

# Economics at the Federal Communications Commission: 2006-2007<sup>\*</sup>

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**Abstract:** This article focuses on media ownership and spectrum auction design. These two issues have not only been particularly important at the Federal Communications Commission (FCC) over the last year, but also are being informed by economic analysis either completed at the FCC or commissioned by the FCC.

**Key Words:** Content Diversity, Economic Experiments, Localism, Media Ownership, News Programming, Package Bidding, Public Affairs Programming, Simultaneous Multiple-Round (SMR) Auction, Spectrum Auction Design, Viewpoint Diversity.

## I. Introduction

The Federal Communications Commission (FCC) has the responsibility for regulating U.S. communications consistent with statutory objectives. Its jurisdiction includes the wireline, cable, satellite, broadcasting and wireless communications industries. FCC economists have the responsibility to analyze the economic efficiency of policy proposals and help develop more efficient alternatives.

Major issues that have been at the forefront this year at the FCC include – mergers, spectrum auctions, public safety communications, the universal service fund, media ownership, broadband deployment, and local franchising. Here we will focus on

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discussing the economics that have been called upon to help inform policy-making within the FCC for media ownership and spectrum auction design. To the extent that rule making has as of yet not occurred in the media ownership proceedings, we limit our comments to the studies undertaken as part of the process of rule making and abstract from attempting to make any policy suggestions in this article.

Economic theory has a large role to play in policy making. It is true that theory abstracts from the real world and cannot take into account all of the possible restrictions of policymaking. Nonetheless, economic analysis can provide a useful and rigorous framework in which to consider policy goals and regulatory interventions. Both economic theory and empirical research are important to help determine, first, if there is a market failure, and if so, what is the best *feasible* policy intervention.

Good economic analysis begins with theory. It attempts to model how people, markets, and governments interact and to suggest causal mechanisms. Empirical research can potentially discredit or provide evidence consistent with theory. Moreover, empirical research can help estimate the magnitude of causal links when they exist. Economics can thereby provide policymakers with a greater understanding of causal mechanisms involved in a particular issue. In turn, this can suggest what, among the feasible regulatory interventions, are likely to achieve the desired outcome.

Section II of this article discusses Media ownership. It first presents the policy concerns related to media ownership, and then highlights key findings from some of the media ownership studies completed this year as they relate to the structure of media ownership and various policy concerns. Section III reviews experimental economic tests conducted to provide guidance with auction design. Section IV concludes.

## II. Media Ownership

The Telecommunications Act of 1996 requires that every two years, the FCC review its broadcast ownership rules to "determine whether any of such rules are necessary in the public interest as the result of competition." The Telecommunications Act also states that the FCC must "repeal or modify any regulation that it determines is no longer in the public interest." In 2004, Congress amended the review frequency to a four-year cycle.

The last review of the media ownership regulations was undertaken in 2002, resulting in the release of the 2002 Biennial Review Order in 2003. This order generally relaxed the pre-existing ownership rules. Among the changes were:

1. a relaxation of the local television ownership rule;<sup>1</sup>
2. a change in the method for determining radio markets by replacing the previous contour overlap method with the geography-based market defined by Arbitron;
3. a repeal of prohibited common ownership of a full-service television broadcast station and a daily public newspaper in the same market and the limits on the number of television and radio stations that may be commonly owned with limits that vary with the size of the market. Instead, the Commission imposed a new single rule on cross-media limits. Cross-

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<sup>1</sup> With respect to how many television stations in the same market could be owned by the same owner, the previous rule allowed for television station duopolies, so long as at least one of the stations was not ranked among the market's four largest stations and so long as at least eight independently owned and operated full-power television stations would remain in the market post-merger. Note that in this case duopoly refers to common ownership of two stations, rather than the economic definition of duopoly. The 2003 order relaxed the local television ownership rule to allow for up to three commonly owned television stations in markets with 18 or more television stations and television station duopolies in markets with 17 or fewer television stations. These provisions further required that no single firm could own more than one top-four station in any given market.

ownership is allowed in large markets (with over eight television stations). Newspaper-television cross-ownership along with ownership of up to 50% of the radio stations, or newspaper-radio cross ownership of up to 100% of the radio stations is allowed in medium-sized markets (four to eight television stations). No newspaper-television or radio/television cross-ownership is allowed in markets with three or fewer full-power commercial or noncommercial television stations; and

4. a relaxation of the maximum percentage of national households that a single television owner's stations can reach from 35% to 45%. In January 2004, Congress amended the 1996 Telecommunications Act, increasing the national television ownership rule's audience reach cap from 35% to 39%. Hence, this last change was superseded by Congress.

Shortly after the release of the 2002 Biennial Review Order, several organizations, including the Prometheus Radio Project, filed suits with the courts. In June 2004, the Third Circuit Court of Appeals issued its decision in [\*Prometheus v. FCC\*](#), affirming some Commission decisions and remanding others for further justification or modification:<sup>2</sup>

Though we affirm much of the Commission's Order, we have identified several provisions in which the Commission falls short of its obligation to justify its decisions to retain, repeal, or modify its media ownership regulations with reasoned analysis. The Commission's derivation of new Cross-Media Limits, and its modification of the numerical limits on both television and radio station ownership in local markets, all have the same essential flaw: an unjustified assumption that media outlets of the same type make an equal contribution to diversity and competition in local

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<sup>2</sup> The U.S. Supreme Court declined to review the Third Circuit decision in June 2005.

markets. We thus remand for the Commission to justify or modify its approach to setting numerical limits.<sup>3</sup>

As part of the Third Circuit's ruling, it upheld the FCC's position that a flat ban on newspaper/broadcast combinations was no longer necessary. However, the court remanded the specific numerical caps. Consequently, the 2002 cross-media limits have not taken effect. Similarly the local television rule changes have also not taken effect.

Because of this court decision, as well as the mandated Quadrennial Review of Media Ownership rules, in 2006 the FCC began a review of the existing ownership rules.<sup>4</sup> As part of this review, the FCC commissioned a total of ten Media Ownership studies. These studies were released to the public on July 31, 2007.

Six of the Media Ownership studies were conducted by external economists and four of the studies were conducted by FCC economists.<sup>5</sup> Additionally, Study 2, "Ownership Structure and Robustness of Media," by FCC economists Duwadi, Roberts, and Wise (2007) pulls together data on the availability and ownership of media throughout the entire U.S. from 2002 to 2005. This is one of the largest datasets on media ownership ever assembled and therefore provides the most comprehensive data set to date. Duwadi, Roberts, and Wise collected data on over 1,700 television stations, over 13,500 radio stations, over 7,800 cable systems, and over 1,400 newspapers. Over the four-year time period under consideration, this amounts to over 100,000 observations, and over 13 million data points. The FCC economists aggregated the data to the level of

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<sup>3</sup> [\*Prometheus v. FCC\*](#), 373 F.3d 372, 435.

<sup>4</sup> For a full list of the media ownership rules under review see <http://www.fcc.gov/ownership/rules.html>.

<sup>5</sup> Studies 2, 4, and 10 were undertaken by FCC economists including Pedro Almoguera, Kiran Duwadi, Kenneth Lynch, Scott Roberts, Daniel Shiman, Craig Stroup, George Williams, and Andrew Wise. C. Anthony Bush authored the Technical Appendix on Minority ownership for Study 2.

the designated market areas (DMAs) so that it could be made available to both internal and external authors of the other media ownership studies.

## **II.1. Policy concerns**

During its review of media ownership rules, the FCC must both take into account the current state of the industry and see how current ownership patterns affect the policy goals of localism, diversity, and competition.

The FCC is concerned about local content for a variety of reasons: First, local news and local current affairs information is important to the creation of a sense of community. It helps create a more informed voter base for local elections and may potentially help increase community involvement. Second, in the event of local emergencies, mechanisms for the dissemination of local emergency information are crucial for public safety. Third, our democratic process in the U.S. is such that all elections are inherently local. We vote for our local city and state government officials, and with the electoral system we even vote for our federal government at the local level. Access to local news and local current affairs is therefore crucial to our democratic process.

The FCC's interest in diversity lies in maintaining a diversity of media outlets and of viewpoints. This policy lies at the heart of democracy, which works best with well informed voters. Democracy depends not only on the information that is made available, but also on the manner in which it is presented.

## **II.2. Localism**

Several of the 2007 FCC Media Ownership Studies consider the effects of ownership on the availability of local content. Studies 3, 4, and 6 -- discussed below -- all find statistically significant relationships between ownership structure and the provision of local news. Studies 3 and 6 were undertaken by external economists. Study 4 was completed by four FCC economists.

Study 3, "Television Station Ownership Structure and the Quantity and Quality of Television Programming," by Crawford (2007), considers all television programming available on each major and most minor broadcast and cable television program networks offered in the United States from 2003 to 2006. Crawford measures what programming is produced, what programming is most readily available, and, finally, what programming is watched. This study covers data for 1,583 broadcast stations and 192 Cable Networks.

Crawford analyzes whether there are any empirical patterns to be found between the ownership structure of broadcast television stations and programming. The two main findings from Study 3 in relation to ownership structure are:

- Television stations that are cross-owned with a newspaper in the same market offer more local news programming than do stations that are not cross-owned; and
- Local ownership is associated with more public affairs and family programming.

The first finding, namely that of a positive association of newspaper-television cross-ownership with greater local news programming, suggests the presence of economies of scope for the provision of local news for television stations co-owned with a local

newspaper. This particular finding for local news is also supported in Study 6 which considers different data from the Crawford study.

In Study 6, “The Effects of Cross-Ownership on the Local Content and Political Slant of Local Television News,” Milyo (2007) analyzes local television news broadcasts for three nights in the week leading up to the November 7<sup>th</sup>, 2006, election. The study covers all television stations in markets where at least one station was cross-owned with a newspaper. There are 29 cross-owned television stations in 27 different U.S. markets. In total, Milyo’s study gathers programming information from 104 stations and 312 late-evening news broadcasts. 87 of these news broadcasts are from cross-owned television stations. Each of these broadcasts was taped by Video Monitoring Services and then coded by Milyo and his research assistants.<sup>6</sup>

With respect to local content, Milyo finds that television stations that are cross-owned with a newspaper provided 7 to 10% more local news coverage when one includes sports and weather in the definition of local news and 8 to 10% more local news coverage when one excludes sports and weather from the definition of local news, than is true for the average station that is not cross-owned with a local newspaper. Milyo also finds that cross-owned stations have between 24 and 27% more coverage of state and local politics than do non-cross-owned stations, depending on the model specification. All of these results are statistically significant.

These findings suggest that television stations cross-owned with newspapers benefit from economies of scope with respect to the provision of local news. Conversely, television stations that are cross-owned with a radio station (and not a

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<sup>6</sup> The DVDs of the broadcasts are available at the FCC, and the coding for the broadcasts are posted on the FCC website.

newspaper) provided less coverage of state and local politics and less coverage of local news when sports and weather were excluded from the definition of local news. Milyo stipulates that future research would be needed to understand whether radio cross-ownership encourages a rationalization of content across radio and television formats, or in fact results in less total local political coverage across both radio and television formats.

Study 4, “News Operations” is an internal FCC study composed of four sections that respectively consider

- news programming in television;
- news programming in radio;
- the decision by a radio station to adopt a news format; and
- the quantity of news in newspapers.

We will discuss the other sections of Study 4 later, but one section has findings that are relevant to the issue of local programming. Section II of Study 4, “Ownership Structure, Market Characteristics and the Quantity of News and Public Affairs Programming: An Empirical Analysis of Radio Airplay,” by Lynch (2007) examines a random sampling of broadcasts of over 1,000 radio stations in 2005. With respect to local programming, the only statistically significant finding is that the greater the geographic distance between a radio station’s parent company and the station, the less local public affairs programming was provided.

### **II.3. News and Public Affairs Programming**

FCC Media Studies 4 and 6 also find statistically significant relationships between ownership structure and the provision of total news and public affairs.

Section I of Study 4, “The Impact of Ownership Structure on Television Stations’ News and Public Affairs Programming,” by Shiman (2007) examines the programming of around 6,700 television stations between 2002 and 2005. Shiman finds that television stations that are cross-owned with a newspaper provided 11% more news programming per day. This result is suggestive of economies of scope in news programming for a television station when cross-owned with a local newspaper, and echoes the two similar findings in Crawford (2007) and Milyo (2007) with respect to local news programming. Shiman further finds that each additional co-owned television station in the same market was associated with 15% more news programming. Additional sister stations nationwide tended to lead to less news programming. Local ownership of the television station was associated with 4% less news programming per day.

Section II of Study 4 by Lynch (2007) was described previously and considers radio broadcasts for over 1,000 stations in 2005. Lynch finds that radio stations that are cross-owned with television stations in the same market provide more news than do radio stations that are not cross-owned. Radio stations with more national sister radio stations provide slightly more public affairs, and each additional sister radio station in the same market leads to a 10% increase in the amount of public affairs programming. As discussed above with respect to local public affairs, greater geographic distance of the radio station from its owner also decreases the total amount of news (but not the overall amount of public affairs). This sampling of over 1,000 radio stations includes only three stations that have received waivers from the newspaper cross-ownership rule, and, hence,

as Lynch states clearly, there are not enough cases in this sample to draw meaningful inferences from the findings with respect to that variable.<sup>7</sup>

Section III of Study 4, “Factors that Affect a Radio Station’s Propensity to Adopt a News Format,” by Stroup (2007) examines the format choices of about 8,000 radio stations between 2002 and 2005. The assumption here is that a radio station with a news format is likely to air more news than are other radio stations. Hence, ownership structures that positively affect the likelihood that a station will choose the news format will likely also positively affect the amount of news provided. Stroup finds that a radio station that is cross-owned with a newspaper is four-to-five times more likely to be a news station. Radio stations that are cross-owned with TV stations are two-to-three times more likely to be news stations.

Both of these findings support the idea that economies of scope exist for radio stations cross-owned with either a newspaper or a TV station in the same market. Based on these estimates, cross-ownership with a local newspaper provides greater incentive to choose a news format than does cross-ownership with a TV station. Each sister news radio station in the market increases the likelihood that a radio station will have a news format by about 40%. Using a narrow definition of news format, Stroup finds that each additional parent radio station in the same market makes a station 7% more likely to be a news station.

Section IV of Study 4, “The Effect of Ownership and Market Structure on News Operations,” by Almoguera (2007) examines the amount of news published by 134

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<sup>7</sup> In the three cases of radio stations that are cross-owned with local newspapers in this sample, the radio stations did provide more news, more public affairs, and more local news if one just compares time averages. Again, however, the fact that this sampling of over 1,000 radio stations includes only three cases of radio-newspaper cross-ownership means that one cannot make a reliable statement as to what effects, if any, such cross-ownership has on a radio station based on these data.

newspapers in 2005. These were the only newspapers for which data are available. Based on estimates of column inches devoted to news in the “General News” section of these newspapers, Almoguera finds that newspapers that are co-owned with other newspapers within the same MSA are associated with a 5% drop in the absolute amount of news provided. This study found no statistically significant effect of cross-ownership with radio or TV on the quantity of news published by the newspapers.

The local news broadcast study by Milyo (2007) described earlier, finds that the local late-evening news broadcasts of television stations that are cross-owned with a newspaper provided more news coverage, more local news coverage (including or excluding sports and weather), and more state and local candidate coverage than did other stations in the same markets. These findings are again consistent with the presence of economies of scope for television stations cross-owned with a newspaper in the same market.

#### **II.4. Diversity and Quality of Content**

In Study 5, “Station Ownership and Programming in Radio,” Chipty (2007) analyzes the programming content of the same sample of over 1,000 radio stations in 2005 used by Lynch (2007). However, rather than focusing solely on news programming, Chipty considers all types of programming with an eye towards how ownership structure might affect programming diversity and quality.

As she discusses, there are potentially anti-competitive and pro-competitive effects of common ownership. Consolidation of ownership might lead to lower quality programming, reduced variety, and higher advertising prices. Conversely, “consolidation may allow firms to exploit economies of scale and scope in programming specific genres,

attracting and promoting talent, obtaining desirable non-music programming, and selling advertising.”<sup>8</sup> For example, Sweeting (2006) investigates the impact of either local or national common ownership of radio stations on programming and listenership for 1,095 contemporary music radio stations from 1998 to 2001. Sweeting finds greater song differentiation among commonly-owned local station-pairs in the same format category than their separately-owned station-pairs counterparts. This can be explained by the notion that sister stations in the same market and with the same format want to distinguish themselves from one another so as to maximize their combined listenership.

In Study 5, Chipty finds that at the market level, more concentrated radio markets have less “pile-up” of stations on individual format categories. Moreover, she finds that large national radio owners offer more formats and less pile-up.

Chipty further finds that owners with several local stations offer longer, uninterrupted blocks of sports programming in the evening. This shift towards sports programming, of course, implies a decrease in other types of programming. Chipty’s study also suggests that common ownership results in more diversity in actual programs aired. Based on an analysis of news and sports formatted stations, she finds some overlap in the programs aired across the two formats generally, but not within commonly owned station-pairs within the same market.

Finally, Chipty considers various proxies for station quality, namely ratings/listenership, advertising prices, and advertising quantity. National radio ownership negatively affects advertising prices, while cross-ownership with local television positively affects advertising prices in big markets.<sup>9</sup> Stations with sister

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<sup>8</sup> Chipty (2007), p. 3.

<sup>9</sup> This finding is not present when looking at small markets.

stations in the same market receive higher ratings than do independent stations. A radio station that is cross-owned with a local newspaper is found by Chipty to have higher numbers of listeners than do radio stations that are not cross-owned. Greater listenership for radio stations that are cross-owned with newspapers and higher ratings for radio stations that are cross-owned with television stations are suggestive that this cross-ownership across media is, for whatever reason, correlated positively with these proxies for station quality.

## **II. 5. Diversity of Viewpoint**

Milyo (2007) designed Study 6 specifically to analyze whether or not ownership structure affects the viewpoint presented by a television station in its local news broadcasts. Milyo uses four measures of partisan slant to see if any differences existed between television stations that are cross-owned with newspapers and non-cross-owned stations in the same market and on the same days of reporting. The four measures include:

- political candidate speaking time;
- political candidate coverage;
- coverage of opinion polls favoring one political party or another; and
- partisan issue coverage (defined based on websites of major party candidate for state governor or U.S. Senate in every state intersecting any of the DMAs included in the analysis).

These measures do not allow one to estimate whether or not a particular broadcast is biased or not. They do, however, allow one to see whether a broadcast by one station is

more skewed in one direction than is another station in the same market. In other words, these are relative measures of political slant.

Milyo finds “little consistent and significant difference between cross-owned stations and other major network-affiliated stations in the same market” in terms of any partisan slant of their news coverage. Three of the four measures are not found to be statistically significantly different between cross-owned and non-cross-owned television stations. Specifically, the speaking time devoted to Democrat versus Republican candidates, candidate coverage time of Democrats versus Republicans, and coverage of polls favorable to Democrats or Republicans are all found to have no discernable difference between television stations that are cross-owned with a newspaper relative to television stations in the same market that are not cross-owned.

The only measure of partisan slant that was found, in certain specifications, to be significant is the measure of partisan issue coverage. For those regressions, the difference between Democratic issue coverage and Republican issue coverage ends up being positively associated with newspaper cross-ownership in the first of two specifications preferred by Milyo. In the second specification, overall coverage of partisan issues is not statistically different for cross-owned and non-cross-owned television stations.<sup>10</sup> Finally, in pooled estimates, where Milyo does not separate television stations that are cross-owned with a newspaper from those that are cross-owned with both a newspaper and radio, none of the four measures of partisan slant were statistically significantly related to the common newspaper cross-ownership variable.

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<sup>10</sup> The first and second specifications are identical, except for the inclusion of time and length of broadcast fixed effects in the second specification.

Milyo also considers the newspaper editorial endorsements for the 2004 presidential election and campaign contributions tied to the corporate ownership of each television station. Endorsement for Kerry (Bush) by a newspaper was positively associated with a Democratic (Republican) slant as measured by the difference in state and local candidate speaking time. It was not associated with the other three measures of political slant. Differences in contributions to campaigns are not found to have any relationship with any of the measures of political slant. However, when differences in campaign contributions are interacted with newspaper cross-ownership, Milyo finds that they are positively associated with differences in candidate coverage. The other three measures of political slant were not statistically associated with the interacted cross-ownership and campaign contributions variable.

Finally, Milyo finds that the percentage of the population who voted for Democratic Party presidential candidate John Kerry in each DMA in 2004 is positively associated with the television station's partisan slant towards Democrats in three of the four measures of slant. This last set of results suggests that market characteristics play an important role in determining the political slant of local television broadcasts.

### **III. Spectrum Policy and Auction Design Experiments**

The mandate for the FCC with respect to spectrum allocation is to ensure that the spectrum is used to the benefit of the national public. Specific areas of concern are

- Public safety and national security;
- Efficient deployment of technologies and services;
- Encouragement of further innovations; and
- Protection from excessive concentration of market power.

In 1993, Congress granted the FCC the authority to conduct auctions of licenses for the electromagnetic spectrum through the Omnibus Budget Reconciliation Act. Since 1994, the FCC has conducted auctions of licenses for spectrum. Auctions generally award licenses to those who will use them most effectively (more effectively than random assignment by lottery) and involve less rent-seeking activities than did administrative assignment (comparative hearings).

The Balanced Budget Act of 1997 *requires* the FCC to use auctions to resolve mutually exclusive applications for initial licenses except for public safety radio services, digital television licenses to replace analog licenses, and non-commercial educational and public broadcast stations. Although much emphasis has been placed on auction revenues by the press, it should be pointed out that the welfare gains from the effective use of the spectrum far outweigh any auction revenues collected by the FCC. Hence, it is extremely important for the FCC to carefully design its spectrum auctions.

The FCC relies on economic theory, historical experience, and economic experiments in designing spectrum auctions. Testing an auction design in an economic laboratory is analogous to testing a model of a new aircraft in a wind tunnel. Both wind tunnel tests and economic experiments can provide information about the performance of new designs beyond what experience with old designs or theory can predict. Economic theory and past experience suggest desired outcomes, which the FCC must keep in mind when designing auctions. In particular, ideally auction design should

- Assign licenses efficiently;
- Facilitate efficient spectrum aggregation and substitution;
- Raise significant revenue;

- Assign licenses quickly;
- Be simple and inexpensive to run and participate in;
- Be robust to collusion and other destructive strategic behavior; and
- Be perceived as fair, transparent and objective.

The FCC has employed auction designs to promote these outcomes, although every design must make tradeoffs among the various objectives. The FCC designed and has used simultaneous multiple round (SMR) auctions since its first auction in 1994. In an SMR auction all licenses are available during entire auction and bids are accepted until there are no new bids on any licenses. The fact that all licenses are put up for bid *simultaneously* facilitates both efficient spectrum aggregation and substitution. Giving bidders the ability to aggregate spectrum is important given that the government cannot know optimal bandwidth sizes or geographic coverage. Providing for multiple bidding rounds (ascending auction) along with simultaneity allows bidders to pursue efficient backup strategies as they observe prices changing during the course of the auction. To further facilitate efficient aggregation of geographic areas the FCC has decided to provide for “package” bidding on the C block of the 700 MHz auction scheduled to commence on January 24, 2008. Package (or combinatorial) bidding allows bidders to make all or nothing bids on groups of licenses, avoiding the risk of winning only part of a desired set of licenses. For the 700 MHz auction the FCC has defined three packages of the 12 licenses in the block: the 50 states package, the Atlantic package and the Pacific Package.

The FCC has historically relied upon economic experiments to guide its auction design for spectrum. Most recently, the FCC commissioned two separate economic experiments to help inform its decisions about the 700 MHz and future auction designs.

Spectrum auctions are simulated in a laboratory by assigning experiment participants (typically students) private valuations for licenses and paying them in cash the difference between what they bid and the value of the licenses they win. Experiments can be run with alternative structures of license valuations (*e.g.*, the package AB may be worth A plus B, more than A plus B, or less than A plus B) and with alternative auction designs (*e.g.*, licenses may be auctioned sequentially or simultaneously, in a single round or in multiple rounds, individually or in packages). By repeating experiments multiple times with each design it is possible to make statistically meaningful comparisons of the performance (*e.g.*, efficiency, revenue, and time to completion) of alternative auction designs in a given environment.

Experiments sponsored by PacTel and conducted at Caltech in 1993 helped convince the FCC that auctioning licenses simultaneously in a SMR auction is likely to be more efficient than auctioning them one-at-a-time when the value of a license depends on what other licenses a bidder holds (complementary values). In a SMR auction all licenses are available for bidding throughout the entire auction.

The first auction experiments sponsored by the FCC were conducted at Caltech in 1994 to test the design and software used in the first FCC spectrum auction. As part of the testing of the software, students were paid a bonus if they identified any errors in the software.

The most recent auction experiments sponsored by the FCC were run in 2006 and 2007 by Goeree, Holt, and Ledyard (G-H-L). In 2006, G-H-L tested the efficiency of package bidding within SMR auctions relative to SMR auctions without the option of combinatorial bidding. Package bidding was found to increase the efficiency of the

auction, as measured by how well the auction allocates licenses to those with the highest valuations, when complementarities between licenses are high. While package bidding was found to require 20% more rounds than did the simple SMR auction, all licenses were sold under package bidding, whereas some licenses remained unsold in the simple SMR auction.

In 2007, G-H-L tested two alternative package bidding auction designs: “Modified flexible package bidding” in which bidders could define their own packages was compared to “tiered package bidding” in which the regional packages are predefined. Both types of package bidding were compared to SMR without any package bidding as a benchmark.

In these experiments a “national bidder” is interested in acquiring all 12 licenses in the “National Block,” while each of the six “regional bidders” is interested in four geographically adjacent licenses in the National Block and two licenses in the “Regional Block.” Regional bidders were allowed to acquire a maximum of four licenses.

In four of the five experimental trials all of the licenses were complements -- i.e., they are of greater value in packages than individually. In one of the trials, only licenses in the National Block were complements. Without package bidding, bidders face the “exposure” risk of not winning the entire package that they are seeking and paying more than their valuation of the licenses that they do win. For example, suppose that for some bidder license A is worth \$50 alone, license B is worth \$75 alone, and the package AB is worth \$150. Without package bidding if the bidder bids \$60 for A and \$85 for B, he will have a net gain of \$5 if he wins both A and B. But if he ends up winning only A or only B, he will have a net loss of \$10.

On the other hand, with package bidding some bidders face the “threshold” or “free rider” problem of being unable to beat a package bid by combining their bids with those of other bidders even though their combined value for the licenses exceeds that of the party making the package bid. For example, suppose bidder 1 values license A at \$100, bidder 2 values license B at \$150 and bidder 3 values the package AB at \$200. Bidder 1 would like bidder 2 to bid as high as possible thus minimizing the amount that bidder 1 must bid in order for the sum of the individual bids on A and B to beat the package bid on AB. The analogous reasoning applies to bidder 2, who would like to free ride on bidder 1’s making up the shortfall between the individual bids and the package bid.

The threshold problem may be even more difficult when bidders are interested in overlapping packages. For example, consider the case of four licenses: A, B, C, and D. Bidder 1’s bid on package ABC can’t be combined with bidder 2’s bid on CD to beat bidder 3’s bid on ABCD because packages ABC and CD overlap. For bidders 1 and 2 collectively to beat bidder 3’s bid they must make non-overlapping bids that include all four licenses: e.g., packages AB and CD.

The G-H-L experiments were designed to provide insights into this aspect of the threshold problem. The four adjacent licenses in the National Block that each regional bidder is interested in partially overlap; *e.g.*, bidder 1 is interested in licenses A, B, C and D, while bidder 2 is interested in licenses C, D, E and F. Note that in the tiered package bidding design, the predefined packages only match the preferred packages for half of the regional bidders.

One might expect that the greatest efficiency would occur when bidders are allowed to define their own packages. However, the G-H-L experiments find that the predefined, “tiered” package bidding outperformed flexible package bidding both in terms of efficiency (93% relative to 83%) and auction revenue. The reason for this is that the simplicity and transparency of the package definitions and pricing under tiered packages helps regional bidders coordinate and more effectively compete with the national bidder. Essentially, these gains were sufficient to offset the losses due to limited and imperfect package choices under the tiered package auction.

When bidders were able to define their own packages, those packages tended to overlap, causing a “fitting problem” that made it difficult for strong regional bidders to unseat a national package bid. This was evident in the fact that under the flexible design auction, the national bidder won more licenses than optimal. Even when the national bidder did not win all the licenses in a particular round, regional bidders were unable to coordinate their bids in the sense that a significant number of the licenses had no provisional winner. This problem did not occur with the predefined tiered packages.

As expected given the 2006 experiment, with significant value complementarities among licenses, both types of package bidding auctions outperformed the simple SMR auctions in terms of efficiency and revenue. However the tiered package design, with a limited number of non-overlapping, pre-specified licenses, was more efficient and raised more revenue than did the flexible package bidding design where bidders could design their own packages. This was true even though the tiered packages only matched the preferred packages of half of the regional bidders. The average economic efficiency (actual allocation value/best allocation value) was 85.1% for SMR auctions without

package bidding, 89.7% for flexible package bidding auctions, and 92% for tiered package bidding auctions.

These results suggest that predefined, tiered package bidding will generally outperform flexible package bidding when a) regional bidders have sufficiently overlapping preferences that coordination between the regional bidders is problematic, and b) the FCC can predefine packages that reasonably match the preferences of regional bidders. If the predefined tiered packages badly match the bidders' preferences, then flexible bidding will likely be more efficient. This underlines the importance of the FCC's choosing the tiered packages carefully when using the tiered package bidding design. Based at least in part on these experimental results, the FCC will be using the tiered package bidding auction design in the upcoming 700 MHz Auction.

#### **IV. Conclusion**

While we have presented only some of the economic analysis being used to help guide policy making at the FCC, these examples illustrate the usefulness of thorough economic analysis for the FCC as well as for other government institutions. Strong theoretical work, combined with empirical or experimental work, can provide clear insights into the markets and relationships under consideration in most policy settings. Even if objectives are non-economic, economics can help regulatory agencies identify the true mechanisms involved and thereby guide decisions as to the best feasible policy choices.

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