bidders need not fear serious overbidding. Additionally, PCS licenses will be awarded far more expeditiously, possibly years sooner, than would likely occur with sequential oral auctions.

Use of a separate national license to facilitate aggregation is both unnecessary and inefficient. With simultaneous ascending bid auctions, such a license can be readily assembled by a bidder. Furthermore, auctioning a national license separately is likely to lead to inefficient aggregation. The existence of the separate auction for a national license also reduces competition for the individual licenses, leading to lower prices.

In sum, the recommended auction design, with several rounds of sealed bids for the simultaneous sale of different geographic areas, is preferable to the Commission's two-part system of sequential oral auctions for different geographic areas in conjunction with a separate sealed bid for a national license.

Appendix A

Appendix B

FCC Bid Data Compiliation Sheet
MTA 1 and Channel Block A

	Day 1	Day 2	Day 3	Day 4	...
Minimum Valid Bid					
Suggested Minimum Bid					
Bidder 1					
Bidder 2					
Bidder 3					
⋮					
Maximum Bid					

PCS Auction Bid Sheet for
Channel Block A

Bidder Code Number:_____
Date:_____
Time:_____

MTA	Channel Block A $ (bid)

Appendix C

1. Simultaneous Auctions of Channel Blocks A and B

As mentioned in section III, all the 102 Channel Block A and B licenses could be auctioned simultaneously with 51 MTA auctions. Such a series of auctions would more rapidly award the PCS licenses and yield more information to the bidders with which to estimate the values of the licenses. This section describes the modifications to the recommended auction design that would be necessary to implement the simultaneous auctioning of Channel Blocks A and B.

The first round of the auction is identical to the recommended auctions in which the Channel Block A licenses are sold for all 51 MTAs, followed by the Channel Block B licenses. The auction proceeds to the second round if at least *three* applicants submit bids as large as the suggested minimum bid. Thus the auction can end in one of two ways:

1. No bids submitted,
2. Bids submitted, but two or fewer in excess of the suggested minimum bid.

If no bids are received, then the two highest bidders in the previous round win the auction for Channel blocks A and B for a given MTA. The firm with the highest bid gets to pick whether it wants Channel Block A or B. Note that one firm cannot win both Channel Blocks because of the Commission's 40 MHz maximum.

If exactly two bids are submitted that exceed the suggested minimum bid, then these two applicants win the auction for Channel Blocks A and B for the given MTA. Again, the firm with the highest bid gets to pick whether it prefers Channel Block A or B.

If one bid is submitted that exceeds the suggested minimum bid, then this applicant and the second highest bidder win the auction for Channel Blocks A and B, and the applicant with the highest bid selects which of the two blocks it prefers.

Finally, if bids are submitted but none exceed the suggested minimum bid, then the two highest bidders win the auction for Channel Blocks A and B and, again, the applicant with the highest bid selects its preferred block.

In the case of ties, the tied applicants submit one final round of sealed bids to determine the winners.

2. Reserve Prices

It is quite common for sellers to impose reserve prices, or minimum acceptable bids. The imposition of an appropriate reserve price tends to force prices paid to be higher. The effect of a reserve price is approximately to add an additional bidder, i.e., the seller, to the pool of bidders, increasing the price paid when the competition is not very intense. Reserve prices also carry some risk that the license will not sell at all, when no bidder is willing to pay the reserve price. Viewed this way, it becomes clear that reserve prices are less important when there are many bidders.

While appropriately chosen reserve prices may increase the government's revenue, three factors mitigate against the imposition of a reserve. First, reserve prices operate by creating an inefficiency because in some circumstances the government may end up not selling the license even though a bidder was willing to pay something for it. Thus, the imposition of reserve prices conflicts with the goal of efficiency. Second, if the Commission will attempt in the future to sell all unsold license rights, or award them by lottery, the usefulness of a reserve price is undercut, because a buyer has the opportunity to wait until the next sale rather than pay the reserve price. This will tend to eliminate the effectiveness of the reserve in forcing prices up, while causing the Commission to incur the

additional transaction costs associated with resale. Finally, one of the main advantages of auctions is that they allow a seller to obtain a fair market price without knowing the demand. However, in order to implement an appropriate reserve price, the Commission would have to have assembled substantial information regarding demand. Thus, in imposing a reserve, the Commission risks imposing an inappropriate reserve, which might be worse than no reserve at all.

For these reasons, I agree with the Commission that it should not impose a reserve price (see Notice at ¶ 66-67). However, I recommend that the Commission impose *suggested* increments, as a way to encourage faster completion of the auction. Because such suggested increments are not binding, they do not operate like reserve prices, and in particular do not induce an inefficient outcome.

3. Royalties

A royalty is a payment made to the government by the winning bidder, generally a percentage of revenue, although percentages of profit are sometimes used. Appropriately chosen royalties can increase the revenue of the seller. Royalties are used in offshore oil sales and book publishing contracts. The equivalent of a royalty for a buying contract, called *cost-sharing*, is observed in procurement auctions.

Royalties increase the revenue of the government by two distinct means. First, royalties shift risk from the winning bidder to the government. Provided the bidders are more averse to risk than the government, this risk shifting or risk sharing has the effect of reducing the risk to the government. The associated cost of risk, the *risk premium,* accrues to the government (see Notice at ¶ 70). Second, royalties tend to "level the playing field" among the bidders -- bidders with a high value of a license will not be so much better positioned than bidders with a low value because the bidders with a high value must pay a larger royalty (a percentage of the larger value) to the government. This

makes weaker competitors relatively stronger and ensures a more competitive outcome to the auction.

Royalties create an inefficiency analogous to the inefficiencies created by taxation: the winning bidder retains a smaller portion of the revenues, and therefore has less incentive to develop the license fully. Thus, royalties trade off efficiency against revenue raising, and for this reason, I do not recommend their use in the PCS context.

Moreover, the base for royalties may be quite difficult to measure. It is preferable to impose the royalty on revenue associated with the license, which means revenue associated with the use of the spectrum. However, the price competition in cellular has focused on the pricing of equipment rather than the pricing of the airwaves. It is not uncommon to see the cellular phone virtually given away in exchange for a commitment to use a particular cellular provider for some period of time. This arrangement presumably serves the consumer well. Imposing royalties on revenue associated with the use of the spectrum may encourage firms to "play games" in attempting to avoid the royalties. For example, by charging a large price for the equipment and reducing the price of the airwaves. Such avoidance of royalties reduces the efficiency of the market and deters firms from serving consumers as well as they might.

Finally, royalties would require an army of accountants and auditors to ensure that firms pay the appropriate royalties and do not shift revenues from PCS to paging or cellular or other operations. Given the complexity of the wireless market, the ability of firms to shift revenues would likely create huge transactions costs in collection of the revenues, interfering with the efficiency of the market.

4. Risk Aversion

Because PCS spectrum is expected to sell for a large amount of money, firms may potentially gain or lose very large amounts of money. Therefore, the attitudes of the firms toward risk may be significant in determining the prices paid for PCS license rights.

Auctions present bidders with two types of risk: risk associated with the *winner's curse* and risk associated with whether one wins the auction or not. The risk associated with the winner's curse tends to favor ascending-bid auctions, because the release of information reduces the *risk premium*, or cost of risk, associated with participation in the auction, a dollar amount lost to the seller. However, risk associated with winning or losing the auction, ignoring *winner's curse* effects, tends to favor first-price, sealed-bid auctions. This follows because a slight increase in the bid tends to reduce the likelihood of losing, which is a tradeoff that a risk-averse firm is willing to make, at least starting from the bid which maximizes average profits.

Given the enormous uncertainty of the value of the licenses, risk associated with winner's curse effects may well dominate risk associated with winning or losing the auction. But on balance, it is impossible to say which auction form is preferred given aversion to risk by the bidders.

Risk aversion affects the efficiency of the auction insofar as the bidders have different levels of risk aversion. Typically, one might expect small firms to be more averse to large financial risks than large firms, as large firms have the resources to withstand larger losses. This may give large firms an advantage in bidding on the more valuable licenses. To some extent, the reduction of risk associated with ascending bid auctions may then favor small firms over the riskier first-price, sealed-bid auctions.

5. Second-Price, Sealed-Bid Auctions and a National License

The Commission suggests that a second-price, sealed-bid auction may solve the free rider problem associated with the use of a national license (see Notice at ¶ 62). This reasoning is incorrect. The use of second-price, sealed-bid auctions does not necessarily create efficient outcomes. The reason is that bidders for individual licenses no longer have an incentive to bid their estimated value of the license, even ignoring winner's curse effects. Formally, in a private values environment, where bidders know their own value, bidders in the individual auction have an incentive to *overstate* their actual values. The reason is that a slight increase in the bid over one's actual value has a negligible effect on profits conditional on outbidding the others for the individual license (since it produces a small probability of a small loss) but a non-negligible effect on the likelihood that the license is sold individually rather than as a group. Thus, the value revelation of the second-price, sealed-bid auction is destroyed by the use of the bids to determine whether to sell the licenses as a group. Nevertheless, the use of second-price, sealed-bid auctions may assist in permitting efficient assembly relative to other options, although it can not generally overcome the combinatorial problem short of using trillions of auctions.

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PUBLICATIONS

ARTICLES

[1] "Endogenous Availability, Cartels and Merger in an Equilibrium Price Dispersion", forthcoming ***Journal of Economic Theory.***

[2] "Industrial Blackmail: Dynamic Tax Competition and Public Investment", forthcoming ***Canadian Journal of Economics*** (with Ian King and Linda Welling).

[3] "The Price Decline Anomaly", forthcoming ***Journal of Economic Theory***, (with Daniel Vincent)

[4] "Horizontal Mergers in Spatially Differentiated Noncooperative Markets" forthcoming ***Journal of Industrial Economics***, (with Joseph Simons and Michael Williams).

[5] "Updating the Reserve Price in Common Value Auctions" ***American Economic Review Papers and Proceedings***, May 1992, 512-8 (with Daniel Vincent).

[6] "The Competitive Effects Section", ***International Merger Law Events and Commentary 21***, May 1992, 6-9 (with Joseph Simons and Michael Williams).

[7] "Investment Decisions under First and Second Price Auctions", forthcoming ***Economic Letters***, (with Ian King and Linda Welling).

[8] "Animal Spirits" ***American Economic Review 82***, no.3, June 1992, 493-507 (with Peter Howitt).

[9] "Bidding Rings", ***American Economic Review 82***, no.3, June 1992, 579-99 (with John McMillan).

[10] "Amicable Divorce: Dissolving a Partnership with Simple Mechanisms", ***Journal of Economic Theory 56***, no.2, April 1992, 266-93.

[11] "A Dominant Strategy Double Auction", forthcoming ***Journal of Economic Theory 56***, no.2, April 1992, 434-50.

[12] "Horizontal Mergers and Antitrust Policy", forthcoming ***Journal of Industrial Economics*** (with Michael Williams).

[13] "A Stone-Weierstrass Theorem without Closure under Suprema", ***Proceedings of the American Mathematical Society 114***, Number 1, January 1992, 61-67 (with Philip Reny).

[14] "On What Economic Grounds should Horizontal Mergers be Challenged?", ***International Merger Law*** (with Michael Williams), no. 7, March 1991.

[15] "Optimal Contracts for Teams", ***International Economic Review 32***, no.3, August 1991: 561-77 (with John McMillan).

[16] "Correlated Information and Mechanism Design", ***Econometrica 60***, No. 2, March 1992, 395-421 (with Philip Reny).

[17] "Efficient Allocation with Continuous Quantities", ***Journal of Economic Theory 53***, no. 1, February 1991: 51-74.

[18] "Externalities and Asymmetric Information", ***Quarterly Journal of Economics*** **CVI**, no. 1, February 1991: 103-121 (with Jeremy Greenwood).

[19] "Extracting the Surplus in Common Value Auctions", ***Econometrica 57***, no.6, November, 1989: 1451-9, (with John McMillan and Philip Reny).

[20] "The Department of Justice Merger Guidelines: A Critique and a Proposed Improvement", ***Pepperdine Law Review 6***, no.4, 1989 (with Michael Williams).

[21] "Government Procurement and International Trade", ***Journal of International Economics 26***, 1989: 291-308 (with John McMillan).

[22] "Commodity Bundling by a Monopolist," ***Quarterly Journal of Economics***, May 1989, 371-83 (with John McMillan and Michael Whinston).

[23] "Multidimensional Incentive Compatibility and Mechanism Design", ***Journal of Economic Theory 46***, December 1988: 335-54 (with John McMillan).

[24] "Stability of Equilibria with Aggregate Externalities", ***Quarterly Journal of Economics 103***, May 1988: 261-77 (with Peter Howitt).

[25] "Search Mechanisms", ***Journal of Economic Theory 44***, February 1988: 99-123 (with John McMillan).

[26] "Can Event Studies Detect Anticompetitive Mergers?", ***Economic Letters 28***, 1988: 199-203 (with Michael Williams).

[27] "Auctions with a Stochastic Number of Bidders", ***Journal of Economic Theory 43***, October 1987: 1-19 (with John McMillan).

[28] "Competition For Agency Contracts", ***Rand Journal of Economics***, Summer 1987 (with John McMillan).

[29] "Auctions with Entry", ***Economics Letters 23***, 1987: 343-7 (with John McMillan).

[30] "Auctions and Bidding", ***Journal of Economic Literature***, June 1987 (with John McMillan).

[31] "Nonlinear Contracts, Zero Profits and Moral Hazard", ***Economica 54***, February 1987: 97-102 (with Raymond Fishe).

[32] "Costly Search and Recruiting", ***International Economic Review 28***, February 1987: 89-107 (with Peter Howitt).

[33] "Bidding for Contracts: A Principal-Agent Analysis", ***Rand Journal of Economics***, Autumn 1986 (with John McMillan)

[34] "Sequential Procurement Auctions", ***Journal of Public Economics 31***, 1986: 181-95 (with Richard Luton).

[35] "Optimal Tenure and the Timing of Faculty Meetings", ***Studies in Economic Analysis 10***, 1986.

[36] "Unemployment Insurance and the Entitlement Effect: A Tax Incidence Approach", ***International Economic Review 27***, February 1986 (with John Barron and Paul Speaker).

[37] "Joint Search for Several Goods", ***Journal of Economic Theory 32***, April 1984 (with John Carlson).

[38] "American Economic Growth and the Voyage of Columbus", ***American Economic Review***, September 1983.

[39] "Discrete Equilibrium Price Dispersion", ***Journal of Political Economy***, June 1983 (with John Carlson).

[40] "On the use of Bonus Payments in an Experimental Study of Electricity Demand", ***Review of Economics and Statistics LXV***, no.3, August 1983: 506-11 (with Raymond Fishe).

[41] "Optimal Design of a Decision Support System", ***International Journal of Policy Analysis and Information Systems 6***, 1982 (with Andrew Whinston).

[42] "An OIS Model for Internal Control Evaluation", ***ACM Transactions on Office Information Systems***, ACM-SIGOA, November 1982 (with Andrew Bailey, James Gerlach and Andrew Whinston).

[43] "An Application of Complexity Theory to the Analysis of Internal Control", ***Auditing: A Journal of Practice and Theory***, Summer 1981: 38-52 (with Andrew Bailey and Andrew Whinston).

[44] "Internal Accounting Controls in the Office of the Future", ***IEEE Computer Journal***, May 1981 (with Andrew Bailey, James Gerlach and Andrew Whinston).

[45] "Formal Analysis of Internal Control-An Introduction" ***The Proceedings of the First European Workshop on Information Systems***, Aix-en-Provence,1981 (with Andrew Bailey, James Gerlach and Andrew Whinston).

[46] "A Formal Model of Problem Solving", ***International Journal of Policy Analysis and Information Systems 4***, 1980 (with Andrew Whinston).

BOOK

Incentives in Government Contracting, with John McMillan, Toronto: University of Toronto Press, December, 1988.

CHAPTERS IN BOOKS

[1] "Modelling Transactions under Asymmetric Information", ***Recent Developments in Game Theory***, Eds: J. Creedie, J. Eichberger, and J. Borland, London: Edward Elger, 1991 (with John McMillan).

[2] "Ticom II - The Internal Control Language - An Introduction", ***Internal Control and the Impact of the Foreign Corrupt Practices Act***, ed: Abdel-Khalik, Gainesville: University of Florida Press, 1982 (with Andrew Bailey, James Gerlach and Andrew Whinston).

[3] "Office Automation", ***Handbook of Industrial Engineering***, New York: Wiley and Sons, 1982 (with Andrew Bailey, James Gerlach and Andrew Whinston).

BOOK REVIEW

The Economics of Conformism, by Stephen Jones, reviewed for ***The Canadian Journal of Economics***, February 1986, reprinted in ***The Canadian Journal of Economics***, February, 1987.

UNPUBLISHED MANUSCRIPTS (most recent version in parentheses)

"Collusive Bidding in Hostile Takeovers", (1992) (with Dan Vincent, Mike Williams and Melanie Havens)

"Multiproduct Equilibrium Price Dispersion" (1991)

"Two-Part Tariffs to Competing Firms: Destructive Recontracting and Exclusivity" (1992) (with Marius Schwartz)

"Organizational Diseconomies of Scale" (1992) (with John McMillan)

"Mechanism Design by Competing Sellers" (1992)

OLD UNPUBLISHED MANUSCRIPTS

"Deterring Bid Rigging in Forest Service Timber Auctions" (1987) (with Luke Froeb)

"Empirical Bidding Distributions" (1986) (with John McMillan)

"The Nature of Risk Aversion" (1984)

"Effective Computability and Economic Decisions" (1984)

"Risk, Income, Search, and Price Stabilization" (1983)

"Uncertain Entry and the Theory of Entry Behavior" (1983) (with John Chilton)

POLICY PAPERS

"Objectives in Government Procurement: Analysis and International Comparisons", prepared for the Department of Supply and Services Canada, 1986 (with John McMillan)

"Optimal Government Contracts", 1984 (with John McMillan)

"Favoring Minority Contractors: A Proposal", 1984 (with John McMillan)