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Paul Klemperer: Auctions: Theory and Practice

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Preface

February 2000 was a stressful month for me: the UK 3G auction was about to begin. For over two years I had been working with the UK government to design the world's first auction of spectrum for "third generation" (3G) mobile-phone services. A lot was at stake. If our auction worked well, it would allocate the spectrum efficiently and raise a lot of money, but many previous auctions had been embarrassing flops that had failed to generate the sums expected. This time the politicians were hoping for billions of dollars.

We had written numerous papers, developed theories, and tested prototype auction designs in experiments. But would it all work on the day? What might go wrong? The bidders all had armies of consultants and lawyers. What loopholes in the rules might they find to exploit? Could they find a devious way to coordinate their bidding and so avoid competing against each other? Or might our rules actually have discouraged some potential bidders from entering the auction at all—so destroying competition for a different reason?

The 1990s had been littered with examples of auctions—especially of new products or services—that had gone disastrously wrong. Several US auctions had fallen down because bidders signaled to each other by including lot identification numbers and even phone numbers as the final digits of their bids. The winner of a New Zealand auction had bid \$7 million, but the rules required it to pay only \$5,000. Only three bidders had turned up for a German auction of three blocks of spectrum, which therefore sold only at the tiny reserve price. Closer to home, an auction of UK television broadcasting rights sold licenses for some regions of the country at prices less than one ten-thousandth of others. UK electricity auctions were widely criticized for yielding collusive prices. So would our new auction end up as just another humiliating giveaway?

The tension only mounted over the seven weeks the auction ran. The auction started well. Day after day the prices climbed, but we continued to worry about what we might have missed, and what could still go wrong. As the prices kept rising through 150 rounds of bidding, and records started falling, nerves gave way to astonishment. Still, it was an enormous relief when the gavel finally came down on five bids totaling over 34 billion dollars—our auction had raised more money than any previous auction in history. It was even more of a relief when the bidders all paid at the appointed time, and the sale process was finally over, without a hitch.

In the following months, other countries held 3G auctions. The results were very different. Whereas our auction raised almost 600 dollars per head of population, most countries earned far less revenue, and the Swiss made only 20 dollars per head. The key reason was, quite simply, how the auctions were designed: good auction design matters enormously.

This book is in large part a story of the thinking behind the United Kingdom's auction. I survey the basic theory of how auctions work; emphasize the practical lessons that can make the difference between successful auctions and catastrophic ones; and discuss the 100 billion dollar 3G mobile-phone auctions as a case study.

I also explore the connections with other areas of economics that originally drew me into studying auctions. The increasing use of auction theory to develop insights into *other* parts of economics has been one of the most exciting parts of my professional life. So I look in detail at the relationships between auctions and other economic questions. I show how modern auction theory can illuminate such diverse phenomena as booms and busts in housing markets, financial crashes and trading "frenzies", political lobbying and negotiations, the differing costs of alternative legal systems, and the relative intensities of different forms of industrial competition. Thus the tools of auction theory help to explain many issues in economics—and every economist should learn about auctions.

OVERVIEW

This book can be used by a general reader, for a graduate course on auction theory, or—by picking more selectively—an advanced undergraduate or MBA course on auctions and auction design.

None of the writing is technical, except in the appendix to chapter 1. (Indeed there are barely any mathematical symbols, let alone equations, outside footnotes and appendices).

Part A introduces the basic theory, and surveys the existing literature. It includes exercises, and technical appendices (in chapter 1).

Part B shows that modern auction-theoretic tools and intuitions can provide extremely useful arguments and insights in a broad range of economic settings. Auction theory has turned out to be surprisingly powerful in places that are superficially unconnected with auctions—many economic contexts that do not at first sight look like auctions can be recast to use auction-theoretic techniques.

Part C argues that important insights also flow in the other direction—from other parts of economics to the analysis of auctions: in particular, the key issues in practical auction design are not so much those that have been addressed by recent advanced auction theory, but rather the traditional

industrial-organization issues of collusion, entry-deterrence, etc. I give numerous examples. I then discuss economic policy-making more broadly, including the need to pay attention to political pressures and to the wider economic context, but illustrate these points using auction examples.

Part D describes and evaluates the world-record-setting 2000–2001 3G mobile-phone license auctions, as a case study for the earlier parts. I discuss the design *process*, as well as the designs and the overall successes of the different auctions. I also analyze why bidder strategies were a little different from those that would be suggested by the elementary theory described in Part A. I conclude by considering the merits of running auctions versus the alternatives.

USING THIS BOOK

The independent **general reader** may read the parts in whichever order interests him or her—each part is self-sufficient and can be read in isolation, even by those without any previous background in auction theory.

A **graduate course** on auctions (or a segment of a core microeconomics course) would dwell on Parts A and B, and cover Parts C and D more cursorily. It should include the exercises and the technical appendices to chapter 1, and could usefully be complemented by some additional readings from those discussed in chapter 1. (These further readings are reprinted in Klemperer, 2000a.)

Undergraduate lectures might cover the first half of Part A (and, perhaps, some of chapter 1's appendices), and Parts C and D.

An **MBA course** segment might focus on Parts C and D (except chapter 7). Some suggested course outlines are at the end of the volume.

ACKNOWLEDGMENTS

Most of this material was first published in 2002–2003. The exception is chapter 1 which was first published in 1999; I have therefore added a short Afterword to that chapter to bring it up to date.

Since the papers were originally written as stand-alone contributions, there is inevitably a little repetition, but the overlaps should be obvious and cause the reader no problems.

The papers were originally published as follows:

Chapter 1 (except Afterword and Exercises). Auction Theory: A Guide to the Literature. *Journal of Economic Surveys* 1999, 13(3), 227–286.¹

¹ Also reprinted in *The Current State of Economic Science*, S. Dahiya (ed.), 1999.

- Chapter 2. Why Every Economist should Learn some Auction Theory. In Dewatripont, M., Hansen, L., and Turnovsky, S. (eds.), (2003) *Advances in Economics and Econometrics: Theory and Applications* vol. 1, pp. 25–55 (reprinted by permission of Cambridge University Press).²
- Chapter 3. What Really Matters in Auction Design. *Journal of Economic Perspectives* 2002, 16(1), 169–189 (reprinted by permission of the American Economic Association).
- Chapter 4. Using and Abusing Economic Theory. *Journal of the European Economic Association* 2003, 1(2–3), 272–300 (reprinted by permission of the European Economic Association).³
- Chapter 5. How (Not) to Run Auctions. *European Economic Review* 2002, 46(4–5), 829–845 (reprinted by permission of Elsevier).⁴
- Chapter 6. The Biggest Auction Ever. *Economic Journal* 2002, 112, C74–C96, with Ken Binmore (reprinted by permission of Blackwell Publishing, and the Royal Economic Society).
- Chapter 7. Some Observations on the British 3G Telecom Auction. *ifo Studien* 2002, 48(1), 115–120, and Some Observations on the German 3G Telecom Auction. *ifo Studien* 2002, 48(1), 145–156 (reprinted by permission of the Ifo Institute).⁵
- Chapter 8. The Wrong Culprit for Telecom Trouble. *Financial Times* 26 November 2002, 21.
- Exercises. Oxford University MPhil in Economics Examination (reprinted by permission of Oxford University).

Collecting these papers together in a volume was inspired by the invitation to give the inaugural series of the Toulouse Lectures which were based on them. I am most grateful to Jacques Crémer, Jean-Jacques Laffont, and Jean Tirole for the invitation and for their hospitality during my visit, and to Richard Baggaley of Princeton University Press for his smooth running of the whole publication process.

I could not have written any of these papers without the benefit of the enormous amount I have learnt from my friends and colleagues. Many of these are thanked in the acknowledgments to the individual chapters, but Jeremy Bulow and Marco Pagnozzi deserve special thanks.

Finally, I was the principal auction theorist advising the UK Government on the design of its “3G” mobile-phone auction,⁶ I am a Member of the UK

² Also Invited Lecture to Eighth World Congress of the Econometric Society, 2000.

³ Also Alfred Marshall Lecture to European Economic Association, 2002, and reprinted in *Advances in Economics and Econometrics: Theory and Applications*, S. Hurn (ed.), forthcoming.

⁴ Also reprinted in *Spectrum Auctions and Competition in Telecommunications*, G. Illing and Klüh, U. (eds.), MIT Press, 2004.

⁵ Both papers also reprinted in *Spectrum Auctions and Competition in Telecommunications*, G. Illing and Klüh, U. (eds.), MIT Press, 2004.

⁶ Ken Binmore led the team and supervised experiments testing the proposed designs.

Competition Commission, and I have advised several other Government agencies in the United Kingdom, United States, and European Union, but the views expressed in this book are mine alone. Furthermore, although some observers thought some of the behavior described below warranted regulatory investigation, I do not intend to suggest that any of it violates any applicable rules or laws.