UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Calpine Corporation, Dynegy Inc., Eastern Generation, LLC, Homer City Generation, L.P., NRG Power Marketing LLC, GenOn Energy Management, LLC, Carroll County Energy LLC, C.P. Crane LLC, Essential Power, LLC, Essential Power OPP, LLC, Essential Power Rock Springs, LLC, Lakewood Cogeneration, L.P., GDF SUEZ Energy Marketing NA, Inc., Oregon Clean Energy, LLC and Panda Power Generation Infrastructure Fund, LLC,	)	**Docket No. EL16-49-000**
Movants,	)	
v.	)	
PJM Interconnection, L.L.C.,	)	
Respondent.	)	

DECLARATION OF ROBERT WILLIG

TABLE OF CONTENTS

I. QUALIFICATIONS, ASSIGNMENT AND SUMMARY OF CONCLUSIONS

A. QUALIFICATIONS

1. My name is Robert D. Willig. I am Professor of Economics and Public Affairs Emeritus at the Woodrow Wilson School of Public and International Affairs and the Economics Department of Princeton University. There I served for many years as the Field Coordinator for Economics at the Woodrow Wilson School and as the Faculty Chair of the Masters Program in Public Affairs. Before joining the senior faculty of Princeton University in 1978, I was Supervisor in the Economics Research Department of Bell Laboratories. My teaching and research have specialized in the fields of industrial organization, government-business relations, and social-welfare theory.

2. I served as Deputy Assistant Attorney General for Economics in the Antitrust Division of the U.S. Department of Justice from 1989 to 1991. I also served on the Defense Science Board task force on the antitrust aspects of defense industry consolidation and on the Governor of New Jersey's task force on the market pricing of electricity.

3. I am the author of *Welfare Analysis of Policies Affecting Prices and Products*, *Contestable Markets and the Theory of Industry Structure* (with William Baumol and John Panzar), and numerous articles in the professional literature of economics and law. I am a co-editor of *The Handbook of Industrial Organization*, and have served on the editorial boards of the *American Economic Review*, the *Journal of Industrial Economics* and the MIT Press Series on regulation. I am also an elected Fellow of the Econometric Society.

4. I have performed applied research and have developed expertise on market structure, competitive conduct, contractual relations, optimal pricing, micro-economic reforms, and the architecture and practice of infrastructure regulation. I have been a consultant to firms in many sectors of the economy, including telecommunications, transportation, energy, health care, pharmaceuticals, aeronautics, automobiles, information technology, chemicals, consumer products, and financial markets.

5. I have researched, taught, consulted, and testified on antitrust issues including horizontal mergers, vertical mergers, allegedly monopolizing conduct and allegedly collusive conduct in a host of industries. I have researched, taught, consulted, and testified on regulatory issues including

pricing, access, vertical and horizontal firm structure and the roles of governments and markets in the energy, telecommunications, and transportation industries.

6. I have worked as a consultant with the Federal Trade Commission, the Organization for Economic Cooperation and Development, the Inter-American Development Bank, the World Bank, and various private clients. I serve as a senior consultant to Compass Lexecon, an economic consulting firm that I helped to found. A list of my articles, books, and other professional publications and activities is presented in my curriculum vitae (Attachment A).

B. BACKGROUND AND PURPOSE OF TESTIMONY

7. On December 7, 2016 the Illinois legislature passed comprehensive energy legislation[1] intended to ensure that Illinois remains on track to meet its environmental goals by continued and increased reliance on zero emission electric generation resources (hereinafter "Zero Emissions Standard" or "ZES").[2] Among the legislative goals encompassed in the ZES is "[p]reserving existing zero emission energy generation and promoting new zero emission energy generation," which "is vital to placing the State on a glide path to achieving its environmental goals and ensuring that air quality in Illinois continues to improve."[3] The program's means of accomplishing this goal is to compensate nuclear generators that might otherwise retire for the environmental attributes of their production.

8. To compensate certain Illinois nuclear generation units for the social benefits of their zero carbon dioxide emissions generation – that would be lost if these units retired – the ZES calls for the creation of Zero Emission Credits ("ZECs"). The value of a ZEC is based on the U.S. government's estimated social cost of carbon emissions, which is not currently reflected in wholesale-power market prices. Under the ZES, the Illinois Power Agency ("IPA") must develop a zero-emission standard procurement plan and procure contracts for ZECs from facilities capable of generating zero-emissions credits cost-effectively in an amount equal to 16% of the electricity delivered by Illinois electric utilities with more than 100,000 customers in calendar year 2014.[4]

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[1] Illinois SB 2814 (available at http://www.ilga.gov/legislation/99/SB/PDF/09900SB2814enr.pdf) ("SB 2814").

[2] SB 2814 at Section 1.

[3] Id.

[4] SB 2814 at (d-5) Zero emission standard (1).

Facilities will be selected to provide ZECs based on a public interest standard that includes, among other things, minimizing carbon dioxide, sulfur dioxide, nitrogen oxide, and particulate emissions that adversely impact Illinois citizens.[5]

9. In response to the ZES, the Electric Power Supply Association ("EPSA") and Indicated Complainants[6] (collectively "Movants") filed a motion to amend, and amendment to a March 21, 2016 Complaint[7] pending in an open Federal Energy Regulatory Commission ("FERC" or "Commission") docket.[8] In the March 2016 Complaint proceeding, the complainants sought buyer-side market power mitigation in association with electric utility ratepayer-funded cost-of-service power purchase agreements ("PPAs") approved by the Public Utility Commission of Ohio ("PUCO") for existing generating units owned by American Electric Power Company, Inc. ("AEP") and FirstEnergy Corporation ("FirstEnergy").[9]

10. In particular, the March 2016 Complaint, now amended by Movants, was filed in response to efforts by AEP's and FirstEnergy's state-regulated utilities in Ohio to put in place long-term, inter-affiliate PPAs that would have transferred the control of over 6,000 MW of potentially uneconomic electric generating capacity from AEP and FirstEnergy merchant generation affiliates to AEP's and FirstEnergy's state-regulated utilities in Ohio.[10] In association with the transfer of control of these electric generation resources, AEP's and FirstEnergy's state-regulated utilities in Ohio would assume the financial risks of these generating units' operations by committing to compensate AEP's and FirstEnergy's merchant generation companies for all current and future costs incurred to operate and maintain the PPA generating units.[11] These costs (then identified as

[5] SB 2814 at (d-5) Zero emission standard (1)(C).

[6] Indicated Complainants include all of the existing complainants in the above-captioned proceeding except for GDF SUEZ Energy Marketing NA, Inc.

[7] Complaint Requesting Fast Track Processing, Docket No. EL16-49-000 (filed Mar. 21, 2016), (March 2016 Complaint").

[8] Motion to Amend, and Amendment to, Complaint and Request for Expedited Action on Amended Complaint, FERC Docket No. EL16-49-000, 1/9/2017 ("Movants' Amended Complaint").

[9] At the time the March 2016 Complaint was filed, the PPAs had not been approved by the PUCO. The PUCO approved the PPAs in association with stipulations previously filed by AEP and FirstEnergy on March 31, 2016. The AEP Order is available at: http://dis.puc.state.oh.us/TiffToPDf/A1001001A16C31B40932C01840.pdf and the FirstEnergy Order is available at: http://dis.puc.state.oh.us/TiffToPDf/A1001001A16C31B41521H01842.pdf.

[10] March 2016 Complaint at 16-20 and 26-27.

[11] *Id.*

"ongoing carrying costs"), and the costly risk associated with not knowing the future operational and maintenance costs of the generating units, would be passed through to AEP's and FirstEnergy's state-regulated utilities' ratepayers. Thus, the March 2016 Complaint alleges that the PPAs are inappropriate affiliate agreements between AEP's and FirstEnergy's Ohio regulated utilities and their merchant generator subsidiaries that would shift all risk associated with the operation and maintenance of the PPA generating units on to AEP's and FirstEnergy's state-regulated utilities' ratepayers.

11. The March 2016 Complaint also alleges that the proposed AEP and FirstEnergy PPAs would result in the AEP and FirstEnergy state-regulated utilities offering the capacity and energy from the PPA generating units into the PJM wholesale markets.[12] Because the AEP and FirstEnergy state-regulated utilities would seek to maximize the market revenues that could be realized from the PPA generating units whose cost of service they would be obligated to pay, the utilities would be expected to offer the capacity and energy from these generating units into PJM's markets at the lowest price possible.[13] Given the concerns raised by the then-proposed PPAs, the March 2016 Complaint requests that PJM's capacity market buyer-side Minimum Offer Price Rule ("MOPR") be revised to apply to existing generators under certain circumstances.[14] Following the filing of the March 2016 Complaint, the Commission rescinded AEP's and FirstEnergy's waivers of affiliate power-sales restrictions, which resulted in the abandonment of the proposed AEP and FirstEnergy PPAs.[15]

12. The Movants' Amended Complaint asks that the Commission order the same specific revisions to PJM's buyer-side market power mitigation that were requested in the March 2016 Complaint. These revisions would apply a MOPR to generating units that are assumed to be eligible for ZECs under the ZES.[16]

[12] March 2016 Complaint at 24-27.

[13] *Id.*

[14] March 2016 Complaint at 33-38.

[15] *See Electric Power Supply Ass'n v. AEP Generation Res., Inc.*, 155 FERC ¶ 61,102 (2016); *Electric Power Supply Ass'n v. FirstEnergy Sol. Corp.*, 155 FERC ¶ 61,101 (2016).

[16] Movants' Amended Complaint at 16-18.

13. I have been asked by counsel for Exelon to evaluate the impact of the implementation of a ZES on electricity market efficiency and whether the impact of the ZES requires the Commission to impose buyer-side market power mitigation in order to prevent harm to market efficiency.

C. SUMMARY OF FINDINGS AND CONCLUSIONS

14. I have reached the following findings and conclusions:

(a) When environmental externalities are not accounted for in a marketplace, the result is an inefficient allocation of resources. Taxes and subsidies can be designed to minimize the costs to society from negative environmental externalities, or to obtain the benefits of positive environmental externalities.

(b) The ZES provides compensation to nuclear power generation plants that reflects the cost of carbon dioxide emissions that society avoids as a result of the production of electricity from these generation resources. The program is designed to ensure that the estimated monetary benefit to society of the avoided carbon dioxide emissions is always greater than the amount paid to nuclear power plants to avoid those emissions. The economic rationale for the ZES is grounded in the field of welfare economics, which addresses the social benefits associated with eliminating a negative externality or facilitating a positive externality.

(c) Compensating nuclear generation for its zero emissions attributes is a move toward greater economic efficiency, as compared to compensating the environmental attributes of only renewable generators. Preserving existing nuclear generation by compensating it for its positive environmental externalities is more socially beneficial than allowing it to retire. Moreover, if the cost of preserving existing nuclear generation is less than the cost of building new renewables to replace that generation, then preserving nuclear generation is a more efficient method of abating carbon emissions than subsidizing construction of new renewable generation. By offering appropriate environmental attribute payments, the ZES complements the workings of competitive wholesale electricity markets and ensures that there will be incentives to preserve existing nuclear generation if it is socially efficient to do so, taking both externalities and private production costs into account.

(d) Under the ZES the IPA must consider the financial viability of existing nuclear generation resources when determining what facilities will be the winners of contracts to provide ZECs. It is economically efficient and appropriate in such circumstances to target a narrowly-focused subsidy where it will have a direct impact and achieve the desired result of reducing harmful environmental externalities in a cost-effective manner.

(e) The Commission approves buyer-side market power mitigation in centralized wholesale capacity markets in order to prevent the successful bidding of uneconomic capacity resources that are brought to market to suppress capacity-market prices. There are a number of reasons why the ZES is not an exercise of buyer market power and the recipients of ZEC payments should not be subject to buyer-side market power mitigation.

(f) First, the ZES is clearly not an exercise of buyer market power because the estimated benefits of the program exceed the costs without any consideration of the impact the program may otherwise have on market prices. The cost of a ZEC and its financial benefit to its recipient are based on the value of the externality being addressed – the social cost of the abated carbon dioxide emissions. According to the program design, the value of the ZEC cannot rise above the cost of this externality. This ensures that the receipt of the ZECs does not result in participating nuclear plants making economically inefficient decisions about whether or not to continue operating. If the sum of market revenues and the value of the abated externality exceeds the costs of production, then production is socially worthwhile, and is privately compensatory as well due to the ZEC. This alignment of private and social incentives to produce power from the participating nuclear units is the core economically beneficial characteristic of the ZES. In an exercise of buyer-side market power, by contrast, there is no alignment of social value and private incentives; instead, the exercise of market power is based on the buyer's private incentive to transfer value from other producers to itself by suppressing market prices, even if the added supply that suppresses prices is socially inefficient.

(g) Second, the ZES does not insulate the participating nuclear generation unit owners from market risk or guarantee financially viable operations. Under the ZES, the generating units could fail to produce and/or be retired in the event of significant unforeseen costs and/or operational problems. If the externality benefits of production, as reflected by the ZECs, are insufficient to close the gap between the expected private costs of production and the expected revenues derived from the market sales of production, then production from the participating units will not be compensatory. A program designed to exercise buyer-side market power, by contrast, would provide sufficient compensation to guarantee future plant operations even if the plants' operation were economically inefficient.

(h) Third, the ZES does not require a unit to bid into the wholesale energy or capacity market, or clear in the wholesale capacity market. The ZES provides narrowly defined compensation associated with plant production, not sale of energy or capacity. By contrast, efforts to exercise buyer market power ordinarily, so as to warrant mitigation, would require bidding and clearing as a condition for compensation, in order to ensure that compensation is paid only if prices are suppressed through direct market participation. As such, the ZES complements FERC's competitive market policies and does not directly interfere with FERC's market pricing mechanisms.

(i) A program intended to exercise market power would be structured differently without incentives so closely linked to emissions-reducing production. Compensation intended to support generation for the suppression of market prices would not be limited, as is compensation under the ZES, to the social benefits of the averted carbon emissions. Instead, the exercise of buyer-side market power would motivate compensation up to the size of the buyers' financial gains from the lowered prices.

(j) Finally, the absence of the internalization of the social cost of carbon emissions in market prices creates the appearance that financially challenged nuclear units are not efficiently competitive. In fact, these units are economically efficient and their continued presence in the market, if justified under the ZES, should be viewed as

pro-competitive when considering the benefit to society of their zero carbon emissions attributes.

15. It is imperative that the ZEC recipients be allowed to bid into the organized electricity markets without the constraints of mitigation. The ZECs must be permitted to offset production costs in the determination of their recipients' market bids because the ZECs compensate real social benefits of the units' production that avert the social costs of the negative environmental externality. Socially efficient production by the recipients will only occur if that production is privately compensatory. And production will be privately compensatory only if the revenues from the ZECs can be given full consideration as cost offsets. The imposition of a regulatory floor on the recipients' bidding would prevent the full consideration of the ZECs as cost offsets and would thus permit the continued occurrence of unnecessary and inefficient environmental externality harms.

16. In the following sections of my affidavit I first review the economics of environmental externalities. I then provide an overview of the ZES and explain how it compensates units for the currently uncompensated positive externalities of continued generation by certain nuclear plants. Finally I analyze the Commission's buyer-side market power rules and explain why there is no reason to apply these rules to nuclear generating units eligible for ZEC payments.

II. THE ECONOMICS OF ENVIRONMENTAL EXTERNALITIES

17. The generation of electricity causes environmental externalities to different degrees depending on the generation technology and the fuel type. In particular, all electric generation resource technologies that consume fossil fuels in the production of electricity emit pollutants into the environment.[17] The degree to which an electric generation production process emits pollutants depends on the type of fossil fuel consumed (i.e., coal, oil, gas, etc.) and the efficiency of the fuel to electricity conversion technology employed by the electric generation unit. Electric generation resource pollutants impact air, water, and land. As a result, electric generation units have been the subject of extensive federal and state environmental regulation for decades. While fossil fuel generation creates pollution, zero-emission generation resources that displace these polluting

[17] Other electric generation resources impact the environment as well, although not with the same type of direct impact that result from fossil fuel resources.

generators yield positive externalities by reducing the pollution that would have otherwise occurred.

18. Various federal and state programs directly regulate the impact of electric generation units on air quality. One of the most well-known examples of air pollution regulation is a "cap and trade" air emission control policy. The U.S. Environmental Protection Agency has relied on a federal cap and trade policy to control emissions of sulfur dioxide and nitrogen oxides from electric power generation units for decades. More recently, California and the Northeastern and Eastern Mid-Atlantic States have relied on the same type of regulatory policy for control of carbon dioxide emissions.

19. In the U.S., there is not a uniform federal regulatory policy that controls the costs imposed on society by emissions of carbon dioxide through cap and trade programs. Instead, there are numerous federal and state programs that promote investment in resources with zero carbon dioxide emissions, either with forms of subsidy or with regulatory requirements.[18] Such programs include renewable-resource production and investment tax credits, and a variety of renewable portfolio-standard programs, by just over half the states, that require investment in zero emission resources.[19]

20. Programs to limit the negative externalities from carbon dioxide emissions are needed to complement otherwise socially efficient electricity market mechanisms. The Commission's capacity and energy wholesale markets are not currently designed to induce suppliers to account in their decisions for the social externality costs of carbon emissions that result from generation. Instead, the Commission has left environmental regulation to other federal agencies and state governments, and these other federal and state programs influence the decisions of participants in the Commission's markets so as to promote environmental goals. As a result, even as our wholesale markets are designed to stimulate and harness competition to yield an efficient allocation of resources, market outcomes would predictably be socially inefficient in the absence of complementary environmental programs adopted by other regulators. Markets would result in the emission of too much carbon dioxide, creating corresponding social externality costs.

[18] *See, generally*, NC Clean Energy Technology Center, Database of State Incentives for Renewables & Efficiency, available at: http://www.dsireusa.org/.

[19] *Id.*

Complementary programs, whether implemented at the state or federal level, can align suppliers' market-based decision making with social efficiency by taking environmental externalities into account, without undermining the design and effectiveness of our competitive wholesale markets. Such programs can result in better outcomes for society, without conflicting with the policy goals or operations of competitive wholesale markets.

21. In the following sections I define and provide examples of externalities. I then explain how economists analyze the impact of externalities and identify policies, including taxes and subsidies, that can be adopted to complement markets and correct for the impact of externalities.

A. EXTERNALITIES

22. Basic economics defines an externality as the effect of an individual's action on a bystander that is not taken into account by the individual undertaking the action.[20] Common examples of negative externalities are air and water pollution that reduce other individuals' welfare, but the associated costs to others are not accounted for by the individual polluter when deciding whether and how much to pollute.[21] Obversely, positive externalities arise when an individual's activity improves the welfare of others, but the individual does not account for these benefits when deciding whether and how much to engage in the beneficial activity.

23. Stated more formally, externalities exist when the private benefits or costs of actions are not equal to the social benefits or costs. The first formal analysis of the impact of externalities was provided by Arthur C. Pigou, who demonstrated that when marginal social costs or benefits diverge from private marginal costs or benefits, the market outcome is unlikely to be efficient.[22] Pigou showed that a tax or subsidy could be used to internalize the negative or positive externality so that it would be taken into account by market participants and correct for the market inefficiency that would otherwise result.

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[20] *See, e.g.*, Samuelson, P. A. and Nordhaus, W. D., *Economics*, at 751, McGraw-Hill, Inc., 1995.

[21] Environmental externalities are the classic example found in almost every economics textbook. See, for example, Samuelson, P. A. and Nordhaus, W. D., *Economics*, at 346-355, McGraw-Hill, Inc., 1995 and Pindyck, R. S. and Rubinfeld, D. L., *Microeconomics*, Second Edition, at 639-657, Macmillan Publishing Company, 1992.

[22] Pigou, A. C. *The Economics of Welfare*, 4th edition, Macmillan and Co., 1932, available at: http://www.econlib.org/library/NPDBooks/Pigou/pgEW.html.

B. CORRECTING FOR THE IMPACT OF EXTERNALITIES

24. Basic economics teaches that externalities can be corrected either through taxing behavior that results in harmful (negative) externalities, or subsidizing behavior that results in beneficial (positive) externalities, including behavior that prevents negative externalities. When seeking to correct for a negative externality, such as carbon dioxide emissions, the ideal theoretical approach is to measure the marginal external cost associated with the externality and compare it to the marginal private benefits net of marginal private costs (i.e., net marginal private benefits) in order to define the cost of the externality that is not being captured by private individuals in their decision making. This idea is illustrated conceptually in Exhibit No. RDW-1. Marginal external cost rises as economic activity increases, while net marginal private benefits decline. Increases in marginal external cost represent the impact of the damage from the amount of atmospheric carbon dioxide on society, expressed monetarily. Decreases in the net marginal private benefit represent the decline in private profitability as production levels increase and produce higher levels of atmospheric carbon dioxide.[23]

25. As Exhibit No. RDW-1 shows, economic activity (production) is assumed to be at an equilibrium without any policy intervention to reflect the externalities where net marginal private benefits equal zero (i.e., marginal cost equals marginal revenue). Here, without market participants internalizing the marginal external cost associated with their activities, the level of actual production (shown as Q_{Actual}) is greater than its optimal level ($Q_{Optimal}$), represented as the intersection of the curves showing marginal external cost associated with the externality and net marginal private benefits. Although the exhibit depicts a stylized framework, there is an ever-increasing body of empirical analysis that estimates a range of values for the social (external) cost of carbon dioxide emissions over an assumed future trajectory of economic activity.[24] By having

[23] This example assumes markets are competitive and that price does not vary with production level, and applies to linear functions. However, this does not limit the conceptual application which also can apply to non-linear functions.

[24] *See, e.g.*, Technical Support Document (2016): Technical Update of Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866 Interagency Working Group on Social Cost of Greenhouse Gases, United States Government, August 2016, available at: https://www.epa.gov/sites/production/files/2016-12/documents/sc_co2_tsd_august_2016.pdf. Note that the values for the social cost of carbon reported in this technical support document are reported after adjusting for expected inflation in the following document: Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard, Order Adopting a Clean Energy Standard, Case Nos. 15-E-0302, et al. (Aug. 1, 2016), Appendix E at 11, ("2016 SCC Estimate") available at http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7b44C5D5B8-14C3-4F32-8399-F5487D6D8FE8%7d.

a measure of the social cost of carbon emissions it is possible to approximate the marginal external cost of activities that emit carbon dioxide and, and through a tax or subsidy, internalize the cost of the negative externality.

26. A classical theoretical approach for internalizing the cost of a negative environmental externality, such as carbon dioxide emissions associated with fossil fuel combustion, is the imposition of a Pigouvian tax.[25] The objective of a Pigouvian tax is to internalize the marginal external cost associated with the externality that is otherwise not accounted for in producers' marginal costs. As such, producers experience higher costs due to the tax, charge higher prices, experience less demand, move away from technologies that create relatively more of the harmful externality, and reduce production to reflect the social cost of the externality.

27. A general tax on carbon emissions has not been the policy action of choice in the U.S. for addressing the social cost of carbon, for many complex and practical reasons.[26] For example, if Illinois had sought to impose a tax on electric generation resources that emit carbon dioxide, it would have encountered difficulties designing the tax so as to ensure carbon dioxide reduction. Most prominent among these difficulties would be leakage, wherein high-emitting in-state resources impacted by the tax shift their facilities out-of-state, and reshuffling, wherein high emitting out-of-state resources not impacted by the tax in adjacent geographic regions substitute for taxed in-state generation resources. Experiences to date in California and RGGI make clear the complexity that would be faced by a small geographic region considering the use of a tax policy to reduce carbon dioxide.[27] The use of a targeted subsidy—such as the payment of environmental

[25] Baumol, W. J. and Oates, W. E., *The theory of environmental policy*, Second Edition, Chapter 3, Cambridge University Press, 1995.

[26] Although the carbon dioxide cap and trade programs in certain parts of the U.S. do seek to internalize the externality, the resulting cost per ton of carbon emissions under these programs has been lower than the estimated social cost of carbon.

[27] *See*, *e.g.*, Bushnell, J., Peterman, C., and Wolfram, C., Local Solutions to Global Problems: Climate Change Policies and Regulatory Jurisdiction, *Review of Environmental Economics and Policy*, volume 2, issue 2, summer 2008 at 175-176. Note also when California implemented its carbon emissions cap and trade policy it struggled with complex issues associated with trying to accommodate what would be considered acceptable resource shuffling (See State of California Air Resources Board, California Cap-and-Trade Program, Resolution 12-51, October 18, 2012, Appendix A). Similarly, emissions leakage continues to be an important issue for the RGGI program with ongoing studies analyzing the impact (See , Ramseur, J. L., The Regional Greenhouse Gas Initiative: Lessons Learned and Issues for Congress, Congressional Research Service, 7-5700, April 27, 2016 at 16).

attribute credits—simplifies and ensures that the costs incurred will directly reduce carbon dioxide emissions.

28. In the U.S. there has been a mixture of federal tax incentives and state Renewable Portfolio Standards ("RPS") that provide subsidies to zero emission resources. States generally rely on RPS programs to account, in part, for environmental externalities arising from emissions of carbon dioxide. California is a leading example where a cap and trade program and RPS work in combination to reduce emissions of carbon dioxide and provide a less carbon-intensive footprint for the future. In particular, California has determined that "[m]eeting the state's climate change goals by reducing emissions of greenhouse gases associated with electrical generation" is itself justification for the implementation of RPS.[28] Moreover, several other states have evaluated the impact of RPS programs on emissions of carbon dioxide and sought to estimate the costs avoided by reduced emissions.[29] The ZES is in essence one such program, but unlike programs encouraging development of new zero emission resources, the level of compensation is explicitly tied to the externality being abated—namely, the social cost of carbon emissions avoided by the continued operation of existing zero-emission nuclear generation resources. Thus, from the standpoint of economics, the ZES is more efficient than many REC programs, which may allow the REC price to rise to a level far greater than the value of the environmental externalities the renewable resources are abating.

29. Estimates of the social cost of carbon emissions are a theoretically sound basis for incorporating the external cost of carbon emissions into zero-emission resource subsidization policies (both generally and specifically in the case of the ZES). Given that the policy purpose of compensating zero-emission attributes is to avoid the harm that would be caused by otherwise higher emissions of carbon dioxide from more carbon-intensive resources, it is appropriate to base the level of the subsidy on the avoided social cost of carbon dioxide emissions (assuming that the subsidy is paid in accordance with output).

[28] Cal. Pub. Util. Code § 399.11(b).

[29] *See, e.g.*, Heeter, J., Barbose, G., Bird, L., Weaver, S., Flores-Espino, F., Kuskova-Burns, K. and Wiser, R., 2014, A Survey of State-Level Cost and Benefit Estimates of Renewable Portfolio Standards, *National Renewable Energy Laboratory. NREL/TP-6A20-61042(May 2014)* at 52-56. Available at: http://www.res4med.org/uploads/studies/1402067633NREL.pdf.

C. MARKET IMPACT OF CORRECTING EXTERNALITIES

30. Correcting for externalities – whether via appropriate taxes or subsidies – is likely to affect prices and the mix of resources in the market. However, economic theory teaches that such taxes and subsidies are complementary to the ordinary workings of competitive markets, and help to guide private economic supply and demand decisions towards socially efficient outcomes that reflect both the underlying positive and negative externalities, along with the privately experienced costs of production and benefits of consuming the production's outputs. The impacts of Pigouvian taxes or subsidies on the outcomes of competitive markets improve social welfare by internalizing to the private decision-makers the costs of negative externalities through the tax and the benefits of positive externalities through the subsidy, thus ensuring that the private decision-makers take the externalities into account and adjust accordingly.

31. It is possible to design a subsidy to encourage production from resources whose generation does not impose negative externalities. For example, consider a program that offers subsidies to production to prevent harmful environmental externalities, where the per-unit subsidy is equated to the social (external) cost of the negative externality that the unit of production prevents. Such a program does not necessarily guarantee the production. But it does efficiently complement market incentives, so that production will be motivated to occur if the market price of production output plus the unit subsidy exceeds the private cost of production. This motivation is socially efficient since the production is socially worthwhile if its value to its purchaser, which is reflected by the price of its output, plus its value from reducing negative externalities, which is reflected by the unit subsidy, together exceed the cost of production. Without the subsidy program, such socially efficient production would be lost if the output price alone failed to cover the cost of production.

32. By providing zero-emission generators with compensation for the external benefits they provide, the ZES reduces the amount of carbon emissions and improves the social desirability of the market outcome.[30] This is especially the case, where, as with the ZES, the design of the procurement process specifically targets the preservation of zero emission resources that might

[30] *See, e.g.*, Case, K. E., Fair R. C., and Oster, S. M., *Principles of Microeconomics*, Ninth Edition, Prentice Hall, 2009 at 327 noting that "[a]ctivities that provide such external social benefits may be subsidized at the margin to give decision makers an incentive to consider them."

otherwise exit the marketplace. These nuclear resources' current production significantly reduces negative environmental externalities associated with the generation of electricity, to the extent that this production replaces output by carbon-emitting generators. Since the level of the proposed environmental attribute payments corresponds closely to the social value of reduced carbon dioxide emissions, the total direct costs of those payments are aligned with the benefits realized by society.[31]

33. Moreover, it is not a socially inefficient outcome if compensating nuclear units for their environmental attributes results in lower production from, or retirement of, polluting resources. Aligning private incentives with social welfare, whether through a tax or subsidy, will shift the market's generation resource mix as resources that impose environmental costs on society through their carbon emissions will face reduced production levels and reduced net revenues.

34. Compensating nuclear generators for their zero emissions attributes is a move toward greater efficiency relative to compensating only new renewable resources going forward. This is because preserving existing nuclear generation may very well be more socially cost effective than allowing its retirement, in view of its positive externalities, and it may be a more efficient method of abating carbon emissions than subsidizing new renewable construction. By offering appropriate subsidies, the ZES complements and supports the workings of competitive wholesale markets so that there will be incentives to preserve existing nuclear generation only if doing so is socially efficient, taking externalities and private production costs into account.

35. Finally, and critically, the ZES is entirely consistent with the Commission's policy of reliance on competitive markets. The ZES complements the FERC-approved markets by providing compensation for environmental attributes that is directly and explicitly based on environmental externalities that FERC has left other regulators to address. These programs work in tandem with FERC-approved market mechanisms to produce outcomes that are more socially

[31] The value of a ZEC adopted by the ZES of $16.50/MWh until June 1, 2023 (increasing thereafter $1/MWh each year for the final four years of a ZEC contract term) corresponds to a carbon dioxide emission rate of 800 lbs/MWh (.40 tons CO_2/MWh * $41.40/ton CO_2 (from 2016 SCC Estimate for the year 2017) ~ $16.50/MWh). This value is approximately 20% lower than the 2015 PJM-wide average carbon dioxide emission rate of 1,014 lbs/MWh (See, PJM 2012-2015 CO2, SO2 and NOX Emission Rates, March 18, 2016, at 4, available at: http://www.pjm.com/~/media/library/reports-notices/special-reports/20160318-2015-emissions-report.ashx).
Moreover, because PJM's average marginal carbon dioxide emission rate (~1,600 lbs/MWh, 2015) is higher than the average carbon dioxide emission rate, the value of a ZEC is set at a level considerably less than the expected avoided social cost of carbon throughout the term of the ZEC contracts.

efficient. If the facilities receiving ZECs are cheaper than fossil-fueled competitors once the value of the environmental externality is taken into account, then the facilities receiving ZEC revenues should run. The ZES represents a narrow, targeted approach to contribute to the objective of complementing FERC's wholesale power markets.

36. In contrast, the previously proposed Maryland and New Jersey new generation-unit subsidization programs resulted in state regulatory agencies directly interfering with prices set in FERC-regulated capacity market auctions. These programs were not attempting to address an environmental externality. However, as I have explained before, a program that subsidizes a generation technology based on its environmental attributes is "just another element of compensation for the benefits that the state feels that generator is bringing to the population through the environmental impact. So it doesn't displace, it influences, but it doesn't displace the market mechanism."[32]

III. THE ZERO EMISSIONS STANDARD

37. The ZES is an effort to correct for the increase in the harmful environmental negative externalities of fossil fuel generation by providing environmental attribute payments to zero-emission generation that might otherwise retire. As the ZES states, "a zero emission standard, [] will increase the State's reliance on zero emission energy through the procurement of zero emission credits from zero emission facilities, in order to achieve the State's environmental objectives and reduce the adverse impact of emitted air pollutants on the health and welfare of the State's citizens."[33]

38. The implementation of the zero emission standard requires that the IPA procure on an annual basis for 10 years beginning June 1, 2017 a quantity of ZECs defined as 16% of the actual amount of electricity delivered by Illinois electric utilities with more than 100,000 customers during calendar year 2014.[34] The IPA is charged with developing and implementing a ZEC procurement plan that will include a solicitation process to select nuclear facilities that will be

[32] Testimony of Robert D. Willig, In the United States District Court for the District of Maryland Northern Division, Case No. MJG-12-1286, March 8th, 2013 at 81.

[33] SB 2814 at Section 1.

[34] SB 2814 at (d-5) Zero emission standard.

awarded ZEC supply contracts.[35] Under the solicitation process, the selection of winning ZEC supplier offers must be based on public interest criteria which include minimizing emissions of pollutants from other carbon-based electricity sources and accounting for incremental environmental benefits that include the preservation of zero-emission resources.[36] Once the procurement plan is approved and executed, the ICC must review and accept the results and explain how the results comply with the procurement plan's bid review criteria.[37]

39. To participate in the ZEC solicitation process, zero emission facilities must meet eligibility criteria. These criteria include provision of information on the remaining useful life of a facility, historical and estimated future production, and annual facility cost projections for 6 delivery years, as well as a commitment to continue operating for the duration of the executed contract(s).[38] However, in the event a generation unit ceases operation as a result of an unexpected increase in capital cost, or other unforeseen operational problems that result in the need for increased capital cost expenditures, prior to the completion of the 10-year contract term, ZEC purchases will be terminated.[39]

40. The program is designed to ensure that compensation for the environmental attributes of the nuclear facilities that are awarded ZEC contracts, to stimulate the positive externalities created by the displacement of socially harmful carbon emissions, does not exceed the estimated cost to society associated with the displaced carbon emissions. In particular, under the ZES, the value of the attribute payments is defined based upon the Social Cost of Carbon as reported by the United States Interagency Working Group ("USIWG") in effect at the time of the promulgation of the law, converted to $/MWh based upon the emission rates of newer gas-fired generation facilities serving the PJM geographic region.[40] The attribute payments compensate nuclear resource zero-

[35] The ZES sets out a suggested timeline where the IPA would publish its procurement plan 45 days following the effective date of the act, finalize the plan no more than 15 days later, and file the plan for review with the Illinois Commerce Commission ("ICC") by this same later date. However, the IPA and ICC can modify these dates as appropriate. (See SB 2814 at (d-5) Zero emission standard (1) (C) and (C-5)).

[36] SB 2814 at (d-5) Zero emission standard (1) (C).

[37] SB 2814 at (d-5) Zero emission standard (1) (C-5).

[38] SB 2814 at (d-5) Zero emission standard (1) (A).

[39] SB 2814 at (d-5) Zero emission standard (1) (E).

[40] The ZEC value corresponds to a carbon dioxide emission rate of 800 lbs/MWh, which is roughly the emission rate of a new gas-fired combined cycle. For example, a new-gas fired combined cycle plant with a heat rate of 7 MMBTU/MWH would emit 819 lbsCO2/MWH (7 MMBTU/MWH* 117 lbs CO2/MMBTU gas). For carbon dioxide

emission generation for the value of its environmental attributes, for which the FERC regulated markets do not attempt to compensate (instead leaving other regulators with the task of addressing environmental externalities). As noted above, the value of the environmental attributes is in reality significantly higher than the maximum ZEC value, because PJM's average emissions rate is higher than the emission rate of a newer gas-fired generation facility, and its marginal emissions rate is higher still. Thus, the avoided environmental externalities that would otherwise be borne by society if the nuclear units were to shut down would be more costly than the ZEC compensation to sustain the operations of these nuclear generation resources.

41. The value of the ZECs is capped in two ways to limit Illinois power consumers' overall cost burden and ensure that the ZEC value will never be greater than the $16.50/MWh established under the ZES. First, the total cost of the ZECs cannot exceed an amount for each delivery year that would cause retail electric utility customers to pay more than 1.65% of the amount paid per kilowatt-hour during the year ending 2009.[41] Second, if the weighted average of PJM and MISO capacity prices plus forecast energy prices in Northern Illinois are projected to rise above a baseline level of $31.40/MWh, the ZEC value ($16.50/MWh) will decline commensurately.[42]

IV. APPLYING A MOPR TO RESOURCES RECEIVING ZEC REVENUES WOULD BE INAPPROPRIATE

42. The Movants' Amended Complaint asks the Commission to expand PJM's buyer-side market power mitigation to apply it to existing nuclear generation resources that may be eligible for ZECs under the ZES.[43] However, their request fundamentally misconstrues the purpose of the

content emissions from natural gas combustion see, U.S. Energy Information Administration, "How much carbon dioxide is produced per kilowatthour when generating electricity with fossil fuels?" Available at: https://www.eia.gov/tools/faqs/faq.cfm?id=74&t=11. For heat rate of new gas-fired combined cycle plant see "Cost of New Entry Estimates for Combustion Turbine and Combined Cycle Plants in PJM With June 1, 2018 Online Date," The Brattle Group, May 15, 2014, at 16. Available at: http://www.brattle.com/system/publications/pdfs/000/005/010/original/Cost_of_New_Entry_Estimates_for_Combustion_Turbine_and_Combined_Cycle_Plants_in_PJM.pdf.

[41] SB 2814 at (d-5) Zero emission standard (2). Based on a reported estimate of the annual value of the ZECs, $214 million (representing an estimate of the cap on retail ratepayer increase included in SB 2814), and the estimated annual number of ZECs, 20.1 million MWh, I estimate that this limitation is likely to limit initial ZEC contract payments to $10-11/MWh (*See* Energy Information Administration Full-Service Provider 2009 average price of 10.39 cents/kwh, available at https://www.eia.gov/electricity/data.cfm#sales; Illinois Commerce Commission, Illinois Electric Utilities, Comparison of Electric Sales Statistics, For Calendar Years 2015 and 2014 (Table 22, 2014 ComEd and AmerenIL sales to retail customers), available at: https://www.icc.illinois.gov/publicutility/salesstatistics.aspx Movants' Amended Complaint at 7).

[42] *Id*. This ZEC payment price cap is applied at the end of the first 6 years of the term of the ZEC contracts.

[43] Movants' Amended Complaint at 16-18.

FERC's reliance on buyer-side market power mitigation (i.e., MOPRs). Moreover, their contention that it would be appropriate to apply a capacity market MOPR in any circumstance where a resource -- new or existing -- receives any form of subsidization would undermine state policies that are validly complementary to, rather than in conflict with, FERC's wholesale market policies.

A. A MOPR PREVENTS THE EXERCISE OF BUYER MARKET POWER

43. The FERC has approved market-power mitigation rules for capacity markets that protect against the potential exercise of buyer market power. Under the PJM Open Access Transmission Tariff, PJM implements FERC-approved buyer market power protection.[44] To guard against buyer market power, PJM applies a MOPR to sellers of new capacity. PJM's buyer market power protection seeks to prevent market buyers from offering new, otherwise uneconomic resources into PJM's capacity auctions at a very low price, or zero, in order to push down monthly spot capacity market prices.[45]

44. The FERC has acknowledged on several occasions that its approval of MOPRs is associated with protecting capacity markets from possible attempts by buyers to introduce new, otherwise uneconomic capacity into a capacity market auction to lower capacity prices enough to compensate the buyer for the additional costs of adding the new uneconomic capacity. As the FERC recently reiterated: "The Commission has approved various buyer-side market power mitigation tariff provisions as just and reasonable mechanisms to mitigate the potential for uneconomic entry and deter the exercise of buyer-side market power. By mitigating actual buyer-side market power, these tariff provisions can help to ensure markets reflect competitive prices and adequate capacity in the short-run and the long-run."[46]

45. The FERC's concern is well founded that the exercise of buyer market power in capacity markets could distort prices away from otherwise competitive levels. When a large buyer intentionally increases supply, and but for its suppression of market prices that supply would be at

[44] PJM Open Access Transmission Tariff, Attachment DD, Section 5.14(h), Effective Date: 6/27/2016 - Docket #: ER16-1520-000, available at: http://www.pjm.com/media/documents/merged-tariffs/oatt.pdf.

[45] The term "uneconomic" refers to new capacity resources that would otherwise be offered at prices that do not clear in the capacity auctions.

[46] *Consolidated Edison Company of New York, Inc.*, 150 FERC ¶ 61,139 (2015) at P 3 (footnote omitted).

a loss even after accounting for externalities, the resulting market prices will not reflect competitive levels at the time of the auction. Such an exercise of market power can be anticompetitive, interfering with the efficient workings and outcomes of otherwise well-functioning markets.

46. For example, Exhibit No. RDW-2 illustrates the effect of introducing 500 MW of new uneconomic capacity into a hypothetical monthly capacity market auction. The exhibit depicts a capacity market auction supply curve with and without the introduction of the new, uneconomic generation capacity.[47] As the exhibit shows, the addition of new capacity shifts the supply curve to the right. The downward sloping demand curve used in capacity markets will intersect the supply curve that is shifted to the right at a lower price than the original supply curve. As a result, the introduction of new, uneconomic capacity will lead to lower prices (all other things equal) for all auction participants. By depressing prices in the capacity auction, the exercise of buyer market power makes the owners of other capacity resources worse off because they receive a lower price for their generation capacity.

47. For the large buyer that committed the new, uneconomic capacity to the auction, the intention is to lower the price paid for all other capacity in order to lower its total capacity costs. For example, assume that in Exhibit No. RDW-2 the large buyer that has purchased uneconomic capacity has a total capacity obligation of 5,000 MW, and that the auction clearing price is $8/kW-month including the addition of the new, uneconomic capacity. Next assume that this buyer paid $10/kW-month for the 500 MW of uneconomic capacity, and $8/kW-month for the remaining 4,500 MW, for a total of $41 million. Had the buyer purchased 5,000 MW at a clearing price of $9/kW-month (the clearing price without the addition of the new, uneconomic supply), its cost would have been $45 million. Thus, by introducing new, uneconomic capacity into the capacity auction the buyer saved $4 million for the month.

48. FERC-approved MOPRs guard against the potential exercise of market power illustrated in Exhibit No. RDW-2. As the acronym implies, the application of a MOPR prevents buyers that bring to market new, otherwise uneconomic resources from offering the resource at an artificially low price, or zero. Instead, the resource must be offered at a price level no less than that defined

[47] For simplicity, Exhibit No. RDW-2 shows the effect of bidding the new generation capacity at a price of $0/kW-Month and also assumes most capacity is offered at a price of 0 for expositional purposes.

in association with what the estimated cost of a similar resource would be absent out-of-market payments. Depending upon the mitigated offer price, the resource may not clear the capacity auction in part, or at all, and the auction price suppression will be reduced from what would have resulted if the capacity resource were allowed to make a price offer significantly lower than the mitigated level.

49. Because mitigating resources can significantly impact the capacity markets, restrain competitive pricing, and interfere with states' legitimate policies, FERC has consistently adhered to the principle that the application of buyer-side market power mitigation should be limited to those instances where there is an incentive and ability to exercise market power by bringing new, otherwise uneconomic capacity resources to the marketplace.

B. THE ZES GENERATION RESOURCES SHOULD NOT BE SUBJECT TO A MOPR

50. Compensating zero emission resources for their environmental attributes using a payment structure like the ZES does not give rise to the buyer market power concerns that justify the application of a MOPR. The ZES is a legitimate environmental program aimed at addressing the externalities of carbon-based power generation, and not an exercise of market power. The ZES clearly explains that "to achieve its environmental goals, Illinois must expand its commitment to zero emission energy generation and value the environmental attributes of zero emission generation that currently falls outside the scope of the existing renewable portfolio standard, including, but not limited to, nuclear power."[48] The Act explains further that the creation of ZECs allows Illinois to "achieve the State's environmental objectives and reduce the adverse impact of emitted air pollutants on the health and welfare of the State's citizens."[49] None of these aims is price suppression.

51. There are a number of objective characteristics of the ZES that bear out Illinois' avowed purpose and distinguish the program from an exercise of buyer market power. First, the cost of a ZEC and its financial benefit to its recipient are based on the social cost of the abated carbon dioxide emissions – which is the value of the externality being addressed – and cannot rise above

[48] SB 2814 at Section 1.

[49] *Id.*

that amount. The cost of a ZEC may decline over time as power market conditions change (see above), and PJM's generation mix becomes cleaner, but it will not increase based on the financial obligations of the generating units. This ensures that nuclear generators will participate in the program and continue producing electricity only if they believe it will be sufficiently compensatory, and it aligns with economic efficiency, taking into account the social cost of the abated carbon emissions. In contrast, buyer-side market power increases the private incentives to build electricity plants beyond the plants' social value by the suppression of market prices caused by the plants' construction.

52. Second, the payment of the ZECs to the nuclear units does not guarantee that the facilities will remain in operation over the 10-year term of the contracts. If the units receiving ZECs do not remain financially viable due to operational or other issues resulting in unexpected capital investment needs, even after their carbon abatement value is accounted for, market forces will impel the units to retire, which would be the socially efficient outcome under those circumstances. Thus, the ZEC payments do not shelter the units from market forces as would a program that sought to guarantee that they would remain operational in order to suppress prices.

53. Third, the ZES does not insulate eligible units from market risk. The generating unit owners still bear the risk of increasing costs and the risk that market prices will fall below levels that prevailed at the time the ZES was approved. The program is designed to align with social efficiency the incentives for the decision to continue operation, inclusive of the impact on emissions.

54. Fourth, the ZES does not require any bid into the wholesale energy or capacity market nor that the unit clear the wholesale capacity market.[50] Thus, if the units fail to clear the capacity market, ZEC payments will still be made, in accordance with actual production, and it is that actual production that has the positive environmental impact of displacing substitute production that creates socially costly emissions. If the ZES sought to exercise buyer market power, it would clearly condition payment on generation unit participation in the capacity market in order most directly to forestall increases in capacity prices.

[50] PJM, however, is likely to require participating nuclear units to make energy and capacity bids in its wholesale markets.

55. Finally, there is no exercise of buyer market power as the benefits of the ZES exceed the costs regardless of any ancillary impact on market prices. The ZES requirement that the procurement of ZECs meets a cost-effectiveness standard ensures that the benefits from the avoided costs of carbon emissions exceed the financial costs of the program.[51] The costs of the ZECs to consumers cannot exceed $16.50/MWh.[52] This ceiling is an under-estimate of the avoided costs of carbon emissions that would result from production that would replace potentially retired nuclear production. It is set conservatively at a level that is approximately 20% lower than that applicable to PJM's recently reported 2015 average system wide emission rate.[53] The value of the ZES to consumers is the benefit it provides through the preservation of zero-emission resources, and the resulting avoidance of carbon-emissions. By contrast, in a typical exercise of buyer-side market power, as illustrated with the example above, it is rewarding for an owner to pay for an uneconomic resource only because of the price-suppression benefits that result.

56. In summary, the features of the ZES indicate that it is not designed to have any particular impact on market prices and that any potential impacts on prices are incidental to the attainment of the environmental goal of the program. As explained above, a program intended to exercise market power would be structured differently, without its incentives so closely linked to emissions-reducing production. A program focused on exercising market power would place its emphasis on providing long-term plant financial guarantees and would condition payment on bidding and clearing in wholesale power markets.

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[51] SB 2814 at (d-5) Zero emission standard (C).

[52] Note that this initial value is adjusted upward by $1/MWh each year for the last four years of the ZEC contract term. This adjustment does not alter the conclusion that the benefits will exceed the costs throughout the ZEC contract term. In particular, the estimated social cost of carbon increases each year from 2017-2027 resulting in just over a 50% total increase. The increase in the ZEC cap of $4/MWh over the last four years of the contract term is just under 25%, which less than half the increase in the social cost of carbon. Thus, the ZEC cap will be at a level that does not grow as fast as the social cost of carbon. Moreover, because the ZEC cap is based upon a high efficiency, low emission rate modern gas-fired combined cycle generator, PJM's system wide average and marginal emission rates are substantially above the ZEC cap ensuring that the cost of the ZECs to consumers will be less than the avoided social cost of carbon dioxide emissions (see notes 31 and 40).

[53] As explained above, because the ZEC cap is based on the marginal emission rate of a new gas-fired combined cycle, the PJM system would have to be composed entirely of new gas-fired combined cycles for the ZEC cap to correspond to actual system-wide emissions rates. PJM's currently reported marginal emission rates are considerably higher, as coal fired resources continue to be a large portion of the generation fleet (See, PJM 2012-2015 CO2, SO2 and NOX Emission Rates, March 18, 2016, at 4, available at: http://www.pjm.com/~/media/library/reports-notices/special-reports/20160318-2015-emissions-report.ashx).

57. Application of buyer-side market power mitigation in the absence of anticompetitive concerns would be a serious policy mistake, because it could hamper low bids that are competitive and reflections of truly low costs, where costs include offsets or subsidies based on positive environmental externalities that are not otherwise reflected in market operations. In other words, the absence of the internalization of the social cost of carbon emissions in market prices creates the appearance that financially challenged nuclear units are not efficiently competitive. In fact, these units are economically efficient and their continued presence in the market, if justified under the ZES, should be viewed as pro-competitive when considering the benefit to society of their zero carbon emissions attributes. Thus, generating units receiving environmental credit revenue should not be subjected to a MOPR because the ZEC payment accounts for otherwise unaccounted for environmental attributes.

58. Moreover, if FERC were to apply buyer-side market power mitigation to eligible generating units under the ZES due to assumed impacts on capacity market prices, for consistency FERC would logically need to extend its application of mitigation measures more broadly. FERC would almost certainly find itself evaluating on a case-by-case basis all valid state subsidization programs for all types of resources with environmental as well as possible market-price implications.

59. To the extent the general application of a MOPR to existing units is found to be necessary, revenue received from environmental credits should be considered a cost offset in the development of capacity market bids. Decisions on long-lasting investments in capacity are generally influenced by forward-looking expectations about capacity market revenues. Thus, if applications of MOPRs to existing units disallowed environmental credits as cost offsets, the result would be diminished expectations that future capacity market bids would succeed, thereby discouraging socially efficient investments in capacity with favorable environmental attributes.

C. ELIGIBILITY CRITERIA FOR THE ZES THAT MAY LIMIT IT TO NUCLEAR UNITS AT RISK OF RETIREMENT ENSURES PROGRAM COST EFFECTIVENESS

60. The ZES establishes eligibility criteria for facilities seeking to participate in the ZEC procurement process. Among these criteria is the requirement that a candidate facility submit to

the IPA annual zero emission cost projections over the next 6 delivery years.[54] The ZES also requires that the IPA take into account in its ZEC procurement process "any existing environmental benefits that are preserved by the procurements [] and would cease to exist if the procurements were not held, including the preservation of zero emission facilities.[55] Thus, an important aspect of the ZEC procurement process logically includes an expressed interest in evaluating and considering the expected operating and ongoing maintenance costs of facilities that participate in the ZES. Targeting the payment for ZECs from these facilities that may otherwise be financially challenged and face retirement is a cost effective policy decision that is in the public interest of the State of Illinois.

61. The purpose of a subsidy is to incentivize behavior that would not otherwise take place. Here, the goal of the ZES, together with other statutory changes directed at the Illinois renewable portfolio standard, is to place a value on zero-emissions generation in order to incentivize that generation. The ZES provides for a payment for those nuclear generation facilities that can provide ZECs now at the least cost, for a given quantity, recognizing that a failure to provide the subsidy will result in a loss of zero-emissions generation that cannot be timely replaced. Moreover, under the cost-effectiveness standard of the ZES, the cost of ZECs must compare favorably relative to the costs of additional increments of renewable resources.[56] Finally, as explained above, the cost of the ZECs is limited by the estimated marginal social cost of carbon emissions not otherwise reflected in wholesale power prices already, ensuring that Illinois consumers enjoy positive net benefits from the avoided carbon emissions resulting from the ZES. The ZES eligibility criteria and procurement process appropriately focus on minimizing ZEC expenditures and the value of implementing the program beginning in 2017 to reduce the likelihood of nuclear facility closures.

62. Financially viable nuclear plants do not need attribute payments to continue generating, however. Private incentives are already sufficiently aligned with social welfare for these plants that environmental attribute payments are not necessary to ensure that society continues to receive the benefits. Thus, at this time it is in the public interest to target the ZEC payments to the plants that may be otherwise at risk of retirement. The ZES appropriately focuses on facilities that may

[54] SB 2814 at (d-5) Zero emission standard (1).

[55] SB 2814 at (d-5) Zero emission standard (1)(C).

[56] SB 2814 at (d-5) Zero emission standard (1)(C-5).

face shut-down that would detrimentally impact Illinois consumers by the loss of their zero-emission attributes.

63. While a single uniform tax on carbon emissions, or a single uniform subsidy for production that displaces carbon emissions, would accomplish the needed internalization of externalities and correction of incentives, and would make advance information unnecessary on whether entities would or would not otherwise behave as they would with the tax or subsidy, such a program is not in the offing, perhaps due to its complexities, distributional impacts, and necessary implementation costs. The theoretical benefits of such a program should not be viewed, in its absence, as a valid argument against more practical programs like ZECs, inasmuch as the latter contribute to environmental benefits without causing inefficient interference with well-functioning wholesale markets for electric capacity and energy. The ZES's targeted subsidy design ensures that costs borne by consumers result in a direct reduction of a harmful environmental externality.

64. This completes my declaration.

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Calpine Corporation, Dynegy Inc., Eastern Generation, LLC, Homer City Generation, L.P., NRG Power Marketing LLC, GenOn Energy Management, LLC, Carroll County Energy LLC, C.P. Crane LLC, Essential Power, LLC, Essential Power OPP, LLC, Essential Power Rock Springs, LLC, Lakewood Cogeneration, L.P., GDF SUEZ Energy Marketing NA, Inc., Oregon Clean Energy, LLC and Panda Power Generation Infrastructure Fund, LLC,	)	**Docket No. EL16-49-000**
Movants,	)	
v.	)	
PJM Interconnection, L.L.C.,	)	
Respondent.	)	

DECLARATION OF ROBERT D. WILLIG

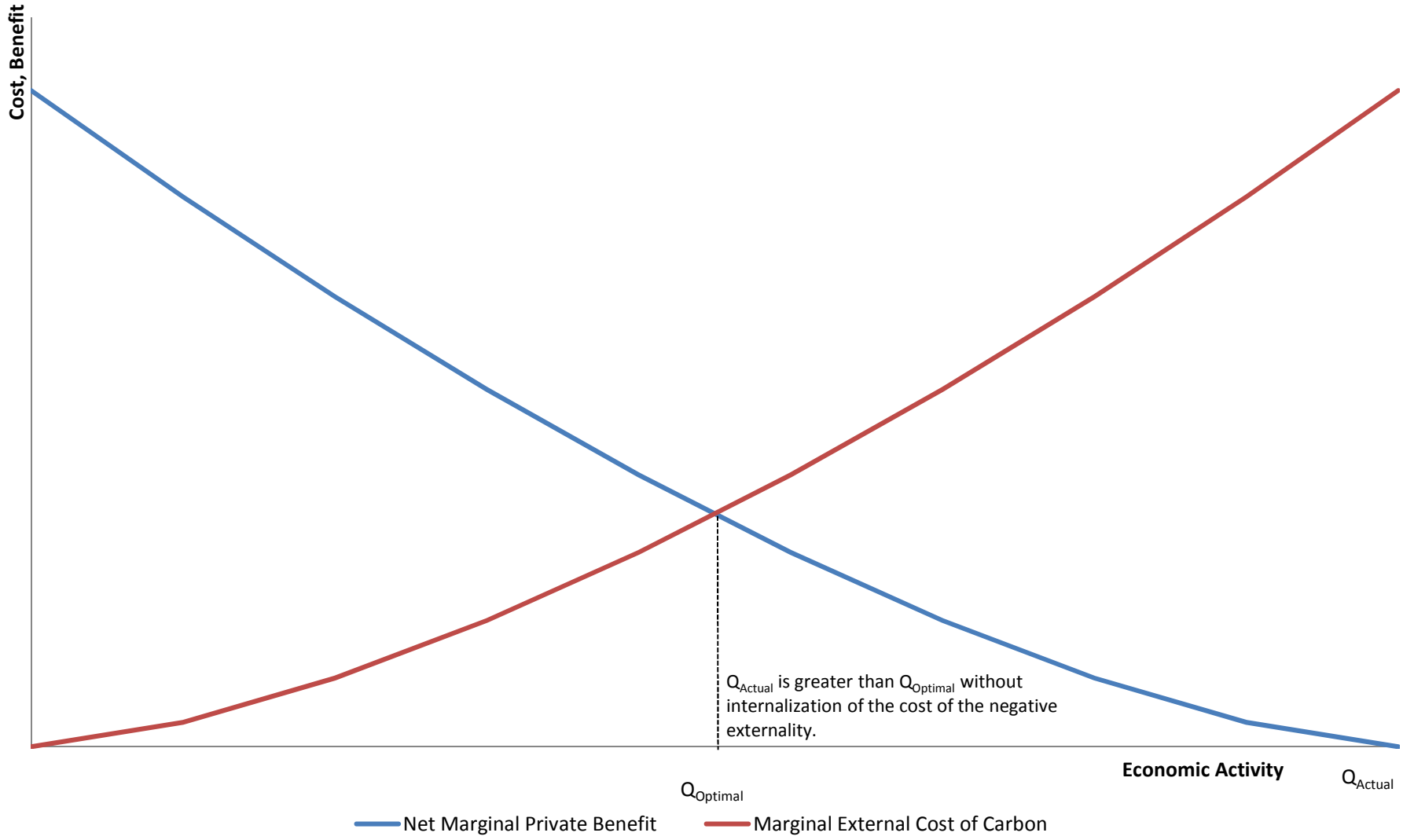
I, Robert Willig, declare under penalty of perjury that the foregoing is true and correct.

Executed: January 29, 2017

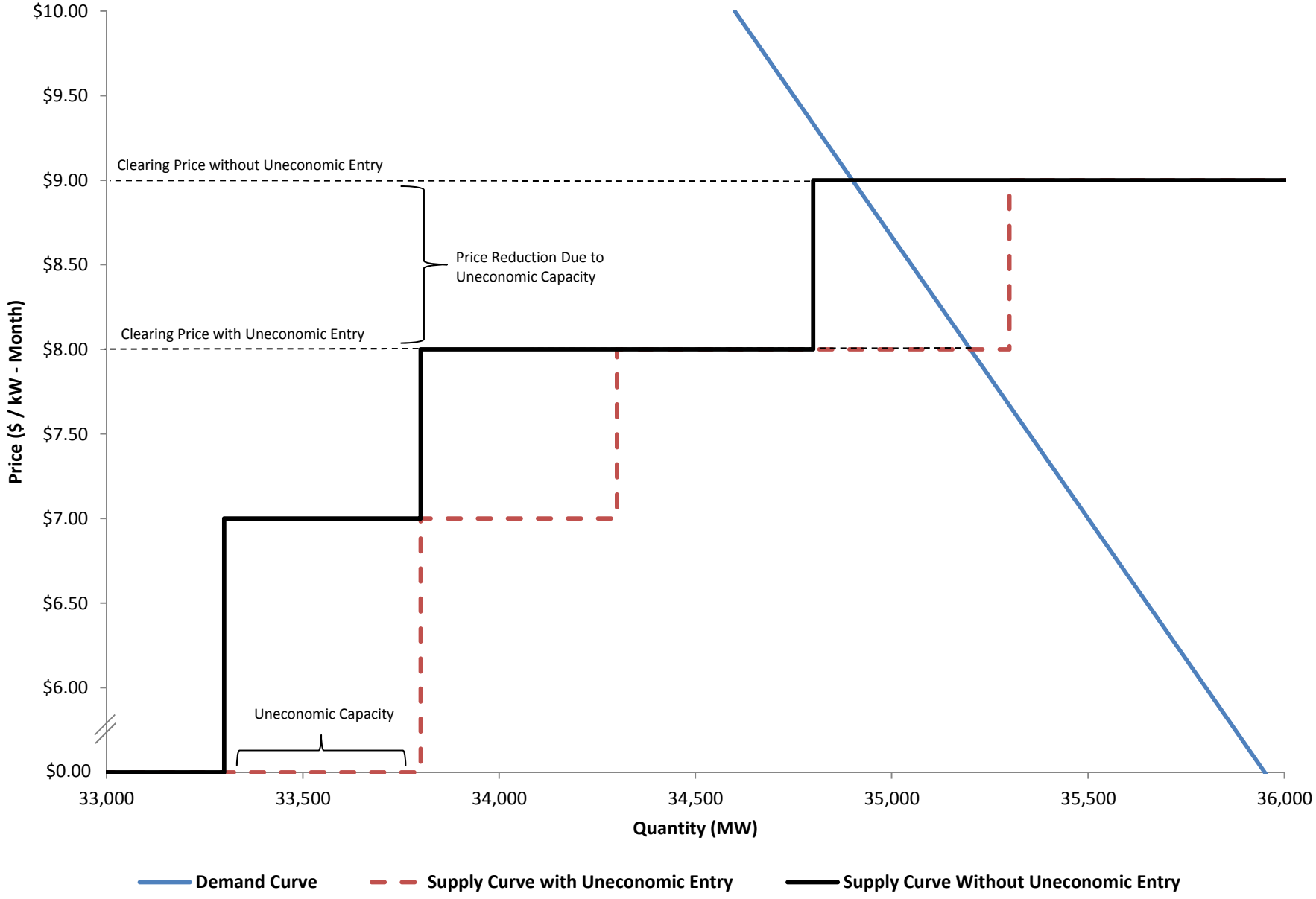
Princeton, New Jersey

Robert D. Willig

Impact on Society of Carbon Dioxide Emissions



Example of Impact of Buyer Market Power in Capacity Market



October, 2016

Curriculum Vitae

Name: **Robert D. Willig**

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Marital Status: Married, four children

Education:

Ph.D. Economics, Stanford University, 1973
Dissertation: Welfare Analysis of Policies Affecting Prices and Products.
Advisor: James Rosse

M.S. Operations Research, Stanford University, 1968.

A.B. Mathematics, Harvard University, 1967.

Professional Positions:

Professor of Economics and Public Affairs, Emeritus, Princeton University, 7/2016 –

Professor of Economics and Public Affairs, Princeton University, 7/1978 - 6/2016.

Principal External Advisor, Infrastructure Program, Inter-American Development Bank, 6/97-8/98.

Deputy Assistant Attorney General, U.S. Department of Justice, l989-1991.

Supervisor, Economics Research Department, Bell Laboratories, 1977-1978.

Visiting Lecturer (with rank of Associate Professor), Department of Economics and Woodrow Wilson School, Princeton University, 1977-78 (part time).

Economics Research Department, Bell Laboratories, 1973-77.

Lecturer, Economics Department, Stanford University, 1971-73.

Other Professional Activities

ABA Section of Antitrust Law Economics Task Force, 2010-2012

Advisory Committee, Compass Lexecon 2010 -

OECD Advisory Council for Mexican Economic Reform, 2008 - 2009

Senior Consultant, Compass Lexecon, 2008 -

Director, Competition Policy Associates, Inc., 2003-2005

Advisory Bd., Electronic Journal of I.O. and Regulation Abstracts, 1996-2008.

Advisory Board, Journal of Network Industries, 2004-2010.

Visiting Faculty Member (occasional), International Program on Privatization and Regulatory Reform, Harvard Institute for International Development, 1996-2000.

Member, National Research Council Highway Cost Allocation Study
Review Committee, 1995-98.

Member, Defense Science Board Task Force on the Antitrust Aspects of Defense Industry Consolidation, 1993-94.

Editorial Board, Utilities Policy, 1990-2001.

Leif Johanson Lecturer, University of Oslo, November 1988.

Member, New Jersey Governor's Task Force on Market-Based Pricing of Electricity, 1987-89.

Co-editor, Handbook of Industrial Organization, 1984-89.

Associate Editor, Journal of Industrial Economics, 1984-89.

Director, Consultants in Industry Economics, Inc., 1983-89, 1991-94.

Fellow, Econometric Society, 1981-.

Organizing Committee, Carnegie-Mellon-N.S.F. Conference on Regulation, 1985.

Board of Editors, American Economic Review, 1980-83.

Nominating Committee, American Economic Association, 1980-1981.

Research Advisory Committee, American Enterprise Institute, 1980-1986.

Editorial Board, M.I.T. Press Series on Government Regulation of Economic Activity, 1979-93.

Program Committee, 1980 World Congress of the Econometric Society.

Program Committee, Econometric Society, 1979, 1981, 1985.

Organizer, American Economic Association Meetings: 1980, 1982.

American Bar Association Section 7 Clayton Act Committee, 198l.

Principal Investigator, NSF grant SOC79-0327, 1979-80; NSF grant 285-6041, 1980-82; NSF grant SES-8038866, 1983-84, 1985-86.

Aspen Task Force on the Future of the Postal Service, 1978-80.

Organizing Committee of Sixth Annual Telecommunications Policy Research Conference, 1977-78.

Visiting Fellow, University of Warwick, July 1977.

Institute for Mathematical Studies in the Social Sciences, Stanford University, 1975.

Published Articles and Book Chapters:

"Unilateral Competitive Effects" (with Bryan Keating), in The Oxford Handbook on International Antitrust Economics, (Roger D. Blair and D. Daniel Sokol, eds.), Oxford University Press, 2014.

“Activating Actavis: A More Complete Story” (with Barry C. Harris, Kevin M. Murphy, and Matthew B. Wright), Antitrust, vol. 28, No. 2 (Spring), 2014.

“'Reverse Payments' in Settlements of Patent Litigation: Split Opinions on Schering-Plough’s K-Dur (2005 and 2012)" (with John P. Bigelow), in The Antitrust Revolution (Sixth Edition), (J. Kwoka and Laurence White, eds.), Oxford University Press, 2013.

"The Delta-Northwest Merger: Consumer Benefits from Airline Network Effects (2008)" (with Mark Israel, Bryan Keating and Daniel Rubinfeld), in The Antitrust Revolution **(**Sixth Edition), (J. Kwoka and Laurence White, eds.), Oxford University Press, 2013.

"Airline Network Effects and Consumer Welfare" (with Bryan Keating, Mark Israel and Daniel Rubinfeld), Review of Network Economics, published online November 2013.

"The Liftoff of Consumer Benefits from the Broadband Revolution" (with Mark Dutz and Jon Orszag), Review of Network Economics (2012) vol. 11, issue 4, article 2.

"Competition and innovation-driven inclusive growth" (with Mark Dutz, Ioannis Kessides and Stephen O'Connell), in Promoting Inclusive Growth: Challenges and Policies, Luiz de Mello and Mark Dutz (eds.), OECD, 2011.

"Unilateral Competitive Effects of Mergers: Upward Pricing Pressure, Product Quality, and Other Extensions," Review of Industrial Organization (2011) 39:19–38.

"Antitrust and Patent Settlements: The Pharmaceutical Cases," (with John Bigelow) in The Antitrust Revolution (Fifth Edition), John Kwoka and Lawrence White (eds.), 2009.

"The 1982 Department of Justice Merger Guidelines: An Economic Assessment," (with J. Ordover) reprinted in Economics of Antitrust Law, Benjamin Klein (ed.), Edward Elgar, 2008.

"On the Antitrust Treatment of Production Joint Ventures," (with Carl Shapiro) reprinted in Economics of Antitrust Law, Benjamin Klein (ed.), Edward Elgar, 2008.

"Consumer's Surplus Without Apology," reprinted in Applied Welfare Economics, Richard Just, Darrel Hueth and Andrew Schmitz (eds.), Edward Elgar, 2008; reprinted in Readings in Social Welfare: Theory and Policy, Robert E. Kuenne (ed.), Blackwell, 2000, pp. 86-97; reprinted in Readings in Microeconomic Theory, M. M. La Manna (ed.), Dryden Press, 1997, pp. 201-212.

"The Risk of Contagion from Multi-Market Contact," (with Charles Thomas), The International Journal of Industrial Organization, Vol. 24, Issue 6 (Nov. 2006), pp 1157 – 1184.

"Pareto-Superior Nonlinear Outlay Schedules," reprinted in The Economics of Public Utilities, Ray Rees (ed.), Edward Elgar, 2006; reprinted in The Economics of Price Discrimination, G. Norman, (ed.), Edward Elgar, 1999.

"Economic Effects of Antidumping Policy," reprinted in The WTO and Anti-Dumping, Douglas Nelson (ed.), Edward Elgar, 2005.

"Merger Analysis, Industrial Organization Theory and the Merger Guidelines," reprinted in Antitrust and Competition Policy, Andrew Kleit (ed.) Edward Elgar, 2005

"Antitrust Policy Towards Agreements That Settle Patent Litigation," (with John Bigelow), Antitrust Bulletin, Fall 2004, pp. 655-698.

"Economies of Scope," (with John Panzar), reprinted in The Economics of Business Strategy, John Kay (ed.), Edward Elgar, 2003.

"Panel on Substantive Standards for Mergers and the Role of Efficiencies," in International

Antitrust Law & Policy, Barry E. Hawk (ed.), Juris Publishing, 2003.

"Practical Rules for Pricing Access in Telecommunications," (with J. Ordover) in Second Generation Reforms in Infrastructure Services , F. Basanes and R. Willig (eds.), Johns Hopkins Press, 2002.

"Comments on Antitrust Policy in the Clinton Administration," in American Economic Policy in the 1990s, J. Frankel and P. Orszag (eds.), MIT Press, 2002.

"Entrepreneurship, Access Policy and Economic Development: Lessons from Industrial Organization," (with M. Dutz and J. Ordover), European Economic Review, (44)4-6 (2000), pp. 739-747.

"Public Versus Regulated Private Enterprise," reprinted in Privatization in Developing Countries, P. Cook and C. Kirkpatrick (eds.), Edward Elgar, 2000.

"Deregulation v. the Legal Culture: Panel Discussion," in Is the Telecommunications Act of 1996 Broken?, G. Sidak (ed.), AEI Press, 1999.

"Economic Principles to Guide Post-Privatization Governance," in Can Privatization Deliver? Infrastructure for Latin America, R. Willig co-editor, Johns Hopkins Press, 1999.

"Access and Bundling in High-Technology Markets," (with J. A. Ordover), in Competition, Innovation and the Microsoft Monopoly: Antitrust in the Digital Marketplace, J. A. Eisenach and T. Lenard (eds.), Kluwer, 1999.

"Competitive Rail Regulation Rules: Should Price Ceilings Constrain Final Products or Inputs?," (With W. J. Baumol), Journal of Transport Economics and Policy, Vol. 33, Part 1, pp. 1-11.

"Economic Effects of Antidumping Policy," Brookings Trade Forum: 1998, 19-41.

"Interview With Economist Robert D. Willig," Antitrust , Vol. 11, No. 2, Spring 1997, pp.11-15.

"Parity Pricing and its Critics: A Necessary Condition for Efficiency in Provision of Bottleneck Services to Competitors," (with W. J. Baumol and J. A. Ordover), Yale Journal on Regulation, Vol. 14, No. 1, Winter 1997, pp. 145-164.

"Restructuring Regulation of the Rail Industry," (with Ioannis Kessides), in Private Sector, Quarterly No. 4, September 1995, pp. 5 - 8. Reprinted in Viewpoint, October, 1995, The World Bank. Reprinted in Private Sector, *special edition*: Infrastructure, June 1996.

"Competition and Regulation in the Railroad Industry," (with Ioannis Kessides), in Regulatory Policies and Reform: A Comparative Perspective, C. Frischtak (ed.), World Bank, 1996.

"Economic Rationales for the Scope of Privatization," (with Carl Shapiro), reprinted in The

Political Economy of Privatization and Deregulation, E. E. Bailey and J. R. Pack (eds.), The International Library of Critical Writings in Economics, Edward Elgar Publishing Co., 1995, pp. 95-130.

"Weak Invisible Hand Theorems on the Sustainability of Multi-product Natural Monopoly," (with W. Baumol and E. Bailey), reprinted in The Political Economy of Privatization and Deregulation, E. E. Bailey and J. R. Pack (eds.), The International Library of Critical Writings in Economics, Edward Elgar Publishing Co., 1995, pp. 245-260.

"Economists' View: The Department of Justice Draft Guidelines for the Licensing and Acquisition of Intellectual Property," (with J. Ordover), Antitrust, V. 9, No. 2 (spring 1995), 29-36.

"Public Versus Regulated Private Enterprise," in Proceedings of the World Bank Annual Conference on Development Economics 1993, L. Summers (ed.), The World Bank, 1994.

"Economics and the 1992 Merger Guidelines: A Brief Survey," (with J. Ordover), Review of Industrial Organization, V. 8, No. 2, (1993), pp. 139-150.

"The Role of Sunk Costs in the 1992 Guidelines' Entry Analysis," Antitrust, V. 6, No. 3 (summer 1992).

"Antitrust Lessons from the Airlines Industry: The DOJ Experience," Antitrust Law Journal, V. 60, No. 2 (1992).

"William J. Baumol," (with E. E. Bailey), in New Horizons in Economic Thought: Appraisals of Leading Economists, W. J. Samuels (ed.), Edward Elgar, 1992.

"Anti-Monopoly Policies and Institutions," in The Emergence of Market Economies in Eastern Europe, Christopher Clague and Gordon Rausser (eds.), Basil Blackwell, 1992.

"Economics and the 1992 Merger Guidelines," (with Janusz Ordover), in Collaborations Among Competitors: Antitrust Policy and Economics, Eleanor Fox and James Halverson (eds.), American Bar Association, 1992.

"On the Antitrust Treatment of Production Joint Ventures," (with Carl Shapiro), reprinted in Collaborations Among Competitors: Antitrust Policy and Economics, Eleanor Fox and James Halverson (eds), American Bar Association, 1992.

"Merger Analysis, Industrial Organization Theory, and Merger Guidelines," Brookings Papers on Economic Activity -- Microeconomics 1991, pp. 281-332.

"On the Antitrust Treatment of Production Joint Ventures," (with C. Shapiro), Journal of Economic Perspectives, Vol. 4, No. 3, Summer 1990, pp. 113-130.

"Economic Rationales for the Scope of Privatization," (with Carl Shapiro), in The Political Economy of Public Sector Reform and Privatization, E.N. Suleiman and J. Waterbury (eds.), Westview Press, Inc., 1990, pp. 55-87.

"Contestable Market Theory and Regulatory Reform," in Telecommunications Deregulation: Market Power and Cost Allocation, J.R. Allison and D.L. Thomas (eds.), Ballinger, 1990.

"Address To The Section," Antitrust Law Section Symposium, New York State Bar Association, 1990.

"Price Caps: A Rational Means to Protect Telecommunications Consumers and Competition," (with W. Baumol), Review of Business, Vol. 10, No. 4, Spring 1989, pp. 3-8.

"U.S.-Japanese VER: A Case Study from a Competition Policy Perspective," (with M. Dutz) in The Costs of Restricting Imports, The Automobile Industry. OECD, 1988.

"Contestable Markets," in The New Palgrave: A Dictionary of Economics, J. Eatwell, M. Milgate, and P. Newman (eds.), 1987.

"Do Entry Conditions Vary Across Markets: Comments," Brookings Papers on Economic Activity, 3 - 1987, pp. 872-877.

"Railroad Deregulation: Using Competition as a Guide," (with W. Baumol), Regulation, January/February 1987, Vol. 11, No. 1, pp. 28-36.

"How Arbitrary is 'Arbitrary'? - or, Toward the Deserved Demise of Full Cost Allocation," (with W. Baumol and M. Koehn), Public Utilities Fortnightly, September 1987, Vol. 120, No. 5, pp. 16-22.

"Contestability: Developments Since the Book," (with W. Baumol), Oxford Economic Papers, December 1986, pp. 9-36.

"The Changing Economic Environment in Telecommunications: Technological Change and Deregulation," in Proceedings from the Telecommunications Deregulation Forum; Karl Eller Center; 1986.

"Perspectives on Mergers and World Competition," (with J. Ordover), in Antitrust and Regulation, R.E. Grieson (ed.), Lexington, 1986.

"On the Theory of Perfectly Contestable Markets," (with J. Panzar and W. Baumol), in New Developments in The Analysis of Market Structure, J. Stiglitz and F. Mathewson (eds.), MIT Press, 1986.

"InterLATA Capacity Growth and Market Competition," (with C. Shapiro), in Telecommunications and Equity: Policy Research Issues, J. Miller (ed.), North Holland, 1986.

"Corporate Governance and Market Structure," in Economic Policy in Theory and Practice, A. Razin and E. Sadka (eds.), Macmillan Press, 1986.

"Antitrust for High-Technology Industries: Assessing Research Joint Ventures and Mergers," (with J. Ordover), Journal of Law and Economics, Vol 28(2), May 1985, pp. 311-334.

"Non-Price Anticompetitive Behavior by Dominant Firms Toward the Producers of Complementary Products," (with J. Ordover and A. Sykes), in Antitrust and Regulation, F.M. Fisher (ed.), MIT Press, 1985.

"Telephones and Computers: The Costs of Artificial Separation," (with W. Baumol), Regulation, March/April 1985.

"Transfer Principles in Income Redistribution," (with P. Fishburn), Journal of Public Economics, 25 (1984), pp. 1-6.

"Market Structure and Government Intervention in Access Markets," in Telecommunications Access and Public Policy, A. Baughcam and G. Faulhaber (eds.), 1984.

"Pricing Issues in the Deregulation of Railroad Rates," (with W. Baumol), in Economic Analysis of Regulated Markets: European and U. S. Perspectives, J. Finsinger (ed.), 1983.

"Local Telephone Pricing in a Competitive Environment," (with J. Ordover), in Telecommunications Regulation Today and Tomorrow, E. Noam (ed.), Harcourt Brace Jovanovich, 1983.

"Economics and Postal Pricing Policy," (with B. Owen), in The Future of the Postal Service, J. Fleishman (ed.), Praeger, 1983.

"Selected Aspects of the Welfare Economics of Postal Pricing," in Telecommunications Policy Annual, Praeger, 1987.

"The Case for Freeing AT&T" (with M. Katz), Regulation, July-Aug. 1983, pp. 43-52.

"Predatory Systems Rivalry: A Reply" (with J. Ordover and A. Sykes), Columbia Law Review, Vol. 83, June 1983, pp. 1150-1166. Reprinted in Corporate Counsel's Handbook - 1984.

"Sector Differentiated Capital Taxation with Imperfect Competition and Interindustry Flows," Journal of Public Economics, Vol. 21, 1983.

"Contestable Markets: An Uprising in the Theory of Industry Structure: Reply," (with W.J. Baumol and J.C. Panzar), American Economic Review, Vol. 73, No. 3, June 1983, pp. 491-496.

"The 1982 Department of Justice Merger Guidelines: An Economic Assessment," (with J. Ordover), California Law Review, Vol. 71, No. 2, March 1983, pp. 535-574. Reprinted in

Antitrust Policy in Transition: The Convergence of Law and Economics, E.M. Fox and J.T. Halverson (eds.), 1984.

"Intertemporal Failures of the Invisible Hand: Theory and Implications for International Market Dominance," (with W.J. Baumol), Indian Economic Review, Vol. XVI, Nos. 1 and 2, January-June 1981, pp. 1-12.

"Unfair International Trade Practices," (with J. Ordover and A. Sykes), Journal of International Law and Politics, Vol. 15, No. 2, winter 1983, pp. 323-337.

"Journals as Shared Goods: Reply," (with J. Ordover), American Economic Review, V. 72, No. 3, June 1982, pp. 603-607.

"Herfindahl Concentration, Rivalry, and Mergers," (with J. Ordover and A. Sykes), Harvard Law Review, V. 95, No. 8, June 1982, pp. 1857-l875.

"An Economic Definition of Predation: Pricing and Product Innovation," (with J. Ordover), Yale Law Journal, Vol. 90: 473, December 1981, pp. 1-44.

"Fixed Costs, Sunk Costs, Entry Barriers, and the Sustainability of Monopoly," (with W. Baumol), Quarterly Journal of Economics, Vol. 96, No. 3, August 1981, pp. 405-432.

"Social Welfare Dominance," American Economic Review, Vol. 71, No. 2, May 1981, pp. 200-204.

"Economies of Scope," (with J. Panzar), American Economic Review, Vol. 72, No. 2, May 1981, pp. 268-272.

"Income-Distribution Concerns in Regulatory Policymaking," (with E.E. Bailey) in Studies in Public Regulation (G. Fromm, ed.), MIT Press, Cambridge, 1981, pp. 79-118.

"An Economic Definition of Predatory Product Innovation," (with J. Ordover), in Strategic Predation and Antitrust Analysis, S. Salop (ed.), 1981.

"What Can Markets Control?" in Perspectives on Postal Service Issues, R. Sherman (ed.), American Enterprise Institute, 1980.

"Pricing Decisions and the Regulatory Process," in Proceedings of the 1979 Rate Symposium on Problems of Regulated Industries, University of Missouri-Columbia Extension Publications, 1980, pp. 379-388.

"The Theory of Network Access Pricing," in Issues in Public Utility Regulation, H.M. Trebing (ed.), MSU Public Utilities Papers, 1979.

"Customer Equity and Local Measured Service," in Perspectives on Local Measured Service, J. Baude, etal. (ed.), 1979, pp. 71-80.

"The Role of Information in Designing Social Policy Towards Externalities," (with J. Ordover), Journal of Public Economics, V. 12, 1979, pp. 271-299.

"Economies of Scale and the Profitability of Marginal-Cost Pricing: Reply," (with J. Panzar), Quarterly Journal of Economics, Vol. 93, No. 4, Novmber 1979, pp. 743-4.

"Theoretical Determinants of the Industrial Demand for Electricity by Time of Day," (with J. Panzar) Journal of Econometrics, V. 9, 1979, pp. 193-207.

"Industry Performance Gradient Indexes," (with R. Dansby), American Economic Review, V. 69, No. 3, June 1979, pp. 249-260.

"The Economic Gradient Method," (with E. Bailey), American Economic Review, Vol. 69, No. 2, May 1979, pp. 96-101.

"Multiproduct Technology and Market Structure," American Economic Review, Vol. 69, No. 2, May 1979, pp. 346-351.

"Consumer's Surplus Without Apology: Reply," American Economic Review, Vol. 69, No. 3, June 1979, pp. 469-474.

"Decisions with Estimation Uncertainty," (with R. Klein, D. Sibley, and L. Rafsky), Econometrica, V. 46, No. 6, November 1978, pp. 1363-1388.

"Incremental Consumer's Surplus and Hedonic Price Adjustment," Journal of Economic Theory, V. 17, No. 2, April 1978, pp. 227-253.

"Recent Theoretical Developments in Financial Theory: Discussion, "The Journal of Finance, V. 33, No. 3, June 1978, pp. 792-794.

"The Optimal Provision of Journals Qua Sometimes Shared Goods," (with J. Ordover), American Economic Review, V. 68, No. 3, June 1978, pp. 324-338.

"On the Comparative Statics of a Competitive Industry With Infra-marginal Firms," (with J. Panzar), American Economic Review, V. 68, No. 3, June 1978, pp. 474-478.

"Pareto Superior Nonlinear Outlay Schedules," Bell Journal of Economics, Vol. 9, No. 1, Spring 1978, pp. 56-69.

"Predatoriness and Discriminatory Pricing," in The Economics of Anti-Trust: Course of Study Materials, American Law Institute-American Bar Association, 1978.

"Economies of Scale in Multi-Output Production," (with J. Panzar), Quarterly Journal of Economics, V. 91, No. 3, August 1977, pp. 481-494.

"Weak Invisible Hand Theorems on the Sustainability of Multi-product Natural Monopoly," (with W. Baumol and E. Bailey), American Economic Review, V. 67, No. 3, June 1977, pp. 350-365.

"Free Entry and the Sustainability of Natural Monopoly," (with J. Panzar), Bell Journal of Economics, Spring 1977, pp. 1-22.

"Risk Invariance and Ordinally Additive Utility Functions," Econometrica, V. 45, No. 3, April 1977, pp. 621-640.

"Ramsey-Optimal Pricing of Long Distance Telephone Services," (with E. Bailey), in Pricing in Regulated Industries, Theory and Application, J. Wenders (ed.), Mountain State Telephone and Telegraph Co., 1977, pp. 68-97.

"Network Externalities and Optimal Telecommunications Pricing: A Preliminary Sketch," (with R. Klein), in Proceedings of Fifth Annual Telecommunications Policy Research Conference, Volume II, NTIS, 1977, pp. 475-505.

"Otsenka ekonomicheskoi effektivnosti proizvodstvennoi informatsii" ["The Evaluation of the Economic Benefits of Productive Information"] in Doklady Sovetskikh i Amerikanskikh Spetsialistov Predstavlennye na Pervyi Sovetsko-Amerikanskii Simpozium po Ekonomicheskoi Effektivnosti Informat sionnogo Obsluzhivaniia [Papers of Soviet and American Specialists Presented at the First Soviet- American Symposium on Costs and Benefits of Information Services], All Soviet Scientific Technical Information Center, Moscow, 1976.

"Vindication of a 'Common Mistake' in Welfare Economics," (with J. Panzar), Journal of Political Economy, V. 84, No. 6, December 1976, pp. 1361-1364.

"Consumer's Surplus Without Apology," American Economic Review, V. 66, No. 4, September 1976, pp. 589-597.

Books

Second Generation Reforms in Infrastructure Services, F. Basanes and R. Willig (eds.), Johns Hopkins Press, 2002.

Can Privatization Deliver? Infrastructure for Latin America, R. Willig co-editor, Johns Hopkins Press, 1999.

Handbook of Industrial Organization, (edited with R. Schmalensee), North Holland Press, Volumes 1 and 2, 1989.

Contestable Markets and the Theory of Industry Structure, (with W.J. Baumol and J.C. Panzar),

Harcourt Brace Jovanovich, 1982. Second Edition, 1989.

Welfare Analysis of Policies Affecting Prices and Products, Garland Press, 1980.

Unpublished Papers and Reports:

"Brief of Leading Economists as Amici Curiae in Support of Respondents," In the Supreme Court of the United States; Douglas R. M. Nazarian, et al, v. PPL Energyplus, LLC, et al. and CPV Maryland, LLC, v. PPL Energyplus, LLC, et al.; On Writ of Certiorari to the US Court of Appeals for the Fourth Circuit; Nos. 14-614, 14-623; January 19, 2016.

"Technological change and labor market segmentation in the developing world: Evidence from Brazil," (with Dutz, Mark, Lucas Ferreira-Mation, and Stephen O'Connell), 2015 Background Paper for the 2016 World Bank's World Development Report.

"Brief for Amici Curiae J. Gregory Sidak, Robert D. Willig, David J. Teece, and Keith N. Hylton, Scholars and Experts in Antitrust Economics in Support of Defendants-Appellants and Supporting Reversal," 15-1672 In the United States Court of Appeals for the Second Circuit; United States of America, et al., v. American Express Company, et al., 8/10/2015.

"Commentary on Economics at the FTC: Hospital Mergers, Authorized Generic Drugs, and Consumer Credit Markets" (with Nauman Ilias, Bryan Keating, and Paolo Ramezzana), under revision for Review of Industrial Organization**.**

"Recommendations for Excessive-Share Limits in the Surfclam and Ocean Quahog Fisheries" (with Glenn Mitchell and Steven Peterson), Report to National Marine Fisheries Service and the Mid-Atlantic Fishery Management Council, 5/23/2011.

"Public Comments on the 2010 Draft Horizontal Merger Guidelines," paper posted to Federal Trade Commission website, 6/4/2010

"An Econometric Analysis of the Matching Between Football Student-Athletes and Colleges," (with Yair Eilat, Bryan Keating and Jon Orszag)

Supreme Court Amicus Brief Regarding Morgan Stanley Capital Group Inc. v. Public Utility District No. 1 of Snohomish County, Washington, (co-authored), AEI-Brookings Joint Center Brief No. 07-02, 12/2/07

"(Allegedly) Monopolizing Tying Via Product Innovation," statement before the Department of Justice/Federal Trade Commission Section 2 Hearings, November 1, 2006.

"Assessment of U.S. Merger Enforcement Policy," statement before the Antitrust Modernization Commission, 11/17/05.

"Investment is Appropriately Stimulated by TELRIC," in Pricing Based on Economic Cost,

12/2003.

“Brief of Amici Curiae Economics Professors, re Verizon v. Trinko, In the Supreme Court of the U.S.,” (with W.J. Baumol, J.O. Ordover and F.R. Warren-Boulton), 7/25/2003.

“Stimulating Investment and the Telecommunications Act of 1996,” (with J. Bigelow, W. Lehr and S. Levinson), 2002.

“An Economic Analysis of Spectrum Allocation and Advanced Wireless Services,” (with Martin N. Baily, Peter R. Orszag, and Jonathan M. Orszag), 2002

“Effective Deregulation of Residential Electric Service,” 2001

“Anticompetitive Forced Rail Access” (with W. J. Baumol), 2000

“The Scope of Competition in Telecommunications” (with B. Douglas Bernheim), 1998 “Why

Do Christie and Schultz Infer Collusion From Their Data? (with Alan Kleidon), 1995.

"Demonopolization," (with Sally Van Siclen), OECD Vienna Seminar Paper, 1993.

"Economic Analysis of Section 337: The Balance Between Intellectual Property Protection and Protectionism," (with J. Ordover) 1990.

"The Effects of Capped NTS Charges on Long Distance Competition," (with M. Katz).

"Discussion of Regulatory Mechanism Design in the Presence of Research Innovation, and Spillover Effects," 1987.

"Industry Economic Analysis in the Legal Arena," 1987.

"Deregulation of Long Distance Telephone Services: A Public Interest Assessment," (with M. Katz).

"Competition-Related Trade Issues," report prepared for OECD.

"Herfindahl Concentration Index," (with J. Ordover), Memorandum for ABA Section 7 Clayton Act Committee, Project on Revising the Merger Guidelines, March 1981.

"Market Power and Market Definition," (with J. Ordover), Memorandum for ABA Section 7 Clayton Act Committee, Project on Revising the Merger Guidelines, May 1981.

"The Continuing Need for and National Benefits Derived from the REA Telephone Loan Programs - An Economic Assessment," 1981.

"The Economics of Equipment Leasing: Costing and Pricing," 1980.

"Rail Deregulation and the Financial Problems of the U.S. Railroad Industry," (with W.J. Baumol), report prepared under contract to Conrail, 1979.

"Price Indexes and Intertemporal Welfare," Bell Laboratories Economics Discussion Paper, 1974.

"Consumer's Surplus: A Rigorous Cookbook," Technical Report #98, Economics Series, I.M.S.S.S., Stanford University, l973.

"An Economic-Demographic Model of the Housing Sector," (with B. Hickman and M. Hinz), Center for Research in Economic Growth, Stanford University, 1973.

Invited Conference Presentations:

George Mason Law Review Annual Antitrust Symposium: Antitrust in an Interconnected World
"GUPPI and the Safe Harbor" 2016

Competition Law & Policy Institute of New Zealand Annual Workshop
"Merger Analysis Keynote" 2015

Economic Studies at Brookings: Railroads, Policy and the Economy
"The Industry Perspective" 2015

Georgetown University McDonough School of Business Railroad Economics Symposium
"The Role of Economic Theory in the 'Deregulated' Rail Industry" 2015

Brazilian School of Economics and Finance (FGV EPGE) Seminario
"Public Interest Regulation: Lessons from Railroads" 2015

NYU School of Law Conference on the Fiftieth Anniversary of United States v. Philadelphia National Bank: The Past, Present and Future of Merger Law
"Discussion with Agency Economists" 2013

Brookings Institution Conference on The Economics of the Airline Industry
"Airline Network Effects and Consumer Welfare" 2012

AGEP Public Policy Conference on Pharmaceutical Industry Economics, Regulation and Legal Issues; Law and Economics Center, George Mason University School of Law
"Pharmaceutical Brand-Generic Disputes" 2012

U.S.-EU Alliance Study Peer Review Conferences
"Review of Cooperative Agreements in Transatlantic Airline Markets" 2012
"The Research Agenda Ahead" 2012

Antitrust in the High Tech Sector Conference
"Developments in Merger Enforcement" 2012

Georgetown Center for Business and Public Policy, Conference on the Evolution of Regulation
"Reflections on Regulation" 2011

Antitrust Forum, New York State Bar Association
"Upward Price Pressure, Market Definition and Supply Mobility" 2011

American Bar Association, Antitrust Section, Annual Convention
"The New Merger Guidelines' Analytic Highlights" 2011

OECD and World Bank Conference on Challenges and Policies for Promoting Inclusive Growth
"Inclusive Growth From Competition and Innovation" 2011

Villanova School of Business Executive MBA Conference
"Airline Network Effects, Competition and Consumer Welfare" 2011

NYU School of Law Conference on Critical Directions in Antitrust
"Unilateral Competitive Effects" 2010

Conf. on the State of European Competition Law and Enforcement in a Transatlantic Context
"Recent Developments in Merger Control" 2010

Center on Regulation and Competition, Universidad de Chile Law School
"Economic Regulation and the Limits of Antitrust Law" 2010

Center on Regulation and Competition, Universidad de Chile Law School
"Merger Policy and Guidelines Revision" 2010

Faculty of Economics, Universidad de Chile
"Network Effects in Airlines Markets" 2010

Georgetown Law Global Antitrust Enforcement Symposium
"New US Merger Guidelines" 2010

FTI London Financial Services Conference
"Competition and Regulatory Reform" 2010

NY State Bar Association Annual Antitrust Conference
“New Media Competition Policy” 2009

Antitrust Law Spring Meeting of the ABA
"Antitrust and the Failing Economy Defense" 2009

Georgetown Law Global Antitrust Enforcement Symposium
"Mergers: New Enforcement Attitudes in a Time of Economic Challenge" 2009

Phoenix Center US Telecoms Symposium
"Assessment of Competition in the Wireless Industry" 2009

FTC and DOJ Horizontal Merger Guidelines Workshop
"Direct Evidence is No Magic Bullet" 2009

Northwestern Law Research Symposium: Antitrust Economics and Competition Policy
"Discussion of Antitrust Evaluation of Horizontal Mergers" 2008

Inside Counsel Super-Conference
"Navigating Mixed Signals under Section 2 of the Sherman Act" 2008

Federal Trade Commission Workshop on Unilateral Effects in Mergers
"Best Evidence and Market Definition" 2008

European Policy Forum, Rules for Growth: Telecommunications Regulatory Reform
"What Kind of Regulation For Business Services?" 2007

Japanese Competition Policy Research Center, Symposium on M&A and Competition Policy
"Merger Policy Going Forward With Economics and the Economy" 2007

Federal Trade Commission and Department of Justice Section 2 Hearings
"Section 2 Policy and Economic Analytic Methodologies" 2007

Pennsylvania Bar Institute, Antitrust Law Committee CLE
"The Economics of Resale Price Maintenance and Class Certification" 2007

Pennsylvania Bar Institute, Antitrust Law Committee CLE
"Antitrust Class Certification – An Economist's Perspective" 2007

Fordham Competition Law Institute, International Competition Economics Training Seminar
"Monopolization and Abuse of Dominance" 2007

Canadian Bar Association Annual Fall Conference on Competition Law
"Economic Tools for the Competition Lawyer" 2007

Conference on Managing Litigation and Business Risk in Multi-jurisdiction Antitrust Matters
"Economic Analysis in Multi-jurisdictional Merger Control" 2007

World Bank Conference on Structuring Regulatory Frameworks for Dynamic and Competitive South Eastern European Markets
"The Roles of Government Regulation in a Dynamic Economy" 2006

Department of Justice/Federal Trade Commission Section 2 Hearings
"(Allegedly) Monopolizing Tying Via Product Innovation" 2006

Fordham Competition Law Institute, Competition Law Seminar
"Monopolization and Abuse of Dominance" 2006

Practicing Law Institute on Intellectual Property Antitrust
"Relevant Markets for Intellectual Property Antitrust" 2006

PLI Annual Antitrust Law Institute
"Cutting Edge Issues in Economics" 2006

World Bank's Knowledge Economy Forum V
"Innovation, Growth and Competition" 2006

Charles University Seminar Series
"The Dangers of Over-Ambitious Antitrust Regulation" 2006

NY State Bar Association Antitrust Law Section Annual Meeting
"Efficient Integration or Illegal Monopolization?" 2006

World Bank Seminar
"The Dangers of Over-Ambitious Regulation" 2005

ABA Section of Antitrust Law 2005 Fall Forum
"Is There a Gap Between the Guidelines and Agency Practice?" 2005

Hearing of Antitrust Modernization Commission
"Assessment of U.S. Merger Enforcement Policy" 2005

LEAR Conference on Advances in the Economics of Competition Law
"Exclusionary Pricing Practices" 2005

Annual Antitrust Law Institute
"Cutting Edge Issues in Economics" 2005

PRIOR Symposium on States and Stem Cells
"Assessing the Economics of State Stem Cell Programs" 2005

ABA Section of Antitrust Law – AALS Scholars Showcase
"Distinguishing Anticompetitive Conduct" 2005

Allied Social Science Associations National Convention
"Antitrust in the New Economy" 2005

ABA Section of Antitrust Law 2004 Fall Forum
"Advances in Economic Analysis of Antitrust" 2004

Phoenix Center State Regulator Retreat
"Regulatory Policy for the Telecommunications Revolution" 2004

OECD Competition Committee
"Use of Economic Evidence in Merger Control" 2004

Justice Department/Federal Trade Commission Joint Workshop
"Merger Enforcement" 2004

Phoenix Center Annual U.S. Telecoms Symposium
"Incumbent Market Power" 2003

Center for Economic Policy Studies Symposium on Troubled Industries
"What Role for Government in Telecommunications?" 2003

Princeton Workshop on Price Risk and the Future of the Electric Markets
"The Structure of the Electricity Markets" 2003

2003 Antitrust Conference
"International Competition Policy and Trade Policy" 2003

International Industrial Organization Conference
"Intellectual Property System Reform" 2003

ABA Section of Antitrust Law 2002 Fall Forum
"Competition, Regulation and Pharmaceuticals" 2002

Fordham Conference on International Antitrust Law and Policy
"Substantive Standards for Mergers and the Role of Efficiencies" 2002

Department of Justice Telecom Workshop
"Stimulating Investment and the Telecommunications Act of 1996" 2002

Department of Commerce Conference on the State of the Telecom Sector
"Stimulating Investment and the Telecommunications Act of 1996" 2002

Law and Public Affairs Conference on the Future of Internet Regulation
"Open Access and Competition Policy Principles" 2002

Center for Economic Policy Studies Symposium on Energy Policy
"The Future of Power Supply" 2002

The Conference Board: Antitrust Issues in Today's Economy
"The 1982 Merger Guidelines at 20" 2002

Federal Energy Regulatory Commission Workshop
"Effective Deregulation of Residential Electric Service" 2001

IPEA International Seminar on Regulation and Competition
"Electricity Markets: Deregulation of Residential Service" 2001
"Lessons for Brazil from Abroad" 2001

ABA Antitrust Law Section Task Force Conference
"Time, Change, and Materiality for Monopolization Analyses" 2001

Harvard University Conference on American Economic Policy in the 1990s
"Comments on Antitrust Policy in the Clinton Administration" 2001

Tel-Aviv Workshop on Industrial Organization and Anti-Trust
"The Risk of Contagion from Multimarket Contact" 2001

2001 Antitrust Conference
"Collusion Cases: Cutting Edge or Over the Edge?" 2001
"Dys-regulation of California Electricity" 2001

FTC Public Workshop on Competition Policy for E-Commerce
"Necessary Conditions for Cooperation to be Problematic" 2001

HIID International Workshop on Infrastructure Policy
"Infrastructure Privatization and Regulation" 2000

Villa Mondragone International Economic Seminar
"Competition Policy for Network and Internet Markets" 2000

New Developments in Railroad Economics: Infrastructure Investment and Access Policies
"Railroad Access, Regulation, and Market Structure" 2000

The Multilateral Trading System at the Millennium
"Efficiency Gains From Further Liberalization" 2000

Singapore – World Bank Symposium on Competition Law and Policy
"Policy Towards Cartels and Collusion" 2000

CEPS: Is It a New World?: Economic Surprises of the Last Decade
"The Internet and E-Commerce" 2000

Cutting Edge Antitrust: Issues and Enforcement Policies
"The Direction of Antitrust Entering the New Millennium" 2000

The Conference Board: Antitrust Issues in Today's Economy
"Antitrust Analysis of Industries With Network Effects" 1999

CEPS: New Directions in Antitrust
"Antitrust in a High-Tech World" 1999

World Bank Meeting on Competition and Regulatory Policies for Development
"Economic Principles to Guide Post-Privatization Governance" 1999

1999 Antitrust Conference
"Antitrust and the Pace of Technological Development" 1999
"Restructuring the Electric Utility Industry" 1999

HIID International Workshop on Privatization, Regulatory Reform and Corporate Governance
"Privatization and Post-Privatization Regulation of Natural Monopolies" 1999

The Federalist Society: Telecommunications Deregulation: Promises Made, Potential Lost?
"Grading the Regulators" 1999

Inter-American Development Bank: Second Generation Issues In the Reform Of Public Services
"Post-Privatization Governance" 1999
"Issues Surrounding Access Arrangements" 1999

Economic Development Institute of the World Bank -- Program on Competition Policy
"Policy Towards Horizontal Mergers" 1998

Twenty-fifth Anniversary Seminar for the Economic Analysis Group of the Department of

Justice
"Market Definition in Antitrust Analysis" 1998

HIID International Workshop on Privatization, Regulatory Reform and Corporate Governance
"Infrastructure Architecture and Regulation: Railroads" 1998

EU Committee Competition Conference – Market Power
"US/EC Perspective on Market Definition" 1998

Federal Trade Commission Roundtable
"Antitrust Policy for Joint Ventures" 1998

1998 Antitrust Conference
"Communications Mergers" 1998

The Progress and Freedom Foundation Conference on Competition, Convergence, and the Microsoft Monopoly
Access and Bundling in High-Technology Markets 1998

FTC Program on The Effective Integration of Economic Analysis into Antitrust Litigation
The Role of Economic Evidence and Testimony 1997

FTC Hearings on Classical Market Power in Joint Ventures
Microeconomic Analysis and Guideline 1997

World Bank Economists --Week IV Keynote
Making Markets More Effective With Competition Policy 1997

Brookings Trade Policy Forum
Competition Policy and Antidumping: The Economic Effects 1997

University of Malaya and Harvard University Conference on The Impact of Globalisation and Privatisation on Malaysia and Asia in the Year 2020
Microeconomics, Privatization, and Vertical Integration 1997

ABA Section of Antitrust Law Conference on The Telecommunications Industry
Current Economic Issues in Telecommunications 1997

Antitrust 1998: The Annual Briefing
The Re-Emergence of Distribution Issues 1997

Inter-American Development Bank Conference on Private Investment, Infrastructure Reform and Governance in Latin America & the Caribbean
Economic Principles to Guide Post-Privatization Governance 1997

Harvard Forum on Regulatory Reform and Privatization of Telecommunications in the Middle East
Privatization: Methods and Pricing Issues 1997

American Enterprise Institute for Public Policy Research Conference
Discussion of Local Competition and Legal Culture 1997

Harvard Program on Global Reform and Privatization of Public Enterprises
"Infrastructure Privatization and Regulation: Freight" 1997

World Bank Competition Policy Workshop
"Competition Policy for Entrepreneurship and Growth" 1997

Eastern Economics Association Paul Samuelson Lecture
"Bottleneck Access in Regulation and Competition Policy" 1997

ABA Annual Meeting, Section of Antitrust Law
"Antitrust in the 21st Century: The Efficiencies Guidelines" 1997

Peruvian Ministry of Energy and Mines Conference on Regulation of Public Utilities
"Regulation: Theoretical Context and Advantages vs. Disadvantages" 1997

The FCC: New Priorities and Future Directions
"Competition in the Telecommunications Industry" 1997

American Enterprise Institute Studies in Telecommunications Deregulation
"The Scope of Competition in Telecommunications" 1996

George Mason Law Review Symposium on Antitrust in the Information Revolution
"Introduction to the Economic Theory of Antitrust and Information" 1996

Korean Telecommunications Public Lecture
"Market Opening and Fair Competition" 1996

Korea Telecommunications Forum
"Desirable Interconnection Policy in a Competitive Market" 1996

European Association for Research in Industrial Economics Annual Conference
"Bottleneck Access: Regulation and Competition Policy" 1996

Harvard Program on Global Reform and Privatization of Public Enterprises
"Railroad and Other Infrastructure Privatization" 1996

FCC Forum on Antitrust and Economic Issues Involved with InterLATA Entry
"The Scope of Telecommunications Competition" 1996

Citizens for a Sound Economy Policy Watch on Telecommunications Interconnection
"The Economics of Interconnection" 1996

World Bank Seminar on Experiences with Corporatization
"Strategic Directions of Privatization" 1996

FCC Economic Forum on the Economics of Interconnection
Lessons from Other Industries 1996

ABA Annual Meeting, Section of Antitrust Law
The Integration, Disintegration, and Reintegration
of the Entertainment Industry 1996

Conference Board: 1996 Antitrust Conference
How Economics Influences Antitrust and Vice Versa 1996

Antitrust 1996: A Special Briefing
Joint Ventures and Strategic Alliances 1996

New York State Bar Association Section of Antitrust Law Winter Meeting
Commentary on Horizontal Effects Issues 1996

FTC Hearings on the Changing Nature of Competition in a Global and Innovation-Driven Age
Vertical Issues for Networks and Standards 1995

Wharton Seminar on Applied Microeconomics
Access Policies with Imperfect Regulation 1995

Antitrust 1996, Washington D.C.
Assessing Joint Ventures for Diminution of Competition 1995

ABA Annual Meeting, Section of Antitrust Law
Refusals to Deal -- Economic Tests for Competitive Harm 1995

FTC Seminar on Antitrust Enforcement Analysis
Diagnosing Collusion Possibilities 1995

Philadelphia Bar Education Center: Antitrust Fundamentals
Antitrust--The Underlying Economics 1995

Vanderbilt University Conference on Financial Markets

Why Do Christie and Schultz Infer Collusion From Their Data? 1995

ABA Section of Antitrust Law Chair=s Showcase Program
Discussion of Telecommunications Competition Policy 1995

Conference Board: 1995 Antitrust Conference
Analysis of Mergers and Joint Ventures 1995

ABA Conference on The New Antitrust: Policy of the '90s
Antitrust on the Super Highways/Super Airways 1994

ITC Hearings on The Economic Effects of Outstanding Title VII Orders
"The Economic Impacts of Antidumping Policies" 1994

OECD Working Conference on Trade and Competition Policy
"Empirical Evidence on The Nature of Anti-dumping Actions" 1994

Antitrust 1995, Washington D.C.
"Rigorous Antitrust Standards for Distribution Arrangements" 1994

ABA -- Georgetown Law Center: Post Chicago-Economics: New Theories - New Cases?
"Economic Foundations for Vertical Merger Guidelines" 1994

Conference Board: Antitrust Issues in Today's Economy
"New Democrats, Old Agencies: Competition Law and Policy" 1994

Federal Reserve Board Distinguished Economist Series
"Regulated Private Enterprise Versus Public Enterprise" 1994

Institut d'Etudes Politiques de Paris
"Lectures on Competition Policy and Privatization" 1993

Canadian Bureau of Competition Policy Academic Seminar Series, Toronto.
"Public Versus Regulated Private Enterprise" 1993

CEPS Symposium on The Clinton Administration: A Preliminary Report Card
"Policy Towards Business" 1993

Columbia Institute for Tele-Information Conference on Competition in Network Industries, New York, NY
"Discussion of Deregulation of Networks: What Has Worked and What Hasn't" 1993

World Bank Annual Conference on Development Economics
"Public Versus Regulated Private Enterprise" 1993

Center for Public Utilities Conference on Current Issues Challenging the Regulatory Process
"The Economics of Current Issues in Telecommunications Regulation" 1992
"The Role of Markets in Presently Regulated Industries" 1992

The Conference Board's Conference on Antitrust Issues in Today's Economy, New York, NY
"Antitrust in the Global Economy" 1992
"Monopoly Issues for the '90s" 1993

Columbia University Seminar on Applied Economic Theory, New York, NY
"Economic Rationales for the Scope of Privatization" 1992

Howrey & Simon Conference on Antitrust Developments, Washington, DC
"Competitive Effects of Concern in the Merger Guidelines" 1992

Arnold & Porter Colloquium on Merger Enforcement, Washington, DC
"The Economic Foundations of the Merger Guidelines" 1992

American Bar Association, Section on Antitrust Law Leadership Council Conference, Monterey, CA
"Applying the 1992 Merger Guidelines" 1992

OECD Competition Policy Meeting, Paris, France
"The Economic Impacts of Antidumping Policy" 1992

Center for Public Choice Lecture Series, George Mason University Arlington, VA
"The Economic Impacts of Antidumping Policy" 1992

Brookings Institution Microeconomics Panel, Washington, DC,
"Discussion of the Evolution of Industry Structure" 1992

AT&T Conference on Antitrust Essentials
"Antitrust Standards for Mergers and Joint Ventures" 1991

ABA Institute on The Cutting Edge of Antitrust: Market Power
"Assessing and Proving Market Power: Barriers to Entry" 1991

Second Annual Workshop of the Competition Law and Policy Institute of New Zealand
"Merger Analysis, Industrial Organization Theory, and Merger Guidelines" 1991
"Exclusive Dealing and the Fisher & Paykel Case" 1991

Special Seminar of the New Zealand Treasury
"Strategic Behavior, Antitrust, and The Regulation of Natural Monopoly" 1991

Public Seminar of the Australian Trade Practices Commission
"Antitrust Issues of the 1990's" 1991

National Association of Attorneys General Antitrust Seminar
"Antitrust Economics" 1991

District of Columbia Bar's 1991 Annual Convention
"Administrative and Judicial Trends in Federal Antitrust Enforcement" 1991

ABA Spring Meeting
"Antitrust Lessons From the Airline Industry" 1991

Conference on The Transition to a Market Economy - Institutional Aspects
"Anti-Monopoly Policies and Institutions" 1991

Conference Board's Thirtieth Antitrust Conference
"Antitrust Issues in Today's Economy" 1991

American Association for the Advancement of Science Annual Meeting
"Methodologies for Economic Analysis of Mergers" 1991

General Seminar, Johns Hopkins University
"Economic Rationales for the Scope of Privatization" 1991

Capitol Economics Speakers Series
"Economics of Merger Guidelines" 1991

CRA Conference on Antitrust Issues in Regulated Industries
"Enforcement Priorities and Economic Principles" 1990

Pepper Hamilton & Scheetz Anniversary Colloquium
"New Developments in Antitrust Economics" 1990

PLI Program on Federal Antitrust Enforcement in the 90's
"The Antitrust Agenda of the 90's" 1990

FTC Distinguished Speakers Seminar
"The Evolving Merger Guidelines" 1990

The World Bank Speakers Series
"The Role of Antitrust Policy in an Open Economy" 1990

Seminar of the Secretary of Commerce and Industrial Development of Mexico
"Transitions to a Market Economy" 1990

Southern Economics Association
"Entry in Antitrust Analysis of Mergers" 1990
"Discussion of Strategic Investment and Timing of Entry" 1990

American Enterprise Institute Conference on Policy Approaches to the Deregulation of Network Industries
"Discussion of Network Problems and Solutions" 1990

American Enterprise Institute Conference on Innovation, Intellectual Property, and World Competition
"Law and Economics Framework for Analysis" 1990

Banco Nacional de Desenvolvimento Economico Social Lecture
"Competition Policy: Harnessing Private Interests for the Public Interest" 1990

Western Economics Association Annual Meetings
"New Directions in Antitrust from a New Administration" 1990
"New Directions in Merger Enforcement: The View from Washington" 1990

Woodrow Wilson School Alumni Colloquium
"Microeconomic Policy Analysis and Antitrust--Washington 1990" 1990

Arnold & Porter Lecture Series
"Advocating Competition" 1991
"Antitrust Enforcement" 1990

ABA Antitrust Section Convention
"Recent Developments in Market Definition and Merger Analysis" 1990

Federal Bar Association
"Joint Production Legislation: Competitive Necessity or Cartel Shield?" 1990

Pew Charitable Trusts Conference
"Economics and National Security" 1990

ABA Antitrust Section Midwinter Council Meeting
"Fine-tuning the Merger Guidelines" 1990
"The State of the Antitrust Division" 1991

International Telecommunications Society Conference
"Discussion of the Impact of Telecommunications in the UK" 1989

The Economists of New Jersey Conference
"Recent Perspectives on Regulation" 1989

Conference on Current Issues Challenging the Regulatory Process
"Innovative Pricing and Regulatory Reform" 1989
"Competitive Wheeling" 1989

Conference Board: Antitrust Issues in Today's Economy
"Foreign Trade Issues and Antitrust" 1989

McKinsey & Co. Mini-MBA Conference
"Economic Analysis of Pricing, Costing, and Strategic Business Behavior" 1989
1994

Olin Conference on Regulatory Mechanism Design
"Revolutions in Regulatory Theory and Practice: Exploring The Gap" 1989

University of Dundee Conference on Industrial Organization and Strategic Behavior
"Mergers in Differentiated Product Industries" 1988

Leif Johanson Lectures at the University of Oslo
"Normative Issues in Industrial Organization" 1988

Mergers and Competitiveness: Spain Facing the EEC
"Merger Policy" 1988
"R&D Joint Ventures" 1988

New Dimensions in Pricing Electricity
"Competitive Pricing and Regulatory Reform" 1988

Program for Integrating Economics and National Security: Second Annual Colloquium
"Arming Decisions Under Asymmetric Information" 1988

European Association for Research in Industrial Economics
"U.S. Railroad Deregulation and the Public Interest" 1987
"Economic Rationales for the Scope of Privatization" 1989
"Discussion of Licensing of Innovations" 1990

Annenberg Conference on Rate of Return Regulation in the Presence of Rapid Technical Change
"Discussion of Regulatory Mechanism Design in the Presence
of Research, Innovation, and Spillover Effects" 1987

Special Brookings Papers Meeting
"Discussion of Empirical Approaches to Strategic Behavior" 1987
"New Merger Guidelines" 1990

Deregulation or Regulation for Telecommunications in the 1990's
"How Effective are State and Federal Regulations?" 1987

Conference Board Roundtable on Antitrust
"Research and Production Joint Ventures" 1990
"Intellectual Property and Antitrust" 1987

Current Issues in Telephone Regulation
"Economic Approaches to Market Dominance: Applicability of Contestable Markets" 1987

Harvard Business School Forum on Telecommunications
"Regulation of Information Services" 1987

The Fowler Challenge: Deregulation and Competition in The Local Telecommunications Market
"Why Reinvent the Wheel?" 1986

World Bank Seminar on Frontiers of Economics
"What Every Economist Should Know About Contestable Markets" 1986
Bell Communications Research Conference on Regulation and Information
"Fuzzy Regulatory Rules" 1986

Karl Eller Center Forum on Telecommunications
"The Changing Economic Environment in Telecommunications: Technological Change and Deregulation" 1986

Railroad Accounting Principles Board Colloquium
"Contestable Market Theory and ICC Regulation 1986

Canadian Embassy Conference on Current Issues in Canadian -- U.S. Trade and Investment
"Regulatory Revolution in the Infrastructure Industries" 1985

Eagleton Institute Conference on Telecommunications in Transition
"Industry in Transition: Economic and Public Policy Overview" 1985

Brown University Citicorp Lecture
"Logic of Regulation and Deregulation" 1985

Columbia University Communications Research Forum
"Long Distance Competition Policy" 1985

American Enterprise Institute Public Policy Week
"The Political Economy of Regulatory Reform" 1984

MIT Communications Forum
"Deregulation of AT&T Communications" 1984

Bureau of Census Longitudinal Establishment Data File and Diversification Study Conference
"Potential Uses of The File" 1984

Federal Bar Association Symposium on Joint Ventures
"The Economics of Joint Venture Assessment" 1984

Hoover Institute Conference on Antitrust
"Antitrust for High-Technology Industries" 1984

NSF Workshop on Predation and Industrial Targeting
"Current Economic Analysis of Predatory Practices" 1983

The Institute for Study of Regulation Symposium: Pricing Electric, Gas, and Telecommunications Services Today and for the Future
"Contestability As A Guide for Regulation and Deregulation" 1984

University of Pennsylvania Economics Day Symposium
"Contestability and Competition: Guides for Regulation and Deregulation" 1984

Pinhas Sapir Conference on Economic Policy in Theory and Practice
"Corporate Governance and Market Structure" 1984

Centre of Planning and Economic Research of Greece
"Issues About Industrial Deregulation" 1984
"Contestability: New Research Agenda" 1984

Hebrew and Tel Aviv Universities Conference on Public Economics
"Social Welfare Dominance Extended and Applied to Excise Taxation" 1983

NBER Conference on Industrial Organization and International Trade
"Perspectives on Horizontal Mergers in World Markets" 1983

Workshop on Local Access: Strategies for Public Policy
"Market Structure and Government Intervention in Access Markets" 1982

NBER Conference on Strategic Behavior and International Trade
"Industrial Strategy with Committed Firms: Discussion" 1982

Columbia University Graduate School of Business, Conference on Regulation and New Telecommunication Networks
"Local Pricing in a Competitive Environment" 1982

International Economic Association Roundtable Conference on New Developments in the Theory of Market Structure

"Theory of Contestability" 1982
"Product Dev., Investment, and the Evolution of Market Structures" 1982

N.Y.U. Conference on Competition and World Markets: Law and Economics
"Competition and Trade Policy--International Predation" 1982

CNRS-ISPE-NBER Conference on the Taxation of Capital
"Welfare Effects of Investment Under Imperfect Competition" 1982

Internationales Institut fur Management und Verwalturg Regulation Conference
"Welfare, Regulatory Boundaries, and the Sustainability of Oligopolies" 1981
NBER-Kellogg Graduate School of Management Conference on the Econometrics of Market Models with Imperfect Competition
"Discussion of Measurement of Monopoly Behavior: An Application to the Cigarette Industry" 1981

The Peterkin Lecture at Rice University
"Deregulation: Ideology or Logic?" 1981

FTC Seminar on Antitrust Analysis
"Viewpoints on Horizontal Mergers 1982
"Predation as a Tactical Inducement for Exit" 1980

NBER Conference on Industrial Organization and Public Policy
"An Economic Definition of Predation" 1980

The Center for Advanced Studies in Managerial Economics Conference on The Economics of Telecommunication
"Pricing Local Service as an Input" 1980

Aspen Institute Conference on the Future of the Postal Service
"Welfare Economics of Postal Pricing" 1979

Department of Justice Antitrust Seminar
"The Industry Performance Gradient Index" 1979

Eastern Economic Association Convention
"The Social Performance of Deregulated Markets for Telecom Services" 1979

Industry Workshop Association Convention
"Customer Equity and Local Measured Service" 1979

Symposium on Ratemaking Problems of Regulated Industries
"Pricing Decisions and the Regulatory Process" 1979

Woodrow Wilson School Alumni Conference
"The Push for Deregulation" 1979

NBER Conference on Industrial Organization
"Intertemporal Sustainability" 1979

World Congress of the Econometric Society
"Theoretical Industrial Organization" 1980

Institute of Public Utilities Conference on Current Issues in Public Utilities Regulation
"Network Access Pricing" 1978

ALI-ABA Conference on the Economics of Antitrust
"Predatoriness and Discriminatory Pricing" 1978

AEI Conference on Postal Service Issues
"What Can Markets Control?" 1978

University of Virginia Conference on the Economics of Regulation
"Public Interest Pricing" 1978

DRI Utility Conference
"Marginal Cost Pricing in the Utility Industry: Impact and Analysis" 1978

International Meeting of the Institute of Management Sciences
"The Envelope Theorem" 1977

University of Warwick Workshop on Oligopoly
"Industry Performance Gradient Indexes" 1977

North American Econometric Society Convention
"Intertemporal Sustainability" 1979
"Social Welfare Dominance" 1978
"Economies of Scope, DAIC, and Markets with Joint Production" 1977

Telecommunications Policy Research Conference
"Transition to Competitive Markets" 1986
"InterLATA Capacity Growth, Capped NTS Charges and Long Distance Competition" 1985
"Market Power in The Telecommunications Industry" 1984
"FCC Policy on Local Access Pricing" 1983
"Do We Need a Regulatory Safety Net in Telecommunications?" 1982
"Anticompetitive Vertical Conduct" 1981
"Electronic Mail and Postal Pricing" 1980
"Monopoly, Competition and Efficiency": Chairman 1979

"A Common Carrier Research Agenda" 1978
"Empirical Views of Ramsey Optimal Telephone Pricing" 1977
"Recent Research on Regulated Market Structure" 1976
"Some General Equilibrium Views of Optimal Pricing" 1975

National Bureau of Economic Research Conference on Theoretical Industrial Organization
"Compensating Variation as a Measure of Welfare Change" 1976
Conference on Pricing in Regulated Industries: Theory & Application
"Ramsey Optimal Pricing of Long Distance Telephone Services" 1977

NBER Conference on Public Regulation
"Income Distributional Concerns in Regulatory Policy-Making" 1977

Allied Social Science Associations National Convention
"Merger Guidelines and Economic Theory" 1990
Discussion of "Competitive Rules for Joint Ventures" 1989
"New Schools in Industrial Organization" 1988
"Industry Economic Analysis in the Legal Arena" 1987
"Transportation Deregulation" 1984
Discussion of "Pricing and Costing of Telecommunications Services" 1983
Discussion of "An Exact Welfare Measure" 1982
"Optimal Deregulation of Telephone Services" 1982
"Sector Differentiated Capital Taxes" 1981
"Economies of Scope" 1980
"Social Welfare Dominance" 1980
"The Economic Definition of Predation" 1979
Discussion of "Lifeline Rates, Succor or Snare?" 1979
"Multiproduct Technology and Market Structure" 1978
"The Economic Gradient Method" 1978
"Methods for Public Interest Pricing" 1977
Discussion of "The Welfare Implications of New Financial Instruments" 1976
"Welfare Theory of Concentration Indices" 1976
Discussion of "Developments in Monopolistic Competition Theory" 1976
"Hedonic Price Adjustments" 1975
"Public Good Attributes of Information and its Optimal Pricing" 1975
"Risk Invariance and Ordinally Additive Utility Functions" 1974
"Consumer's Surplus: A Rigorous Cookbook" 1974

University of Chicago Symposium on the Economics of Regulated Public Utilities
"Optimal Prices for Public Purposes" 1976

American Society for Information Science
"The Social Value of Information: An Economist's View" 1975

Institute for Mathematical Studies in the Social Sciences Summer Seminar

"The Sustainability of Natural Monopoly" 1975

U.S.-U.S.S.R. Symposium on Estimating Costs and Benefits of Information Services
"The Evaluation of the Economic Benefits of Productive Information" 1975

NYU-Columbia Symposium on Regulated Industries
"Ramsey Optimal Public Utility Pricing" 1975

Research Seminars:

Bell Communications Research (2)
Bell Laboratories (numerous)
Department of Justice (3)
Electric Power Research Institute
Federal Reserve Board
Federal Trade Commission (4)
Mathematica
Rand
World Bank (3)
Carleton University
Carnegie-Mellon University
Columbia University (4)
Cornell University (2)
Georgetown University
Harvard University (2)
Hebrew University
Johns Hopkins University (2)
M. I. T. (4)
New York University (4)
Northwestern University (2)
Norwegian School of Economics and Business Administration
University of California, San Diego
University of Chicago
University of Delaware
University of Florida
University of Illinois
University of Iowa (2)
Universite Laval
University of Maryland
University of Michigan
University of Minnesota
University of Oslo
University of Pennsylvania (3)
University of Toronto
University of Virginia
University of Wisconsin
University of Wyoming
Vanderbilt University
Yale University (2)
Princeton University (many)
Rice University
Stanford University (5)
S.U.N.Y. Albany