.

A. I began my work on energy and environmental issues at the Los Alamos National Laboratory (LANL) in 1980. The following year I entered graduate school at Harvard University, where I received an S.M. in Applied Mathematics and Ph.D in Economics. For the past fifteen years, I have been engaged in a research program studying privatization, competition, and regulation in network industries such as electricity and natural gas. A major focus of my academic research is market design in restructured electricity markets. Over the past ten years, I have worked on aspects of the design and operation of the PJM, New York, New England and California electricity markets, as well as virtually all restructured electricity markets currently operating around the world. Since April 1, 1998, I have been the Chairman of the Market Surveillance Committee (MSC) for the Independent System Operator (ISO) of California electricity supply industry. A copy of my CV is attached to this testimony as Appendix A. It lists the documents I have authored or co-authored as Chairman of the MSC.

1 **Q. HAVE YOU PREVIOUSLY FILED TESTIMONY AT THE COMMISSION?**

2 A. I have not previously filed testimony at the Commission. However, I served as
3 ERCOT's Independent Economist to the Texas Nodal Team from February 2004 to
4 November of 2004.

5 **Q. ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS PROCEEDING?**

6 A. I am testifying on behalf of Denton Municipal Electric, hereafter referred to as
7 "DME".

8 **Q. HOW IS YOUR TESTIMONY ORGANIZED?**

9 A. My testimony begins in Section I with a statement of my qualifications. In Section II,
10 I discuss the scope of my testimony. My testimony continues with Section III, which
11 presents a summary of my conclusions and recommendations for this proceeding.
12 Section IV continues with a description of my analysis of the nodal protocols as filed
13 at the Commission. Section V concludes with a summary of my findings.

14 **II. SCOPE OF TESTIMONY**

15 **Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?**

16 A. The purpose of my testimony is to present recommendations concerning proposed
17 changes or deficiencies in portions of the nodal protocols as filed at the Commission
18 concerning Congestion Revenue Rights, or CRRs.

19 **Q. WHAT IS THE SCOPE OF YOUR TESTIMONY?**

20 A. My testimony outlines the market efficiency, transactions costs and distributional
21 equity advantages of allocating CRRs as opposed to auctioning them as proposed in
22 the nodal protocols.

1 **Q. WHAT HAVE YOU RELIED UPON IN MAKING YOUR EVALUATION AND**
2 **ARRIVING AT YOUR CONCLUSIONS AND RECOMMENDATIONS?**

3 A. I have relied upon the nodal protocols filed at the Commission on September 23,
4 2005, the Commission's Order in Project 26376 which established the stakeholder
5 process to create the nodal protocols and directed certain objectives and standards be
6 met in establishing the protocols.

7 **Q. WHAT STANDARD DID YOU APPLY IN EVALUATING THE NODAL**
8 **PROTOCOLS CONCERNING CONGESTION REVENUE RIGHTS?**

9 A. I relied upon the standards set in the Public Utility Commission of Texas (PUC) in
10 their Preliminary Order issued in this docket, particularly Section III, which details
11 the issues to be addressed in this proceeding, which includes:

- 12 *1. Reliability unit commitment;*
- 13 *2. The proposed credit requirements, including their scope and adequacy;*
- 14 *3. The day-ahead market;*
- 15 *4. Load zones, including their number and configuration;*
- 16 *5. Congestion-revenue rights, including their distribution; and*
- 17 *6. The real-time market*

18 **III. CONCLUSIONS AND RECOMMENDATIONS**

19 **Q. PLEASE SUMMARIZE THE CONCLUSIONS THAT YOU HAVE REACHED**
20 **AS A RESULT OF YOUR ANALYSIS.**

21 A. I have reached the following conclusions:

- 1) The nodal protocols, as filed, establish a mechanism for distribution of CRRs that includes allocation of pre-assigned CRRs (PCRRs) to NOIEs with ownership or contractual commitments that were of a term of five years or longer and in place prior to September 1, 1999. (Sect. 7.4.1)
- 2) The nodal protocols call for certain flowgate rights associated with wind generation in the McCamey area to be allocated to available wind generation resources in the area. (Sect. 7.7)
- 3) The nodal protocols call for all remaining CRRs to be auctioned in a series of annual and monthly auctions. (Sect. 7.5.1)
- 4) Proceeds from the auctioning of CRRs are to be distributed to QSEs on a zonal load ratio share basis for CRRs with the source and sink points in the same zone and on an ERCOT-wide load ratio share basis for CRRs with the source and sink points in different zones. (Sect. 7.5.7)
- 5) The distribution of CRR auction revenues is guaranteed for the first three years only. Within the first three years of the implementation of the nodal market design the Protocols direct the ERCOT Board to consider extending this policy or ratify another alternative. (Sect. 7.5.7)
- 6) The Protocols, as filed, do not serve the long term public interest because they auction CRRs instead of allocating CRRs to loads that are ultimately paying for congestion in their zonal average LMP prices.
- 7) Even if the Commission determines that auctioning CRRs is in the public interest, the Protocols, as filed, do not serve the long term public interest because they do not guarantee that CRR auction revenues will be allocated to the loads that are paying the price for congestion in their zonal average LMP prices, beyond three years into the nodal-pricing market.

To summarize, if the nodal Protocols are to be in the public interest, they must take into account the needs and interests of all parties. This includes the interests of loads and load-serving entities, who ultimately pay for the costs of congestion under the nodal market design.

Q. PLEASE SUMMARIZE THE RECOMMENDATIONS THAT YOU ARE MAKING AS THE RESULT OF YOUR ANALYSIS.

1 A. Based on my analysis of the nodal Protocols as filed, the requirements of the nodal
2 market design set forth in the Commission's order in Project 26376 and other material
3 review and studied I recommend the following:

- 4 1) The nodal protocols should be amended to allocate CRRs directly to the
5 loads in ERCOT instead of being auctioned to all market participants.
6 Loads should be allowed, but not required, to sell these CRRs to other
7 parties..
- 8 2) If the Commission does not allocate CRRs to loads, the nodal protocols
9 should be amended to ensure that auction revenues are allocated to loads
10 in perpetuity in a manner similar to that guaranteed for the first three years
11 of the nodal protocols.

12 **IV. ANALYSIS OF CRR ISSUES**

13 **Q. WHAT IS YOUR UNDERSTANDING OF THE MANNER IN WHICH CRRS**
14 **ARE TREATED IN THE NODAL PROTOCOLS?**

15 A. I understand that ERCOT will allocate certain CRRs, which are defined as Pre-
16 assigned CRRs or PCRRs to NOIEs who have existing ownership or purchase
17 arrangements from generators of at least five years in length and were entered into
18 prior to September 1, 1999. ERCOT is also to allocate certain flowgate rights to the
19 wind generation unit owners in the McCamey area. ,The remaining CRRs are to be
20 auctioned to eligible CRR Account Holders. The auctions will be held on an annual
21 basis for one and two year CRRs and on a monthly basis for monthly CRRs. CRR
22 owners can resell previously acquired CRRs at the auctions.

23 **Q. DO YOU THINK THERE IS A BETTER METHOD TO MITIGATE THE**
24 **IMPACT OF EXCESS COLLECTIONS FOR LOADS TO FUND CRR**
25 **PAYMENTS THAN THE ALLOCATION OF CRR AUCTION PROCEEDS?**

1 A. Yes. A direct allocation of CRRs to loads enhances wholesale market efficiency
2 and system reliability relative to the current two-step Auction Revenue Right (ARR)
3 allocation and CRR auction mechanism. A simplified allocation mechanism reduces
4 the cost to ERCOT of offering CRRs and the cost to market participants of obtaining
5 CRRs. Finally, a simplified allocation can enhance the competitiveness of the
6 ERCOT retail electricity market.

7 **Q. CAN YOU PROVIDE A DIRECT CRR ALLOCATION MECHANISM THAT**
8 **ACHIEVES THE ABOVE GOALS?**

9 A. Yes. I have prepared a paper which outlines the role of CRRs in a nodal market,
10 describes the efficiency costs of auctioning versus allocating CRRs, and details a
11 simple and transparent procedure for allocating CRRs to loads in a manner that
12 maximizing the likelihood of achieving the goals described above. This mechanism
13 also allows CRRs to be sold in a secondary market, if the initial owner finds this
14 attractive. A copy of my paper is included as Attachment 1.

15 **Q. DO YOU THINK THAT AUCTIONING CRRS AND ALLOCATING CRR**
16 **AUCTION REVENUES TO LOADS DOES SERVE AS A PARTIAL HEDGE**
17 **AGAINST LOCATIONAL PRICE DIFFERENCES?**

18 A. Yes, but as I mentioned in my previous answer, the existing ARR allocation and CRR
19 auction mechanism is dominated by a direct allocation of CRRs to loads.

20 **Q. WHAT IS THE DISPOSITION OF THE REVENUES ERCOT RECEIVES**
21 **FROM THE CRR AUCTIONS IN THE NODAL PROTOCOLS?**

22 A. For the first three years after implementation of the nodal market, the Protocols call
23 for auction revenues to be distributed to QSEs on a load ratio share basis. CRRs in

1 which the source and sink lie in the same zone will have the auction revenues
2 associated with these CRRs allocated on a load ratio share to QSEs within the zone.
3 CRRs in which the source and sink lie in different zones will have the auction
4 revenues associated with these CRRs allocated to QSEs on an ERCOT-wide load
5 ratio share basis.

6 **Q. WHAT IS THE DISPOSITION OF THE REVENUES ERCOT RECEIVES**
7 **FROM THE CRR AUCTION AFTER THE INITIAL THREE YEARS OF THE**
8 **NODAL MARKET?**

9 A. That is uncertain. The current filed nodal Protocols state that prior to the end of the
10 first three years of the market, the ERCOT Board will consider whether to extend the
11 policy of allocating CRR revenues back to QSEs on a load ratio share basis or ratify
12 another alternative.

13 **Q. DO YOU BELIEVE THAT CRR AUCTION REVENUES SHOULD BE**
14 **ALLOCATED TO LOADS AS CALLED FOR IN THE FIRST THREE YEARS**
15 **OF THE NODAL PROTOCOLS?**

16 A. Yes, if CRRs are to be auctioned rather than allocated to loads. Loads will pay for
17 energy based on the weighted zonal average of LMPs within the zone in which they
18 are located. This price not only reflects the price paid to generators for their
19 production, but also includes the additional cost of dispatching high-cost generation
20 units local to the major ERCOT load centers instead of lower-cost distant generation
21 units. ERCOT uses the revenues collected from loads in excess of those paid out to
22 generation unit owners to fund CRRs. Allocation of CRR auction revenues to QSEs
23 on a zonal basis for CRRs with source and sink in the same zone and on a ERCOT-

1 wide load ratio share basis for CRRs with source and sink in different zones is an way
2 to ensure that the parties funding the CRRS via the excess collections from loads
3 receive the benefit of the auction revenue received from the sale of those CRRs..

4 **V. SUMMARY**

5 **Q. PLEASE SUMMARIZE YOUR FINDINGS.**

6 A. Auction of CRRs and the distribution of auction proceeds to QSEs on a load ratio
7 share basis as proposed in the Nodal Protocols is not in the public interest because
8 there is an alternative available that will lead to a more efficient wholesale market
9 outcomes, a more reliable transmission network, a lower cost to operate and
10 participate in the short-term wholesale market. This mechanism also increases the
11 likelihood that all LSEs, both the very small and very large ones, benefit from the
12 transition to a LMP market relative to the proposed ARR allocation and CRR auction
13 mechanism. Finally, the proposed simplified direct allocation mechanism facilitates a
14 competitive retail market more than the proposed CRR auction mechanism. The
15 logic underlying these conclusions is discussed in the attached paper..

16 If the Commission decides to proceed with the CRR auction construct as detailed in
17 the Nodal Protocols, the allocation of auction proceeds to QSEs on a load ratio share
18 basis, both zonally and ERCOT-wide, as appropriate, should be established in
19 perpetuity. The directive to have the ERCOT Board review this approach and
20 consider alternative approaches prior to the end of the first three years of the nodal
21 market should be removed from the nodal protocols..

22

1 **Q. DOES THIS CONCLUDE YOUR TESTIMONY?**

2 A. Yes, it does.

3

APPENDIX A

Professional Qualifications of Frank A. Wolak

Work Address:
Department of Economics
Stanford University
Stanford, CA 94305
Phone: 650-723-3944
FAX: 650-725-5702

Home Address:
951 Shauna Lane
Palo Alto, CA 94306
Phone: 650-856-0109
Internet Address: wolak@zia.stanford.edu
Homepage: <http://www.stanford.edu/~wolak>

Work Experience

September 1986 to Present

Professor, Department of Economics, Stanford University.

September 1989 to September 1990

National Fellow, Hoover Institution, Stanford University

June 1985 to August 1986

Postdoctoral Research Fellow, Department of Economics, Harvard University.

June 1980 to September 1981

Visiting Staff Member, Los Alamos National Laboratory, Economics Group, Los Alamos, NM.

Research Interests

Industrial Organization, Regulatory Economics, Econometrics, and Health Economics.

Teaching Interests

Empirical Industrial Organization, Regulatory Economics, Econometric Theory

Professional Awards and Honors

Chairman, Market Surveillance Committee, California Electricity Industry Independent
System Operator, April 1998-

Invited Lecture, World Congress of Econometric Society, Seattle, 2000

Invited Lecture, Econometric Society European Meetings, Toulouse, France, 1997

Research Associate, National Bureau of Economic Research, 1993-

Allen V. Cox Medal, 1991. Awarded annually to the Stanford University faculty member who has
established a record of excellence directing undergraduate research over a number of years.

Faculty Research Fellow, National Bureau of Economic Research, 1991-1993

Presidential Young Investigator Award, National Science Foundation, 1990-1995

National Fellow, Hoover Institution, Stanford, CA, 1989-1990.

E.B. Earhart Foundation Graduate Fellowship, Harvard University, 1982-1984.

Education

June 1985, Ph.D., Economics, Harvard University, Cambridge, MA.

June 1984, S.M., Applied Mathematics, Harvard University, Cambridge, MA.

August 1980, M.A., Economics, University of New Mexico, Albuquerque, NM.

May 1979, B.A., Economics, Rice University, Houston, TX.

Frank Anthony Wolak

Market Surveillance Committee Reports/Opinions

(available from <http://www.caiso.com/docs/2000/09/14/200009141610025714.html>)

"ISO Market Surveillance Committee Opinion on Firm Transmission Rights Proposals," May 22, 1998

"Preliminary Report on the Operation of the Ancillary Services Markets of the California Independent System Operator (ISO)," August 19, 1998.

"Report on the Redesign of the Markets for Ancillary Services and Real-Time Energy," March 25, 1999.

"Reliability Must-Run Contracts for the California Electricity Market," April 2, 1999.

"Report on the Redesign of the California Real-Time Energy and Ancillary Services Markets," October 18, 1999.

"The Competitiveness of the California Energy and Ancillary Services Markets," March 9, 2000.

"Comments on 'Comprehensive Congestion Management Reform--Zonal-Forward Market--White Paper' by California ISO," April 24, 2000.

"Opinion on the California ISO's Proposal for Interim Locational Market Power Mitigation ('Interim LMPM')," June 13, 2000.

"Recent Events in the California Electricity Industry and the Level of Price Caps on the ISO's Energy and Ancillary Services Markets," July 6, 2000.

"Market Surveillance Committee Opinion on the ISO's Proposal For Congestion Management Reform," July 31, 2000.

"Designing the Market for Local Reliability Service," August 3, 2000.

"An Analysis of the June 2000 Price Spikes in the California ISO's Energy and Ancillary Services Markets," September 6, 2000.

"Long-Term Price Cap Policy," September 20, 2000.

"Analysis of 'Order Proposing Remedies for California Wholesale Electric Markets (Issued November 1, 2000)'" December 1, 2000.

"Proposed Market Monitoring and Mitigation Plan for California Electricity Market," February 6, 2001.

"Comments on 'Staff Recommendation for Market Prospective Market Monitoring and Mitigation for California Wholesale Electricity Market,'" March 22, 2001.

Frank Anthony Wolak

Market Surveillance Committee Reports/Opinions

(available from <http://www.caiso.com/docs/2000/09/14/200009141610025714.html>)

- “Comments on ‘Market Design 2002 Project: Preliminary Draft Comprehensive Design Proposal’,” February 20, 2002.
- “Comments of the Market Surveillance Committee of the California ISO on the Proposed October 1, 2002 Market Power Mitigation Measures,” April 22, 2002
- “Supplementary Comments on the 2002 Market Design Proposal of the California ISO,” May 16, 2002
- “Opinion on Oversight and Investigation Review,” July 22, 2002
- “Comments on Mitigating Local Market Power and Interim Measures For Intra-Zonal Congestion Management,” September 10, 2002
- “Comments on the London Economics Methodology for Assessing the Benefits of Transmission Expansions,” October 7, 2002
- “Opinion on Scheduling Priority for Balanced Schedules,” May 9, 2003
- “Opinion on the Necessity of Effective Local Market Power Mitigation for a Workably Competitive Wholesale Market,” May 29, 2003
- “Comments on Proposal to Establish a Federal Control Area from Within the California ISO Control Area,” August 7, 2003
- “Letter of Support for Amendment 55 Filing by California ISO” September 4, 2003
- “Opinion on MD02 Single-Step Implementation and LMP Testing,” November 18, 2003
- “Opinion on Large Generator Interconnection Rule,” January 7, 2004
- “Managing Congestion Costs in the Miguel-Imperial Valley Region,” January 13, 2004
- “Opinion on Defining ‘Workable Competition’ with Respect to the Creation of New Zones,” February 19, 2004
- “Designing a Retail Electricity Market That Enhances Wholesale Competition,” Testimony to California Public Utilities Commission for Core/Non-Core Electric Market Structure Options: En Banc Hearing, 4/20/2004.
- “Memorandum on Residual Unit Commitment Process,” April 26, 2004.
- “Comments on the California ISO’s Transmission Expansion Assessment Methodology (TEAM),” June 1, 2004.

Frank Anthony Wolak

Market Surveillance Committee Reports/Opinions

(available from <http://www.caiso.com/docs/2000/09/14/200009141610025714.html>)

“Alternatives to Implementing a Locational Marginal Pricing Market ,” November 16, 2004.

“Opinion on the California ISO’s Proposal for Honoring Existing Transmission Contracts (ETCs) under the Market Redesign and Technology Upgrade (MRTU) ,” November 16, 2004.

“Market Power Mitigation under Locational Marginal Pricing,” November 23, 2004.

“Assessment of An Economic Analysis of the Palo Verde-Devers Line Number 2 (PVD2) Transmission Network Upgrade,” February 22, 2005.

“Opinion on the California ISO’s Market Redesign and Technology Upgrade (MRTU) Conceptual Filing ,” April 26, 2005.

“Adendum to the Opinion on the California ISO’s Market Redesign and Technology Upgrade (MRTU) Conceptual Filing,” May 6, 2005.

“Medium-Term Solution to Clearing Intertie Bids in the Real-Time Energy Market,” June 21, 2005.

“Opinion on Aspects of the California ISO’s Market Redesign and Technology Upgrade (MRTU) Conceptual Filing,” September 26, 2005.

Frank Anthony Wolak

Publications

- Competition in Interregional Taxation: The Case of Western Coal, *Journal of Political Economy*, vol. 91, no. 3, 1983, 443-460 (with C.D. Kolstad).
- Strategy and Market Structure in Western Coal Taxation, *Review of Economics and Statistics*, vol. LXVII, no. 2, 1985, 239-249 (with C.D. Kolstad).
- A Capital-Labor-Energy Model of Fuel Demand in the Manufacturing Sector of Seven Major OECD Countries, *OPEC Review*, vol. X, no. 2, 1986, 179-214. (with C.D. Kolstad, A. Bopp, and R.E. Pendley).
- Conjectural Variation and the Indeterminacy of Duopolistic Equilibria, *Canadian Journal of Economics*, vol. XIX, no. 4, 1986, 656-677 (with C.D. Kolstad).
- An Exact Test for Multiple Equality and Inequality Constraints in the Linear Regression Model, *Journal of the American Statistical Association*, vol. 82, no. 399, 1987, 782-793.
- Duality in Testing Multivariate Hypotheses, *Biometrika*, 1988, vol. 75, no. 3, 611-615.
- Measuring Relative Market Power in the Western U.S. Coal Market Using Shapley Values, *Resources and Energy*, 1988, vol 10, 293-314 (with C.D. Kolstad).
- Testing Inequality Constraints in Linear Econometric Models, *Journal of Econometrics*, 1989, vol. 41, no. 2, 205-236.
- Local and Global Testing of Linear and Nonlinear Inequality Constraints in Nonlinear Econometric Models, *Econometric Theory*, 1989, vol. 5, no. 1, 1-35.
- A Model of Homogeneous Input Demand under Price Uncertainty, *American Economic Review*, June 1991, 514-538 (with C.D. Kolstad).
- The Local Nature of Hypothesis Tests Involving Nonlinear Inequality Constraints, *Econometrica*, July 1991, 981-996.
- The Econometric Implications of Incentive Compatible Regulation, *Advances in Econometrics*, Volume 9, 1991, George F. Rhodes (ed), pp. 159-204 (with J.S. Feinstein).
- The Effect of Domestic Antidumping Law in the Presence of a Foreign Monopolist, *Journal of International Economics*, vol. 32(3/4), 1992, 265-288 (with R.W. Staiger).
- Collusive Pricing with Capacity Constraints in the Presence of Demand Uncertainty, *The Rand Journal of Economics*, Summer 1992, 203-220 (with R.W. Staiger).
- Telecommunications Demand Modeling, *Information Economics and Policy*, 5, 1993, 179-195.
- The Trade Effects of Antidumping Investigations: Theory and Evidence, in *Analytical and Negotiating Issues in the Global Trading System*, Alan W. Deardorff and Robert M. Stern (editors), University of Michigan Press: Ann Arbor, 1994, 231-261 (with R.W. Staiger).

Frank Anthony Wolak

- A Procedure for Estimating the Unconditional HIV Infection Distribution and Its Variability, *The Journal of the Royal Statistical Society, Series C*, 43(4), 1994, 559-624 (with J. W. Hay).
- Measuring Industry-Specific Protection: Antidumping in the United States, *Brookings Papers on Economic Activity, Microeconomics*, 1994, 51-118 (with R.W. Staiger).
- An Econometric Analysis of the Asymmetric Information Regulator-Utility Interaction, *Annales d'Economie et de Statistique*, 34, 1994, 13-69.
- Differences in the Uses and Effects of Antidumping Law Across Import Sources, in *The Political Economy of American Trade Policy*, Anne O. Krueger (editor), University of Chicago Press, 1996, 385-415 (with R.W. Staiger).
- The Effect of Import Source on the Determinants and Impacts of Antidumping Suit Activity, in *The Political Economy of Trade Protection*, Anne O. Krueger (editor), University of Chicago Press, 1996, 85-93 (with R.W. Staiger).
- Why Do Firms Simultaneously Participate in Spot and Contract Markets? Evidence from the United States Steam Coal Market, in *Agricultural Markets: Mechanisms, Failures and Regulation*, David Martimort (editor), North-Holland Publishing Company, 1996, 109-158.
- Can Universal Service Survive in a Competitive Telecommunications Environment? Evidence from the Consumer Expenditure Survey, *Information Economics and Policy*, volume 8(3), 1996, 163-204.
- Industry Structure and Regulation in the England and Wales Electricity Market, in *Pricing and Regulatory Innovation under Increasing Competition*, in Michael Crew (editor), Kluwer Academic Publishers, 1996, 65-90 (with R.H. Patrick).
- The Consumption and Welfare Impacts of Competitive Telecommunications Supply: A Household-Level Analysis, *Brookings Papers of Economic Activity, Microeconomics*, 1997, 269-340.
- Changes in the Household-Level Demand for Postal Delivery Services from 1986 to 1994, in *Managing Change in the Postal and Delivery Industries*, Michael Crew and Paul Kleindorfer (editors), Kluwer Academic Publishers, 1997, 162-191.
- Electronic Substitution in the Household-Level Demand for Postal Delivery Services, *A Communications Conucopia: Markle Foundation Essays on Information Policy*, Roger G. Noll and Monroe E. Price (editors) Brookings Institution Press, 1998, 421-447.
- Price Cap Regulation in Newly Privatized Industries, *Oxford Energy Forum*, August 1998, 12-14.
- Market Design and Price Behavior in Restructured Electricity Markets: An International Comparison, in *Competition Policy in the Asia Pacific Region, EASE Volume 8*, Takatoshi Ito and Anne Krueger (editors) University of Chicago Press, 1999, 79-134.
- An Empirical Analysis of the Impact of Hedge Contracts on Bidding Behavior in a Competitive Electricity Market, *International Economic Journal*, Summer 2000, 1-40.
- Identification and Estimation of Cost Functions Using Observed Bid Data: An Application to Electricity, *Advances in Econometrics: Theory and Applications, Eighth World Congress, Volume II*, Mathias Detwatiripont, Lars Peter Hansen, and Stephen J. Turnovsky (editors), Cambridge University Press, 2003, 133-169.

Frank Anthony Wolak

Measuring Market Inefficiencies in California's Restructured Wholesale Electricity Market, *American Economic Review*, December 2002, 1367-1405 (with Severin Borenstein and James Bushell).

Measuring Unilateral Market Power in Wholesale Electricity Markets: The California Market 1998 to 2000, *American Economic Review*, May 2003, 425-430.

Diagnosing the California Electricity Crisis, *The Electricity Journal*, August/September 2003, 11-37.

Regulating Wholesale Electricity Markets in the Aftermath of the California Crisis, *The Electricity Journal*, August/September 2003, 50-55.

Structural Econometric Modeling: Rationales and Example from Industrial Organization, forthcoming in *Handbook of Econometrics*, forthcoming 2004 (with Peter C. Reiss).

Conference Proceedings

Competitive Interstate Taxation of Western Coal, in Government and Energy Policy, Proceedings of the Fifth Annual North American Meeting of the International Association of Energy Economists, June 9 and 10, 1983, R.L. Itteilag, (editor), 289-303 (with C.D. Kolstad).

Using Shapley Values to Measure Market Power in the Western U.S. Coal Market, in The Changing World Energy Economy, Papers and Proceedings of the Eighth Annual North American Meeting of the International Association of Energy Economists, November 1986, 248-252 (with C.D. Kolstad).

Discussion of Session, Regression Topics: Non-nested Hypothesis Tests, Constrained Estimation and Extrapolation, Proceedings of Business and Economics Statistics Section of the 1987 American Statistical Association Meetings, 1988, 399-401

Electronic Substitution in the Household-Level Demand for Postal Delivery Services, forthcoming, in *Proceedings of the 24th Annual Telecommunications Policy Research Conference*, Gregory Rosston and David Waterman (editors), 1997.

ITC Injury Determination and the Abuse of Antidumping Law: Evidence from the US Manufacturing Industries, in David Orden and Donna Roberts (editors), *Understanding Administered Barriers to Agricultural Trade*, The International Agricultural Trade Research Consortium, January 1997, 227-253 (with R.W. Staiger).

Working Papers (Available at <http://www.stanford.edu/~wolak>)

Strategic Use of Antidumping Law to Enforce Tacit International Collusion, mimeo, August 1993, (with R.W. Staiger).

The Relative Value of Major League Baseball Player Attributes: Evidence from the Baseball Card Market, mimeo, August 1993.

Detecting Misspecified Variance Functions in the Heteroscedastic Regression Models, mimeo, August 1993.

The Impact of Market Rules and Market Structure on the Price Determination Process in the England and Wales Electricity Market, mimeo, February 1996 (with R. H. Patrick).

Frank Anthony Wolak

The Time Series Behavior of Market Prices and Output in the England and Wales Electricity Market, mimeo, October 1996 (with R. H. Patrick).

A Comparison of Methods for Multiprocessing Computing in Econometrics, mimeo, December 1998, (with M. Shum).

Estimating the Customer-Level Demand for Electricity Under Real-Time Market Prices, mimeo, August 1997, (with R.H. Patrick).

Relative Prices, Electronic Substitution and Unobserved Heterogeneity in the Household-Level Demand for Postal Delivery Services, November 1997.

An Equilibrium Model of Multi-Unit Auction Market: The Case of a Competitive Electricity Market, January 1999.

Regulation and the Leverage of Local Market Power in the California Electricity Market, July 1999 (with James Bushnell).

Designing a Competitive Wholesale Market that Benefits Consumers, October 2001

Competition-Enhancing Local Market Power Mitigation in Wholesale Electricity Markets, November 2002

Report on Brazilian Power Sector Reform, January 2003 (with Nils-Hendrik von der Fehr)

Using Environmental Emissions Permit Prices to Raise Electricity Prices: Evidence from the California Electricity Market, March 2003 (with Jonathan Kolstad).

Designing Competitive Wholesale Markets for Latin American Countries, June 2003.

Report on Monitoring Competition in the Central American Electricity Market, March 17, 2004.

International Experience with Electricity Market Monitoring, June 2004

Reforming the Indian Electricity Supply Industry, June 2004

Book Reviews

Review of *Nonlinear Statistical Models* by A.R. Gallant, *Journal of Business and Economics Statistics*, 1988, vol. 6, no. 3, 518-520.

Review of *Regulatory Reform: Economic Analysis and the British Experience*, by Mark Armstrong, Simon Cowan and John Vickers, *Journal of Economic Literature*, 1996, vol 34, no. 4, 1983-1985.

Frank Anthony Wolak

Government Reports

Electric Utility Oil and Gas Use in the Eighties, Los Alamos National Laboratory report LA-9319-MS, Los Alamos, NM (April 1982, with C.D. Kolstad, D.S. Abbey, A.J. Martinez, D.S. Williams, and M.K. Yeaman).

Documentation of the Los Alamos Coal and Utility Modeling System, Version 3.0, Los Alamos National Laboratory report LA-8863-MS, Los Alamos, NM (May 1981, with R.L. Bivins, C.D. Kolstad, and M.L. Stein).

Projecting the Costs of AIDS and ARC in the United States, Final Report for Grant No. HS 06092-01 to the Agency for Health Care Policy and Research, U.S. Department of Health and Human Services, Public Health Service (May 1990, with J.W. Hay and D.H. Osmond).

U.S. Congressional Testimony

Senate Committee on Governmental Affairs, June 13, 2001, On Role of Federal Energy Regulatory Commission in Functioning of California Electricity Market

House Committee on Financial Services, June 20, 2001, On California Energy Crisis and Its Implications for Long-Term Energy Policy

Senate Committee on Commerce, Science and Transportation, May 15, 2002, On Enron's Role in California Energy Crisis

Senate Committee on Government Affairs, November 12, 2002, On the Lessons that Should Be Learned About Regulating Energy Markets from the California Electricity Crisis and the Enron Bankruptcy

Newspaper Opinion/Editorial Pieces

"Will FERC See the Light on the Law?" (Los Angeles Times, 4/30/01).

"Want 10,000 megawatts? Use Variable Power Pricing" (San Jose Mercury News, May 4, 2001).

"FERC Fixes Have Fallen Short" (San Jose Mercury News, June 20, 2001).

"\$9 Billion Rebate Should Be Just the Beginning," (North County Times, July 11, 2001).

"Is Price Gouging Really the Problem?" (San Diego Union Tribune, July 27, 2001) FERC's duty is clear: Order energy refunds for California" (San Jose Mercury News, March 28, 2003)

"Upgrading Power Grid Could Lead to Lower Prices" (San Jose Mercury News, August 28, 2003)

"Why Are California Gasoline Prices So High?" (San Jose Mercury News, April 25, 2004)

Frank Anthony Wolak

Research Grants

Winter 1989 to Spring 1990

Econometric Models of the Regulatory Rate-Setting Process, Center for Economic Policy Research, Stanford University, \$20,000.

Summer 1990 to Spring 1991

Regulation of Water Delivery in California, Stanford University Office of Technology Licensing Research Incentive Fund, \$20,750.

Summer 1990 to Summer 1991

Empirical Studies of Japanese Industry, CEPR Program on the Japanese Economy, \$17,000.

Summer 1990 to Summer 1996

Empirical Studies of Firm and Industry Behavior, 5-Year Presidential Young Investigator Award, National Science Foundation, \$312,500.

Summer 1993 to Winter 1997

The Trade Effects of Antidumping Investigations, 3-Year National Science Foundation, \$165,000 (with R.W. Staiger).

Summer 1994 to Spring 1996

Studies of Competition and Demand in Telecommunications, Postal Delivery and Cable Television Markets, Markle Foundation, \$75,000.

Summer 1994 to Summer 1996

Measuring the Structure of Consumer Demand for Electricity Using Real-Time Pricing Data from the United Kingdom Electricity Market, Electric Power Research Institute, \$30,000.

Summer 1995 to Summer 1996

A Comparison of Statistical Forecasting Models for Real-Time Electricity Price, Electric Power Research Institute, \$35,000.

Summer 1997 to Summer 2001

Empirical Studies of Regulated Industries, National Science Foundation, 3-Year Grant, National Science Foundation, \$212,612

Autumn 2001 to Summer 2002

Research on California Energy Policy, Energy Foundation, 1-Year Grant, \$65,000.

Summer 2004 to Summer 2006

Empirical Methods for Measuring and Improving Market Performance in Network Industries, 2-Year Grant National Science Foundation, \$121,000

Frank Anthony Wolak

Professional Service

Member, Electric Power Networks Efficiency and Security Panel, National Science Foundation, 2002-03
Member, Economics Panel, National Science Foundation, 1998-2000
Associate Editor, *The Journal of Economic Literature*, 1994-1998
Associate Editor, *Journal of Econometrics*, 1994-2002
Associate Editor, *Journal of Industrial Economics*, 1995-2002
Associate Editor, *Journal of Business and Economic Statistics*, 1995-1998
Program Committee Member, 1995 North American Winter Meeting of the Econometric Society.
Program Committee Member, 1996 American Economic Association Meetings
Program Committee Member, 1997 North American Summer Meeting of the Econometric Society

Departmental and University Service

Session-Organizer, Stanford Institute for Theoretical Economics for Summers of 1994-1996, 1998-2004
Co-Chairman, Junior Faculty Recruiting Committee, 1992, 1997, 2000-2004
Faculty Participant, Economics Department Summer Honors Program, 2000-
Econometric Comprehensive Exam Committee, 1989-
Faculty Participant, Athlete Recruiting for Stanford Athletic Department, 1989-
Associate Director, Center for Economic Policy Research, Stanford University, 1996-1998
Member, Dean's Advisory Committee on Curriculum, 1994-1995
Director of Undergraduate Studies, Department of Economics, September 1994- September 1996
Associate Chair, Department of Economics, September 1993-September 1994
Faculty Member, American Economic Association Summer Minority Program, 1993-1995.
Faculty Participant in Stanford Summer Minority Research Program, 1989-1992.

Graduate Students Supervised (Primary Advisor)

Vivian Ho Hamilton, Ph.D., 1991
Miriam Culjak, Ph.D., 1993
Christopher P. Kilby, Ph.D., 1993
Dana P. Goldman, Ph.D., 1994
Stephen Schmidt, Ph.D., 1994
Paul Liu, Ph.D., 1995
Gregory Crawford, Ph.D., 1997
Christopher Timmons, Ph.D. 1997
Jennifer Chen, Ph.D., 1997
Matthew Shum, Ph.D., 1998
Raphael Thomadsen, Ph.D., 2001
Johannes Van Biesebroeck, Ph.D., 2001
Jun Ishii, Ph.D., 2001
Marshall Jingming Yan, Ph.D., 2001
Faye Steiner, Ph.D., 2001
Ron Borekowski, Ph.D., 2002
Jeremy Fox, Ph.D., 2003
John Romley, Ph.D., 2003
Robert McMillan, Ph.D. 2004
Seung-Hyun Hong, Ph.D., 2005

Graduate Students Supervised (Reader/Advisor)

Frank Anthony Wolak

Sarah J. Lane, Ph.D. , 1988
Craig College, Ph.D., 1989
David Green, Ph.D., 1990
Kuen-Kwan Ryu, Ph.D., 1990
Joel Waldfogel, Ph.D., 1990
Jeffrey Sundberg, Ph.D., 1991
Walter Garcia-Fontes, Ph.D., 1992
Penny Goldberg, Ph.D., 1992
Ng Hock Guan, Ph.D., 1992
Hilary W. Hoynes, Ph.D., 1992
J. Bradford Jenson, Ph.D., 1992
William H. Lehr, Ph.D., 1992
Susan Smart, Ph.D., 1992
Lisa Takeyama, Ph.D., 1992
Michael Cragg, Ph.D., 1993
Mario Epelbaum, Ph.D., 1993
Bernd Fitzenberger, Ph.D., 1993
Young Sun Ghauh, Ph.D., 1993.
Fumihito Goto, Ph.D., 1993
Barton H. Hamilton, Ph.D., 1993
Giovanni Maggi, Ph.D., 1994
Thomas N. Hubbard, Ph.D., 1995
Dongseok Kim, Ph.D., 1995
Scott Stern, Ph.D., 1995
Janusz Mrozek, Ph.D., 1996
Hoon Sahib, Soh, Ph.D., 1996
Harumi Ito, Ph.D., 1997
Jason S. Scott, Ph.D., 1997
Andrea Breuhan, Ph.D. 1997
William Vogt, Ph.D. 1998
Michael Mazzeo, Ph.D., 1998
David Mancuso, Ph.D., 1999
Cristian Santesteban, Ph.D., 2000
Koshy Mathai, Ph.D. 2002