

Peter Cramton list of recent publications and abstracts (last three years)

Cramton, Peter, R. Richard Geddes and Axel Ockenfels, “Set Road Charges in Real Time to Ease Traffic,” *Nature*, 23-25, 2 August 2018.

Traffic congestion costs us time, money and health. Being stuck in traffic is frustrating and stressful. The global economic damage exceeds \$1 trillion each year. The solution is dynamic road pricing. Track vehicle use and charge the social cost of this use. We describe how this can be done in a way that respects privacy and equity concerns.

Cramton, Peter, “Electricity Market Design,” *Oxford Review of Economic Policy*, 33:4, 589-612, November 2017.

Electricity markets are designed to provide reliable electricity at least cost to consumers. This paper describes how the best designs satisfy the twin goals of short-run efficiency—making the best use of existing resources—and long-run efficiency—promoting efficient investment in new resources. The core elements are a day-ahead market for optimal scheduling of resources and a real-time market for security-constrained economic dispatch. Resources directly offer to produce per their underlying economics and then the system operator centrally optimizes all resources to maximize social welfare. Locational marginal prices, reflecting the marginal value of energy at each time and location, are used in settlement. This spot market provides the basis for forward contracting, which enables participants to manage risk and improves bidding incentives in the spot market. There are important differences in electricity markets around the world, reflecting different economic and political settings. Electricity markets are undergoing a transformation as the resource mix transitions from fossil fuels to renewables. The main renewables, wind and solar, are intermittent, have zero-marginal cost, and lack inertia. These challenges can be met with battery storage and improved demand response. However, good governance is needed to assure the market rules adapt to meet new challenges.

Cramton, Peter and Axel Ockenfels, “The German 4G Spectrum Auction: Design and Behaviour,” *Economic Journal*, 127, F305-F324, October 2017.

The 2010 German 4G spectrum auction was an unusually large simultaneous ascending multi-band auction. The bidding was competitive and the final assignment was efficient. However, our analysis suggests that independent and rational bidders had an opportunity to coordinate implicitly on a low-revenue outcome. Coordination was difficult, though, because of a multiplicity of focal points. One important focal point involved post-auction negotiations, posing risks to bidders and the auctioneer. We analyse different bidding scenarios and how post-auction negotiations can affect values, bidding and efficiency. We also discuss how the simultaneous ascending auction format can be augmented to mitigate the risks.

Cramton, Peter, David JC MacKay, Axel Ockenfels and Steven Stoft, *Global Carbon Pricing—The Path to Climate Cooperation*, MIT Press, 2017.

After twenty-five years of failure, climate negotiations continue to use a pledge and review approach: countries pledge (almost anything), subject to (unenforced) review. This approach ignores everything we know about human cooperation. In this book, leading economists describe an alternate model for climate agreements, drawing on the work of the late Nobel laureate Elinor Ostrom and others. They show that a “common commitment” scheme is more effective than an “individual commitment” scheme; the latter depends on altruism while the former involves reciprocity (“we will if you will”). The contributors propose that global carbon pricing is the best candidate for a reciprocal common commitment in climate negotiations. Each country would commit to placing charges on carbon emissions sufficient to match an

agreed global price formula. The contributors show that carbon pricing would facilitate negotiations and enforcement, improve efficiency and flexibility, and make other climate policies more effective. Additionally, they analyze the failings of the 2015 Paris climate conference.

Cramton, Peter and Linda Doyle, [“Open Access Wireless Markets,”](#) *Telecommunications Policy*, 41:5-6, 379-390, June 2017.

This paper describes an open access market for capacity. Open access means that in real-time, network capacity cannot be withheld—capacity is priced dynamically by the marginal demand during congestion. The paper offers the open access market as a means for managing growing spectrum demand and as an alternative to naked spectrum sharing. The paper describes the parameters of the open access market showing that it can be implemented using today's technology and without significant regulatory change. The paper discusses how the open access market can eliminate barriers at the service level, allowing any number of service providers to compete in response to market drivers. The paper emphasises that the spatial and temporal granularity at which capacity can be purchased, allows for smaller entities to acquire resources, which is important for new entrants testing the water and those with non-standard business plans. The paper also shows how the open access market can provide a path to achieve greater sharing and efficient trade in the future.

Cramton, Peter, Axel Ockenfels, and Jean Tirole [“Translating the Collective Climate Goal into a Common Climate Commitment,”](#) *Review of Environmental Economics and Policy*, 11:1, 165-171, February 2017.

The 2015 Paris Climate Conference elicited largely independent and individual commitments from the participating countries (so-called “Intended Nationally Determined Contributions”) in an attempt to counter climate change and to achieve the collective climate goals. We argue that the Paris approach, based on individual commitments, promotes narrowly self-interested contributions. Narrow self-interest, however, will not be enough to reach the climate goals. To promote international cooperation and to discourage free-riding, the collective goals must be translated into a reciprocal, common commitment. A reciprocal, common commitment is an agreement to abide by rules that specify cooperation efforts, provided others abide by the same rules. The best candidate for a common commitment, one that facilitates international negotiations and cooperation, is a global carbon price.

Budish, Eric, Peter Cramton, and John Shim, [“The High-Frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response,”](#) *Quarterly Journal of Economics*, 130:4, 1547-1621, November 2015.

The high-frequency trading arms race is a symptom of flawed market design. Instead of the continuous limit order book market design that is currently predominant, we argue that financial exchanges should use frequent batch auctions: uniform price double auctions conducted, e.g., every tenth of a second. That is, time should be treated as discrete instead of continuous, and orders should be processed in a batch auction instead of serially. Our argument has three parts. First, we use millisecond-level direct-feed data from exchanges to document a series of stylized facts about how the continuous market works at high-frequency time horizons: (i) correlations completely break down; which (ii) leads to obvious mechanical arbitrage opportunities; and (iii) competition has not affected the size or frequency of the arbitrage opportunities, it has only raised the bar for how fast one has to be to capture them. Second, we introduce a simple theory model which is motivated by, and helps explain, the empirical facts. The key insight is that obvious mechanical arbitrage opportunities, like those observed in the data, are built into the market design – continuous-time serial processing implies that even symmetrically observed public information creates arbitrage rents. These rents harm liquidity provision and induce a never-ending socially-wasteful arms race for speed. Last, we show that frequent batch auctions directly address the flaws of the

continuous limit order book. Discrete time reduces the value of tiny speed advantages, and the auction transforms competition on speed into competition on price. Consequently, frequent batch auctions eliminate the mechanical arbitrage rents, enhance liquidity for investors, and stop the high-frequency trading arms race.

MacKay, David JC, Peter Cramton, Axel Ockenfels and Steven Stoft, “[Price Carbon—I will if you will,](#)” *Nature*, 15 October 2015.

A common goal that is in everyone’s self-interest is needed for countries to sign up to a strong climate agreement at Paris, say David MacKay and colleagues.

Cramton, Peter, Axel Ockenfels and Steven Stoft, “[Symposium on International Climate Negotiations,](#)” *Economics of Energy & Environmental Policy*, 4:2, 1-64, September 2015.

Cramton, Peter, Axel Ockenfels and Steven Stoft, “[An International Carbon-Price Commitment Promotes Cooperation,](#)” *Economics of Energy & Environmental Policy*, 4:2, 51-64, September 2015.

To promote cooperation in international climate negotiations, negotiators should focus on a common commitment. The advantage of a common commitment is that it facilitates reciprocal “I will if you will” agreements in a group. Reciprocity is the basis for cooperation in repeated public goods games, and a uniform price would provide a natural focal point for a common international commitment. Such a price is also essential for efficient abatement. Countries would retain flexibility in how to implement the price—with a carbon tax, cap-and-trade, or a hybrid approach. Country risk is reduced relative to risk under emission caps since carbon revenues stay within the country. Price commitments also tend to equalize effort intensity and can facilitate enforcement. To encourage participation by less-developed countries, a green fund is needed to transfer money from high per-capita emitters to low per-capita emitters. Transfers are smaller and more predictable with a uniform price commitment than with international cap and trade.

Ausubel, Lawrence M., Peter Cramton, Marek Pycia, Marzena Rostek, and Marek Weretka, “[Demand Reduction and Inefficiency in Multi-Unit Auctions,](#)” *Review of Economic Studies*, 81:4, 1366-1400, 2014.

Auctions often involve the sale of many related goods: Treasury, spectrum and electricity auctions are examples. In multi-unit auctions, a bid for one unit may affect payments for other units won, giving rise to an incentive to shade bids differently across units. We establish that such differential bid shading results generically in ex post inefficient allocations in the uniform-price and pay-as-bid auctions. We also show that, in general, the efficiency and revenue rankings for the two formats are ambiguous. However, in settings with symmetric bidders, the pay-as-bid auction often outperforms. In particular, with diminishing marginal utility, symmetric information and linearity, it yields greater expected revenues. We explain the rankings through multi-unit effects, which have no counterparts in auctions with unit demands. We attribute the new incentives separately to multi-unit but constant marginal utility and diminishing marginal utility.

Cramton, Peter, Sean Ellermeyer and Brett E. Katzman, “[Designed to Fail: The Medicare Auction for Durable Medical Equipment,](#)” *Economic Inquiry*, 53:1, 469-485, 2015.

We examine the theoretical properties of the auction for Medicare Durable Medical Equipment. Two unique features of the Medicare auction are (1) winners are paid the median winning bid and (2) bids are nonbinding. We show that median pricing results in allocation inefficiencies as some high-cost firms potentially displace low-cost firms as winners. Further, the auction may leave demand unfulfilled as some winners refuse to supply because the price is set below their cost. We also introduce a model of nonbinding bids that establishes the rationality of a lowball bid strategy employed by many bidders in the

actual Medicare auctions and recently replicated in Caltech experiments. We contrast the median-price auction with the standard clearing-price auction where each firm bids true costs as a dominant strategy, resulting in competitive equilibrium prices and full efficiency.

[“Implementation Details for Frequent Batch Auctions: Slowing Down Markets to the Blink of an Eye”](#) (with Eric Budish and John Shim), *American Economic Review P&P*, 104:5, 418-424, May 2014.

Our recent research (Budish, Cramton and Shim, 2013) proposes frequent batch auctions – uniform-price sealed-bid double auctions conducted at frequent but discrete time intervals – as a market design alternative to continuous-time trading in financial markets. This short paper discusses the implementation details of frequent batch auctions. We outline the process flow for frequent batch auctions, discuss a modification to the market design that accommodates market fragmentation and Reg NMS, and discuss the engineering and economic considerations relevant for determining the batch interval. Open questions are discussed throughout.